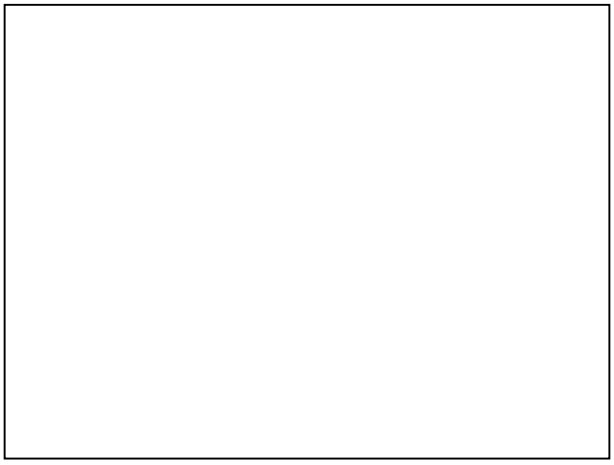
Private Sector Participation in the Brazilian Agricultural Research System:

Case studies from the cotton and dairy industries

A thesis submitted for the degree of
Doctor of Philosophy
at the University of Queensland
in December 2006



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Statement of Originality

The work presented in this thesis, to the best of my knowledge, is the original work of the author, except as acknowledged in the text. It has not been submitted for a degree at this or any other university.

Lucio Brunale
December 2006

Dr. Malcolm Wegener
December 2006

Acknowledgements

Throughout this study I have had the contribution and support of many people and institutions. The main support and influence have come from my supervisor and my family who provided guidance and encouragement for the successful completion of this study.

First, my very special thank to my family, father, mother, brother, sisters and nephews, for their affection, incentive and emotional support. And mainly I would like to express my eternal gratitude to my lovely wife and friend Rosa, and to my precious children Rodrigo and Marina for their understanding, patience and solidarity with me in this project, that helped to make our stay in Australia more enjoyable and productive

I sincerely acknowledge and express gratitude to my supervisor Dr Malcolm Wegener, for his interest, encouragement and his professional assistance throughout my thesis. He has also been a friend and support to my family and myself during our stay in Australia.

It is a pleasure to express my gratitude to my employer Embrapa for its financial support and the permission to take the extended leave required to complete the thesis. I am also be grateful to my friends in Embrapa, Alberto Duque Portugal, Gerson Soares Alves Barreto, Eliseu Alves, Maria Gorete Medeiros Santos, Francisco Reifschneider, Jose Robert Peres, Allert Rosa Suhet, Carlos Moisés Andreotti, Lelis, Divino dos Santos, Walmir Luiz R. Gomes, Cristine Vieira Valério, Roberto Cobbe, and Marcos Coutinho for the incentive to undertake the post graduate program, and for the constant help, support and orientation during the period of the course.

I would like to express my appreciation and gratitude to my Academic Counselor in Embrapa, Dr Airdem G. Assis, for his support and contribution of ideas, particularly in designing the survey, in the preparation of the dairy questionnaire, in the organization of the Focus Group Meetings involving the dairy industry stakeholders, and also important suggestions to conclude my thesis.

Sincere thanks go to Marlene de Souza Costa França for your friendship, support, and for looking after our affairs and assets in Brazil. God bless you!

My special thanks go to Angelo Massignam who provided valuable advice on the statistical analyses, and for his contribution of ideas, particularly in designing the survey and also important suggestions to complete my thesis.

I would like to thank Hélio Tollini, Edeon Vaz Ferreira, Odilon Reny R. F. da Silva, Robério Ferreira dos Santos, Alvaro Salles, Evandro R. R. da Silveira, and Isaura Lopes Ferreira who provided important ideas in designing the survey, in the preparation of the cotton questionnaire, and in the organization of the FGMs involving the cotton industry stakeholders in Rondonópolis, MT.

I would like to express my gratitude to René de Assis Sordi, Marina Souza Sordi, Lygia Romanach, Luiz Gomes de souza, Solange Fernandes de Souza, Michelle B. Q. Araujo, Luiz Carlos Guedes Pinto, and Elísio Contini for their co-operation in organizing and participating in the interviews and farms visits, part of the data collection of my study.

I sincerely thank Aloísio Teixeira Gomes, Sérgio Rustichelli Teixeira, Amilcar Lacerda de Almeida, Nilson Muniz, Paulo Martins, Ana Terezinha Stambassi Anselmo, and João Bosco Umbelino Santos for assisting in designing the dairy questionnaire, and selecting and contacting dairy industry stakeholders to answer the questionnaire and participate of the FGMs in Juiz de Fora and Goiânia in Brazil.

Special thanks must go to all the cotton and dairy industry stakeholders in MT, MG, GO and BA, who gave their valuable time during the survey and focus group meetings.

I would like to thanks Hung Vu (Ho) who provided the web conditions necessary to develop the electronic survey, to Stephanie Cash who made important contributions to improve the format of the thesis report, and to Rita Mortiss for her patience and very competent editing work.

I also thank David Durack Marchant and Scott Waldron for their valuable ideas and for providing constructive and insightful comments for my research.

Special thanks also go to Airton and Carlise Spies for their assistance in organizing our arriving in Brisbane, and gave to us a relative tranquility to start our life in Australia.

I would like to express my especial gratitude to my friends and office mates Yo Worachananant and Peter Wegener for supporting me and for the pleasant and productive working environment provided that was essential for the success of my studies. I'm really glad to say I'm your friend!

Last but not least, I would like to express my sincere gratitude to my brother and friend Sérgio Brunale who played a key role in my research, selecting and involving the necessary departments to collect data about Embrapa and the Brazilian agricultural research system. I really appreciate your love and support. I also would like to thanks Orlando Campelo, José João Reis, Ester Lilian Alves Castro, Maria Amália Gusmão Martins, Osmar Rodrigues Farias, Ilton Barbosa, Fernando do Amaral Pereira, and José Alexandre Silva Rocha for helping me in my field work in Brazil, and making available information and statistical data about Embrapa and the State agricultural research institutions.

Dedication

This thesis is dedicated to my parents Palmerino (in memoriam) and Maria Carmela, who with their work, humility, family devotion, and example of life, had served as support and guide for us (sons and daughters) to meet the great challenges in our lives.

Abstract

One of the major issues for agricultural R&D Systems is the extending of private sector participation, especially the level of investment that the private sector is prepared to make. Private sector investment in agricultural research institutions in developed countries averaged 55.2% of the total invested in 2000 while, in the same year, the investment in agricultural research in developing countries by the private sector was only six percent. In Brazil the government invested about 95% of the funds spent on agricultural research, while the private sector invested the balance. However, this study shows that, over the past 15 years, investment by the Brazilian government in agricultural research institutions has been declining, indicating that the government has not been able to maintain its capacity to invest in agricultural research activities. In recent years, the government has been signalling to the community, through the creation of legal instruments, the necessity of increasing private sector participation in the agricultural research and development process.

This study endeavoured to identify why Brazilian agribusiness is still not participating as effectively as it might. The study was carried out to define what needs to be changed, and how to promote these changes, to increase private sector participation in agricultural research, and to improve the performance of the Brazilian agricultural research system.

This issue was analysed by surveying stakeholders from two different industries in Brazil: cotton and dairy.

The thesis is presented in three parts. The first part introduces the study and describes the analytical methods used in this research. In the second part, there is a descriptive analysis of the Brazilian Agricultural Research System, a comparative analysis of various international and other national R&D systems, and an overview of the global markets for agricultural commodities and business environment in which Brazilian agribusiness companies operate. The third part presents the results from three focus group meetings analysis of and an electronic survey of 405 stakeholders in the Brazilian cotton and dairy industries. About 77% of respondents were from the private sector and 23% from the public sector. A prescriptive analysis of measures to improve participation by the private sector in the Brazilian agricultural research system is then presented. Finally, recommendations from the study are presented in

four sections: Section 1 makes recommendations to develop and implement policies necessary to improve the Brazilian science and technology system which involves the entire government sector. Section 2 presents recommendations to be implemented by both federal and state governments, and also recommends involving the private agricultural companies. Recommendations concerning the restructuring of Embrapa are set out in Section 3, while Section 4 includes recommendations directed to Brazilian agricultural industries. It is believed that adoption of these recommendations this would create better prospects for the Brazilian agricultural research system to service agribusiness as they enter into increasingly competitive domestic and overseas markets.

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List of Abbreviations

ABAPA	Cotton Producer Association of Bahia
ABRAPA	Brazilian Cotton Producer Association
ACOPAR	Cotton Producer Association of Paraná
ACP	African, Caribbean and Pacific Countries
AGCAN	Agricultural Canada
AGDR	Regional Development Agency of Goiás
AGOPA	Cotton Producer Association of Goiás
AIC	Brazilian Agro-Industrial Complex
AMAPA	Agricultural Research Organization – Maranhão
AMIPA	Cotton Producer Association of Minas Gerais
AMPA	Cotton Producer Association of Mato Grosso
AMPASUL	Cotton Producer Association of Mato Grosso do Sul
APPA	Cotton Producer Association of São Paulo
APROSMATE	Seeds Producers Association of Mato Grosso
APT	Paulista Agency for Technology and Agribusiness – São Paulo
ARC	Australia Research Council
ARS	Agricultural Research Service
BA	Bahia (State of Brazil)
BARS	Brazilian Agricultural Research System
BIRPI	United International Bureau for the Protection of Intellectual Property
BNDES	National Bank of Economic and Social Development
CCC	Commodity Credit Corporation
CEPEA	Centre of Advanced Studies in Applied Economy
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center of Tropical Agriculture
CIED	Contribution of Intervention in Economic Domain
CIMMYT	International Wheat and Maize Research Center
CIRAD	The Agricultural Research Centre for International Development
CNA	National Confederation of Agriculture in Brazil
CNI	National Industries Confederation
CNPq	National Counsel of Technological and Scientific Development
CONAB	National Company of Supplying
CPA	Agricultural Research Coordination – São Paulo
CPCI	Combined Parliamentary Commission of Inquiry
CRC	Cooperative Research Centre
CRIs	Crown Research Institutes
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Science and Industries Research Organization
CTC	Center for Sugarcane Technology
DF	Distrito Federal
DNPEA	Departamento Nacional de Pesquisa Agropecuária
DPIA	Department of International Promotion of Agribusiness
EBDA	Agricultural Development Organization – Bahia
EMATER/GO	Research, Technical Assistance, and Rural Extension Organization - Goiás
EMBRAPA	Brazilian Agricultural Research Corporation
EMBRATER	Brazilian Agricultural Extension Company
EMCAPA	Agricultural Research Organization – Espírito Santo
EMDAGRO	Agricultural Development Organization – Sergipe
EMEPA	Agricultural Research Organization – Paraiba

EMPAER/MS	Research, Technical Assistance, and Rural Extension Organization – Mato Grosso do Sul
EMPAER/MT	Research, Technical Assistance, and Rural Extension Organization – Mato Grosso
EPAGRI	Agricultural research and Rural Extension Organization – Santa Catarina
EMPARN	Agricultural Research Organization – Rio Grande do Norte
EPACE	Agricultural Research Organization – Ceará
EPAMIG	Agricultural Research Organization – Minas Gerais
EPEAL	Agricultural Research Organization – Alagoas
EU	European Union
FACUAL	Fund of Support to the Cotton Culture
FAO	Food and Agricultural Organization
FEPAGRO	State Foundation of Agricultural Research – Rio Grande do Sul
FGMs	Focus Group Meetings
FGV	Getulio Vargas Foundation
FINEP	Agency for Financial Support for Studies and Projects
FNDCT	National Fund for Scientific and Technological Development
FUNDER	Foundation of Rural Development
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GENOMA	Program of Science and Technology for the Agricultural Sector, Genetic Resources and Biotechnology
GIRD	Grants for Industry Research and Development
GO	Goiás (State of Brazil)
IAC	Agronomic Institute of Campinas
IAPAR	Agricultural Institute of the state of Paraná
IBRD	international Bank of Reconstruction and Development
IFAFS	Initiative for Future Agriculture and Food Systems
IITA	International Institute of Tropical Agriculture
IMF	The International Monetary Fund
INIA	Agricultural Research Institute in Chile
IPA	Agricultural Research Organization – Pernambuco
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
JICA	The Japan International Cooperative Agency
JIRCAS	Japan International Research Centre for Agricultural Sciences
LABEX	Virtual Laboratories Program
MAPA	Ministry of Agriculture, Cattle and Supplying
MCT	Ministry of Science and Technology
MT	Mato Grosso (State of Brazil)
MG	Minas Gerais (State of Brazil)
NARS	National Agricultural Research System
NRI	National Research Initiative in the United States of America
OECD	Organization for Economic Co-operation and Development
OPEC	Organization of Oil Producing Countries
PADCT	Scientific and Technological Development Support Program
PDTA	Program of Agricultural Technology Development
PDTI	Program of Industrial Technology Development
PESAGRO	Agricultural Research Organization – Rio de Janeiro
PLANALSUCAR	National Program of Sugarcane Improvement
PR	Presidência da República
PROALMAT	Cotton Incentive Program of Mato Grosso
PVP	Plant Varieties Protection

RCU	Research Cooperative Unit
R&D	Research and Development
RDC	Research Development Corporations
RIDESA	Network of Sugarcane Sector Development Institutions
RIRDC	Rural Industries Research and Development Corporation
RQF	Research Quality Framework
SAROs	States Agricultural Research Organizations
SENAR	National Rural Apprenticeship Service
SITC	Standard International Trade Classification
SRI	Secretariat of Agribusiness International Relationships
S&T	Science and Technology
STAC	Science and Technology Advisory Committee
STFs	Science and Technology Funds
TPRM	Trade Policy Review Mechanism
TRIPS	Trade-related Aspects of Intellectual Property Rights
UFAL	Federal University of Alagoas
UFG	Federal University of Goiás
UFPR	Federal University of Paraná
UFRRJ	Federal University of Rio de Janeiro
UFRPE	Federal Agricultural University of Pernambuco
UFS	Federal University of Sergipe
UFSCar	Federal University of São Carlos
UFV	Federal University of Viçosa
UNESP	State University of São Paulo
UNICAMP	University of Campinas
UNITINS	University of the State of Tocantins
UNO	United Nations Organizations
UPOV	International Union for the Protection of New Varieties of Plants
US	United States
USA	The United States of America
USDA	Unites States Department of Agriculture
USP	University of São Paulo
USPTO	United States Patents Trademark Officer
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

CHAPTER 1

PRIVATE SECTOR PARTICIPATION IN AGRICULTURAL RESEARCH: THE CASE OF AGRIBUSINESS IN BRAZIL

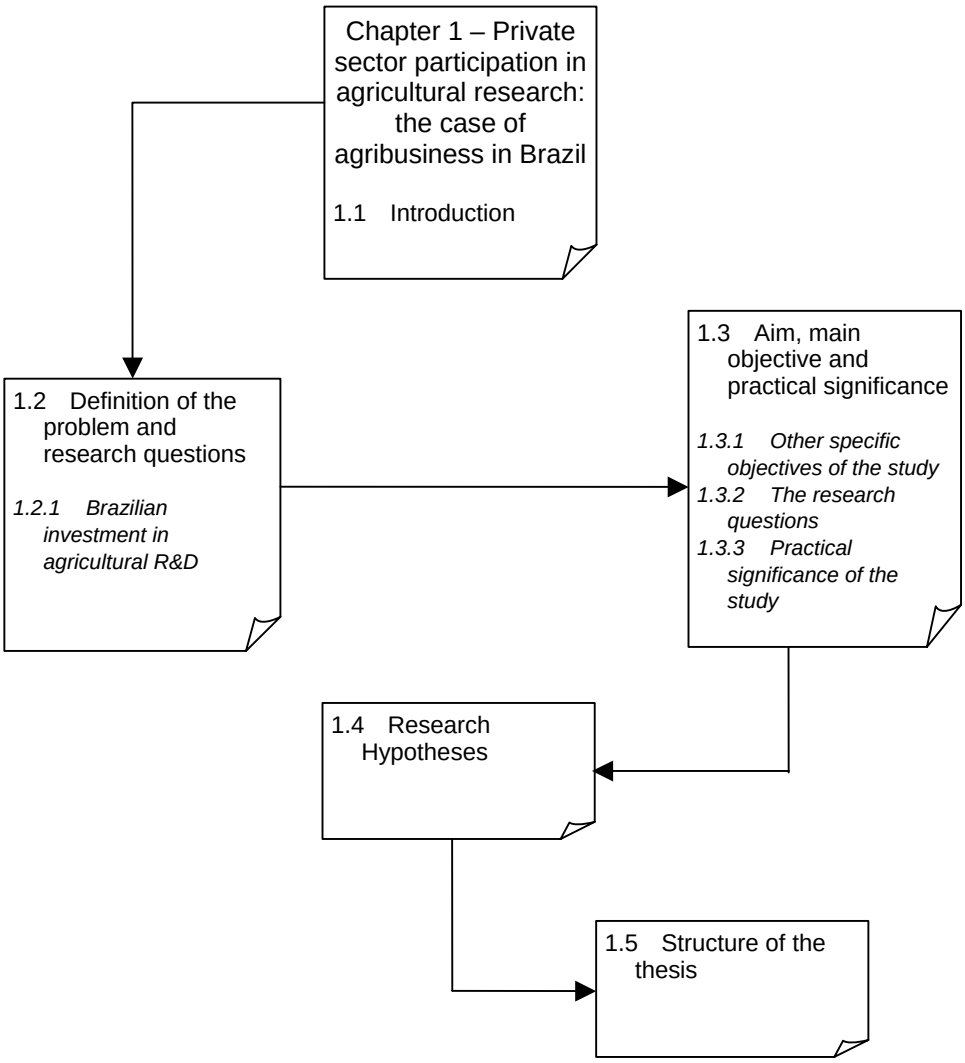


Figure 1.1. Structure of Chapter 1

1.1. Introduction

This thesis examines private sector participation in the Brazilian agricultural research system in the context of existing activity and likely future development of agribusiness in Brazil. The study has focused on the relationship between the public agricultural research and development (R&D) institutions and the private companies of Brazilian agribusiness.[1] This focus was chosen in order to evaluate private sector participation in the agricultural research system and to identity the reasons why there is so little involvement by most industries in Brazil at present. As a consequence of this study, it has been possible to suggest what changes could be made to promote increased private sector participation[2] in the agricultural research system in future.

This analysis has led to a set of recommendations for government institutions, agribusiness companies and research institutions to implement a plan to improve private sector participation in the agricultural R&D system and to create better prospects for the agricultural industries they service by expanding the domestic and international markets open to Brazilian farm products.

1.2. Definition of the problem and research questions

During the past 20 years, there have been profound economic, cultural, and social changes in Brazil with the transition from a military dictatorship to a democratically elected government in 1986, and even the election of the country's first left-wing president in 2002. At the base of this process, and, indeed, one of its cornerstones, has been the extraordinary set of economic transformations that have occurred in the Brazilian economy, made possible in large part, by the adoption and implementation

1 Agribusiness or the Agro-industrial Complex, AIC, represents a group formed by: a) the industrial sectors that supply goods and services to agriculture, that is called the agriculture industry (before the farm gate); b) agricultural production proper (inside of the farm gate); c) industrial sectors that have in agriculture their supplying markets, that we will call basic agricultural industry (after the farm gate); and d) the sector of distribution, that involves the segments of transport, commerce and services (also after the farm gate) (Furtuoso 1998).

2 In this thesis, private sector participation means, the involvement of the private sector in the process of identifying and defining the research projects to be developed, contributing to the financial support of the research and its sharing in the returns from the results of the research.

of scientific and technological advances by many of the country's producers of farm products. In 2005, the Brazilian agribusiness generated just under 28% of the country's Gross Domestic Product and 36.9% of the Brazilian total exports (Agricommerce 2005). The dependence of this economic transformation on the scientific and technical advances made by Brazil's scientists and technicians in the previous 20 years (from the early 1970s to the early 1990s), created conditions for an on-going cycle, where each technological conquest made new economic advances possible, which in turn have stimulated the continuing efforts of technicians and scientists (Crestana 2004b; Furtado 2005). Unfortunately, there is a high probability that, in the case of the Brazilian agricultural sector, this powerful cycle will be broken by the failure to fund research and technological development to an adequate level.

The science-driven changes which much of the world has experienced in the past 20 years contrast with what has happened in Brazil. In that period when technological and economic changes in many countries increased in intensity and there was an added volume of discovery in many fields of science. Brazil and several other countries did not maintain the level of investment to keep up with this evolutionary process. In the years ahead, when it appears that the pace of technological and economic change will become even more rapid than it has been in the recent past, Brazil and other major developing countries, such as India and China, will need to focus attention on the evolutionary process of fostering intellectual development in key sectors of the economy, for example, by promoting agricultural research (Ruttan 1991; Reifschneider 2002).

Concern about the weak performance of the Brazilian science and technology sector was registered by the Brazilian National Congress in 1991, when it created a Combined Parliamentary Commission of Inquiry (CPCI), with the objective of investigating the causes and assessing the impact of delays in the process of delivering technology to industrial producers in Brazil, and in the development of research and educational institutions.

After an enquiry lasting one year, the CPCI presented a report revealing a set of problems that were hindering the development of Brazilian science and technology capacity, and presented several suggestions and recommendations to be implemented by government institutions and private sector companies. Some of the problems which were identified and which are relevant to the objectives of this thesis

are listed here. The level of investment in agricultural research was reported to be low (at least when compared with other similar countries, such as South Korea, China, and India). The physical structures (buildings, research farms, equipment, etc.) of the agricultural research institutes were reported to be in a degraded state, and required upgrading. There was a lack of priority for activities in the scientific sector (by both the government and the private sector), and a lack of incentives for the development of science and technology activities. The Commission reported that the University research system in Brazil was badly disconnected from the productive sectors of the economy, and the work of professionals in the area of experimental development was undervalued. Private sector interest in participating in research projects developed by public research institutions and universities appeared to be totally lacking (Passoni 1992).

The CPCI also presented the following recommendations to be implemented by the government (mainly by the executive and legislative sectors) but also requiring some activity by the private sector:

- "*To promote greater integration of the Universities and other research institutions with the private sector*";
- "*To create mechanisms to guarantee the administrative and management continuity of the public scientific and technological institutions*";
- "*To guarantee the continuity of the flow of financial resources to R&D activities, considering the stability of this flow more important to the sector, than the value invested*";
- "*To stimulate private sector investments in science and technology projects*";
- "*To promote the interchange between Brazilian Universities and research institutions and foreign organizations*".

According to Bonelli and Pessôa (1998), the situation described by the CPCI resulted from a combination of interlinked factors whereby Brazil, in the past, had frequently plunged into internal and external indebtedness, creating chronic

government budgetary problems, to which the political system and successive government administrations had been incapable of providing adequate and lasting answers.

To these unsatisfactory circumstances, can be added the fact that the level of investment in science and technology research in Brazil has been low when compared with the investments made by other comparable countries. In 2005, Brazil invested 0.93% of its GDP in Science and Technology, which was below the average of 2.5% invested by the industrialized countries and even below the investment of emerging economies, like South Korea (2.66%, in 2003) and China (1.2%, in 2005). The private sector in Brazil employs fewer than 10% of the workers with PhD degrees, and makes just under 40% of the total investment in science and technology (see Table 4.1 in Chapter 4), while in the developed countries the investment in this area by the private sector can represent as much as 70% of the total investment (Contini and Séchet 2004; Crestana 2004a; Einhorn 2006; OECD 2006; Simões and Teixeira 2006).

In addition, the relation between research[3] and innovation[4] is also an important point to consider when evaluating the performance of science and technology institutions in any country. With the volume of research considered as measured by the number of articles published, and the volume of innovation as measured by the number of patents registered, Table 1.1 shows the position of Brazil in relation to selected countries, reported by the United States Patent and Trademark Office (USPTO)[5] balance in 2002. In that year, only 2% of the researches implemented by the Brazilian research agencies were transformed into innovation, while India and

3 Research in this thesis refers to a systematic investigation, including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge.

4 Innovation in this thesis is the introduction of new ideas, goods, services, and practices which are intended to be useful.

5 The United States Patent and Trademark Office (PTO or USPTO) is an agency in the United States Department of Commerce that provides patent and trademark protection to inventors and businesses for their inventions and corporate and product identification. Since 1991, the office has been fully funded by fees charged for processing patents and trademarks. The USPTO cooperates with the European Patent Office (EPO) and the Japan Patent Office (JPO) pursuant to trilateral agreements. The USPTO is also a Receiving Office, an International Searching Authority and an International Preliminary Examination Authority for international patent applications filed in accordance with the Patent Cooperation Treaty. Each year, the PTO issues thousands of patents to companies and individuals all around the world. As of March 2006, the PTO has issued over seven million patents.

China, both, transformed 5% of their agencies' research into innovations (Teixeira 2005). The transformation ration was much higher in the developed countries.

Table 1.1 Relation between research and innovation in selected countries: 2002

Country	Research [a]	Innovation [b]	Relation between research and innovation *(%)*
Brazil	11,285	243	2
India	17,325	919	5
China	33,561	1,569	5
Canada	32,533	7,375	23
Germany	63,428	20,418	32
United States of America	245,578	184,245	75
Japan	69,183	58,739	85

a Number of articles published in international indexed publications.

b Number of patents registered by institutes in the United State Patents and Trademark Office.

Source: Table imported from Teixeira (2005), page 3.

The strong concentration of researchers and research agencies in the public sector, a limited focus on market demands in research projects, and the lack of private sector participation in the research system may explain this situation.

In the past 15 years, the paucity of innovations originating in Brazil has resulted in its slipping behind developing Asian countries, such as South Korea, India and China, even though the level of development was not very different between these countries a few years ago. With their own inadequate level of investment in research and innovation and therefore insufficient contributions to economic growth, and without the necessary government support (incentives, logistics, policies, etc.), private sector companies in Brazil have preferred to access innovations through the licensing and import of industrial goods and technology, instead of developing a local research capacity (Delgado *et al.* 2000; Erber 2004).

1.2.1. Brazilian investment in agricultural research and development (R&D)

One of the few exceptions to this lack of investment in research and industrial development in Brazil occurred in the agricultural sector from the 1970s to the early

1990s. During that period, the public sector invested heavily in developing a strong agricultural research system (Alves 1989). The results of this investment are shown today: Brazilian agribusiness makes a significant contribution to the domestic economy and, in 2003, achieved the position of worldwide leader in trade in many agricultural products (see Table 5.8 in Chapter 5). Agriculture has also consolidated its contribution to national socio-economic progress, generating almost 37% of the country's jobs, and contributing 36.9% of exports, and 28% of Brazilian GDP. Agriculture contributed approximately US$38 billion to the country's positive trade balance in 2004 (DPIA/SRI/MAPA 2006; Gasques *et al.* 2004b).

However, during the past 15 years, this strong support for agricultural research and development has declined, partly because of many managerial and political problems, but mainly owing to competing needs for government investment in other areas, such as basic infrastructure, health, and education. The economic crisis that commenced in the 1980s, and still persists in 2006, imposed diverse budgetary restrictions on Federal and State governments. These constraints fell, in most cases, on activities that require relatively longer periods to produce results, like R&D activities (Gasques *et al.* 2004b).

Consequently, these circumstances created several ongoing problems for the public agricultural R&D sector (for example budgetary constraints, difficulties in developing basic research activities due to limited financial resources, management instability, problems in keeping the country's scientists up-to-date and stimulated by their work; etc.). These problems made the return from investment in agricultural R&D uncertain. In addition, the previous strong government support for agriculture promoted a culture of reliance on the public sector to carry out research and development in Brazil, resulting in minimal participation by the private sector (Contini and Séchet 2004; Gasques and Verde 1995). As a consequence, the subsequent decline in public funding has not been met by a necessary increase in private sector support.

The reduction in financial resources can be clearly observed if the budget allocated to Embrapa[6] – the Brazilian Agricultural Research Corporation – over the past 10 years is examined. Table 1.2 shows that, overall, Embrapa's budget has been declining steadily since 1996. Currently, Embrapa's budget is around $US295 million, while the Agricultural Research Service (ARS) in the U.S.A., with responsibilities equivalent to those of Embrapa, has been experiencing a constant increase in its budget, reaching $US1 billion in 2004 (Crestana 2004b; USDA 2006).

Table 1.2 Embrapa's annual budget for the various application areas: 1994 to 2004 (in thousands of US dollars) *

Year	Personnel	Other Expenditure	Capital Expenditure	Total
1994	235,044	72,976	32,890	340,910
1995	289,056	83,343	72,109	444,508
1996	404,798	99,314	58,803	562,916
1997	332,041	123,445	42,001	497,487
1998	316,540	124,873	21,795	463,208
1999	205,605	83,612	15,623	304,841
2000	230,873	79,950	21,269	332,092
2001	190,728	72,696	22,825	286,249
2002	168,092	51,398	20,701	240,191
2003	183,076	44,683	4,671	232,430
2004	220,786	64,226	10,285	295,297

* Values converted to US dollars using the FGV (Getulio Vargas Foundation) average annual exchange rate

Source: Financial Administration Department of Embrapa; and Secretariat for Administration and Strategy of Embrapa.

The evolution of Embrapa's annual budget over the years is shown in Chapter 3, in Table 3.3, where the instability of financial flows and the potential implications for its research activities can be observed. In addition, in Table 3.3, it can be seen clearly that the financial resources applied to "personnel expenditures" in the most recent

6 Embrapa is a public corporation, responsible for the execution of 80% of the agricultural research projects developed in Brazil. Federal Universities, the States' Agricultural Research Companies, and private research institutions mainly in soybean, cotton and sugarcane, have developed the other 20%.

years have declined, relative to previous funding levels, when one considers the increase in the number of employees and the consistent trend for researchers' qualifications to rise in the same period.

Similarly, Embrapa's overall budgets from 1994 to 2004 illustrate the low level of private sector investment in agricultural R&D. Table 1.3 reveals that in 2004, approximately 96% of funding came from the federal government and only 4% from the private sector. Over the 11-year period the average level of government funding was 95.22% and average private sector participation was 4.78%, but the level of government support is declining. Most of the private sector funding was focused on commodities with a strong demand in the international market, such as soybeans and cotton.

Table 1.3 Embrapa's total budget 1994 to 2004, showing government and private sector support (in thousands of US dollars – current values) [a]

Years	Government Support (A) [b]	Government Participation (A)/(C) = %	Private Support (B)	Private participation (B)/(C) = %	Total (C)
1994	335,455	98.40	5,455	1.60	340,910
1995	417,304	93.88	27,204	6.12	444,508
1996	529,817	94.12	33,099	5.88	562,916
1997	468,528	94.38	27,959	5.62	497,487
1998	438,890	94.75	24,318	5.25	463,208
1999	288,684	94.70	16,157	5.30	304,841
2000	316,318	95.25	15,774	4.75	332,092
2001	269,818	94.26	16,431	5.74	286,249
2002	229,855	95.71	10,303	4.29	240,158
2003	223,330	96.08	9,100	3.92	232,430
2004	283.249	95.92	12,048	4.08	295,297
	Percent Average	**95.22**		**4.78**	

a Values converted to US dollars using the FGV (Getulio Vargas Foundation) average annual exchange rate.

b All the resources derived from external sources are related to international loans, and therefore a federal government responsibility. Therefore, external resources have been included as contribution from the government.

Source: Financial Administration Department of Embrapa; and Secretariat for Administration and Strategy of Embrapa.

In seeking a more lasting solution to these and many other problems faced by the agricultural sector as a whole, the government implemented a process to deregulate Brazilian agriculture (see Chapter 3, Item 3.7; and Chapter 5, Items 5.4.2.1 and 5.5). Starting in the early 1990s, this process abolished some organizations and some activities that were previously an exclusive part of the federal government. It also eliminated almost all agricultural subsidies, created laws to deal with intellectual property, provided incentives for innovation, and stimulated the public agricultural research institutions to reorganize and to act in partnership with the private sector (Paterniani 2000a; Presidência da República do Brasil 1990b).

Consequently, the Brazilian agricultural research system has experienced many changes in the past 15 years. More than half of the state R&D institutes were closed or were reduced to small departments within other government organizations, and a competitive system to distribute public money was launched. This required the R&D institutes to identify projects that were more relevant to agricultural producers and to compete amongst themselves to acquire resources. In this regard, the Brazilian experience has been somewhat similar to what has happened in other countries like Australia, so there are valuable lessons to be learned from their experience.

Although the Brazilian government's decision to promote agricultural deregulation at the beginning of the 1990s was opportune and necessary, this process has still not concluded (Helfand and Rezende 2001). The deregulation process created the opportunity for research institutions to seek partners in the private sector, but it did not create the necessary conditions to put these partnerships onto a sustainable basis. Despite the changes in government policy, the private sector is still providing minimal support for R&D activities and has not filled the gap left by the reduction in government funding (Helfand and Rezende 2001). Further changes are therefore still required to encourage greater private sector support for R&D activities, particularly through investing private sector funds in public agricultural research.

With the scarce financial resources available to them and the lack of management flexibility, provoked by the creation of a series of laws established to control and to achieve greater efficiency in the spending made by all the public institutions, the agricultural R&D institutions are now facing a similar situation to that of 1973, when Embrapa was created. The reasons for creating Embrapa were identified and reported in 1972, in a report which also documented the valuable

accomplishments in agricultural research and development at that time; these reasons included lack of planning, because there was no obvious research policy, and also the insignificant participation by the private sector in agricultural research was recognised (EMBRAPA 2002a). These recent laws were applied generalizing the decisions, without concern about the specific necessities of sensitive sectors of the economy, such as agricultural research, and without concern for the consequences of their application.

In spite of the t changes introduced by the government and outlined above, the agricultural research system has shown signs of stagnation, exhaustion, and inefficiency, arriving at the point where Embrapa's mission and activities are compromised (Correio Braziliense 2006). This is happening at a time when Brazilian agribusiness has an important position in worldwide trade in agricultural commodities, and globalization encourages competition within and between countries. Internal and external vulnerabilities in Brazilian agricultural industries are increasing and the country's needs in research and innovation are rising in size, complexity, and urgency, while the main research organizations are becoming more vulnerable to internal and external threats.

To maintain its position as one of the most important agricultural producers in the world, achieved partly because of the past support for agricultural research and production, the Brazilian agricultural research system needs to change. If it does not, Brazil runs a serious risk of falling behind other countries in agricultural development and innovation (Crestana 2004b).

In summarizing what has happened over the past 15 years in Brazil, it can be said that the investment by the federal and state governments in agricultural research institutions has been declining (see Table 1.2), showing that the government has not been able to maintain its capacity to invest in agricultural research activities while, on the other hand, it has been signalling to the community, through the creation of legal instruments, the necessity to increase private sector participation in the agricultural research and development process. On the other side, the private sector participation in public agricultural research is very low (see Table 1.3), and the relationship between R&D institutions and agribusiness companies is still at an early stage, despite the efforts of the Brazilian government through EMBRAPA and the states agricultural research institutions, to encourage closer integration. Consequently, the

results are mixed, with good growth in exports of commodities such as soybean, beef, cotton,[7] and sugarcane, but the same success has not been achieved in commodities like rice, beans, and dairy products.[8]

In addition there has not been any recent, considered effort to evaluate the reasons why the relationship between private sector companies and public agricultural research institutions has not developed to the extent that is needed.

Therefore, this study has sought to identify why the effective participation by Brazilian agribusiness in the agricultural research and development system, which is necessary for the continuing development of the industry, has still not materialized to the extent that it might. The study has defined what needs to change and make some suggestions about how to promote these changes.

1.3. Aim, objectives, research questions, and practical significance of the study

The overall aim of this study has been to analyse the relationships that exist between private companies in the agricultural sector and the Brazilian public agricultural research and development institutions, and define their possible role in expanding exports of agricultural commodities. This study has focused on Embrapa's experience in this area, and on the perceptions of stakeholders in dairy and cotton industries.

The main objective of the study has been to develop a set of core recommendations to be implemented by the Brazilian government and by the private sector to improve the relationship between agribusiness companies and public agricultural research institutions with the intention of increasing production and exports of agricultural commodities produced in Brazil.

7 For these reasons and considering its increasing importance in the Brazilian agricultural economy, the cotton industry was the first industry selected for investigation in this study.

8 Dairy was identified as the second industry to be analysed, not only because of its importance to the Brazilian agricultural economy, and also because the private sector participates only to a very small extent in its research and development projects.

1.3.1. Other specific objectives of the study

The literature review and the research methodology have addressed three other specific objectives of the study, namely:

1. to describe the Brazilian agricultural R&D system and its role in the development of new products for the market and in improving the efficiency of production systems for existing products;

2. to describe and compare the relationship between public agricultural R&D institutes and agribusiness companies in selected countries, to show how their experience in restructuring their agricultural R&D systems might provide useful lessons for Brazil; and

3. to describe the global market for agricultural products and the linkage with agricultural R&D institutions which exist to help industries improve their competitiveness.

1.3.2. The research questions

The current agricultural research system in Brazil is clearly not as efficient as it could be, and the minimal level of participation by Brazilian agribusiness companies in agricultural research projects is a persistent problem. This has established the problem to be examined in this study, and it has been addressed through a series of research questions:

Research Question 1 *– How can the experience gained from reform of the agricultural research system that has been implemented in selected countries help Brazil to improve its agricultural research system and to develop Brazilian agricultural industries?*

Research Question 2 *– What is hindering the growth of private sector participation in agricultural research projects developed by public R&D institutions in Brazil?*

Research Question 3 *– Who should provide financial support to maintain the level of activity in public agricultural public research institutions' activities in Brazil?*

Research Question 4 – *Why are private agricultural sector companies not using the incentives established in the State and Federal laws created to stimulate private sector participation in agricultural research projects developed by public R&D institutions?*

1.3.3. Practical significance of the study

The practical significance of this study lies in its potential to assist the government of Brazil and the private agricultural companies to create the appropriate environment for research and to develop specific procedures to promote the interaction between agricultural research institutes and agribusiness companies. The study provides a set of core recommendations considered relevant for government administrators, researchers, farmers, and managers of agribusiness companies to develop a future strategy to put agricultural research in public R&D institutes on a sustainable basis, in the long-term national interest of improving the profitability of Brazilian agribusiness.

1.4. Research hypotheses

In order to guide and to structure the development of the study reported in this thesis, the following four hypotheses were defined to gain answers for the research questions:

Hypothesis 1 (created to find the answer for Research Question 1):
The experience of R&D institutions in other countries in streamlining their administrative structures and creating more participative research activities can provide relevant guidelines and a potential framework to improve the relationship between public agricultural R&D institutions and private sector companies in Brazil.

Hypothesis 2 (created to find the answer for Research Question 2):
The Brazilian public agricultural research institutions are not structured adequately to permit the development of partnership arrangements with private agribusiness companies.

Hypothesis 3 (created to find the answer for Research Question 3)*:*
The private sector companies are of the opinion that the government of Brazil must finance the majority of agricultural research projects, and, therefore, they do not intend to increase their participation in projects proposed by public agricultural research institutions.

Hypothesis 4 (created to find the answer for Research Question 4)*:*
The state and federal laws created to provide incentives for partnerships between the private sector and public agricultural research institutions are not totally adequate to meet the needs of the agricultural sector.

1.5. Structure of the thesis

This thesis has been written in three parts with specific chapters: Part 1 – Introduction and Methodology; Part 2 – Literature Review; and Part 3 – Data analysis and recommendations (see Figure 1.2).

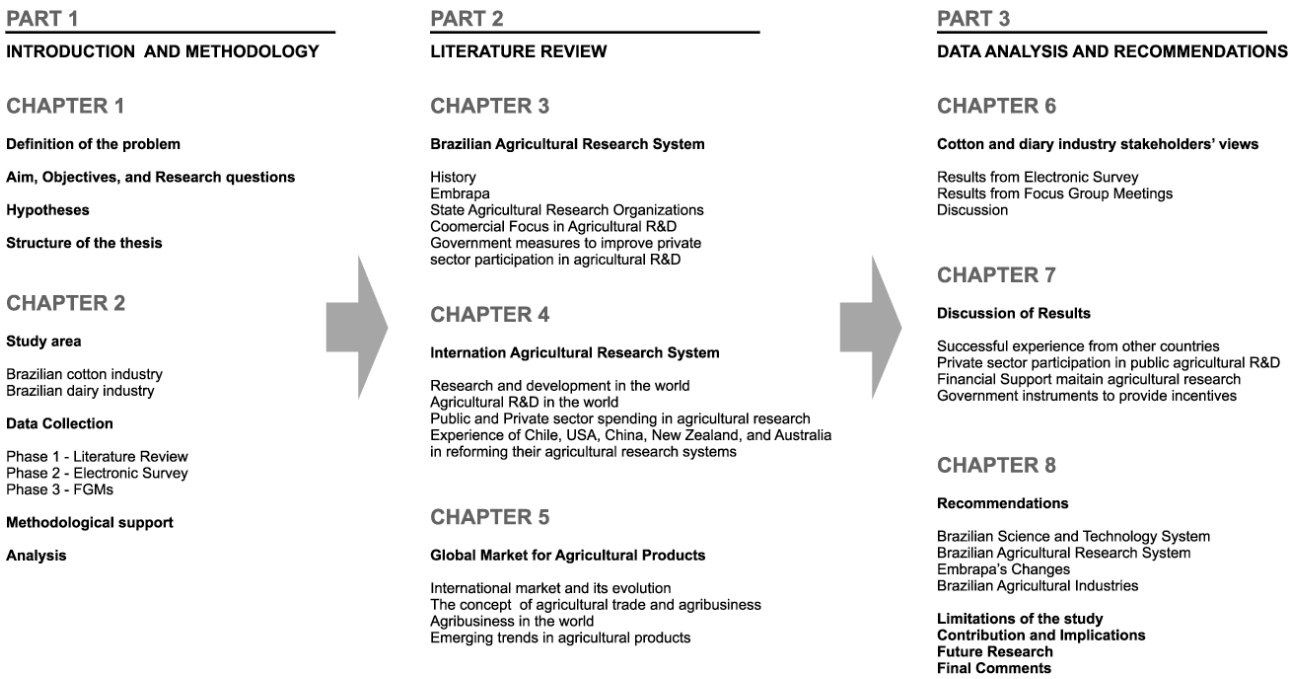


Figure 1.2 Structure of the thesis in three parts

The outline below shows how the thesis was developed.

Part 1 – Introduction and methodology – This part is comprised of Chapter 1 and Chapter 2 as described below. The industries chosen for study were cotton and dairy, since they are both important to the Brazilian agricultural economy, but for different reasons. Their histories and current situations with regard to R&D present a contrast. While the private sector participation in dairy research was 12.5% in 2004, with a tendency for this level of participation to fall, the investment in cotton was about 26% of the total invested in research in the same year, with a tendency for this level of participation to expand (see Chapter 2, Items 2.2.1 and 2.2.2). Representatives of all the segments that comprise these two industries were involved in the identification of the problems that hinder more relevant participation and a larger commitment of funding by the private sector in the research process carried out by public agricultural research institutions.

Chapter 1 – This chapter presents the problem and questions to be studied, defines the aim of and the objectives to be reached by the research, and explains the significance of the study and the applicability of results. Four hypotheses to be tested are defined. This chapter also outlines the overall structure of the thesis.

Chapter 2 – The research methodology is presented in this chapter. First, the conceptual model used to support the study is defined. Next, the qualitative and quantitative methods used in the field research are described. These included an electronic survey and a series of focus group meetings (involving stakeholders from the Brazilian public research institutions and agribusiness companies as well as farm producers), which were used to gather information. Some individual interviews provided additional data. The chapter also describes the study areas and the expected outcomes and implications from the application of the research methodology.

Part 2 – Literature review – The literature review developed in Chapters 3, 4, and 5, was undertaken to examine the Brazilian agricultural research system, and Brazil's situation in the global agricultural market. The role of agricultural research, reform processes therein, the international market and intellectual property concerns were researched. The search of the literature revealed that there has been no previous research with regard to private sector participation in agricultural research in public research institutions in Brazil, which has involved the stakeholders of the cotton and dairy industries of the country. The information obtained in the literature review was used to guide the design of the questionnaire, and FGMs. It was also very useful in the elaboration of the recommendations presented in Chapter 8.

Chapter 3 – The Brazilian Agricultural Research System, including Embrapa, is described in this chapter. The current structure and methods of carrying out research are described, with a focus on the deregulation process that started in the early 1990s, and which can be observed through changes in the system. In the past decade, the approach to delivering research and development services in Brazil has changed from being purely scientific and technological, to include scientific, technological, and commercial dimensions.

Chapter 4 – The international agricultural research and development (R&D) system is described in this chapter. As an introduction, a general description of research and development activities in the world and the global investment in R&D is given. Following that, the focus is on the worldwide agricultural research system, which includes some of the most important international agricultural research organizations such as Consultative Group on International Agricultural Research (CGIAR), The Japan International Cooperative Agency (JICA), the Japan International Research Centre for Agricultural Sciences (JIRCAS), and The Agricultural Research Centre for International Development (CIRAD). Public and private sector spending in agricultural research is examined, as well as the initiative taken by a number of governments, through the establishment of policies, to involve the private sector and increase its participation in the development of agricultural research activities. Lastly, the experience in Chile,

United States of America, China, New Zealand, and Australia in the process of reforming their agricultural research systems is described.

Chapter 5 – With its focus on the global agricultural market, this chapter reviews the relevant literature, beginning with a brief description of the evolution of international trade in agricultural commodities. It describes the activities of the World Trade Organization in agriculture, and the evolution of intellectual property rights, and their impact on the planning of agricultural and agricultural R&D activities. The chapter includes information about the growth of agribusiness in the world and its consequences, as well as the evolution of agribusiness and its implications for the Brazilian economy.

Part 3 – Data analysis and recommendations – the results presented in Chapter 6 and 7, reveal a new perspective on the relationships between cotton and dairy industry stakeholders and public agricultural research institutions, showing the intention of these stakeholders to be part of the research process as a whole, and to invest in agricultural research at a level similar to private sector investment in developed countries. In addition, four groups of recommendation are presented in Chapter 8. These recommendations were elaborated on the basis of the cotton and dairy industry stakeholders' opinions and the information obtained in the literature search.

Chapter 6 – In this chapter, the first phase of statistical analysis is reported. The data from the electronic survey (see Appendices 03 and 04), the focus group meetings, and the individual interviews are presented. The results are considered question by question. At this stage, simple frequency tables showing the response to each question in the questionnaires are presented, and the percentages of responses have been calculated considering the total number of respondents to the questionnaires. In addition, the focus group meeting discussions were collated with respect to each question and the opinions of each professional group were noted separately.

Chapter 7 – This chapter presents a discussion based on the results from the statistical analysis of data collected in the three phases of data collection described in Chapter 2 and presented in Chapter 6. The main aim of this chapter is to frame a response to the research questions and objectives for the thesis defined in Chapter 1. To answer these questions and related objectives, the main points of the literature search presented in Chapter 3, 4, and 5 are integrated with the data collected from the electronic survey, from the focus group meetings, and from the individual interviews, all involving the stakeholders from the cotton and dairy industries.

Chapter 8 – In this chapter, the conclusions of the study are presented, and used to define a set of core recommendations to be implemented by the Brazilian government and the Brazilian private sector to improve the relationship between EMBRAPA and the agribusiness companies, in order to encourage the expansion of production in the case study industries and maximize international trading opportunities for Brazilian agricultural commodities.

CHAPTER 2

RESEARCH METHODOLOGY

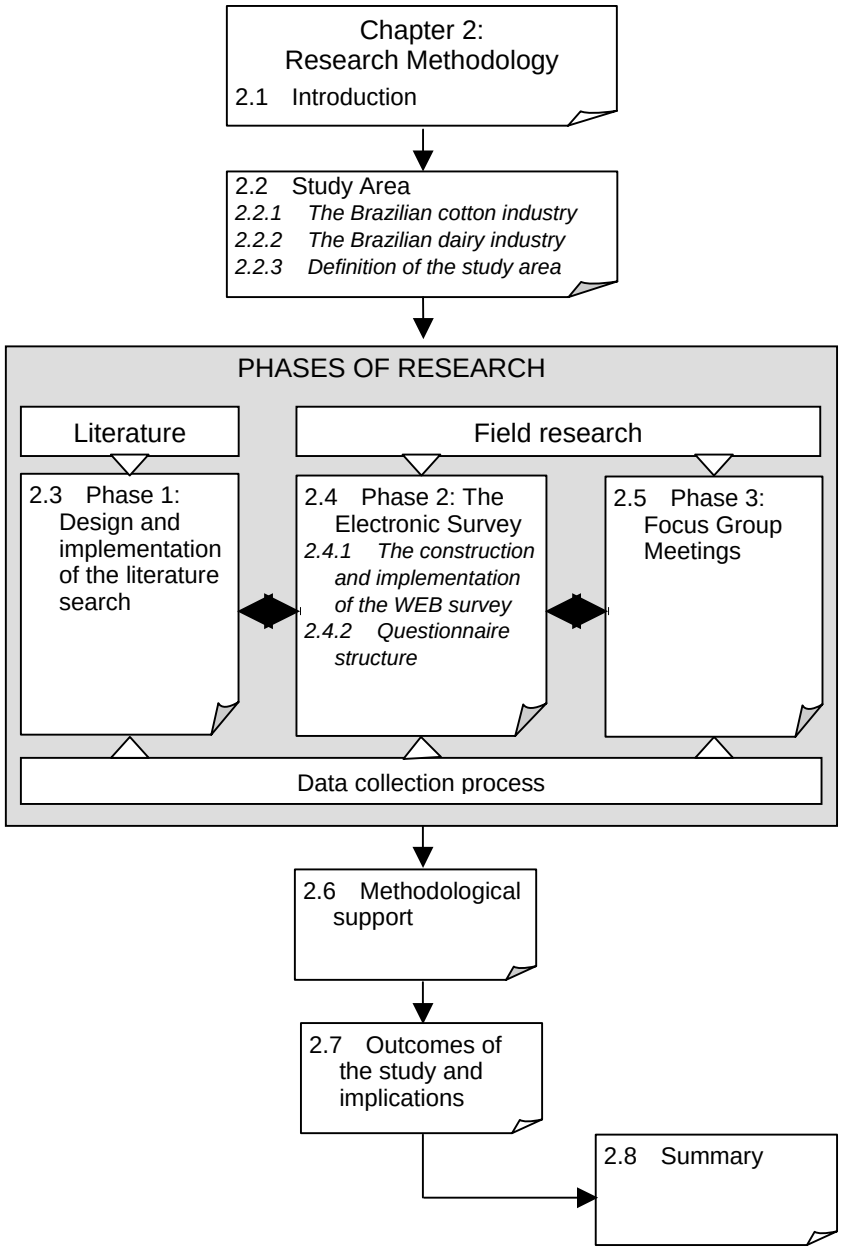


Figure 2.1 Structure of Chapter 2

2.1. Introduction

The research methodology used in this study, and the reasons for selecting the methods employed, are described in this chapter. The aim of the research was to present a clear picture of the Brazilian agricultural research system and describe its significance for Brazilian agribusiness operating in national and international markets. Given the nature of the problem, the stakeholders involved, the research questions to be answered, and the hypotheses defined in Chapter 1, a sequential mixed method of research, involving both quantitative and qualitative elements [QUAL/QUAN, defined by Tashakkori and Teddlie (1998)], was applied. It began with the assembly of qualitative information through a literature search, to identify and describe the relationships between the agricultural research system and the private sector in Brazil as well as in selected other countries. This was followed by a phase in which quantitative data was collected in a survey and several focus group meetings involving stakeholders from the dairy and cotton industries.

The final part of the study was designed to interpret these results to relate findings from the literature to what participants in the study thought about the relationship between research institutions and agribusiness in Brazil and to develop some recommendations for future action.

The research was carried out in three distinct and mutually supporting phases, namely: a review of the theory, to develop a conceptual model illustrated in Figure 2.9; an electronic survey to obtain the opinions of stakeholders in the cotton and dairy industries; and a subsequent set of focus group meetings (FGMs) with selected stakeholders to discuss the results from the first two phases of the investigation and to develop some preliminary conclusions and recommendations.

The information that the literature presents about the Brazilian agricultural system, the evolution of national and international markets for agricultural products, and the experience of other countries in achieving private sector participation in the work of public agricultural research institutions, will be described in Chapters 3, 4 and 5 of this thesis. The information gathered in this first phase of the research served to support the preparation of the questionnaire. In the second phase of the research, Internet resources were used in all of the processes of developing and sending out the questionnaire, as well as receiving the responses and analysing the

data. A set of focus group meetings was then conducted with the objective of discussing and refining the findings from the first two phases.

2.2. Study area

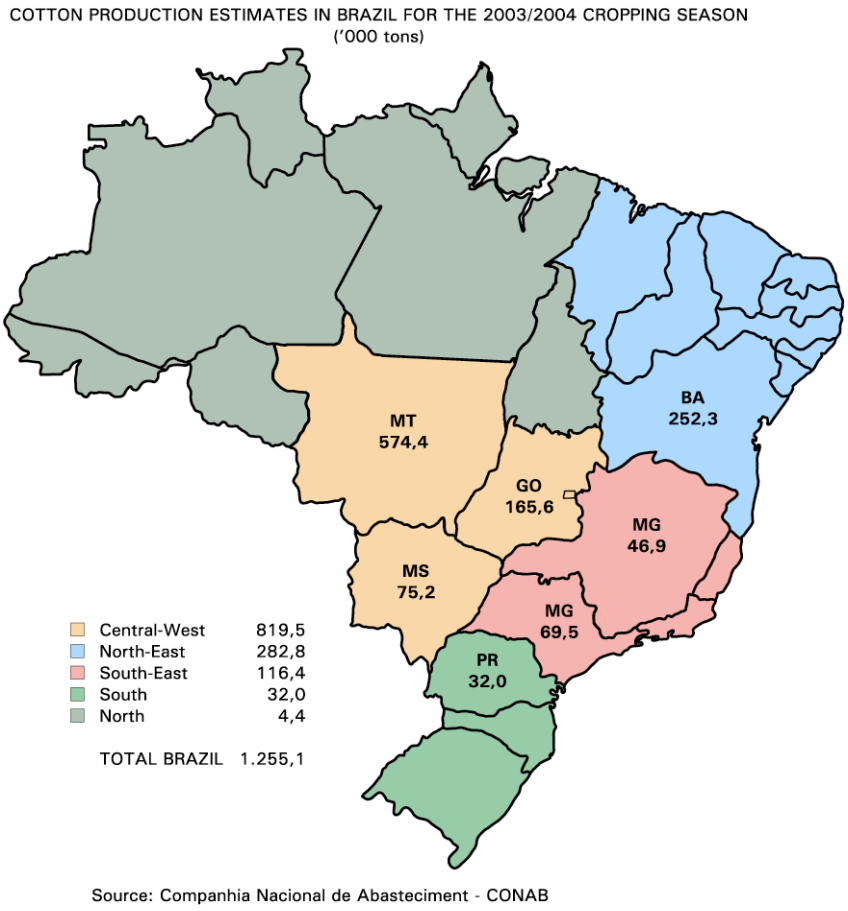
The research methodology described in this chapter was implemented with the participation of the stakeholders in the cotton and dairy industries in the states of Mato Grosso, Minas Gerais, Goiás, and Bahia in Brazil. These industries were chosen because of the rapidly expanding size and increasing export orientation of the cotton industry and the long-established but troubled existence of the dairy industry in the Brazilian agricultural market. The current state and future prospects of these two industries are very different.

2.2.1. The Brazilian Cotton Industry

From a position of importing cotton just a short time ago,[9] Brazil has experienced recent rapid changes in its cotton industry and has now began exporting cotton.

There have been significant increases in both the quantity and quality of cotton produced in Brazil in current years. Average cotton yield has more than doubled in the past decade, rising from slightly over 1,000 kilograms per hectare in 1994, to over 2,500 kg per hectare in 2004. In the 2004 harvest, when cotton production reached a total of 1.25 million tonnes, the country exported approximately 400,000 tonnes, which meant that exports had grown by 116% in the previous four years (Corrêa 2004). Figure 2.2 shows regional cotton production (in thousands of tonnes) in Brazil for the 2003/4 cropping season. The state of Mato Grosso produced 45.7% of the country's cotton output, followed by Bahia with 20.1%; Goiás 13.2%; Mato Grosso do Sul 6%; São Paulo 5.5%; Minas Gerais 3.7%; and Paraná 2.5%.

9 In 1996 Brazil imported about 472,000 tonnes of cotton; this number decreased to 68,000 tonnes in 2002. Sources: SECEX /Aliceweb.



Source: National Company of Supplying (CONAB), linked to the Ministry of Agriculture, Rural Development and Fishery of Brazil

Figure 2.2 Regional cotton production in Brazil: 2003/04 cropping season

Table 2.1 shows that, according to data from the Brazilian Cotton Producers Association, there were 19,202 cotton producers in Brazil in 2005. Of this total, 17,917 are considered small producers (size of production area up to 100 ha), and 1,285 medium-size or large-scale producers (area of production above 100 ha).

Table 2.1 Number of Brazilian cotton producers by state: 2005

State/Association	Number of producers per state		
	Small producers ≤ 100 ha	Medium and large producers > 100 ha	Total
Bahia (ABAPA)	2,092	201	2,293
Paraná (ACOPAR)	8,100	0	8,100
Goiás (AGOPA)	500	284	784
Minas Gerais (AMIPA)	3,000	130	3,130
Mato Grosso (AMPA)	75	295	370
Mato Grosso do Sul (AMPASUL)	80	120	200
São Paulo (APPA)	450	240	690
Other States of Northeast Region	3,620	15	3,635
Total	**17,917**	**1,285**	**19,202**

Source: ABRAPA (2005)

2.2.1.1. Private sector participation in cotton research projects

Private sector support for the public research institutions working in cotton increased significantly, in the past ten years. It went from 1.1% in 1994 to approximately 26% of the total budget in 2004, with this rapid growth reflecting the increased investment in the sector as it responded to the increase in domestic and international demand.

Cotton research in Brazil started in 1924 with the development of research in genetic improvement of cotton varieties introduced from the United States by the Agronomic Institute of Campinas. Ten years later, the producers in the State of São Paulo already had access to selected varieties and entire cotton farms in the State were planted to Brazilian cotton varieties.

Progress in cotton research in Brazil continued in some form until the 1970s. Among the main problems faced by cotton producers were the fluctuation in domestic and international market prices and the total lack of coordination in research projects. Projects were not geared to address any particular problems or to have an orientation aimed at the needs of agribusiness.

In 1975, Embrapa created the National Centre for Cotton Research (today named Embrapa Cotton) in the State of Paraiba in the Northeast of Brazil, with the mission to coordinate cotton research in Brazil and to undertake specific projects.

This organization developed and implemented the first National Program for Cotton Research in Brazil in 1980.

Immediately after this National Program for Cotton Research was developed, and in the years that followed, Embrapa Cotton extended its cotton research activities into the States of Bahia, Ceará, Goiás, and Pará with the support and total involvement of the States' Agricultural Research Organizations in those States. More recently the states of Mato Grosso, Mato Grosso do Sul, and Minas Gerais joined this program.

Embrapa Cotton and its State and private sector partners generated a series of results that allowed expansion of cotton farming into frontier agricultural areas. The producers' good level of organization, and the partnership between Government and the private sector, resulting in substantial investments in research and development, has been largely responsible for the Brazilian cotton industry's success in the past 10 years.

The evolution of the Embrapa Cotton budget (1994-2004), presented in Table 2.2, is an example of increasing private sector investment in agricultural R&D. Table 2.2 shows that private sector participation in the Embrapa Cotton budget represented a very significant increase, over 23 times, in 10 years from 1994 to 2004. In the most recent five years, private sector input into the Embrapa Cotton budget increased by 106%, starting at 12.5% in 2000 and reaching 25.7% of the budget for 2004, with a strong tendency for growth to reflect the increase in the research investment recorded for all cotton industry segments in the past years as demand for cotton on domestic and international markets increased. This result, if compared with the statistics presented in Table 3.4 in Chapter 3 where private sector participation in Embrapa's global budget does not exceed 5%, can be considered an excellent standard for private sector participation in public agricultural research institutions. The same situation is registered with the cotton research and development programs in organizations like EBDA, EMPAER-MT, IPA, APTA, and IDATERRA-MS.

Table 2.2 Embrapa Cotton's budget: 1994 to 2004, showing government and private sector support (in millions of US dollars, current values) [a]

Year	Government support			rt	Total
	Financial contribution (A)	(A)/(C) %	Financial contribution (B)	(B)/(C) %	(C)
1994	4,894	98.9	52	1.1	4,946
1995	7,275	99.4	45	0.6	7,320
1996	7,803	96.6	276	3.4	8,079
1997	6,538	96.0	275	4.0	6,813
1998	6,904	97.7	166	2.3	7,070
1999	4,470	83.9	857	16.1	5,327
2000	4,900	87.5	700	12.5	5,600
2001	4,092	77.0	1,223	23.0	5,315
2002	2,946	79.0	785	21.0	3,731
2003	4,200	78.7	1,140	21.3	5,340
2004	5,026	74.3	1,734	25.7	6,760
	Percent average	**88.1**		**11.9**	

a Values converted to US dollars were calculated on the basis of FGV (Getulio Vargas Foundation) average annual exchange rate.

b Because basically all the resources derived from outside Brazil are related to international loans and therefore of federal government responsibility, external resources were considered as provided by the government.

Source: Embrapa Financial Administration Department; Embrapa Secretariat for Administration and Strategy; and Embrapa Cotton.

One of the initiatives that is justified by these good results, and shows that the cotton industry is relatively more organized than the dairy industry, was adopted by the state of Mato Grosso, the largest cotton producing state of Brazil. Through Law 6,683 of 02/06/1997, promulgated by Decree 1,589 of August 1997, the Government of the state created the Cotton Incentive Program (PROALMAT), with the objective to reconstruct, to expand, and to improve the quality of the cotton produced in Mato Grosso, as well as to stimulate new investments in the agricultural textile sector of the State. The resources for this Program come from a 75% reduction in the ICMS

charged on the product[10]. With this same Law and Decree, the Fund for Support of Cotton Culture (FACUAL) was established, with the objective to expand the investment in cotton research, in the training of human resources, and promotion of cotton in Mato Grosso. A proportion (15%) of the financial resources collected by the PROALMAT is allocated to FACUAL for the development of its activities (PROALMAT 2006).

2.2.2. The Brazilian dairy industry

With an annual production of approximately 23 billion litres of milk recorded in 2005, Brazil continues to import milk, and the dairy industry continues to present a set of unique problems.

Dairy activities are part of the farming systems on 1.2 million rural properties in Brazil, the majority of which are worked by families (small farms), which gives a very important social dimension to these activities in the country. The structure of the dairy industry in Brazil is quite remarkable. Of its 1.2 million producers, 2% of them produce one third of the Brazilian national milk output; 5% produce 50%; 10% produce two thirds; while the largest 20% of farms produce 80% of the output and 80% of the industry produces only 20% in aggregate of Brazilian production. Figure 2.3 shows that the South-eastern Region is the main dairying area, recording 45% of the total milk produced in Brazil. It is followed by the regions of the South and Central West, with 25% and 15% respectively (EMBRAPA 2006b; Martins 2004).

10 ICMS – Tax on Circulation of Merchandises and Rendering Services. The ICMS (tax on operations relative to the circulation of merchandises and on renderings of services of interstate, intermunicipal transport and of communication) is the responsibility of the States and the Federal District.

Figure 2.3 Brazilian milk production by region: 2005

In 2003, Brazil was the sixth largest producer of milk in the world, with approximately 4.5% of worldwide production. The dairy sector is one of the most important in Brazilian agribusiness, occupying sixth place in the total value of agricultural production, behind soybeans, bovine meat, maize, poultry, and sugarcane in that order. The state of Minas Gerais, with 28.5% of the production, is the largest producer of milk in Brazil, followed by the states of Goiás with around 11.5%; Rio Grande Do Sul (10.8%); Paraná (9.2%); and São Paulo with 8.1% (Martins 2004).

2.2.2.1. Private sector participation in dairy research projects

Private sector participation in research projects in the dairy industry, in the period from 1999 to 2004, grew by only 27.5%, to reach about 12.5% of the total industry research expenditure in 2004 (see Table 2.3), with a tendency for this level of participation to fall.

Embrapa Dairy Cattle was created in October 1976, and the history of this organization can be understood once something is known about dairy cattle research and development in Brazil and in other countries with a tropical climate. Located in Juiz de Fora in the State of Minas Gerais, the Embrapa Dairy unit has the responsibility for coordinating the national dairy research program, which involves partnerships with agricultural research institutions in the search for solutions for the development of dairy agribusiness (EMBRAPA 2006b).

Table 2.3 Embrapa Dairy Cattle's budget evolution: 1999 to 2004, showing government and private sector support (in thousands of US dollars, current values) [a]

Year	Government support [b]		Private sector support		Total
	Financial contribution (A)	(A)/(C) %	Financial contribution (B)	(B)/(C) %	(C)
1999	7,562	90.2	823	9.8	8,385
2000	7,941	90.3	855	9.7	8,796
2001	7,184	88.2	963	11.8	8,147
2002	5,064	89.3	606	10.7	5,670
2003	6,424	83.2	1,294	16.8	7,718
2004	7,721	87.5	1,098	12.5	8,819
	Percent average	**88.1**		**11.9**	

a Values converted to US dollars were calculated on the basis of FGV (Getulio Vargas Foundation) average annual exchange rate.
b Because basically all the resources derived from outside Brazil are related to international loans and therefore of federal government responsibility, external resources were considered as provided by the government.

Source: Embrapa Financial Administration Department; Embrapa Secretariat for Administration and Strategy; and Embrapa Dairy Cattle.

Table 2.3 shows the development of the Embrapa Dairy Cattle budget over the period from 1999 to 2004, where it can be seen that there was a moderate increase in private sector participation. However, there was a tendency for this participation to decline in later years. The result for 2003 was atypical in view of the contribution made in 2004, when there was a decrease of 26%, giving an average contribution of 11.9%.

The milk market, as much as that of any other farm commodity, is affected by technological, environmental, socio-economic, and government issues. A study carried out by Embrapa Dairy Cattle in partnership with organizations such as MCT,

PADCT, and CNPq[11] in 2001 into the production segment of the dairy industry identified the following problems that are common to all producers across the many production areas of Brazil. They could be divided into three categories (EMBRAPA 2001):

- "***Technological restrictions**:*

  a) low quality of the pastures and soil degradation;

  b) the genetic standard of the animals is such that production tends to be low;

  c) with a tendency for low milk production;

  d) need for specific production systems with validated technological alternatives for the different regions; and

  e) low sanitary quality of the milk produced on the farms."

- "***Economic restrictions**:*

  a) need to evaluate the impact of the institutional policies created to stimulate production and productivity, on producers;

  b) need to study the factors related to management efficiency; need to create a standard system to calculate the costs of milk production; and

  c) identify the extent of informal milk production (e.g., milk from very small producers with 1 - 3 cows)".

11 MCT means Ministry of Science and Technology; PADCT (Scientific and Technological Development Support Program), and CNPq (National Council of Technological and Scientific Development).

- "***Institutional restrictions***:

  a) *lack of standardization of the sanitary inspection and control systems for milk quality;*

  b) *different taxation systems among the Brazilian States;*

  c) *milk producers are not organized to defend their corporate interests, nor do they have qualifications in business management;*

  d) *a national network of laboratories, to analyse milk, needs to be created."*

All of these problems identified by the study, but particularly those relating to technological and institutional areas, allied to the large number and dispersed location of farms involved in milk production, make it difficult to identify and consequently to deal with all of the dairy industry demands.

This set of issues can be considered as the reasons, direct or indirect, which explain the difficulty that Embrapa Dairy Cattle has had in involving the private sector and increasing its participation in the development of its research projects.

2.2.3. Definition of the study area

The research into the cotton industry reported in this thesis was conducted in the two leading cotton-producing states, Mato Grosso and Bahia, which in 2004, together accounted for approximately two-thirds of Brazilian production. In the case of the dairy industry, the data for this study were collected in the states of Minas Gerais, because of its long tradition and well developed infrastructure for milk production, and Goiás, because of the opening there of a new region for milk production based on modern equipment and new technology with strong support from the government of the state.

The sample defined to collect data for this study was drawn from a range of groups including farmers and their research and commercial partners. The medium-sized and largest farmers were to be included (for cotton, see data from Mato Grosso and Bahia in Table 2.1.) In dairy, it was considered that the 2% of producers who

produce one third of the Brazilian milk production are located in Minas Gerais and Goiás, they should be included as were agricultural researchers and lecturers in universities, managers of producers' and manufacturers' cooperatives and associations, managers involved in input supply companies, service providers, logistics, traders, and retailing companies, and any other relevant stakeholders in the cotton and dairy industries operating in the states of Mato Grosso, Bahia, Minas Gerais, and Goiás (see Figure 2.4).

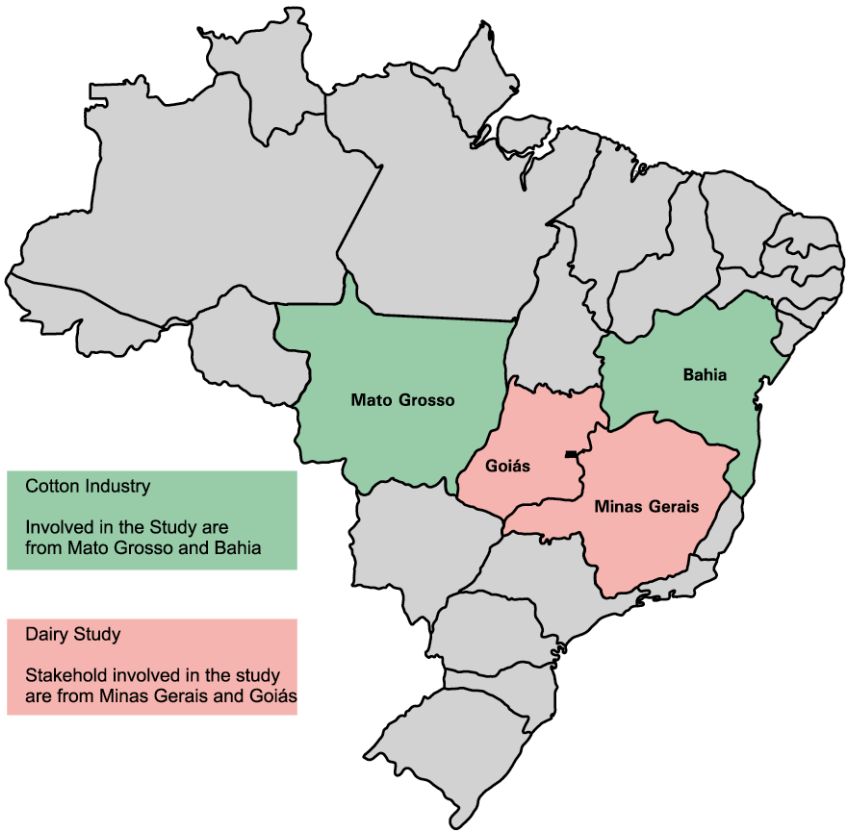


Figure 2.4 States involved in the study area

A strong point in favour of the states selected to be part of this study was the good structure provided by these states in agricultural research and development. In these states, the presence of research organizations such as Embrapa Dairy Cattle (Minas Gerais and Goiás); Embrapa Cotton (Mato Grosso and Bahia); Mato Grosso Foundation (Mato Grosso); The Goiânia Regional Development Agency (Goiás); and The Bahia Agricultural Company (Bahia and Mato Grosso) can be noted. Furthermore, the state and federal universities in those states (Bahia, Mato Grosso, Minas Gerais, and Goiás) and the private agricultural R&D institutes, are developing specific programs for the cotton and dairy industries.

2.3. Phase 1: Design and implementation of the literature search

As part of the first phase of data collection in this study, a framework to describe global agribusiness was developed, identifying the participants and processes involved in the production and export of agricultural commodities around the world, in an attempt to identify whether there was any relationship between agribusiness companies and public agricultural R&D institutions.

The purpose of this conceptual model was to reveal what research should be undertaken, what research methods would be best suited to the problems to be studied, and which segments of society should be involved in the study. The literature search was designed to answer these questions. Among the sources consulted were reports, agricultural research policies, and statistical data from governments, universities, and research organizations in Brazil, Australia, America, Chile, China, and New Zealand, as well as international agricultural research institutions such as the Consultative Group of International Agricultural Research (CGIAR), the Japan International Research Centre for Agricultural Sciences (JIRCAS), and the International Service for National Agricultural Research (ISNAR). Information regarding international institutions, including FAO (the Food and Agricultural Organization), OECD (Organization for Economic Co-operation and Development, and WTO (the World Trade Organization) was analysed. Various relevant works from prominent writers in the field of agricultural economics were also studied.

It became evident from the literature that three distinct elements needed to be examined: the agricultural R&D system in Brazil, as well as in other countries; participation by the private sector in agricultural research, which is conducted mainly in public research institutes in Brazil and in many other countries; and Brazilian and international markets (imports and exports) for a limited range of agricultural products of particular interest in this study. To this end, each of these three areas was investigated and described separately. In each case, who was involved, and what they were doing was accessed and carefully analysed.

The research in this first phase revealed the structure of the Brazilian agricultural R&D system, with its major elements and their relationships. This system and its internal links are shown in Figure 2.5, and are described in Chapter 3, as part of the literature review. A detailed description of Embrapa (which is a Federal institution), and of the State Agricultural Research System, formed basically by the set of private and public institutions that operate at the State level, and are specifically responsible for the development of the scientific and technological agricultural sector in each state of the Brazilian confederation, is also provided. The commercial focus of activities in the government agricultural R&D institutes will be described in detail, and the characteristics of the agribusiness companies that participate in the Brazilian Agricultural Research System are also identified and are described in Chapter 3.

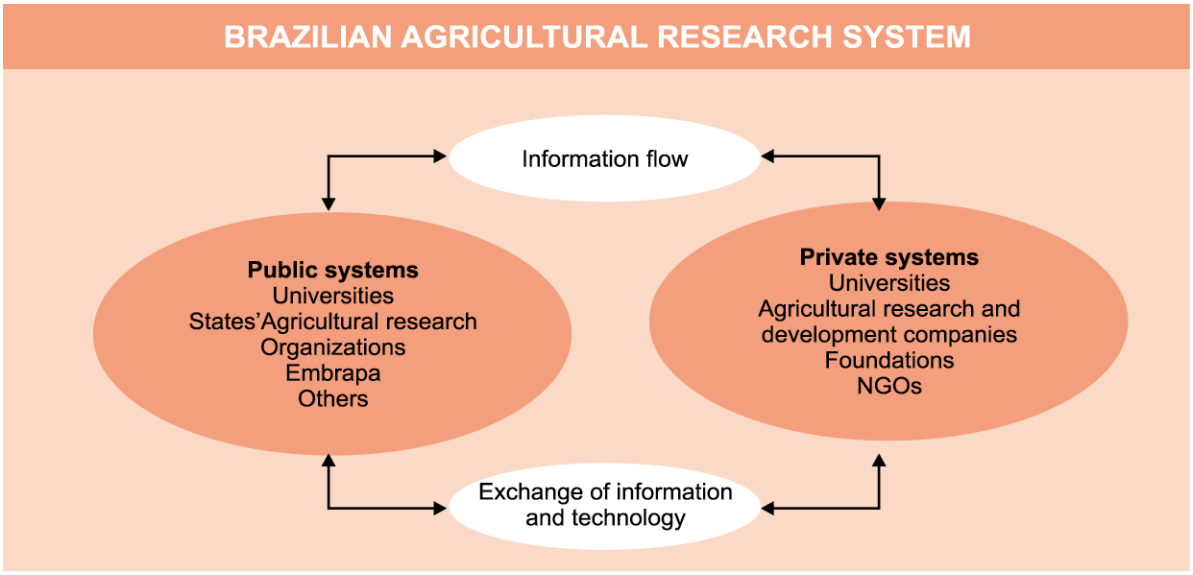


Figure 2.5 Brazilian agricultural research and development system (described in Chapter 3)

The second element of research in Phase 1 was to examine the extent of private sector participation in national agricultural R&D systems in a range of countries. The information obtained in regard to changes in the agricultural R&D systems reforms of Chile, the United States of America, China, New Zealand, and Australia is reported in Chapter 4. The relationship between the agricultural R&D system and agribusiness companies resulting from these reforms appears to have led to improved results in exporting agricultural commodities in some of the countries studied. Figure 2.6 shows the linkages within and between the international agricultural market and the international R&D system, which includes private and public R&D agencies.

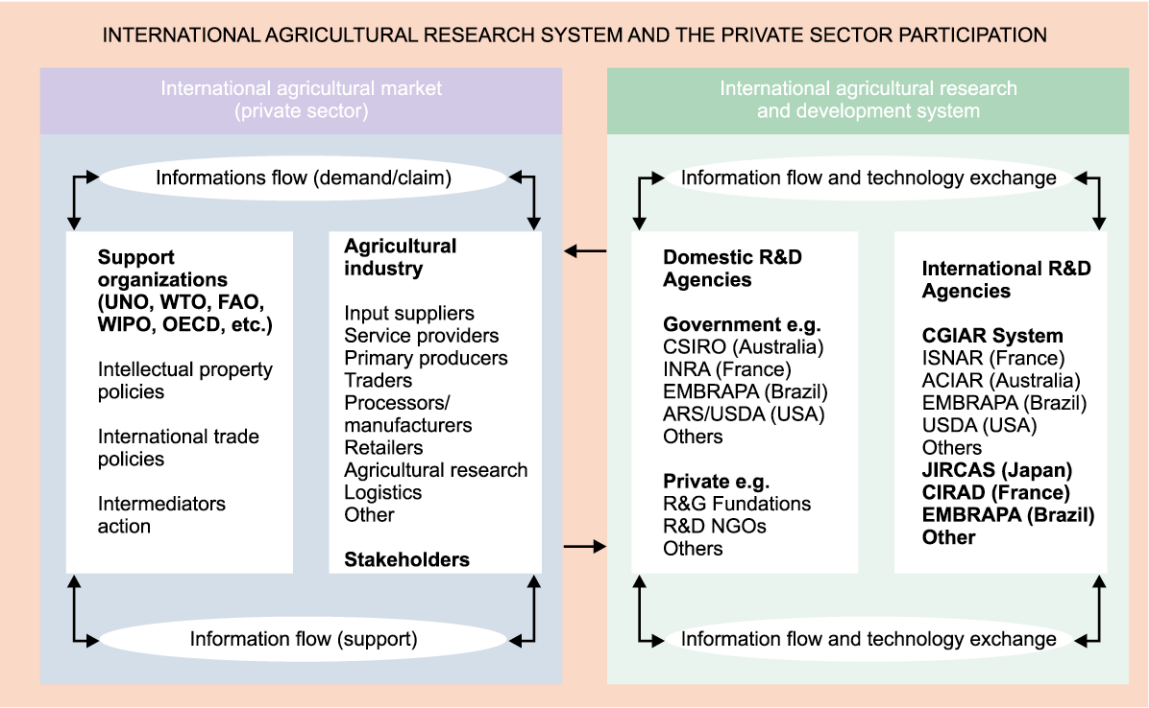


Figure 2.6 International agricultural research systems (described in Chapter 4)

The third major element examined in Phase 1 was the market for agricultural products, divided into domestic and international sections. The results of the research are summarized diagrammatically in Figure 2.7. In Chapter 5, the relevant literature, describing the evolution of international trade in agricultural commodities that has been occurring over the past 100 or so years, is reviewed. The role of the World Trade Organization in international trade in agricultural commodities is outlined. In addition, the development of agribusiness and its consequences for the world economy, and specifically its implications for the Brazilian economy, is also described.

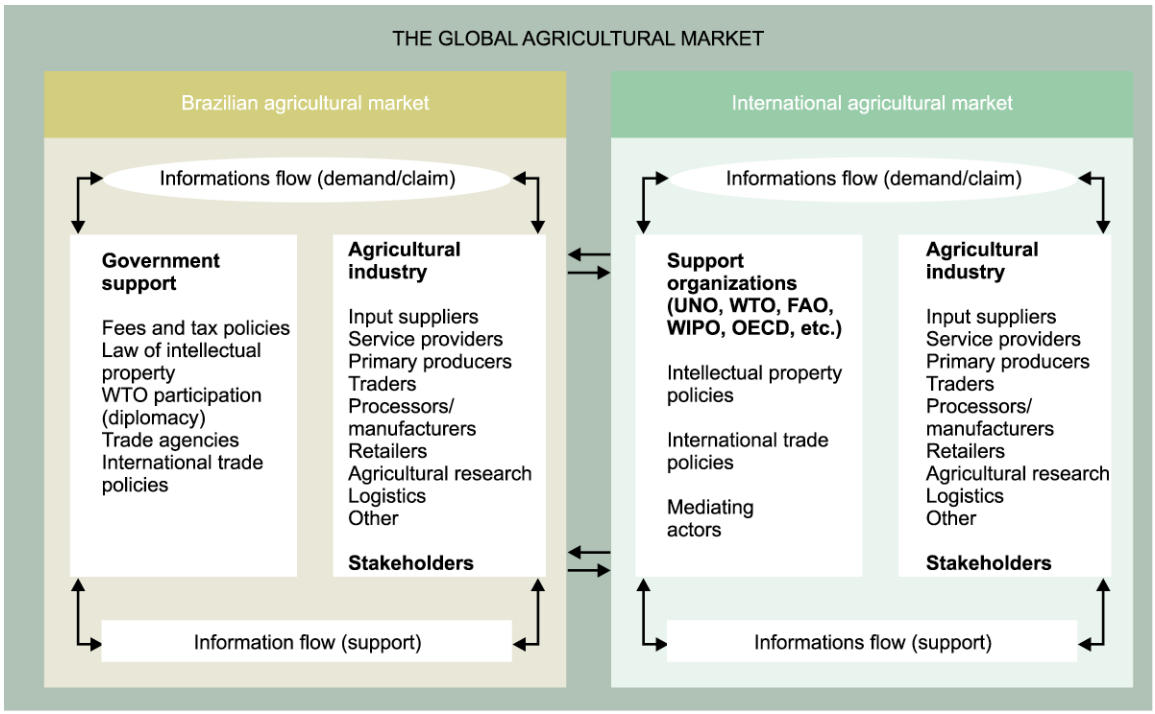


Figure 2.7 Global agricultural markets (described in Chapter 5)

In Figure 2.8, the interaction of the two systems, which is the core interest of this study, is depicted. The figure, based on the information gathered in Phase 1 of the research and described in Chapters 3, 4, and 5, shows the structure of the Brazilian Agricultural Research System and a very simplified outline of the Brazilian market for agricultural commodities, together with their various elements and the flows/exchanges of information, technology, and support through the system. Figure 2.8 thus identifies the elements to be involved during subsequent phases of data collection and interpretation in the conduct of this study. It also makes it evident why it is so desirable to develop a set of recommendations to be implemented by the Brazilian government and by the private sector to improve the relationship between agribusiness companies and public agricultural research institutions in Brazil.

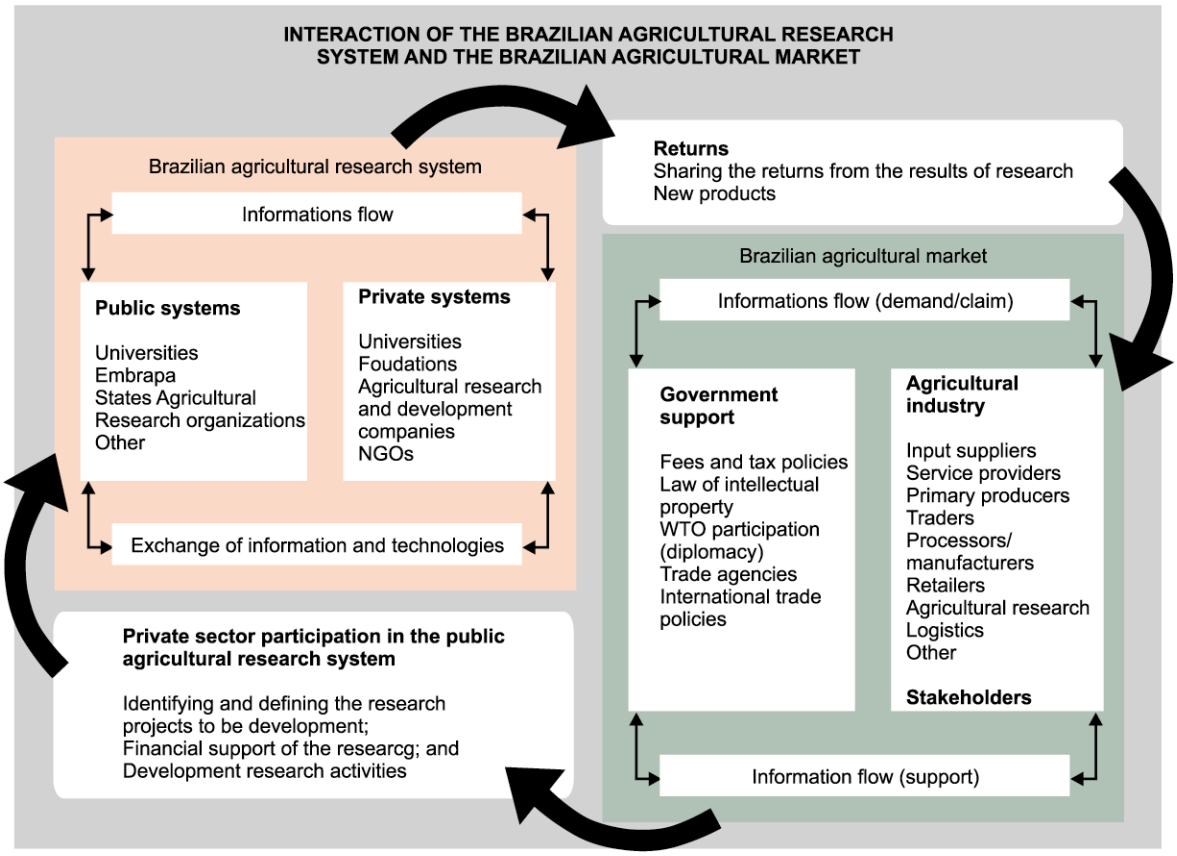


Figure 2.8 Interaction of the Brazilian Agricultural Research System and the Brazilian agricultural market

After the definition and description of these areas, an overall global structure revealed by the literature review is presented, showing the linkages and the demands identified among the sector's participants. Figure 2.9 illustrates the complete framework with its links, thus defining demands among the various elements of the system, and how these relationships evolve. Most importantly, this figure brings out the focus of the study, highlighting the process of developing relationships between public R&D institutions and private sector companies, and the applicability and significance of the results of this investigation. From this diagram, the importance of the study can be deduced. It recognizes the global market for agricultural commodities, and the potential for this research to assist the government of Brazil and the private agricultural companies to create specific procedures to improve existing arrangements, in order to promote greater integration between public agricultural research institutions and agribusiness companies.

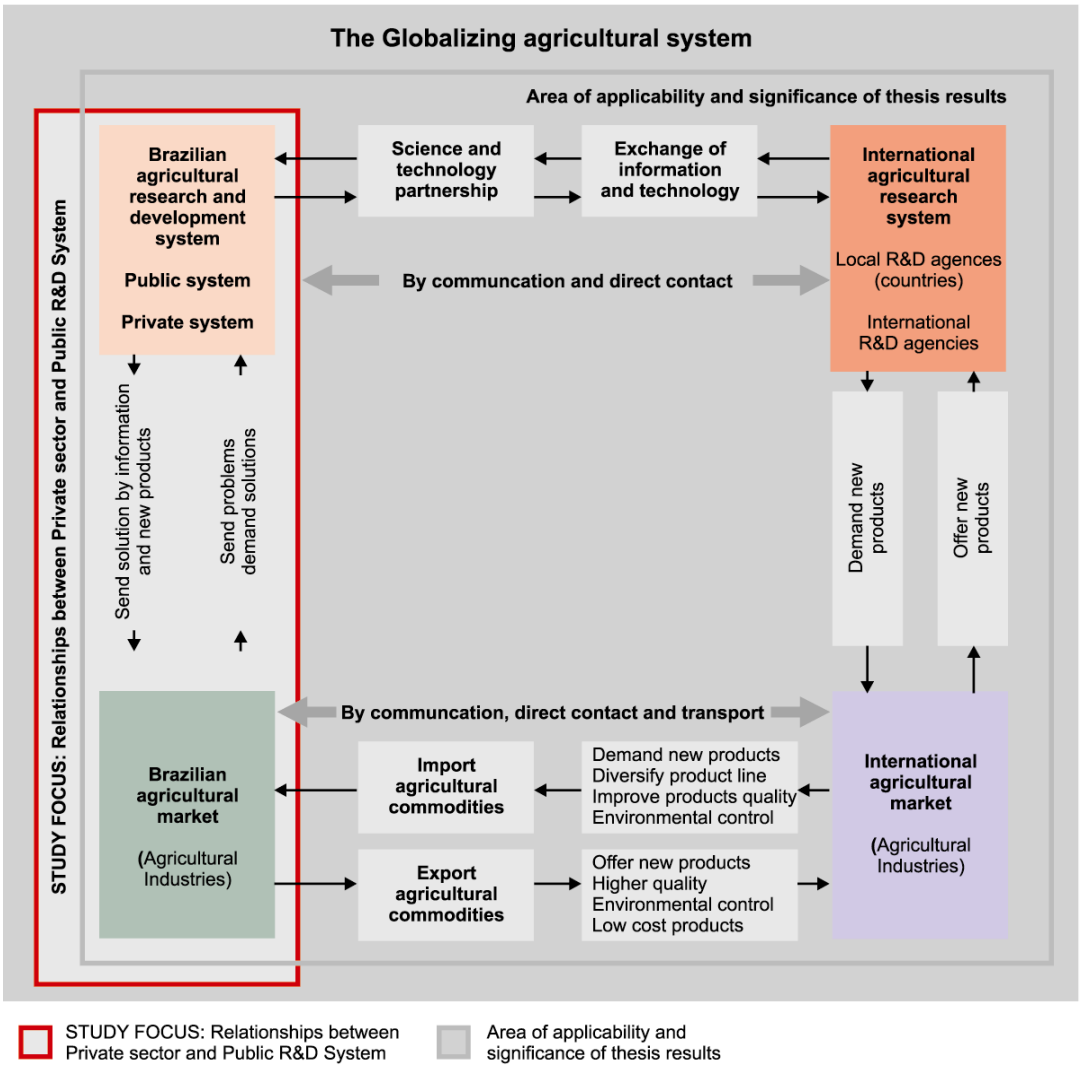


Figure 2.9 The global agricultural system

2.4. Phase 2: The electronic survey

The electronic survey is frequently used in research in the social sciences as a means of gathering information. There are many advantages of using the capacity of the Internet to survey respondents. Using the Internet, the researcher can contact virtually unprecedented samples of people. It is possible to show lists, diagrams, and images to which respondents can react. Such a survey can attract high levels of interaction and verbatim responses, and the speed of implementation is unparalleled. It is also economic to use. Internet research has many applications and, in common with other research techniques, some distinct limitations (Babbie 2005; Creswell 2003; Hewson *et al.* 2003).

The survey has a place in studies like the current investigation, which has the objective of involving and obtaining the opinions of stakeholders in the cotton and dairy industries, in order to evaluate the relationship between public agricultural research institutions and private agribusiness companies in Brazil. Also, considering the size of the country and distances involved between states in Brazil (and taking into account that the study was undertaken from The University of Queensland in Australia), conducting the research survey by the Internet was the most efficient method and the most adaptable approach to gathering data relevant to the defined research hypotheses and questions.

The computerized self-administered questionnaire survey technique was defined by Babbie (2005) in the following way: "*the respondent receives the questionnaire via floppy disk, bulletin board, or other means and runs the software, which asks questions and accepts the respondent's answers. The respondent then returns the data file*". The software "Survey Said"[12] was used in this case to develop and administer the electronic survey, and to process preliminary results.

The use of the Internet for social research is still regarded with curiosity by some people: there is some cynicism, as well as some degree of disbelief that it is effective. Some precautions were taken to avoid the risks reported in the literature review about implementing research by the Internet to collect data (Babbie 2004; Hewson *et al.* 2003; Rubin and Babbie 2001). Issues like availability of equipment to respondents, including both hardware and software, were considered along with the technical expertise of both the researcher and the participants. In addition, other information gathering methods were used to involve the stakeholders in the cotton and dairy industries and to convince them to participate in the research.

12 Survey Said Version 1999 is a Windows application for creation, administration, and reporting of surveys. This package is intended to provide a complete environment for research of this type, from survey design, to survey administration, survey analysis, and reporting. Survey Said will facilitate survey for any study that requires surveying of customers, clients, test subjects, etc. for market research and quality data. Respondents may select their answers directly, by sitting at the PC running the SURVEY RESPONDENT module. Survey Said for the WEB provides a complete system to administer surveys on the Internet.

2.4.1. The construction and implementation of the WEB survey

The attractive features of conducting an on-line research survey include the ease of access and the precision and rapidity with which the data can be collected and analysed. On the other hand, this system requires a series of checkpoints that cannot be neglected in carrying out the research. It is important that the questionnaire has a good presentation, is easy to access, clear in its intention, and permits the respondents to have as little trouble as possible when navigating the site hosting the electronic survey (Babbie 2005).

To this end, and with the intention of facilitating respondents' responses to the questionnaire to the maximum extent possible, the principles presented by Dillman (2000) were followed since they are basic to the process of constructing a research-by-web investigation. Recently, these same principles were adopted and improved by Spies in his PhD study (Spies 2003).

The research reported here was carried out under the rules defined in the Code of Ethics for social science research at The University of Queensland, and has been cleared by the Human Ethics Committee of the School of Natural and Rural Systems Management in accordance with the University of Queensland's policy on research ethics.

The survey was conducted among a sample of stakeholders in the cotton and dairy industries, involving the representatives from the following segments:

- Farm input suppliers (located in regions where cotton and dairy production occurs);

- Logistics managers (working with cotton and dairy industries in the states of Mato Grosso, Bahia, Minas Gerais, and Goiás);

- Producers (farmers) from the states of Mato Grosso, Bahia, Minas Gerais, and Goiás

- Managers of producer and manufacturing associations and traders (cooperatives, syndicates, foundations and associations);

- Agricultural researchers and university lecturers (including scientists from Embrapa Dairy Cattle, Embrapa Cotton, and the State Agricultural Research Organizations in the States of Mato Grosso, Bahia, Minas Gerais, and Goiás);

- Service providers (technical consultants from private and public companies); and

- Government authorities (federal, state, and municipal), directly involved with the dairy and cotton industries.

The study was conducted in the states of Mato Grosso, Bahia, Minas Gerais, and Goiás. To take part in this survey, each respondent received an invitation to participate (see Appendix 01 in English and Portuguese) and provided the answers directly on the Internet homepage of the survey software.

After some careful work to identify and select representatives from all the segments of the cotton and dairy industries, 730 stakeholders considered eligible to answer the questionnaire were identified (see Table 2.4). This was accomplished with the assistance of Embrapa Dairy Cattle, Embrapa Cotton, and ABRAPA – Brazilian Cotton Producers Association. In accordance with guidelines provided by Neuman (2003), the relevance of the contribution of the respondents was considered as more significant than the number of respondents.

Table 2.4 Origin and number of professionals in the sample of cotton and dairy industry stakeholders involved in the data collection process

Industry	Professional groups							
	Farm input suppliers	Logistics company managers	Producers	Managers of producers' associations	Agricultural researchers and lecturers	Technical consultants	Government authorities	Total
Cotton	30	35	145	45	50	35	10	350
Dairy	20	12	210	50	60	20	08	380
Total	**50**	**47**	**355**	**95**	**110**	**55**	**18**	**730**

Of the 730 questionnaires sent, 350 went to cotton industry representatives and 380 to dairy industry representatives. From this total, 246 answers from cotton and 238 from dairy groups were returned, a total of 484 questionnaires answered, and a response rate of 66.3%. This is considered as very good in accordance with Stevens (1996); de Vaus (2002); and Babbie (2005).

From the total of 484 questionnaires returned, 112 questionnaires were discarded (27 questionnaires from cotton industry stakeholders and 85 from dairy stakeholders) owing to technical/operational problems, leaving 372 responses that could be analysed. To this total, 33 more questionnaires (13 from the cotton industry and 20 from the dairy industry) that were completed directly by the producers interviewed (face-to-face) were added. Therefore, results presented in this study, specifically in Chapters 6 and 7, were based on 405 answers to the questionnaire, 232 from the cotton and 173 from the dairy industry.

In addition to all of the procedures adopted for the success of the electronic survey, the process of data collection had direct help and involvement from the heads of Embrapa Dairy Cattle and Embrapa Cotton, and from the executive director of ABRAPA, through the supporting letters sent by e-mail to each of the stakeholders selected to participate in the research. In these documents, the importance of the study that was being undertaken was emphasized, and the respondents were requested to give it their attention and involvement, and to answer and return the questionnaire by the date defined in the timetable (See Appendix 02).

The survey was implemented using the Survey Said Software modules,[13] and the framework that was applied was adapted from Spies (2003). Figure 2.10 shows the steps undertaken in the construction of this survey.

13 The Survey Said Software includes three modules: Survey Creator, Survey Respondent, and Survey Analyzer.

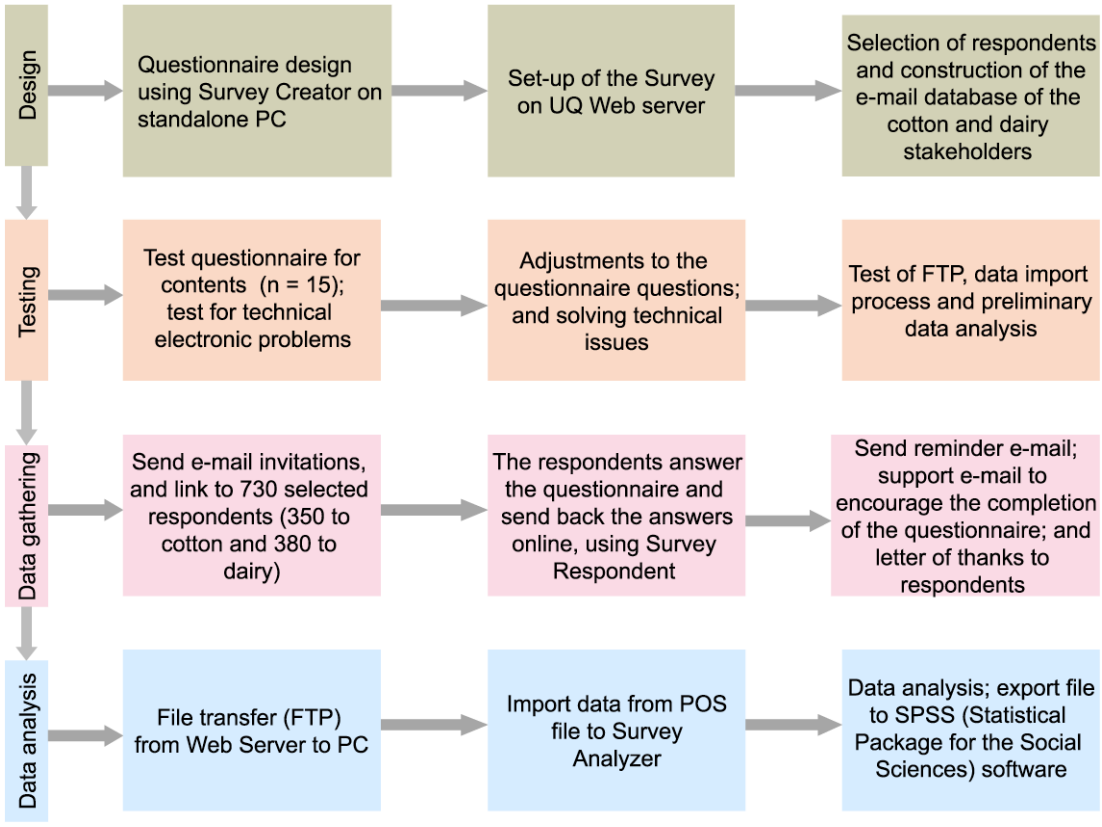


Figure 2.10 Framework of the steps for design and implementation of the electronic survey [adapted from Spies (2003)].

2.4.2. Questionnaire structure

Two questionnaires were developed to obtain the opinions of people involved in the two industries, one for cotton industry stakeholders, with 40 questions (Appendix 03); and another one for the dairy industry stakeholders, with 41 questions (Appendix 04). The two questionnaires have the same structure and include the same questions, with the exception being the questions designed to identify the size of the enterprise. For dairy producers, there were two questions (number of cows, and amount of daily milk production), while for cotton producers, there was only one question, which focused on identifying the size of the planted area.

In addition, the responses were standardized in categories to facilitate the analysis of the data (Babbie 2004). Measurement techniques, as used in the examples below, were applied:

- An ordinal measure for example, would be used to answer the question, 'How important is R&D for agribusiness?' (not important, moderately important, important, very important, extremely important, or do not know). Alternatively, respondents were asked to respond to a statement, 'Agricultural R&D is fundamental for agribusiness success' (disagree, agree, or do not know);

- A ratio measure would provide the answer to some questions, such as: 'What is the size of your farm?' (Less than 500ha, from 501ha to 1000ha, from 1001ha to 3000ha, from 3001ha to 5000ha).

The questionnaires, with questions involving rating, single, and multiple choice, and ranking questions, as well as open-ended questions, included eight groups of linked questions for each subject as can be observed in Table 2.5.

Table 2.5 Questionnaire structure

Group of questions			Purpose of questions
Group 1	Dairy	from 1 to 7	The purpose of this group of questions was to identify the profile of the respondents. General attributes like professional group, education level, institutional sector they belong to (public or private), and size of farms and production levels were collected from responses to these questions.
	Cotton	from 1 to 6	
Group 2	Dairy	from 8 to 22	These questions sought the stakeholders' opinions and perceptions about the Brazilian agricultural research system, the performance of the private and public agricultural research institutions, and the relationships among the cotton and dairy industry segments.
	Cotton	from 7 to 21	
Group 3	Dairy	from 23 to 25	These questions sought data about the stakeholders' perceptions in regard to providing financial support to maintain the activities of the agricultural R&D institutions.
	Cotton	from 22 to 24	
Group 4	Dairy	from 26 to 30	This group of questions sought the stakeholders' views and perceptions about the international market for agricultural products, and about the importance of other countries' successful experiences to help the Brazilian agricultural industries
	Cotton	from 25 to 29	
Group 5	Dairy	from 31 to 32	These questions sought data about the importance of a good information flow between all the different segments of the cotton and dairy industries.
	Cotton	from 30 to 31	
Group 6	Dairy	from 33 to 35	These questions were designed to collect stakeholders' views and perceptions about the performance of state and federal governments in expanding the market for agricultural commodities.
	Cotton	from 32 to 34	
Group 7	Dairy	from 36 to 38	In this group of questions, the stakeholders' perceptions were sought about the legislation created by government to stimulate participation by the private sector in agricultural research projects developed in partnership with universities, and state and federal R&D institutions.
	Cotton	from 35 to 37	
Group 8	Dairy	from 39 to 41	These questions sought to find out about the stakeholders' opinions in regard to the future structural and economic position in the cotton and dairy industries. In addition the participant's intention to continue as a member of the dairy or cotton industry was sought.
	Cotton	from 38 to 40	

Before the questionnaire was distributed among stakeholders in the cotton and dairy industries, it was sent to thirty people (15 from the cotton industry, and 15 from the dairy industry) with the intention of evaluating the content and testing the software to be used. The people involved in this testing stage were contacted by telephone and email and their agreement to participate in this trial was discussed. The trial questionnaires were sent on 01 May 2005. After adjustment and corrections, incorporating the suggestions from the participants in the test, 730 questionnaires were sent to the stakeholders selected to participate in the research on 15 May 2005.

On 30 May 2005, a reminder was sent by email to the participants who had still not answered the questionnaire. In addition, on 08 June 2005, the Head of Embrapa Dairy Cattle sent a letter, by email, to all of the participants selected in the dairy industry, spelling out the importance of this study for the milk sector and requesting them to complete and return the questionnaire as soon as possible. Two letters with similar content were sent, also by email, to cotton industry participants. One letter was sent by the Head of Embrapa Cotton on 10 June 2005, and another by the Executive Director of ABRAPA on 13 June 2005.

On 25 June 2005, when the process of receiving the returned questionnaires was complete, a message was sent to the stakeholders in the cotton and dairy industries, thanking them for their participation and for the information that they had provided.

2.5. Phase 3: Focus Group Meetings

Focus group meetings (FGMs) can be used as a qualitative research technique. They are distinguished by the diversity of people usually involved to discuss, in collective and interactive ways, the same subject with the objective of generating qualitative data about a particular subject. Despite the questions being directed specifically to each of the participants, the researcher works in the direction of encouraging the people involved to exchange ideas, to comment on their experiences and to give their opinions (Kitzinger and Barbour 1999).

Focus groups are a participatory research method, which is why those who intend to use this method need to be confident about engaging the participants. Engaging with participants in their daily activities is an important aspect of effective

communication, and developing trusting relationships between researchers and stakeholders is vital for the success of this method (Babbie 2005). Krueger and Casey (2001) indicate some advantages (considered in this study) that justify the focus group as one of the appropriate techniques adopted to collect data while, on the other hand, they present some disadvantages. These are presented in Table 2.6.

Table 2.6 Advantages and disadvantages of Focus Group method

Advantages	Disadvantages
▪ The focus group technique is a socially oriented research method, capturing real-life data in a social environment	▪ Focus groups give the researcher less control than individual interviews
▪ It is a research technique that has flexibility	▪ Data are difficult to analyse
▪ Focus group results have high face validity	▪ Moderators require special skills
▪ Focus groups give quick results	▪ Differences between groups can be a problem
▪ Focus groups are a low cost method of conducting research	▪ Groups are difficult to assemble

Source: Babbie (2005) and Krueger and Casey (2001).

The focus groups assembled to provide part of the data collected in this study were based on the framework defined by Baker and Hinton (1999) who identified four stages to be considered in the planning and conduct of focus group meetings. These stages included establishing a base for the research and planning the research procedure (Baker and Hinton 1999).

The concepts of relevance to the research questions and the culture of the group activities were considered in the first stage, while planning in the second stage defined what needed to be done before the focus group event began. A set of specific questions (see Appendix 05) that were to be discussed at the FGMs were developed and the cities of Goiânia, Rondonópolis, and Juiz de Fora were selected as venues to hold the meetings. A PowerPoint presentation of the results of the electronic survey was prepared and all of the discussions were recorded, with the participants' permission.

In evaluating the research outcomes, attention was devoted to collecting valid data needed for the research, and to take into account and avoid the limitations of the

focus group method for answering research questions. This was done by taking precautions, in communicating with the participants, to protect the integrity of the data (de Vaus 2002).

Table 2.7 presents the details about the focus group meetings held in Brazil as part of Phase 3 of the data collection process for this study.

Table 2.7 Details of focus groups meetings held in Brazil in July 2005

Date	Industry	Place	City/State	No. of participants	Characteristics of the participants
01/07/05	Dairy	The Goiânia Regional Development Agency (AGDR)	Goiânia/ GO	7	One representative from each of the following related professional groups researchers, farmers, agricultural research managers, government policy makers, technical consultants, dairy industries syndicate, and milk producers syndicate
21/07/05	Cotton	Mato Grosso Seed Producers Association (APROSMAT) headquarters	Rondonópolis/ MS	6	The participants included two farmers, one representative from Mato Grosso Cotton Producers Association (AMPA), one from the Support Fund for Cotton Production (FACUAL), and one representative from the Mato Grosso Seed Production Association (APROSMAT).
29/07/05	Dairy	Headquarters of Embrapa Dairy Cattle	Juiz de Fora/ MG	10	All of the participants were technicians working in different areas of the dairy industry including rural extension, research and development, rural communication, and research projects management.

Some senior executives of important organizations like Embrapa, ABRAPA, the Brazilian Ministry of Agriculture, cotton milling companies, dairy manufacturing companies, and other organizations invited to participate in the focus group meetings could not participate for a number of reasons but they agreed to be interviewed personally. In that case, the same questions used in the FGMs were presented to the interviewees, and the results from these interviews were added to the discussions from the focus group meetings.

To facilitate the process of data collection and the subsequent analysis of the discussion in order to produce defined results from the FGMs, all discussion among the participants was recorded and transcribed in Portuguese and translated into English. These results were then organized and presented in tables (see Chapter 6), with the intention of trying to give some structure to the opinions and perceptions of the participants. To do this, they were separated into professional groups, so that their opinions about the subjects discussed in these meetings could be presented. The topics that were discussed included:

- the Brazilian agricultural research system and its relationship to agribusiness;
- the performance of the National Agricultural Research System (NARS);
- the importance of Embrapa in the context of Brazilian agribusiness;
- financial support by the private sector in public agricultural research projects; and
- access to and application of the technologies generated by public agricultural research institutions across the diverse range of Brazilian agribusiness.

In addition, some comments made by the participants in the FGMs, and considered particularly relevant to the objectives of this study, were transcribed completely in their original form to emphasize the results collected in this phase.

2.6. Methodological support

After consideration of the context and the objectives of this study, and the nature of the participants involved in the process of data collection, a mixed method, combining qualitative and quantitative approaches, was selected as an effective way to collect and analyse the opinions of cotton and dairy industries stakeholders about private sector participation in public agricultural research in Brazil.

The two methods, qualitative and quantitative, use the same scientific principles and have certain individual strengths, so that in the great majority of social research, both of these options are considered in the process of collecting and analysing data.

However, they also have limitations that restrict the process of obtaining complete results if they have been used separately(Creswell 2003; Neuman 2003; Tashakkori and Teddlie 1998).

Table 2.8 shows a comparative analysis of the two methods developed by Creswell (2003), an analysis which was considered in this study and which helped to make the decision to adopt the mixed methodology used in this research.

Table 2.8 Characteristics of Qualitative, Quantitative, and Mixed Methods approaches to research

Characteristics	Qualitative approaches	Quantitative approaches	Mixed method approaches
Philosophical assumptions	Constructivist/Advocacy/ Participatory knowledge claims	Post positivist knowledge claims	Pragmatic knowledge claims
Defined strategies of inquiry	Phenomenology, grounded theory, ethnography, case studies, and descriptive narrative	Surveys and experiments	Sequential, concurrent, and transformative
Range of methods	Open-ended questions, emerging approaches,* text or image data	Closed questions, predetermined approaches, numeric data	Both open-ended and closed questions, both emerging and predetermined approaches, and both quantitative and qualitative data and analysis
Research practices	▪ Researcher positions himself or herself as part of the study ▪ Collects participant meanings ▪ Focuses on a single concept or phenomenon ▪ Brings personal values into the study ▪ Studies the context or setting of participants ▪ Validates the accuracy of findings ▪ Makes interpretation of the data ▪ Creates an agenda for change or reform ▪ Collaborates with the participants	▪ Tests or verifies theories or explanations ▪ Identifies variables to study ▪ Relates variables to questions or hypotheses ▪ Uses standards of validity and reliability ▪ Observes and measures information numerically ▪ Uses unbiased approaches ▪ Employs statistical procedures	▪ Both quantitative and qualitative data collected ▪ Develops a rationale for mixing methods ▪ Integrates the data at different stages of inquiry ▪ Presents visual pictures of the procedures in the study ▪ Employs the practices of both qualitative and quantitative research

* Approaches guided or prompted by data, information or concepts emerging during the research

Source: Adapted from Creswell (2003)

2.7. Outcomes of the study and implications

This study was designed to develop a set of core recommendations, to be implemented by the Brazilian government and by the private sector, to create specific procedures and to improve existing measures in order to promote better integration between government agricultural research institutes and agribusiness companies. These recommendations are provided in Chapter 8 and are considered relevant for researchers, farmers, and managers of agribusiness companies to define future strategies and the role of public R&D institutes in the development of Brazilian agribusiness.

By knowing what is necessary to gain access to new agricultural technologies and how to coordinate national and international financial resources, they can define the best strategy for industry growth and set an example for their fellow stakeholders in all other Brazilian agricultural industries to contribute more to the economy. Other questions to be addressed include what is the best way to export their product and what is the role of the government in the process of developing agricultural production. Suggestions about how to access new international markets and how to implement research projects with the participation of the production sector of the Brazilian cotton and dairy industries were gained from the stakeholders involved in this study.

Given the wealth of its natural resources, allied with its territorial dimensions, Brazil should be one of the largest agricultural producers and exporters in the world. However, its position in the global ranking of agricultural exporters (fourth) places it close to Australia (in sixth position) which has fewer natural resources and more adverse conditions for production. One of the main reasons for this situation is that Australia has a much smaller domestic population but Australia also put much effort into reforming its agricultural sector and improving its agricultural R&D system. These goals have also been pursued in countries such as Chile, the United States of America, China, and New Zealand. Their experiences have suggested some measures that could be adapted by the Brazilian system.

The results of this study, besides assisting the Brazilian agricultural system, will also assist the governments of other countries with similar characteristics in agricultural production to implement specific rules to promote the collection of

financial resources from the internal private market, and possibly from international sources, to help develop their international trading systems for agricultural products.

2.8. Summary

The research methodology presented in this chapter has shown firstly, the conceptual framework used to support the study. The study area, and the qualitative and quantitative methods used in the field research were described. An integrated plan of research, beginning with a literature review, was implemented. An electronic survey and a series of focus group meetings (FGMs) involving stakeholders from the Brazilian cotton and dairy industries, were conducted. Representatives of public research institutions and Brazilian agribusiness companies were involved in a process designed to gather information and to define a set of recommendations (described in Chapter 8) that might be used to strengthen the export performance of the main agricultural industries in Brazil.

The chapter also describes the expected outcomes and implications from the application of the research methodology.

CHAPTER 3

THE BRAZILIAN AGRICULTURAL RESEARCH SYSTEM

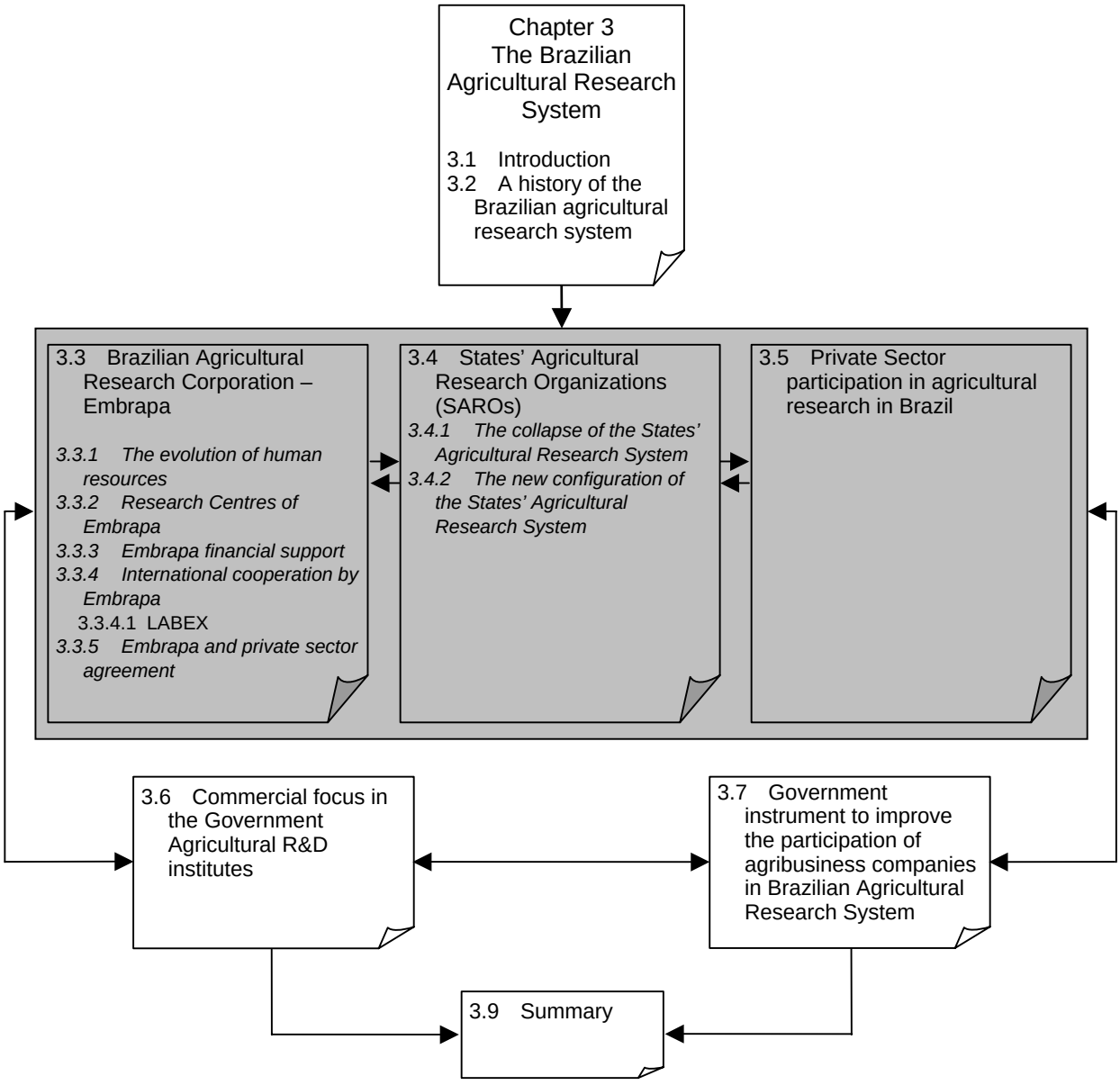


Figure 3.1 Structure of Chapter 3

3.1 Introduction

In this chapter, the Brazilian Agricultural Research System will be described and its importance in the context of this thesis established. The current structure of the various units in the research system in Brazilian agriculture and their methods of operating will be described, with an emphasis on the deregulation process that started in the early 1990s, the effects of deregulation can be observed through changes in the R&D system. In the past decade, the approach to delivering research and development services in Brazil has changed from the purely scientific and technological, to include scientific, technological, and commercial dimensions.

To give an appreciation of its present problems and opportunities, a brief history of the evolution of the Brazilian agricultural research system from 1800 to 1972 will be presented in this chapter. From 1973, the Brazilian agricultural research system has operated under the auspices of the newly created Brazilian Agricultural Research Corporation (Embrapa). A detailed description will be given of Embrapa and of the State Agricultural Research System which was formed by a set of private and public institutions, specifically responsible for the development of the scientific and technological activities related to development of the agricultural sector in each State of the Brazilian confederation.

The commercial focus in the government agricultural R&D institutes will be described in detail, and the participation of agribusiness companies in the Brazilian Agricultural Research System will be also reviewed.

3.2. History of the Brazilian agricultural research system

While the movement called the Scientific Revolution was emerging in Europe, in the period from the XVI to XVII century, there was no consequent attempt by Portugal to develop a structure that supported an internal process of discovery in science and technology in its colony of Brazil. In the early 1800s, France invaded Portugal and forced the transfer of the royal family to Brazil in 1808. As a consequence, Brazil was transformed from a Colony to the Kingdom of Portugal and the policies of prohibition regarding the development of sciences and creation of industries in the Brazilian territory were changed (Sousa 1993).

From 1808, Brazil promoted the opening of its ports to friendly nations; rules for the establishment of industries were created; some cultural incentives were launched; and on 13th June of 1808, the beginning of Brazilian agricultural science was registered with the establishment of the Botanic Garden of Rio de Janeiro which, besides its recreational objectives, also developed many agricultural scientific studies. Ten years later, in 1818, the first Brazilian unit exclusively dedicated to natural science studies, called the Royal Museum, later named the National Museum, was created (EMBRAPA 2002a; Sousa 1993).

After this period, despite the Brazilian economy being basically supported by the extraction of natural resources and the production and sale of agricultural commodities, the Brazilian government gave priority to the development of art and literature, to the detriment of any agricultural research activities.

Only in 1859, 40 years after the creation of the National Museum, did the Brazilian Emperor create the Imperial Agricultural Institute of Bahia Province and the Institute of Pernambuco Province. This move into agricultural research occurred because producers were losing their potential to compete in international market, as a consequence of exhausting the industry's productive capacity from its existing resources.

In 1860, the Imperial Agricultural Institutes in Rio de Janeiro, Sergipe, and Rio Grande do Sul Provinces were established. According to Sousa (1993), these Imperial Institutes of education and agricultural research were created to respond to the demands from agricultural producers, with four main objectives:

- To facilitate the mechanization of agriculture by promoting the introduction and adoption of machines this could be demonstrated in practice to be more productive than existing systems;

- To establish regular organizations, where they would seek to identify the machines and instruments applicable to Brazilian farming, to analyse the most convenient systems of cultivating the land, and identify satisfactory methods for the production, improvement, and storage of agricultural products and the extermination of harmful pests;

- To promote the acquisition of the most suitable seeds and new plants, and, having proved by experiment which were superior, to facilitate their distribution to farmers; and

- To promote the improvement of rations for production animals, and the introduction of the most suitable plant and animal species into general use. Of these five Imperial Agricultural Institutes, only those of Bahia and Rio de Janeiro were successful.

To give a clearer understanding of the evolution of the Brazilian agricultural research system, Table 3.1 was developed to show the sequence of events involved in the creation and evolution of the various institutes from 1808 to 1973.

Table 3.1 The evolution of the Brazilian agricultural research system - 1800 to 1973

Year/Date	Institutes	Location/State	Note
13/06/1808	Botanic Garden of Rio de Janeiro	Rio de Janeiro	Visitation and agricultural research
1818	Royal Museum	Rio de Janeiro	Research in the natural sciences, later named National Museum
01/11/1859	Imperial Agricultural Institute of Bahia Province	Bahia	Successful
Dec 1859	Imperial Agricultural Institute of Pernambuco Province	Pernambuco	Closed
1860	Imperial Agricultural Institute of Sergipe Province	Sergipe	Closed
1860	Imperial Agricultural Institute of Rio Grande do Sul Province	Rio Grande do Sul	Closed
03/10/1860	Imperial Agricultural Institute of Rio de Janeiro Province	Rio de Janeiro	Successful
1866	Geographic and Geologic Commission	São Paulo	Now the Geological Institute
23/06/1875	Bahia Agricultural School	Bahia	Now the Agricultural School of Federal University of Bahia
1883	Agricultural School	Rio Grande do Sul	Now the Superior School of Agricultural Eliseu Maciel
1887	Imperial Agronomic Station of Campinas	São Paulo	Now the Agronomic Institute of Campinas
1899	Manguinhos Therapeutic Serum Institute	Rio de Janeiro	Oswaldo Cruz Institute
1899	Resistance of Materials Cabinet	São Paulo	Now São Paulo Technological Research Institute
03/06/1901	Practical Agricultural School (secondary school)	São Paulo	In 1934 became part of the University of São Paulo
1905	Central Station of Zootecnia	São Paulo	In 1916 became Nova Odessa Zootecnia Station
1908	Agricultural College of Lavras	Minas Gerais	Federal University of Lavras
20/10/1910	Sugarcane Experiment Station of Campos	Rio de Janeiro	Closed
1911	Sugarcane Experiment Station of Escada	Pernambuco	Absorbed by Agricultural Research Company of Pernambuco
1912	Sericícolas Experiment Station of Bento Gonçalves	Rio Grande do Sul	Information about closing or continuity had been not find
1912	Sericícolas Experiment Station of Barbacena	Minas Gerais	Information about closing or continuity had been not find
1913	Cotton Experimental Station of Coroatá	Maranhão	Information about closing or continuity had been not find
1918	Chemical Institute	Rio de Janeiro	In 1934 was transformed into Agricultural Chemical Institute
1920	Cotton Service; Seeds Service; Grape and Wine Services	Diverse States	In 1973 Embrapa assumed these activities
15/09/1920	Biological institute of Agricultural Protection	Rio de Janeiro	Transformed in 1938 into the Agricultural Experimentation Institute
1920	College of Agricultural and Veterinary Science in Viçosa	Minas Gerais	Federal University of Viçosa
28/09/1921	Forest Service of Brazil	Rio de Janeiro	Information about closing or continuity had been not find
1927	Biological Institute of Agricultural and Animal Protection of São Paulo	São Paulo	Information about closing or continuity had been not find
12/03/1935	Agricultural Research Institute	Pernambuco	Agricultural Research Company of Pernambuco
23/12/1938	National Centre for Education and Agricultural Research	Rio de Janeiro	Was extinguished in 1962 with the creation of DNPEA
11/10/1962	Agricultural Research and Experimentation Department	Brasília	In 1967 was transformed into the Research and Experimentation Office
25/02/1967	Research and Experimentation Office	Brasília	In 1971 was transformed into the National Agricultural Research Department
06/05/1971	National Agricultural Research Department	Brasilia	In 1973 was transformed into the Brazilian Agricultural Research Corporation EMBRAPA
26/04/1973	Brazilian Agricultural Research Corporation – EMBRAPA	Brasilia	

Source: Based on information from Sousa (1993); Reichardt (2001); and Embrapa (2002a).

It can be seen from Table 3.1 that the period from 1800 to 1973 was also characterized by instability in the Brazilian agricultural sector. During this time, the agricultural sector passed through a series of important transformations where many research institutes were created and many were closed, and agricultural management companies and exporters' offices were created, some successful while others failed. Two crucial events, the abolition of the Agriculture Ministry in 1892, and its reinstatement in 1909, epitomized the instability of the agricultural sector. The restoration of the Ministry was a turning point and after that happened, the sector assumed an important position in the Brazilian economy after 1909, although it was not yet totally integrated into the industrial production sector. Still, today, the Ministry of Agriculture does not have the power to do what needs to be done to improve performance of Brazilian agribusiness.

Embrapa was created in 1973 as a national corporation linked to the Ministry of Agriculture, but with sufficient administrative flexibility to attract and to manage its own human and financial resources. Added to this was its newly established role as coordinator of the national agricultural research system, which facilitated the drawing together of multidisciplinary research teams, involving agronomists, veterinarians, entomologists, geneticists, economists, statisticians, systems analysts, sociologists, and other professionals from other agricultural research institutes (private and government) in shared agricultural research projects, with national objectives. As a consequence, this system provoked considerable dynamism and objectivity in the domestic research process (Contini and Séchet 2004; Sousa 1993).

Moreover, the creation of Embrapa was considered a great step by the government to facilitate the modernization of the agricultural sector as a whole, creating a way to build good relationships between the agricultural research sector and the industrial sectors of farming, machinery, equipment, farm supplies, storage, and processing, as well as those of the manufacturing and distribution of agricultural products (Contini and Séchet 2004).

3.3. The Brazilian Agricultural Research Corporation – EMBRAPA

In 1972, a study, carried out by the Ministry of Agriculture, provided evidence that the federal agricultural research system was, at that time, not working well enough to serve the country's need to focus on expansion and improvement of the Brazilian agricultural sector. This study produced the document titled "Exposition of Reasons, Number 187", dated 21/09/1972, in which was proposed the creation of a National Agricultural Research System (NARS), of which the Brazilian Agricultural Research Corporation – EMBRAPA – would be an integral part. In addition to its own specific objectives, EMBRAPA would have responsibility for coordinating the new system of agricultural research in the whole country (EMBRAPA 1984).

It was envisaged that, in NARS, other federal organizations, universities, state agriculture secretariats, and private organizations would be involved through the planning and the execution of agricultural research projects in an integrated way. The Federal Government would finance these projects through Embrapa. It is important to note that all these institutions involved in the National Agricultural Research System could develop their own research programs individually as well as being part of this national initiative.

In this context, EMBRAPA was created through Law Number 5,851 dated 7/12/1972. Decree Number 72.020 of 28/03/1973 approved its Statute, and Embrapa was finally established on 26 April 1973 in Brasília-DF.

The creation of Embrapa represented much more than a name change in Brazilian agricultural research and development. This corporation became known for its flexible structure in research administration. Embrapa was created with the autonomy to recruit human resources and search for financial resources from the most diverse sources, to manage these resources in accordance with its priorities, and to seek out the most talented researchers available at the time (Sousa 1993; EMBRAPA 2002a).

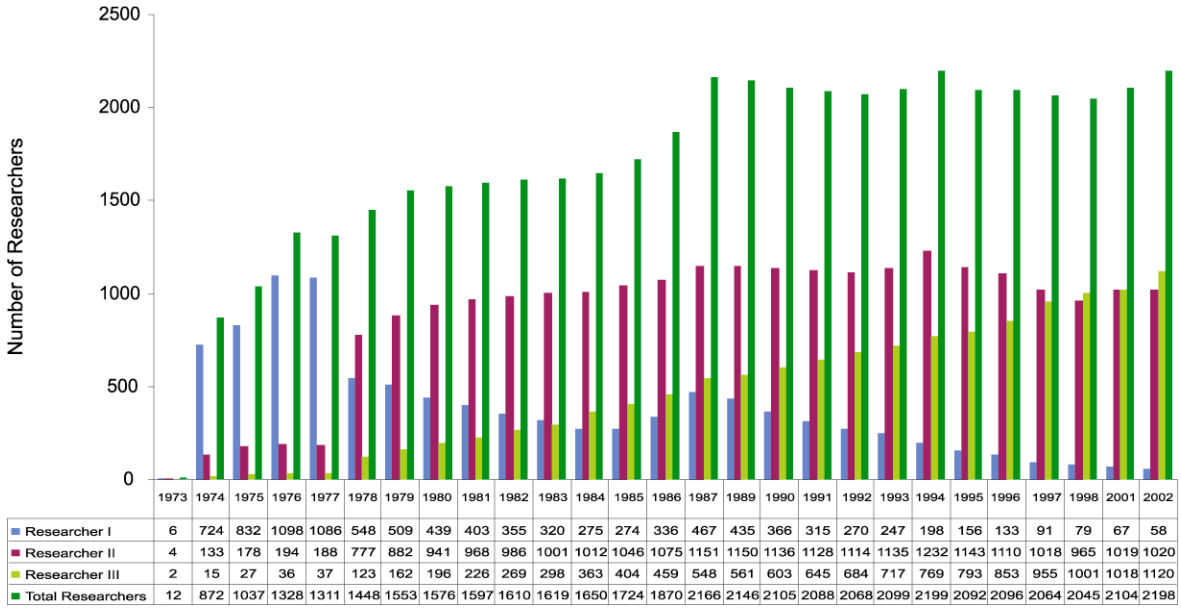
3.3.1. The evolution of human resources in Embrapa

When Embrapa was established, a strong program of staff training was immediately put into operation, with a number of technical staff sent to post-graduate training in Brazilian and foreign universities. At the end of 1974, about 317 researchers were in

training activities, 273 in Masters degree programs (20 of them overseas), and 44 researchers in PhD courses (19 of them overseas) (EMBRAPA 2002a).

An examination of the data on research and support staff at Embrapa from 1973 to 2002 reveals an increase in the number of highly qualified staff, with a consistent upward trend in those with PhDs and, since 1985, a diminishing ratio of support staff to researchers.

Figure 3.2 shows the results of Embrapa's post-graduate training program from its creation until 2002. It can be observed that, of the 2,198 researchers employed by Embrapa in 2002, about 51% have a PhD (Researcher III), 46% have Masters Degrees (Researcher II), and only 3% are basic graduates (Researcher I).



	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2001	2002
Researcher I	6	724	832	1098	1086	548	509	439	403	355	320	275	274	336	467	435	366	315	270	247	198	156	133	91	79	67	58
Researcher II	4	133	178	194	188	777	882	941	968	986	1001	1012	1046	1075	1151	1150	1136	1128	1114	1135	1232	1143	1110	1018	965	1019	1020
Researcher III	2	15	27	36	37	123	162	196	226	269	298	363	404	459	548	561	603	645	684	717	769	793	853	955	1001	1018	1120
Total Researchers	12	872	1037	1328	1311	1448	1553	1576	1597	1610	1619	1650	1724	1870	2166	2146	2105	2088	2068	2099	2199	2092	2096	2064	2045	2104	2198

Note: Researcher I has only a Bachelors Degree, Researcher II has a Masters Degree, and Researcher III has PhD.

Source: Management Staff Department – EMBRAPA

Figure 3.2 Evolution in numbers and qualification levels of research staff in EMBRAPA – 1973 to 2002

The evolution towards more highly qualified staff can be seen in Table 3.2, where there can also be observed the diminishing ratio between support staff and researchers, from the peak in 1985, with 4.12 support employees per researcher, to only 2.92 in 2002.

Table 3.2 Embrapa's staff evolution: 1973 to 2002

Year	Research support employees	Researchers	Total employees	Support staff per researcher
1973	54	12	66	4.50
1974	3118	872	3990	3.57
1975	3772	1037	4809	3.64
1976	4375	1328	5703	3.29
1977	4374	1311	5685	3.34
1978	4698	1336	6034	3.52
1979	5497	1448	6945	3.80
1980	5830	1553	7383	3.75
1981	6105	1576	7681	3.87
1982	6328	1597	7925	3.96
1983	6374	1610	7984	3.96
1984	6553	1619	8172	4.05
1985	6793	1650	8443	4.12
1986	6748	1724	8472	3.91
1987	7008	1870	8878	3.75
1988	6957	1911	8868	3.64
1989	8502	2166	10,668	3.92
1990	8064	2146	10,210	3.76
1991	7756	2105	9861	3.68
1992	7649	2088	9737	3.66
1993	7559	2068	9627	3.65
1994	7477	2099	9576	3.56
1995	7651	2199	9850	3.48
1996	6999	2092	9091	3.34
1997	6895	2096	8991	3.29
1998	6597	2063	8660	3.20
1999	6555	2064	8619	3.17
2000	6485	2045	8530	3.17
2001	6317	2104	8421	3.00
2002	6421	2198	8619	2.92

Source: Management Staff Department - EMBRAPA

3.3.2. Research Centres of Embrapa

In 1974, Embrapa established the Institutional Model for the Execution of Agricultural Research in close cooperation with the private sector, through its technical segments, following its given charter to co-ordinate the Brazilian Cooperative Agricultural Research System. This agreement gave rise to the following structure for national agricultural research (EMBRAPA 2002a):

- National Research Centres for products (for example: Dairy Cattle, Soybean, Rice and Beans, Beef Cattle, Maize and Sorghum, Cotton, Wheat, etc.);
- Regional Research Centres (for particular eco-systems, for example: Semi-Arid, Humid Tropics, Cerrados, Temperate Climatic areas, etc.);
- Units of Research Execution for the various States and Territories; and
- State Agricultural Research Organizations (some of which were being created about that time, and which gradually took over the activities of the State or Territorial Units of Research Execution).

In this model, the first three types of research institution are related directly to Embrapa, while the States, which did not have identical financial and structural conditions, or understanding about the importance of state agricultural research, assumed responsibility for the creation and administration of the States' Agricultural Research Organizations (SAROs). For this reason, these organizations were not created all at the same time (see Table 3.6).

Currently Embrapa has a network of 38 Research Centres, three Service Centres, and 11 Central Divisions. Embrapa has a presence in almost all states of the country, many of which have their own distinct ecological conditions. In addition, the 17 State Organizations of Agricultural Research linked to the Secretariat of Agriculture or in some case, to the Secretariat of Science and Technology (see Table 3.6) from diverse States, are also part of the system.

In the 33 years since its creation, the Research Centres in Embrapa listed below, have generated and recommended more than nine thousand improved practices technologies for Brazilian agriculture. These have helped to reduce production costs on Brazilian farms and helped Brazil to increase the quantity, quality, and variety of food and other agricultural products sold in both the domestic and international markets, wile at the same time, Embrapa's research output has helped to conserve natural resources and the environment. Embrapa's research programs have also decreased dependence on the introduction of foreign technology, basic products, and genetic resources (EMBRAPA 2005).

The list of Embrapa centres includes:

- Embrapa Acre
- Embrapa Agricultural Instrumentation
- Embrapa Agriculture Informatics
- Embrapa Agrobiology
- Embrapa Agroenergy
- Embrapa Amapa
- Embrapa Beef Cattle
- Embrapa Cassava & Tropical Fruits
- Embrapa Cattle Southeast
- Embrapa Cerrados
- Embrapa Coastal Tablelands
- Embrapa Coffee (Service Centre)
- Embrapa Cotton
- Embrapa Dairy Cattle
- Embrapa Eastern Amazon
- Embrapa Environment
- Embrapa Food Technology
- Embrapa Forestry
- Embrapa Genetic Resources & Biotechnology
- Embrapa Goats
- Embrapa Grapes and Wine
- Embrapa Maize & Sorghum
- Embrapa Mid-North Agriculture
- Embrapa Pantanal
- Embrapa Rice & Beans
- Embrapa Rondonia
- Embrapa Roraima
- Embrapa Satellite Monitoring
- Embrapa Soils
- Embrapa South Animal Husbandly & Sheep
- Embrapa Soybean
- Embrapa Swine & Poultry
- Embrapa Technological Information (Service Centre)
- Embrapa Technology Transfer (Service Centre)
- Embrapa Temperate Agriculture
- Embrapa Tropical Agroindustry
- Embrapa Tropical Semi-Arid
- Embrapa Vegetables
- Embrapa Western Amazon
- Embrapa Western Region Agriculture
- Embrapa Wheat

3.3.3. Embrapa's financial support

In its first ten years of existence, Embrapa received strong technical and financial support from international organizations such as the World Bank, the Inter-American Development Bank, and from the Food Agriculture Organization (FAO) as well as from bilateral contracts with various countries. This financial support was used for the construction of laboratories, the acquisition of modern equipment, the construction of administrative and technical accommodation, and in the development of the post-graduate training program.

The evolution of Embrapa's annual budget over the years is shown in Table3.3, where the instability of financial flows and the potential implications for its research activities can be observed. In addition, it can seen clearly that the financial resources applied to "personnel expenditures" in the most recent years have declined, relative to previous funding levels, when one considers the increase in the number of employees and the consistent trend for researchers' qualifications to rise in the same period.

This situation shows that the government has not been able to maintain its capacity to invest in agricultural research activities while, on the other hand, it has been signalling to the community, through the creation of legal instruments, the necessity to increase private sector participation in the agricultural research and development process.

Table3.3 Embrapa's annual budget allocation to staff and other areas: 1974 to 2003 (in millions of US dollars – current values)

Year	Personnel Expenditures	Other Expenditures	Capital Expenditures	Total
1974	-	10,079	-	10,079
1975	10,580	15,902	-	26,482
1976	26,008	21,146	3,501	50,656
1977	39,459	23,394	4,721	67,574
1978	54,050	21,716	8,225	83,992
1979	66,243	44,136	12,334	122,713
1980	68,225	30,596	25,699	124,519
1981	76,378	48,268	24,452	149,098
1982	98,426	55,968	45,596	199,990
1983	67,790	30,619	13,641	112,050
1984	50,711	41,903	10,418	103,032
1985	69,331	42,798	11,921	124,049
1986	73,247	49,807	15,302	138,356
1987	95,982	39,272	29,488	164,742
1988	90,486	45,710	32,343	168,540
1989	167,216	34,531	15,820	217,567
1990	221,789	58,556	10,183	290,528
1991	216,451	70,197	7,157	293,804
1992	176,106	32,433	7,824	216,364
1993	218,061	46,433	19,494	283,988
1994	235,044	72,976	32,890	340,910
1995	289,056	83,343	72,109	444,508
1996	404,798	99,314	58,803	562,916
1997	332,041	123,445	42,001	497,487
1998	316,540	124,873	21,795	463,208
1999	205,605	83,612	15,623	304,841
2000	230,873	79,950	21,269	332,092
2001	190,728	72,696	22,825	286,249
2002	168,092	51,398	20,701	240,191
2003	183,076	44,683	4,671	232,430

Source: Administrative and Financial Department – EMBRAPA

3.3.4. International cooperation by Embrapa

In the international cooperation area, the Embrapa had 275 agreements of technological and scientific cooperation with 56 countries and 155 international agricultural research institutions[14] in 2004. The majority of these contracts involving R&D institutions were negotiated with scientific and technological exchange considered as a principal element of the partnership. Other areas of interest included in these agreements included exchange of germ plasma; training opportunities for Embrapa's employees in other countries, training for other countries technicians by Embrapa, recognition of the qualifications of Embrapa's employees in other countries and a reciprocal arrangement for Embrapa to recognize the technical qualifications of staff from other countries. Some agreements focused on technical assistance, participation in international projects of interest to Brazil and to Embrapa, as well as direct participation in collaborative partnerships with other international agencies to develop scientific and technological projects (EMBRAPA 2005).

These international agreements involving agricultural research and development institutes have expanded significantly in the 12 years up to 2004, in part because Brazilian legislation relating to scientific and technological cooperation was extended. New laws and other official instruments were created to define rules about the collection, conservation, use, research, commercial exploitation, and genetic modification of organisms and useful living creatures and to spell out the intellectual property rights that apply to research results. Another factor contributing to this expansion in international research agreements was that Embrapa created "institutional policies for intellectual property management", and set up, with its administrative restructure, an Intellectual Property Secretariat (IPS) and the Department of Trading and Transference (DTT). The policy document sets out the general orientation for the many forms of intellectual property to be managed within

14 For example: CSIRO (Commonwealth Science and Industries Research Organization); AGCAN (Agricultural Canada); CIRAD (Centre of International Cooperation in Agricultural Research); JICA (Japan International Cooperation Agency); ISNAR (International Service for National Agricultural Research); USDA-ARS (United States Department of Agriculture – Agriculture Research Service); FAO (Food and Agricultural Organization of the United Nations); CGIAR (Consultative Group on International Agricultural Research).

the organization, and established operational mechanisms for the legislation of patents and trade marks, protection of plant cultivars, and copyright applications. This gave Embrapa the capacity to negotiate with domestic and international institutions and led to an increase in the number of agreements in these areas (EMBRAPA 2001a).

3.3.5. Virtual Laboratories Program – LABEX

In addition its national laboratories, and to help the international cooperation process, Embrapa began a Virtual Laboratories Program, named LABEX, with installations in the United States and France, with the support of the World Bank, and was launched in April 1998, with a technical agreement between Embrapa and USDA – ARS the Agricultural Research Service of the United States Department of Agriculture. This was a new approach to international cooperation in agricultural research for Brazil. The mission of these external laboratories is to promote opportunities for institutional cooperation in agricultural research and to monitor scientific advances, trends, and activities of interest to agribusiness in the partner countries.

The positive results from the first four years of Labex in the USA stimulated Embrapa to initiate a similar program in Europe. In January 2002, through an agreement with Agropolis, in Montpellier, France, a second laboratory was opened. Both cooperation programs were proposed to enhance and widen the scientific and technological links among agricultural researchers in Brazil, the US, and Europe and allow senior Brazilian scientists to work together with international colleagues to monitor advanced science and technological trends in the developed world relevant to their home conditions (Assis *et al.* 2001).

The Labex agreement covers Embrapa's 39 research centres, as well as all partners within the National Agricultural Research System, such as State universities and research institutes, as well as several public and private agricultural organizations. From the United States, just over 100 ARS research units are potentially committed to the program, with possible extension to their partners in state universities and other federal agencies. Through the cooperation with Agropolis International in Montpellier, more than 200 research centres, as well as all partners

in the Languedoc-Roussillon region of France, and other institutions and companies in other parts of Europe, are potentially involved (Assis *et al.* 2003).

Since the concept of the virtual laboratory was established, in which the host country's operational and laboratory facilities were made available to foreign partner scientists, Labex has had the potential to be a powerful mechanism for the development and enhancement of international cooperation among developing and developed countries. It is also a way to promote potential international agricultural research networks. On the other hand, there has been little interest by agribusiness companies in the Labex program with no significant results to report in expanded commercial activity as a result of this program.

3.3.6. Embrapa and private sector agreements

In spite of Embrapa having more than three thousand agreements with various groups in Brazil, the financial contribution has represented, on average, no more than 5% of Embrapa's total budget over the past 10 years.

Table 3.4 shows Embrapa's global budget from 1994 to 2005 and private sector participation during this period. The table reveals that external contributions amounted to 6.12% of the Embrapa budget in 1995, compared with 5.18% in 2005. Private sector funding of Embrapa's global budget has declined by about 16% over the past 11 years, a significant decrease.

The contrast between the large number of contracts and the small financial returns from these contracts is explained by the fact that the majority of Embrapa's domestic agreements involve technical cooperation, training, and seed production and trading, activities which bring in relatively little revenue.

The majority of agreements for technical cooperation involve Embrapa's research units, the State agricultural research institutions, and State and Federal Universities. In these cases, almost all the financial resources needed to develop the objectives of these contracts come from State research foundations, while only a small amount comes from private sector companies and private foundations.

Table 3.4 Embrapa's global budget: 1994 to 2005 (in millions of US dollars – current values) [a]

Year	Government		Private		Total
	Support [b]	Participation (A)/(C)	Support	Participation (B)/(C)	
	(A)	*(%)*	(B)	*(%)*	(C)
1994	335,455	98.40	5,455	1.60	340,910
1995	417,304	93.88	27,204	6.12	444,508
1996	529,817	94.12	33,099	5.88	562,916
1997	468,528	94.38	27,959	5.62	497,487
1998	438,890	94.75	24,318	5.25	463,208
1999	288,684	94.70	16,157	5.30	304,841
2000	316,318	95.25	15,774	4.75	332,092
2001	269,818	94.26	16,431	5.74	286,249
2002	229,855	95.71	10,303	4.29	240,158
2003	223,330	96.08	9,100	3.92	232,430
2004	283,249	95.92	12,048	4.08	295,297
2005	391,589	94.82	21,382	5.18	412,971
	Percent average	**95.19**		**4.81**	

a Values converted to US dollars were calculated on the basis of FGV (Getulio Vargas Foundation) average annual exchange rate.

b Considering that basically all of the resources derived from outside Brazil are related to international loans, and therefore a Federal government responsibility, external resources have been included in the same category as those provided by the government.

Source: Embrapa Financial Administration Department; Embrapa Secretariat for Administration and Strategy of Embrapa.

Almost all of the training contracts between Embrapa and State or Federal universities, and between Embrapa and other government institutions were created with the objective of enabling workers in the Brazilian agricultural industries to gain qualifications and competency. They included institutions like the National Rural Apprenticeship Service (called SENAR in Brazil), and the Regional Development Foundation (FUNDER).

The contracts for basic seed production and trading were signed between Embrapa Technology Transfer and private agricultural companies, to meet the requirements of the companies.

3.4. State Agricultural Research Organizations

In its 30 years of existence since 1974, the State Agricultural Research System in Brazil has passed through many transformations. It reached the peak of its performance in the period from the late 1970s to the late 1980s, when each state of the federation had its own Agricultural Research Institution linked to an agricultural extension organization. The state research institutions and extension organizations received strong financial and technical support from the federal government through Embrapa. The State Agricultural Research System passed through its worst period in the 1990s, as a consequence of the new laws and rules established in the 1988 Constitution and the resulting agricultural deregulation that was implemented from the beginning of the 1990s. They provoked a series of institutional, political, and financial reforms that involved the whole Brazilian Agricultural System (EMBRAPA 2002a; Albuquerque *et al.* 1998b).

Since its creation in 1973 with the responsibility to coordinate the Brazilian Agricultural Research System, Embrapa always maintained a close relationship with the state agricultural research organizations. This relationship was tied directly to the institutional model adopted by the corporation, in which the State organizations had basic but important participation.

In the model established for Embrapa in 1974, and which functioned up to 1992, the States' Agricultural Research Institutions were responsible for the development of applied research, restricted to the States' specific interests. The responsibility for generating technology with both nationwide and regional application lay with Embrapa's National Agricultural Research Centres and the Resources Centres, while the universities assumed the role of carrying out basic research (EMBRAPA 1997).

While Embrapa stimulated the States to strengthen their agricultural research structures, by transferring considerable financial resources to them, supporting the training of their technical and administrative staff, and transferring buildings and equipment to the State research institutions, there was still strong expansion and transformation of its own research centres going on. A number of Embrapa Research Units underwent significant expansion, assuming, consequently, responsibility for meeting part of the States' R&D demands, normally regarded as the responsibility of the States' agricultural research institutions (EMBRAPA 2002a).

3.4.1. Collapse of the State Agricultural Research System

Following the adoption of the 1988 Constitution, when the State Agricultural Research System was already drawing away from Embrapa, the new restrictions resulting from the introduced reforms, especially in the tributary (taxation) and fiscal (public treasury) systems, provoked a major collapse in the States' agricultural research model. The continuing transfer of financial resources to the SARS was practically impossible, and maintenance of the human resources of the State institutions was threatened.

In the same way, the introduction of the Patents and Intellectual Property Law, and of the New Plant (cultivar) Protection Law, was also a relevant factor in the process of driving reforms. The legal instruments introduced as a result of this new legislation created the opportunity to recognize the rights over new technologies and favoured the private companies' partnership with the public sector institutions (Ribeiro, R.P. 1999; EMBRAPA 1997).

Another important fact that directly affected the performance of the States' Agricultural Research System was the abolition, in 1990, of the Brazilian Technical Assistance and Rural Extension Company (Embrater). This public corporation had coordinated the Brazilian Technical Assistance and Agricultural Extension System (Presidência da República do Brasil 1990b). Many States also still had a company or agency for agricultural research and another for extension of research results. When Embrater was abolished, the States mostly combined these two agencies into one entity, with the intention of reducing operational costs and rationalizing administrative activities. As a consequence, there were many cases where agricultural research was given very low priority and extension was almost totally neglected (Ribeiro, R.P. 1999; Ribeiro, O.C. 1996).

Agricultural research in developing countries has often been affected by crises in government, and the situation has been no different in Brazil. An increasingly rationalist view began to emerge in developing countries as their capacity to repay international debts dried up. Brazil, in particular, lost its capacity to maintain its level of investment in all its previous areas of responsibility (Previdelli 1998). As in with other developing countries, Brazil was encouraged to invest primarily in basic social needs, such as health and education, to the detriment of research activities (Ohmae

1995; Havrylyshyn and Odling-Smee 2000; Kagan 2002; Mohamad 2002; Casson 1991a).

In addition, the decade of the 1990s was characterized by an increasing reduction in Brazil's investment capacity, with a policy of high interest rates to attract external capital, contraction of the internal market, and a consequent fiscal crisis that had the inevitable outcome of a reduction in the collection of financial resources.

With scarce resources, the Federal and States governments were compelled to promote the privatization process, transferring many activities to the private sector, and concentrating their efforts on retaining social and strategic activities as part of the public service.

In this context, and considering the reforms implemented by the Federal and State governments in 1998, Albuquerque *et al.* (1998a) presented a complete analysis of the States' Agricultural Research Organizations (SAROs) as they existed at that time. This analysis was based on data collected for the years 1996 and 1997. The authors concluded that the SAROs were very heterogeneous institutions. In spite of all these organizations having the same objective of promoting agricultural research in their states, they ranged in size (defined by budget and staff) and had quite different levels of involvement in providing technical assistance and rural extension (see Table 3.5).

Table 3.5 Size of state agricultural research organizations: December 1996

Organization	Budget	Researchers	Other staff	Integrated R&D and RE functions	Size [b]
	($US millions) [b]	*(number)*	*(number)*		
EMAPA – Agricultural Research Organization of the State of Maranhão	1.5	38	126	no	small
EPEAL – Agricultural Research Organization of the State of Alagoas A/S	1.7 [c]	27	275	no	small
EMPARN – Agricultural Research Organization of the State of Rio Grande do Norte	3.7	67	268	no	small
EMEPA – Agricultural Research Organization of the State of Paraiba A/S.	4.6	68	251	no	small
EPACE – Agricultural Research Organization of the State of Ceará	8.3	76	178	no	small
EMCAPA- Agricultural Research Organization of the State of Espírito Santo	10.3	74	523	no	small
EMDAGRO – Agricultural Development Organization of the State of Sergipe	11.0	6	875	yes	small
UNITINS – University of the State of Tocantins	11.0	53	358 [d]	no	small
FEPAGRO – State Foundation of Agricultural Research (Rio Grande do Sul)	13.3	180	540	no	medium
PESAGRO – Agricultural Research Organization of the State of Rio de Janeiro	14.3	73	532	no	medium
EMPAER/MS – Research, Technical Assistance, and Rural Extension Organization of the State of Mato Grosso do Sul	14.6	24	537	yes	medium
IAPAR – Agriculture Institute of the State of Paraná	16.7	152	1,112	no	medium
EMPAER/MT – Research, Technical Assistance, and Rural Extension Organization of the State of Mato Grosso A/S.	19.0	51	560	yes	medium
EMATER/GO – Technical Assistance, and Rural Extension Organization of the State of Goiás	20.5	60	566	yes	medium
EPAMIG – Agricultural Research Organization of the State of Minas Gerais	21.0	160	1050	no	medium
IPA – Agricultural Research Organization of the State of Pernambuco	24.1	116	859	no	medium
EBDA- Agriculture Development Organization of the State of Bahia	29.2	187	1,804	yes	large
CPA – Agricultural Research Coordination of the State of São Paulo	46.3	714	3,700	no	large
EPAGRI – Agricultural Research and Rural Extension Organization of the State of Santa Catarina A/S	62.4	188	2,300	no	large

a To calculate the size of these organizations the authors used cluster analysis – the *joining tree* method k-means.
b Exchange rate US$1 = R$1.05 in December.
c 1995 Budget.
d Number of lecturers and researchers in the organization.

Source : Albuquerque et al. (1998a)

When the federal government withdrew from its previous level of funding for public agricultural research, there was no organized plan for the process. Funding decisions varied from state to state, and the responses of the states themselves varied, with respect to funding, etc. The states adopted different views on the best way to implement agricultural research activities, as can been seen in Table 3.6. The SAROs, which had all been established in the 1970s with the same constitution, evolved into a variety of organizations, with a number of different jurisdictional constitutions.

Furthermore, Table 3.6 shows the SAROs varied in their constitutions[15] a legal structure and because of this, in the sources of capital available to them and their actual and potential involvement with other public and private organizations. They also differed as to which State Government secretariat controlled them. While most came under the Secretariat of Agriculture or similar department of the government (for example, the Secretariat of Agriculture, Supply, and Irrigation), EMAPA, EPACE

15 The range of organisations that are listed in Table 3.6, are defined by law as indicated below:

Sociedade de Economia Mixta (Society of Mixed Economy) constituted as a legal entity under one of the three levels of government (national, states, or municipality), under the regimen of an Anonymous Society, in which the Government is the main shareholder, and the private ones are always minorities in the society. Such societies are different to public companies, where the capital is owned 100% by the public.

Sociedade Anonima S/A (Anonymous Society or share company), this is different to a partnership or a limited liability company. S/A refers to the stricter corporate laws, which allow individuals to form legal corporations without revealing their identity, via the use of bearer bonds. A bearer bond is a legal certificate that usually represents a bond obligation to, or stock in, a corporation or some other intangible property.

Empresa Pública (Public Corporation) is a government corporation with the same business orientation as a private company and operating under private company law but capital provided exclusively from the Federal Government or from the other public corporation. Created by law to develop activities of enterprise nature that the Government has undertaken to execute, for reasons of convenience or administrative contingency, the Public Company is able to arm itself with any of the administrative forms admitted in Law.

Autarquia (Autarchy) is an auxiliary entity of the public administration with management autonomy and decentralized administration. Its patrimony and outcomes are proper, however tutored by the Government. The Federal Universities can be cited as examples of Autarchy.

Fundação Privada (Foundation under private law) is a kind of philanthropic organization with open capital (from private and public sectors), set up as a legal entity either by individuals or institutions, with the purpose of distributing grants to support causes in line with the goals of the foundation.

Fundação Pública (Foundation under public law) is a kind of philanthropic organization with capital exclusively from public sector entities, set up as a legal entity either by individuals or institutions, with the purpose of distributing grants to support causes in line with the goals of the foundation.

and FEPAGRO came under Secretariat of Science and Technology, EMPAER/MS under Secretariat of Environment and Sustainable Development, and UNITINS under Secretariat of Administration.

In addition, the State agricultural research organizations administrative situation was aggravated by characteristics common to most of the public research institutions, such as the constant decline in flexibility in administrative and financial management, a lack of agricultural research infrastructure (including land and buildings needed for research), the difficulty of managing enormous workforce liabilities (e.g., salaries and superannuation); the deterioration of equipment and buildings aggravated by the scarcity of resources for their maintenance; and inadequate numbers of support employees per researcher. Furthermore, in the same period, the government investment in agricultural research declined, despite the recognition that agricultural research had increased producers' profits in many different countries, and that Brazil was not an exception to this rule (Ribeiro, R.P. 1999; Bonelli and Pessôa 1998).

Table 3.6 SAROs: Government entailment and juridical constitution in 1998

Organization	Juridical constitution*	Controlling authority	Year established
CPA	Direct Administration (State responsibility)	Secretariat of Agriculture and Supplying	1998
EBDA	Society of Mixed economy under the form of A/S.	Secretariat of Agriculture	1991
EMAPA	Public company of private law	Secretariat of Science and Technology	1996
EMATER-GO	Public company of private law	Secretariat of Agriculture	1974
EMCAPA	Public company of private law	Secretariat of Agriculture	1973
EMDAGRO	Public company of private law	Secretariat of Agriculture, Supply and Irrigation	1991
EMEPA	Society of Mixed economy under the form of A/S.	Secretariat of Agriculture, Irrigation and Supply	1978
EMPAER/MS	Public company of private law	Secretariat of the Environment and Sustainable Development	1979
EMPAER/MT	Society of Mixed economy under the form of A/S	Secretariat of Agriculture and Agrarian Subjects	1992
EMPARN	Public company of private law	Secretariat of Agriculture	1979
EPACE	Public company of private law	Secretariat of Science and Technology	1975
EPAGRI	Society of Mixed economy under the form of A/S	Secretariat of Rural Development and of Agriculture	1991
EPAMIG	Public company of private law	Secretariat of Agriculture, Cattle and Supply	1974
EPEAL	Society of Mixed economy under the form of A/S	Secretariat of Agriculture	---
FEPAGRO	Foundation of public law	Secretariat of Science and Technology	1994
IAPAR	Autarchy	Secretariat of Agriculture and Supply	1972
IPA	Public company of private law	Secretariat of Agriculture	1974
PESAGRO	Public company of private law	Secretariat of Agriculture and Supply	1976
UNITINS	Foundation of private law	Secretariat of Administration	1992

* These are Brazilian organizations that may, in some cases, have no counterpart in other countries.

Source : developed by author from information provided in Albuquerque et al. (1998a)

3.4.2. Changes in the State Agricultural Research System

In the past five years, the State Agricultural Research Organizations have continued to undergo a process of transformation. Of 19 institutions registered in 1997, three have been abolished (EMAPA, EPEAL and EPACE); and three other institutions have modified their government link and jurisdictional constitution (EMCAPA, EMPAER/MS and EMATER/GO). In the State of Alagoas, when EPEAL ceased to

function, its activities were absorbed by the Department of Agricultural Research and Fishery, under the direct administration of the state. Finally, in the State of Ceará, when EPACE was abolished, the State Research Coordination, an area directly linked to the Secretariat of Science and Technology, absorbed its activities.

Other changes have happened as well, mainly in the State of Goiás, where at the end of 1999, the Goiâna Agency for Agricultural and Agrarian Development was created and assumed, among other functions, the agricultural research and rural extension activities, signalling the end of EMATER-GO. In the State of Mato Grosso do Sul, EMPAER-MS was changed to the Agrarian Development and Rural Extension Institute, linked into the Secretariat of Agrarian Development. Also, EMCAPA, from the State of Espírito Santo, was transformed into the Institute of Research, Technical Assistance, and Rural Extension. Lastly, the CPA in São Paulo State was transformed into the Paulista Agency for Technology and Agribusiness (APT).

Table 3.7 shows the new configuration of the State agricultural research organizations (now reduced to 16 in number) for Brazilian Regions as they existed in 2004, after the changes in the period cited above.

Table 3.7 State Agricultural Research Organization (SAROs): 2004 position

Regions North and Center-West	Northeast Region	South-eastern Region	South Region
Agência Rural	EBDA	Apta	Epagri
Empaer-MT	Emdagro	Epamig	Fepagro
Idaterra-MS	Emepa	Incaper	Iapar
Unitins	Emparn	Pesagro-Rio	
	IPA		

Source: EMBRAPA (2005)

In 1991, as a consequence of the restructure of the Brazilian agricultural sector implemented by the government, Embrapa was given the role of taking over some of the activities of the Brazilian Technical Assistance and Rural Extension Corporation (which was abolished in 1990). At that time, Embrapa created a specific Department in its administrative structure to respond to and manage the demands of the State agricultural research organizations. That Department, like the SAROs themselves,

has passed through many transformations in an attempt to provide the best arrangements, to manage their situation, considering the overall Brazilian context.

Presently, this Department in Embrapa has a mission to promote the expansion and the improvement of partnerships in R&D and transfer of rural technology, taking a regional approach, which has been agreed with State and federal R&D and rural extension organizations, various NGOs, and other organized segments of society involved in these areas (EMBRAPA 2005).

3.5. Private sector participation in agricultural research in Brazil

Currently in the broader economy, there appears to be a general perception that science and technology needs to seek a stronger connection between public research organizations and the private sector. The level of private enterprise participation in funding research and in carrying it out has been gradually rising in many developed countries. These changes in the developed countries' position are reflected directly in the Brazilian agenda for science and technology policy but not in the real state of affairs in Brazil (Furtado 2005).

In practice, the Brazilian Science and Technology Research System continue to be very concentrated in the public sector. The allocation to science and technology remains around 0.93% of Brazilian Gross Domestic Product, with about 60% carried out by the public sector and about 40% by the private sector (position in 2005). This is far below the standard of percentage of GDP devoted to Science and Technology seen in some developed countries, such as Japan (3.15%), South Korea (2.66%), and Germany (2.59%) in 2003, with the private sector contributing varying amounts, between 71% and 77% of the total investment in those countries (Japan 77%, South Korea 76%, and Germany 71%) (Pardey *et al.* 2006a; Matesco and Tafner 1996; Simões and Teixeira 2006; OECD 2006).

In the agricultural sector, worldwide, the situation is similar. Despite the recognized shortage of data and lack of indicators about agricultural research investments in developing countries, there is a relative consensus among the organizations that deal with agricultural development that the developing countries have been investing less than optimal amounts in agricultural research. The developed countries apparently invest on average between 2% and 3% of their

Agricultural Gross Domestic Product in research, while developing countries invest only 0.5%. Specifically in developing countries, of the total investment in agricultural research, the government is responsible on average, for 94% and the private sector only 6% (OECD 2006). Not only are the developing countries investing inadequately in agricultural research, but this investment has actually decreased in recent years, mainly in Latin America and the Caribbean countries. Consequently, this situation widens the technological gap between the poor countries and the rich ones (Pardey and Beintema 2001; Contini *et al.* 2000).

The situation is no different in Brazil. The Embrapa's global budget (Table 3.4) shows that the government is spending an average of 95.19% in the past 10 years, while the private sector investment has averaged 4.81%. In addition, the insufficiency of government funds for investment hinders the agricultural research and development institutions from implementing their planned activities in adequate conditions and then they are not capable of attending to their full range of demands.

The size of the market for identified branded products has a big influence on private agricultural research. It suggests that private research will be concentrated in commodities that are characterized by strong demand in either the domestic or international markets. This has been occurring in Brazil where commodities like soybean, cattle, sugarcane, cotton, milk, and wheat have been attracting the majority of private sector investments in research, as can be seen by referring to Embrapa's budget.

Table 3.8 presents the evolution of budgets for Embrapa Wheat, Embrapa Soybean, and Embrapa Beef Cattle research centres over the period from 1999 to 2004, showing both government and private sector support. The evolution of Embrapa Wheat's budget shows that participation by the private sector is still small, but it has increased by about 41% over the past 5 years, increasing from 10.5% to 14.8%. In the case of Embrapa Soybean, the situation is better than Embrapa Wheat: this centre has consistently achieved a higher level of private investment (average, 27.5%) than Embrapa Wheat (average, 14%) or Embrapa Beef Cattle (average, 11.1%). The budget for Embrapa Soybean is characterized by a 68% rise in private sector contributions, from 21.1% in 1999 to 35.5% in 2004. The percentage rise in private sector participation was most significant in the Embrapa Beef Cattle budget, from 5.9% in 2000 to 13.7% in 2004. This represented an increase of 132% over the past 5

years. In monetary terms, however, private investment over the period, was consistently been greatest in soybean, less in wheat, and least in beef cattle.

Table 3.8 Change in the budgets of Embrapa Wheat, Embrapa Soybean and Embrapa Beef Cattle for the period 1999 to 2004 (million US dollars - current values) [a]

Year		Government support [b]		Private sector support		Total
		Financial contribution (A)	(A)/(C) %	Financial contribution (B)	(B)/(C) %	(C)
1999	WHEAT	6,114	89.5	714	10.5	6,828
2000		6,694	89.9	749	10.01	7,443
2001		5,811	85.0	1,023	15.5	6,834
2002		3,872	82.3	833	17.7	4,705
2003		4,902	84.4	909	15.6	5,811
2004		5,871	85.2	1,020	14.8	6,891
		Percent average	**86.0**		**14.0**	
1999	SOYBEAN	7,746	78.9	2,072	21.1	9,818
2000		8,771	75.0	2,924	25.0	11,695
2001		7,792	75.2	2,574	24.8	10,366
2002		5,289	69.6	2,314	30.4	7,603
2003		6,608	71.6	2,625	28.4	9,233
2004		8,041	64.6	4,403	35.5	12,444
		Percent average	**72.5**		**27.5**	
1999	BEEF CATTLE	--	--	--	--	--
2000		6,485	94.1	405	5.9	6,890
2001		5,591	90.4	595	9.6	6,186
2002		3,761	87.6	532	12.4	4,293
2003		4,599	86.0	745	14.0	5,344
2004		5,688	86.3	905	13.7	6,593
		Percent average	**88.9**		11.1	

a Values converted to US dollars were calculated on the basis of FGV (Getulio Vargas Foundation) average annual exchange rate.

b Because basically all the resources derived from outside Brazil are related to international loans and therefore of federal government responsibility, external resources were considered as provided by the government.

Source: Embrapa Financial Administration Department; Embrapa Secretariat for Administration and Strategy; Embrapa Wheat; Embrapa Soybean; and Embrapa Beef Cattle

The data in Table 3.8 illustrates the rise in private sector support for R&D in commodities with strong market demand (in this case, soybean, wheat, and beef). However, it is a different situation for the producers of products with high social value but without high market demand (e.g. cassava, rice, bean, etc.). They have, of necessity, to depend more strongly on public resources for research and development funding. Moreover, the experience of various countries indicates that if the private sector judges that the rules controlling intellectual property are not sufficiently rigorous to protect it adequately, then companies will have little interest in investing in agricultural research, especially in research that is easily appropriated by other agents.

In Brazil, agricultural research carried out in the private sector is conducted mainly by foundations for research support and foment, but research by producers' cooperatives, and domestic and multinational companies trading in farming supplies (fertilizers, crop and stock protection, rations, fuel and other inputs) and machinery, is also significant.

In the case of multinational corporations, the greatest research effort is directed towards the chemical and mechanical technologies and, more recently, to advancing knowledge in biotechnology for the development of new crop varieties. In these corporations, the generation of new knowledge and technologies is carried out in the organizations' headquarters, which are often closely associated with the production sector, so that adaptations and adjustments, mainly needed to meet registration requirements to sell products in the domestic market, in conformity with the local legislation, are achieved (Ribeiro, R.P. 1999).

Another form of private sector participation in the conduct of agricultural research has been developed between Embrapa, State organizations, and Universities through the establishment of partnerships with Agricultural Research Support Foundations. These Foundations have been formed by leading producers, interested in contributing to research by providing infrastructure, laboratories, human resources, and financial support to expand the level of and to bring more dynamic activity to the research into a number of the Brazilian agricultural commodities. Some examples of these Foundations that have been working with soybean and cotton include the Pro-seeds Foundation in the state of Rio Grande do Sul; Meridional Foundation in Paraná, Vegetal Foundation in Mato Grosso do Sul, Triangle

Foundation in Minas Gerais, Cerrados Foundation in Goiás and Distrito Federal; Centre West Foundation in Mato Grosso; Bahia Foundation in Bahia, Centre North Foundation in Maranhão, and Mato Grosso Foundation in Mato Grosso.

3.6. Commercial focus in the public agricultural R&D institutions

The worldwide trade in agricultural commodities has been important in meeting the demand for food, fibre, and natural resources around the world for centuries, but trade in agricultural commodities has generally become more difficult in the past 30 or so years as a few of the developed countries such as the US, Europe, and Japan, in particular, have sought to protect their farmers from the competition of imports. The entry of a country into the international market for agricultural commodities therefore implies a level of competitiveness, achieved by its industries through an increase in productivity, reduced costs, an efficient allocation of resources, on an increase in the quality of products and services produced and traded. It also implies a less interventionist form of government policy, perhaps going only as far as taking the responsibility for improving the infrastructure and in the establishment of legal instruments that permit security for private investments in the production sectors (Williamon 2002).

In the light of the potential increase in worldwide demand for food, and the diminishing level of natural resources available, the development of agricultural research programs should become one of the most important activities of the global community. In one respect, agricultural science has been the most important of all the sciences to the human species. It has enabled a relatively small number of farmers to provide enough food for the expanding population, and to allow humans to turn their attention to other activities apart from searching for food (Hollanda 2004). However, agricultural researchers may have been too successful for their own survival. There is generally an over-supply of food and agricultural products in the world today, prices are depressed, and some wealthy countries have imposed trade barriers. The amount invested in agricultural research, particularly in developing countries is declining, and the financial support provided by the wealthy countries to research institutions is diminishing (CGIAR 2000).

In this context, successive Brazilian governments looking to improve the agricultural system over the last 20 years, have implemented many reforms in areas such as foreign commerce, deregulating domestic markets, and dismantling state monopolies.

These reforms made in the direction of liberalizing the Brazilian agricultural market started in 1987, when the government created ways to open up the agricultural markets. In 1991, export taxes were eliminated, and licences to permit exports were introduced. Both direct and indirect subsidies to agricultural producers were removed, and the tax on commercialization of merchandise and services (12% of the added value) was eliminated from the export process in 1996. In addition, the Guarantee of Minimum Price Policy for agricultural commodities was modified to introduce the system of free prices, which follow market fluctuations (Gasques *et al.* 2004a; Gasques *et al.* 2004b).

Gasques *et al.* (2004b) observed also that an increase in the level of competition occurred inside each industry, as well as between the agricultural sector and the other sectors of the economy. It occurred due to the removal of government support from sectors such as sugar and alcohol, coffee, dairy, and wheat, which allowed less restricted development of the relationships between the agricultural sector and the other commercial and industrial sectors of the economy.

Specifically in the area of Brazilian science and technology, where almost all of the agricultural research activities have been conducted by public institutions, financial support from the government has shown a constant decline. Government agencies once regarded it as part of their public responsibility to generate and disseminate information to increase the production of food and other agricultural products. Now, the tendency is for less of the funding for agricultural research to come from public sources and for much of the research, at least for some industries, to be privately funded.

Thus, the partnership with agribusiness has become more important to R&D institutes, since agribusiness is providing financial support, and helping to define research projects, by identifying the demand for products from consumers.

In this way, in its Second Strategic Plan 1994 – 1998, Embrapa changed its mission, defining society as a whole as its beneficiary, and not the agricultural sector alone, as was the case in the past. Its mission began to become broader, serving the

whole of society and the representative segments of agribusiness, from the input supply companies, through farming, agro-industrial and forest production and commercialization, to the final consumer market, thus contributing to the nation's sustainable economic and social development. During this period (1994 to 1998), Embrapa created a policy for Institutional Management of Intellectual Property through the Deliberation Nº 22/96 of 02/07/1996 (EMBRAPA 1994).

In 1998, Embrapa once more adjusted its action plan and established, through its Third Strategic Plan 1999 - 2003, the following mission:

- *"To make possible find solutions for the sustainable development of Brazilian agribusiness[16] by the generation, adaptation, and transference of knowledge and technologies, for the benefit of society (EMBRAPA 1998)".*

To achieve the objectives established in its Third Strategic Plan, Embrapa adapted its Research and Development policies and created two new policies to deal with the commercialization and communication areas. Furthermore, the corporation's directors created a Technology Trade Department within its central administrative structure, and installed trade units in all of its Research Centres with the objective of improving the commercial relationship between Embrapa and the other segments of the agricultural sector in the State or Region covered by the Research Centre. They also allowed the Technology Trade Department to trade all of the products produced by Embrapa (seeds, technology, books, etc.) in the regional market. In line with this development, and with the objective of creating legal instruments to enable the negotiation processes regarding access to technologies, services and products to proceed, the Intellectual Property Secretariat was created. It

16 Embrapa considers that the agribusiness concept includes the suppliers of agricultural goods and services, agricultural producers, processors, and those businesses involved in the production, transformation and delivery of agricultural products to the final consumer. The coordinators of this flow of agricultural products such as government market regulators, commercial and financial entities, and services companies also make up part of the agribusiness chain (EMBRAPA 1994).

is responsible for the patents register, negotiating royalties, and similar activities related to the needs of the corporation as a whole.

Similarly, all of the other institutions in the National Agricultural Research System were assisted by these new activities or had followed Embrapa's procedure and changed their mission and structure.

3.7. Government instruments to improve participation by agribusiness companies in the Brazilian Agricultural Research System

The majority of the developed, developing, and poor countries of the world possesses instruments and provides incentives to finance scientific and technological development (Alston *et al.* 1998). In consideration of their conditions and functional structures, these countries are using mechanisms such as fiscal incentives, financing arrangements, investment plans, and specific legislation regulating partners' participation and preferential government purchases, available to those involved in the process. This leads to the creation of programs to support the technological development of specific resources identified by government financial agencies and others (Matesco and Tafner 1996).

It is important to observe that the developed countries, without exception, have been creating an integrated system involving the economy as a whole to support the development of science and technology. According to Matesco and Tafner (1996), the government usually assumes responsibility for the following activities in this process:

- *"to stimulate and to maintain the infrastructure activities through policies, rules and regulations to support the universities, and the further qualification of the scientists and researchers;*

- *to define and to defray the cost of the research programs in basic science, or of those whose application is not absorbed immediately by the private sector;*

- *to promote programs that involve many countries, defining transnational partnerships to improve the scientific infrastructure investments;*

- *to promote, to stimulate and popularize the diffusion of the scientific culture; and*

- *to share the risks and, over all, the high investment costs for scientific and technological development."*

Specifically in Brazil in the past 30 years, it is evident that the government has been striving to create an integrated industrial, scientific, and technological system. The initial attempt was made in 1969 through Decree-Law Nº 719, by the creation of the National Fund for Scientific and Technological Development (named FNDCT in Brazil) with the purpose of giving priority financial support to the programs and projects important for scientific and technological development, mainly the establishment of a Basic Plan for Scientific and Technological Development. In addition, in 1985, the Program of Support for Scientific and Technological Development (named PADCT in Brazil) provided financial support from government agencies like the National Bank of Economic and Social Development (named BNDES in Brazil) and the Agency for Financial Support for Studies and Projects (named FINEP in Brazil) (MCT 2005).

In June 1993, with the objective of stimulating private investment in research and innovation, the government created Law Nº 8.661 (regulated by Decree Nº 949 of 05/10/93 and modified by the Laws 9.532/97 and 10.637 of 2002) establishing fiscal incentives to raise the standard of technological qualifications in industry and agriculture. Under this same Law, the Program of Agricultural Technology Development and the Program of Industrial Technology Development (named PDTA and PDTI respectively in Brazil) were created to stimulate the generation of new products and processes, or make evident improvement in their characteristics (Presidência da República do Brasil 1993; MCT 2005).

In 2000, through Law Nº 10,168, the Brazilian government instituted the Program of Incentives for Support of University and Company Interaction in Innovation, with the main objective of stimulating technological development, through cooperative scientific and technological research programs among universities, research institutions, and the private sector companies. This Law was promulgated only on 11/04/2002 by Decree Nº 4,195.

In this Decree, the program categories named CT GREEN and YELLOW,[17] and several Science and Technology Funds (STFs), such as the Sectoral Agribusiness Fund,[18] and the Sectoral Biotechnology Fund,[19] among others, were established. The intention was to strengthen the partnerships between agricultural research institutes and other segments of the agribusiness sector. The financial resources to implement the CT GREEN and YELLOW activities are collected and administered by the National Fund for Scientific and Technological Development (FNDTC) (Presidência da República do Brasil 2000, 2002a).

On 19/12/2001, with the objective of defining financing mechanisms for the Programs of Science and Technology for the Agricultural Sector, Genetic Resources and Biotechnology (GENOMA), to increase Health Research, Science and Technology for the Aeronautical Sector, and for the Program of Innovation for Competitiveness, Law Nº 10,332 was created. In fact, to specify distinct Programs involving different

17 CT Green and Yellow was created to stimulate the implementation of cooperative projects of scientific and technological research between universities, research institutes and the production sector; to improve and to increase the level of expenses in R&D carried out by companies; to support action and programs that strengthen and consolidate an enterprising culture of venture investment in the country. Origin of the resources: 50% of the Contribution for Intervention in the Economic Domain (CIED Funds) whose collection comes from the aliquot incidence of 10% on the remittance of resources to the exterior for technical assistance payment, royalties, services of specialized or professional services technicians, and 43% of the estimated cost of the incident IPI (Industrialization of products fees) on the goods and products benefited by the tax incentives of the Law of Computer Science.

18 The Sectorial Agribusiness Fund – was established to stimulate scientific and technological qualification in the areas of agronomy, veterinary medicine, biotechnology, economic and agricultural sociology, to promote the modernization of the farming industry, with the introduction of new varieties in order to reduce animal diseases and to stimulate an increase in investments in the area of tropical agricultural biotechnology and new technologies. Origin of the resources: 17.5% of the Contribution of Intervention in Economic Domain (CIED), whose collection comes from the aliquot incidence of 10% on the remittance of resources to the exterior for assistance payment technique, royalties, and specialized or professional services technicians.

19 The Sectorial Biotechnology Fund was established to promote the formation and qualification of human resources, to fortify the national infrastructure of research and services support; to expand the base of knowledge of the area; to stimulate the formation of companies of biotechnological base and the technology transfer by consolidated companies; to carry out prospecting studies ion and monitor the advance of the knowledge in the sector. Origin of the resources: 7.5% of the Contribution of Intervention of Economic Domain (CIED) whose collection comes from the aliquot incidence of 10% on the remittance of resources to the exterior for assistance payment technique, royalties, and specialized or professional services technicians.

segments of the economy, this Law was regulated by two Decrees. Decree Nº 4,157 of 12/03/2002 provided the regulations for Law Nº 10,332 in the definition of financing mechanisms for the Program of Science and Technology for the Agricultural Sector, and Decree Nº 4,154 for the Program of Biotechnology and Genetic Resources (GENOMA). Through these decrees, the government established, as part of the National Fund of Scientific and Technological Development, budgetary categories for specific programs called CT AGRIBUSINESS and CT BIOTECHNOLOGY to be used in the financing of scientific research and technological development of the agricultural sector, and genetic resources and biotechnology. These Decrees also established the guidelines for the Managing Committee for each of these Programs, made up of members from the various sectors of the economy (executive government, academic-scientific segment, government financing agencies, and production sector representatives) (Presidência da República do Brasil 2001, 2002c, 2002b).

Finally, on 02/12/2004 Law Nº 10,973 was created, establishing appropriate measures to provide incentives for innovation in scientific and technological research in the production sector. It also addressed the gaining of qualifications, the achievement of technological autonomy, and other activities directed at Brazilian industrial development. This Law introduced many new concepts, including many subjects that had not been discussed before, such as stimulating and building a specialized and cooperative innovation environment, with minority participation by government institutions in the capital of the established corporations. It was also designed to provide incentives to build international networks for technological and research projects, as well as establish technological entrepreneurship and the creation of innovation areas, such as incubator companies and technological parks. Law Nº 10.973 was promulgated only on 11/10/2005 by Decree Nº 5.563 (Presidência da República do Brasil 2004, 2005).

Another new measure was the establishment of rules for the recognition of intellectual property rights over the results of research, taking into account the rights of the company and the creative researchers. However, the Law also established the possibility that a researcher in a government research institute could become involved directly in a cooperative research project with the private sector, when he/she might receive a pecuniary payment beyond his/her normal wage, through

scholarships to stimulate innovation, or additional remuneration from private sector partners (Presidência da República do Brasil 2004).

Thus the Brazilian government has been creating Laws and Decrees designed to stimulate and to increase the investment in R&D activities carried out by government financed agencies and the private sector, and to support action and programs that strengthen and consolidate an enterprising culture of investment in the country. By implication, this means that research institutes must take greater risks and that many producers of important agricultural products such as wheat, sorghum, corn, rice, dairy, and beans, have still not built strong relationships with the appropriate agricultural research corporations.

The lack of knowledge about, and then the difficulty of accessing the existing legal mechanisms available, is part of the set of problems hindering private sector firms from participating in research and development projects.

Studies developed by the National Industries Confederation (named CNI in Brazil), cited by the authors Matesco and Tafner (1996), with the objective of identifying the reasons why little use was being made of the benefits provided under Law Nº 8,661, were conducted with the involvement of industries with different sizes, structures, and locations. The results show that the majority of the businesses, about 80%, either did not know about the Law or they did not know how to use it. On the other hand, a few entrepreneurs who know the Law consider the values of the incentives to be small and, therefore, they did not seek help on how to access the benefits. Another point raised was the complexity of the legal instruments that must be signed in the application for projects and the low level of preparation by the public agents charged with guiding interested parties in using the Law.

3.8. Summary

The Brazilian Agricultural Research System has been submitted to a series of transformations and adjustments, to prepare it to respond to the expected demand from the domestic and worldwide economy. In particular, these changes were made in consideration of Brazilian government requirements concerning the financial support, administrative structure, and management viability, to be given to the development of agricultural research projects by the system's institutions.

The progress of Brazilian agriculture on the domestic and international scene in the past 20 years, helped by the research institutions' performance and deregulation of the agricultural industries, put a number of Brazilian agricultural products in a premier position on the world market.

Despite the relatively comfortable position occupied by a number of Brazilian agricultural products in the international market, the Brazilian agricultural sector is not as organized as it could be and both public and private sectors need to implement a further series of changes. The taxes on agricultural commodities in general are still very high. If compared with European competitors, for example, Brazilian producers, in 2003, paid approximately 33% of the commercial value of their products, while European producers paid only 7%. On the other hand, the segments that compose the agricultural production chains of Brazilian agribusiness are still not adequately structured, and organized enough to identify, adequately, their needs in research, and to defend their claims.

Additionally to these factors, it can be noted that the cornerstone of Brazilian agriculture, that is the agricultural research system, which for the most part, is operated by public institutions, needs to change further. These institutions have been faced with problems of management and administrative instability, in addition to funding shortages. Furthermore, the constant decline in financial support from State and Federal governments has been aggravated by the low contribution from the private sector to their budgets.

On the other hand, some measures have been adopted, and others are being planned, to solve the problems that the research sector is experiencing. The State and Federal governments have created a series of funds to support agricultural research activities, and many laws have been created with the objective of facilitating private

sector participation in projects conducted by public research institutions and universities. For their part, the public agricultural research institutions have developed a process by which they can adapt to the new reality of the market, promoting changes in their administrative structures and strategic management areas, and creating mechanisms to increase private sector participation in the development of their R&D activities.

However, in spite of all of these improvements, Brazil still needs to move its agricultural research system forward, to a new market driven standard. It needs to work in an innovative way, through its agricultural policies, to build a research system which is competitive in the arena of international research and technological development. While it continues to make only a very small investment in the agricultural research system, the private sector is still not sufficiently organized to demand the research it needs.

CHAPTER 4

INTERNATIONAL AGRICULTURAL RESEARCH AND DEVELOPMENT SYSTEMS

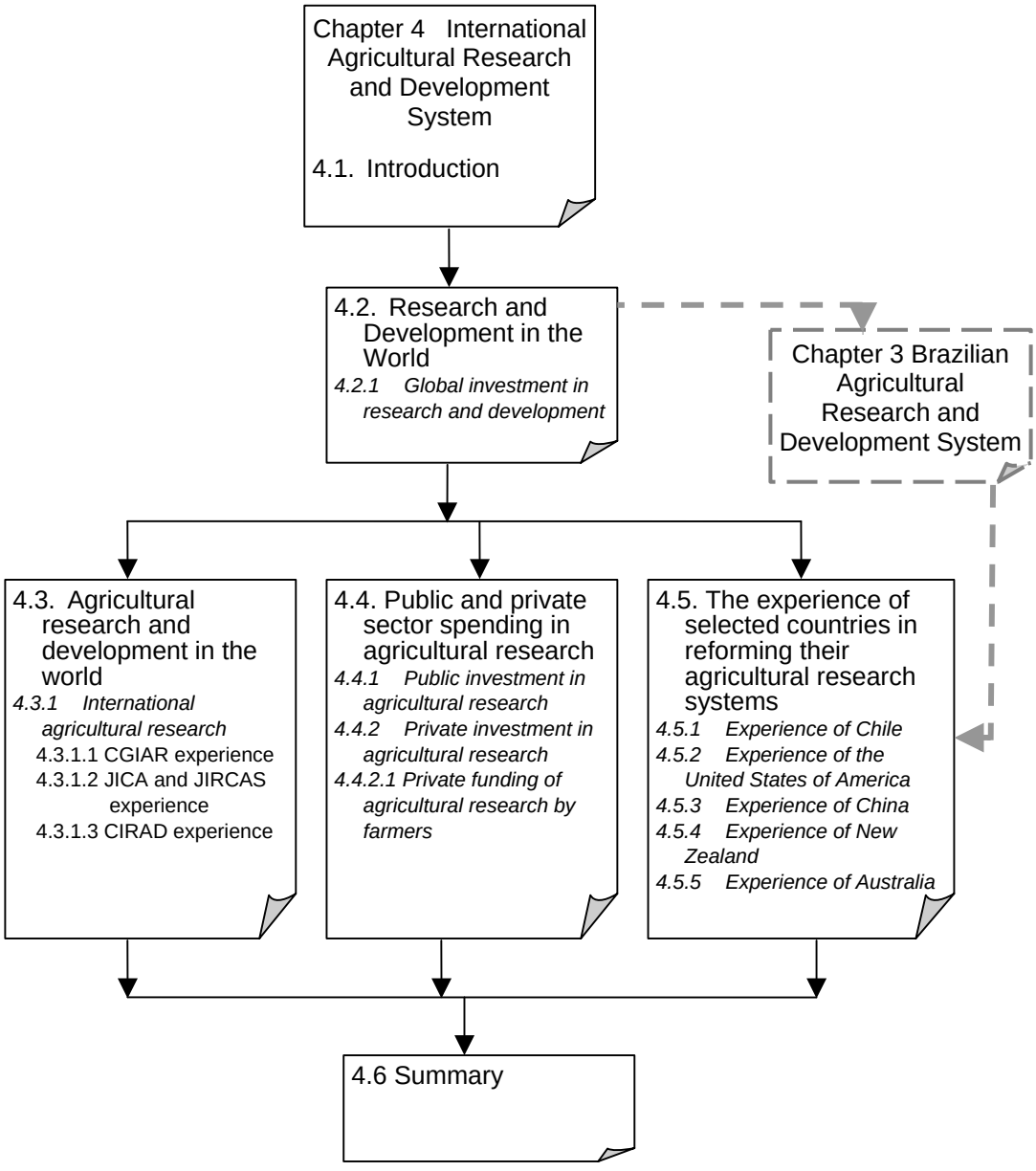


Figure 4.1 Structure of Chapter 4

4.1. Introduction

The international agricultural research and development (R&D) system will be described in this chapter, as part of the conceptual model defined in Chapter 2 (Figure 2.9) and complementary to Chapter 3 where the Brazilian agricultural research system was described, to complete the global view of the agricultural research system.

Initially, there will be a brief introduction to the research and development activities conducted in the world and the global investment in R&D. After that, the chapter will focus on the main elements of the agricultural research system worldwide, describing activities of the most relevant international agricultural research organizations in the world, mainly in developing countries.

Public and private sector spending on agricultural research will be explored in the next section of the chapter. The total investment in agricultural research by the public and private sectors, the proportional spending related to each one, and the effort by governments to involve the private sector and increase its participation in agricultural research activities will be described.

Lastly the experience of five countries in the process of reforming their agricultural research systems will be described. A summary of the experience of agricultural research organisations in Chile, the United States of America, China, New Zealand, and Australia, will be presented, with the aim of identifying the weaknesses and strong points of these reforms to help in developing a set of recommendations for Brazil. The five countries were selected by considering separately or collectively, the similarities in their agricultural production characteristics, evolution of their agricultural research systems, and expertise in agricultural research.

4.2. Research and Development (R&D) in the world

By evaluating the evolution of some major industrialized products and their processing arrangements, it is possible to deduce that research activity, even if not in such a structured form as it is today, has existed since society's first steps into the age of industrialization (Robinson 1987; Vernon and Wells 1976).

A structured R&D system, as an essential part of a country's economic planning in a global sense, is a recent phenomenon, which started at the beginning of the twentieth century. There was little growth in the period between the two world wars but, after the end of the Second World War, research and development became an indispensable activity for the expansion and decentralization plans of firms, and the development of countries (Casson 1991b; Penrose 1959; Robinson 1987).

In the 1950s and 1960s, the theory of economic growth defined technological progress as the most important factor influencing the growth of modern and dynamic industrial economies. Technological changes integrated with strategic instruments such as capital, labour, organizations/institutions, leaderships, and strategic ideas formed a set of factors necessary to make the economy of countries grow, transforming the world, permitting unprecedented mobility of people, materials and products and globalization of markets (Buckley and Casson 1991; Craveiro 2004; Dicken 1992; Snooks 1999; Solow 2000).

A recent report by the OECD showed that investment in R&D in developed countries has been growing faster than investments in infrastructure. While the resources directed towards science had increased by 3.4% in the decade of the 1990s, the investments in infrastructure had grown by only 2.2%. The essential factors supporting the good performances in innovation in OECD member countries had been the partnerships with educational institutions, and the creation of trusts, between small and large companies with a priority of working with manufactured products and in the services areas (OECD 2004).

One of the most important causes of the increased investment in research and development is the growth of private sector participation in supporting the innovation process. A common characteristic of the investments made by the OECD member countries has been the decreasing level of participation by government in investment in innovation. A good example is the case of the USA, where in 1965, the

investment by the government in research and development was 67% of the total. It decreased gradually until, in 2000, it was down to 27%, with the private sector assuming responsibility for 73% of the investment in R&D (Furtado 2005).

In Brazil, not even the obvious diagnosis, that only the production and accumulation of knowledge can guarantee the prosperity of the nation, has been sufficient to mobilize the government to adopt appropriate strategies to create a solid basis in technology for the development of the country. Because of this political deficiency in successive governments, Brazil has fallen behind India and China in scientific and technological achievements. In the 1970s, both of these countries executed research programs at the same level of progress and development as Brazil. Today, these two countries show advances in sectors such as computer science, space research, agricultural research, and other areas of science, that place them among the leading developing nations. The Indian and Chinese nations have invested in science and technology at a rate that is two times greater than the Brazilian investment as a percentage of their GDP (Ribeiro 1999).

Currently, many public research institutions in developed and developing countries are undergoing institutional reorganization, aiming to secure their survival in an environment evermore dominated by restrictions on government financial investment and social pressures seeking the best use of public resources. It is necessary to recognize that this situation has generated a new and expanded approach from the private sector towards their customers. They have adjusted their research programs to meet the dynamic market demand, to the detriment of the needs of other sectors that do not have conditions to attract investment for the generation of new technologies (Ichikawa 2000).

4.2.1. Global investment in research and development

The worldwide tendency is towards reduced investment by the public sector in research and innovation, leaving the private sector to assume this responsibility. Because this change of roles has happened fairly rapidly, many countries have had difficulty in the responding to this process, mainly, in respect to how to involve the private sector and what should be the new role of the government in this situation (Stiglitz 2002b; Ruttan 1999).

In seeking to identify a better role for the government in research and development activities, and considering the necessity of greater private sector involvement in the development of technology, Matesco and Tafner (1996) defined five activities to be assumed as the government's responsibility in developed countries. These conditions can be extended to the developing countries with the same effect. The authors define public sector responsibilities to include the following activities:

1. to stimulate the installation and maintenance of public infra-structure;

2. to define and defray the cost of research programs in pure (basic) science, or research projects where the results cannot be immediately absorbed and applied by the private sector;

3. to develop an international research program involving more than one country, creating a transnationals trust to invest in scientific infra-structure;

4. to promote, to stimulate and popularise a scientific culture; and

5. to share the risks in the development of scientific and technologic programs which require a high level of investment.

The necessity of improving private sector participation in research and development is clear; convincing the private sector to invest in research developed by public research institutions or in private research units is not such an easy task.

Arrow (1959) suggested that the private sector would find difficulty in investing in research for the following reasons.

Increasing returns for large companies, but not for small and medium companies: small and medium companies do not get the same returns as large companies from using the technology created by research. In large companies, the cost of developing new technology can be divided among many products, diluting the cost, something that cannot always be done in small and medium companies. This condition can provoke a monopoly situation and, as a consequence, there is a tendency for the level of research investment to be less than is socially desirable.

The second reason is *uncertainty*: normally, companies find it difficult, and lack the flexibility to invest in risky activities, and research is characterized as a risky activity with uncertain results. Thus, companies will tend to invest less than necessary to maximize profits.

The third reason is *inappropriability* – this situation occurs when new technology can be characterized as in the public domain, where the community is the main beneficiary to the detriment of the private sector. In that case, companies will not be willing to invest in such research.

In addition, if the private sector companies are not convinced that their intellectual property will be protected and the registration of patents is adequate to protect their rights, they will not invest in research, especially in agricultural research that is easily appropriated by other segments of the industry (Pray and Echeverría 1991).

In considering these facts and the necessity to involve the private sector more appropriately in public research projects, many countries have been seeking to reformulate their science policies. This new tendency represents a paradigm shift, moving from the "science push"[20] where basic research is the main force responsible for progress, to the "demand pull" paradigm in which the demands of the market define the research programs to be developed. This paradigm shift has allowed greater private sector participation in the financing and execution of research programs in developed countries. The positive results achieved in the developed countries have influenced the developing countries to improve their situation, restructuring the scientific and technological sector, and adopting a new model to increase private sector participation in the financing and execution of research projects (Biegelbauer and Borras 2003; Furtado 2005).

In this context, the range of tax concessions adopted by the majority of countries interested in increasing financial support for scientific and technological programs has been identified as the most important factor to improve private sector

20 "Science push and demand pull refer to the 'pipeline model', in which innovation is seen as consisting of a chain of events from basic research, to applied research, to development, to engineering and finally to production."

investment in research. However, according to Matesco and Tafner (1996), the tax concession alone, despite its importance, is not enough to encourage private companies to invest in R&D, and they present many other options adopted by developed countries. For example, the United States of America has a system of preferential purchases by the government in addition to the tax concession; and accelerated depreciation for equipment acquired and applied in R&D projects, as well as other incentives.

The British government still carries out direct expenditure on research projects and allows a tax deduction from companies' profits for research expenditure, the credit corresponding to the total costs of the equipment used in research and development.

Holland and Belgium, like the USA, apply the system of preferential purchases by the government, and have subsidized interest-free loans to finance equipment and infra-structure used in research.

In Germany, the government has reduced the tax on technologically based products, allowing accelerated depreciation for equipment acquired and applied in R&D projects. They have also reduced the tax on investment in equipment and infra-structure, and offer additional incentives to small and medium size companies which have the development of research and innovation products as a principal activity.

In Australia, a tax concession allows companies to deduct up to 150% of the expenses incurred through research and development activities from their taxable income.

In France, the government established accelerated depreciation for equipment acquired for and applied in R&D projects and many other tax concessions such as the reduction of tax on the movement of royalties, and on rights and patents trading. They also created, a fund for risk financing for research investment.

Japan and South Korea combine tax concessions and the financing of research through loans with subsidized tax to improve private sector participation in the development of science and technology projects (Matesco and Tafner 1996).

Developed and developing countries both, appear to have plans to create and modify policies to improve their science and technology programs, and to increase research and development spending. Seeking to boost the efficiency and quality of public research and to stimulate business investments in research and to strengthen

linkages between the public and private sector is seen as the cornerstone of these plans (OECD 2004).

Table 4.1 shows the expenditures in selected countries, on R&D performed in the public and private sectors as a percentage of GDP in 2003. It can be observed that private sector investment in R&D is greater than public sector participation in some developed countries (for example the USA, Japan, Germany, France, Denmark, etc.). The inverse occurs in developing countries, where public spending in research is greater than private sector investment (see for example, Brazil, Poland, Turkey, etc.). This fact is evident in the data from OECD member countries which have an average participation by the private sector of 65% and 35% by the public sector.

Table 4.1 Expenditure on R&D performed in the public and private sectors as a percentage of GDP: 2003 *

Country	Private sector participation (A)	Public sector participation (B)	Total (C)	Private sector proportion (100 x A/C)	Public sector proportion (100 x B/C)
	(%)	*(%)*	*(%)*	*(%)*	*(%)*
Mexico	0.13	0.31	0.44	30	70
Poland	0.16	0.40	0.56	29	71
Slovak Republic	0.35	0.25	0.60	58	42
Greece	0.19	0.44	0.63	30	70
Turkey	0.19	0.50	0.69	28	72
Portugal	0.31	0.57	0.88	35	65
Hungary	0.34	0.60	0.94	36	64
Spain	0.63	0.46	1.09	58	42
Italy	0.56	0.64	1.20	47	53
Ireland	0.81	0.39	1.20	68	32
New Zealand	0.43	0.79	1.22	35	65
Czech Republic	0.75	0.50	1.25	60	40
Australia	0.81	0.79	1.60	51	49
Norway	1.00	0.75	1.75	57	43
Netherlands	1.00	0.81	1.81	55	45
OECD	1.18	0.63	1.81	65	35
United Kingdom	1.25	0.59	1.84	68	32
Canada	1.06	0.88	1.94	55	45
Austria	1.44	0.69	2.13	68	32
France	1.38	0.78	2.16	64	36
Belgium	1.75	0.56	2.31	76	24
United States	1.81	0.69	2.50	72	28
Denmark	1.78	0.78	2.56	70	30
Germany	1.84	0.75	2.59	71	29
Switzerland	1.94	0.69	2.63	74	26
South Korea	2.03	0.63	2.66	76	24
Iceland	1.69	1.25	2.94	57	43
Japan	2.42	0.73	3.15	77	23
Finland	2.53	1.00	3.53	72	28
Sweden	2.95	1.03	3.98	74	26
BRAZIL	0.37	0.56	0.93	40	60

* 2005 for Brazil, 2002 for Australia, Austria, Portugal, Switzerland, and Turkey; 2001 for Greece and Mexico.

Source: Adapted from Figure 3.1, page 58 of "Economic Policy Reforms: going for growth, 2006 (OECD 2006), and from Simões and Teixeira (2006).

4.3. Agricultural research and development

The global scene with respect to agricultural research is no different from the situation regarding research in general. A combination of three main factors has converged to stimulate the creation of scientific and trading partnerships and help to define the source of the investment in agricultural research. These are: world food needs, advanced technology and innovation in food grain production, and an adequate and consistent definition of roles in the advancement of agricultural technology. While the second one concentrates the majority of private sector efforts, the first and the third factors require more involvement and investment by the public sector (Ruttan and Pray 1987).

As a consequence, about 63% of the total invested in agricultural research in the world in 2003 came from public funds and 37% from private sector funds. The situation is different when only the developing countries are considered. In the same year, government was responsible for almost all of the spending on agricultural R&D, (94%), while the private sector contributed the rest (6%) (see Table 4.2).

Agricultural research appeared, as an institutional activity, in Germany, the United Kingdom, and France in the latter half of the nineteenth century, when research units were set up in those countries with public financial support. They were led by scientists distinguished at the time as illustrious representatives of the agricultural science research fraternity. At the end of the nineteen century, almost 100 agricultural research units were operating in the majority of European countries, and had spread to some other countries such as Japan, the United States and Canada (Alston and Pardey 1999; Alston *et al.* 1998). Currently almost every country has, as part of their economic structure, agricultural research units which develop technologies with diverse applications and modes of financial support.

Before the 1960s, most of the programs for agricultural technology transfer and R&D activity had been focused in the United States of America and Western European countries and some of their close partners (such as Australia and New Zealand). With expansion of the consumption chain, the relatively recent establishment of international food markets, and new options for agricultural products representing better quality and greater productivity, many countries such as Canada, Mexico, South Africa, Brazil, China, India, and countries from Eastern

Europe, took advantage of the changed conditions. Previously some of these countries did not invest much in agricultural research, but they started to invest directly and, through the opening of their markets, allowed interested companies to invest in agricultural R&D (Boehlje 2003).

The process of globalizing agricultural research had its beginning in the decade of the 1960s, with events such as the inauguration of the International Agricultural Research Centres such as the International Rice Research Institute (IRRI) in the Philippines in 1960, the International Wheat and Maize Research Centre (CIMMYT) in Mexico, 1966, the International Centre of Tropical Agriculture (CIAT) in Colombia, 1967, and the International Institute of Tropical Agriculture (IITA) in Nigeria, 1967. Other important events were the Green Revolution,[21] the creation of agricultural research programs, and the establishment of agricultural research management as a disciplinary area in foundations and universities. This had the effect of transforming some agricultural research programs that had previously had a national focus into ones with an international interest (Borlaug and Dowswell 2002; Hildebrand 2002).

In many countries the decision to create or improve their agricultural research system was forced by a number of internal and global factors, such as major food shortages, loss of export market share, changes in land tenure, and increasing input prices. When these situations affect a country's economy, then the society may support the development of agricultural research activities (Alves 1987).

Currently, the world faces some great challenges, perhaps, the greatest of all time, to provide a population in excess of 6 billion inhabitants with food. An even greater challenge is to keep this rapidly-growing population fed, while preserving the world's exhaustible natural resources such as water, soil, and the general environment.

Estimates made by the Food and Agriculture Organization of the United Nations (FAO) anticipate that the world's food production will have to increase by more than 75% in the next 30 years to keep pace with population growth. For this to be achieved, food production must be intensified, productivity increased, and productive

21 The Green Revolution symbolized the process of employing agricultural science to develop modern techniques for agriculture in the Third World countries.

natural systems must be optimally managed, all in a sustainable manner. It has been predicted that the combined application of biotechnology, including innovative approaches to plant and animal breeding and to other farming practices, will be required in order to improve yields sufficiently to meet this challenge (Diouf 1996; Esquinas-Alcazar 2004).

In addition, 90% of national per capita supplies of food plants come from only 102 species and only 15-20 species represent crops of major economic importance. Only 20 plant species supply 90 per cent of the world's food, and just four plant species – wheat, maize, potatoes, and rice – and 3 animal species – cattle, swine and chickens – provide more than half of the world's food. Food security thus relies on a very small proportion of species (Esquinas-Alcazar 2004; UNO 1990).

Consequently, agriculture has been described as the single most important sector of the world's economy, and the agricultural research process has taken on strategic importance. The necessity for rapid evolution in the generation and adoption of agricultural innovations and the creation of tools to promote conditions to address the challenges mentioned above is now a matter of high priority for the world (Ruttan and Pray 1987).

4.3.1. International agricultural research

As indicated in the previous section, the first steps are being taken to structure the agricultural sector worldwide, to respond to the demands expressed by international market forces. In this situation, given that knowledge is not confined to one place or region in the world, the process of partnership among countries, seeking to promote the exchange of experience and the cooperative development of new research, will become fundamentally important. The need to develop a general framework that could facilitate strategic alliances and joint ventures among domestic and international participants with common objectives and involved in the formulation and implementation of agricultural research programs is evident. It has stimulated many initiatives in this direction, as can been see in the following description of the international agencies for agricultural research (GFAR 2001).

4.3.1.1. CGIAR experience

On May 19, 1971, the Consultative Group on International Agricultural Research (CGIAR) was established to achieve food security and reduce poverty in developing countries through scientific research and research-related activities in the fields of agriculture, forestry, fisheries, policy, and environment. Since then, the membership of the CGIAR has increased from 18 to 64 countries and organizations, and the number of research centres increased from four, to 15 in 2006. With over 8,500 researchers and staff, the CGIAR's projects are operating in more than 100 countries and 13 of their research centres are headquartered in developing countries (CGIAR 2006).

Funding for the CGIAR research agenda comes from group members,[22] non-members, and from the research centres' income. In 2004, the CGIAR research program had total funding of US$437 million. European members contributed 41.4%, North America 19.9%, International and regional organizations 16.7%, non-members 9.2%, Pacific Rim countries 5.9%, developing countries 3.9%, and foundations 3.0%. Individually, the top five contributors were the United States of America with US$54.2 million, the World Bank (U$50.0 million), the United Kingdom (US$35.3 million), Canada (US$32.5 million), and the European Commission (U$26.3 million). Australia contributed US$8.5 million, and Brazil about US$0.2 million to the CGIAR in 2004 (CGIAR 2004).

With the objective of bringing the benefits of modern technologies and innovations to farmers in poor and developing countries, the CGIAR centres have recently been developing their research activities in areas such as sustaining biodiversity, genetic improvement, agricultural diversification, natural resource management, and strengthening policies/institutions. The system demonstrates an adequate and dynamic research structure and encourages flexible administrative

22 The CGIAR partnership includes 25 developing and 22 developed countries, 4 private foundations, and 13 regional and international organizations that provide financing, technical support, and strategic direction. The Food and Agriculture Organization (FAO), the International Fund for Agricultural Development (IFAD), the United Nations Development Program (UNDP), and the World Bank serve as cosponsors.

actions to answer world challenges in the agricultural area (CGIAR 2006; Herdt and Anderson 1987).

In addition, to its natural activities in the process of internationalizing agricultural research and development, the CGIAR system has created a program of partnerships for agricultural research and development with developed countries such as Germany, the United Stated, Canada, the European Commission and others. The aim of this partnership program is to support the adoption of economic policies to enable broad-based growth to occur in developing countries, ensuring equitable access to productive assets, markets, and services. These programs also try to ensure that there is adequate investment in human capital and that sustainable management of natural resources is promoted. This involves managing risks, providing safety nets, and building more effective, accountable, decentralized, and participatory institutions, which have become an extremely important requirement for developing countries. A fundamental objective of CGIAR research has been to generate international public goods linked to two key areas of CGIAR research interest and competence, namely genetic resources, and formulation of international food policies that support and strengthen national institutions (CGIAR 2003b, 2003c, 2003a).

4.3.1.2. Japan – JICA and JIRCAS experience

Japan appears as one of the most important investors in international agricultural research. Besides its direct contribution to CGIAR funding (US$14.4 million, in 2004), the Japanese government maintains two international agencies that develop agricultural research projects in a number of other countries. The Japan International Cooperative Agency (JICA) was established in August 1974 to assume the responsibilities that had previously been carried out by the Japan Overseas Development Corporation, Japan Emigration Service, Overseas Technical Cooperation Agency, and the Overseas Agricultural Development Association. The Japanese government was the sole sponsor of JICA from its creation until October 2003, when the Law Nº 136 of December 2002 was promulgated, and JICA became an independent administrative institution, reorganizing its structure to permit international cooperation which might achieve better targeted results and accountability (JICA 2006).

Besides its administrative structure in Japan, JICA has 56 overseas offices, 52 headquartered in developing and 4 in developed countries. Its Department of Agricultural Research conducts various cooperative activities such as technology transfer, providing incentives for the creation of research institutes and educational institutions and equipment for research, as well as agricultural research projects. By providing assistance in this area, JICA aims to stimulate the growth of agriculture as an industry in developing countries, and to improve the living standards of farmers. In 2006, JICA was involved in developing agricultural programs in India, Mexico, Thailand, Tanzania, and Zambia (JICA 2006).

A second initiative developed by the Japanese government, in October 1993, was to restructure the Tropical Agriculture Research Centre (established in 1970). It was reorganized to establish the Japan International Research Centre for Agricultural Sciences (JIRCAS). JIRCAS is now responsible for domestic research in agriculture, forestry, and fisheries, as well as being involved in collaborative and cooperative agricultural research projects in developing countries in tropical and subtropical regions of the world. In 2003, besides its domestic projects, JIRCAS was involved in nine international projects carried out in China, Vietnam, Malaysia, Thailand, the Philippines, Niger, Paraguay, Argentina, and Brazil (JIRCAS 2004).

4.3.1.3. France – CIRAD experience

The Agricultural Research Centre for International Development (CIRAD), is a French public sector institution, created in 1984, to *"contribute to rural development in tropical and subtropical countries through research, experimentation, training operations in France and overseas, and scientific and technical information, primarily in the fields of agriculture, forestry and agrifoods"* (CIRAD 2004).

CIRAD has 1820 employees including 950 researchers directly involved in the activities of seven administrative departments and 57 research units, 36 of which are in the French metropolitan area and territories (in the latter case, in partnership with the French National Institute for Agricultural Research – INRA). There are 18 joint research units in developing countries, and three international research units. Since its creation, CIRAD has developed cooperative and collaborative research activities in more than 45 developing countries. In 2004, CIRAD's technicians were involved in projects in 25 countries, including tropical and subtropical areas in 5 continents.

With a budget of US$239.5 million in 2004, CIRAD allocated 27.2% specifically to research projects, 64.4% to personnel, and 8.4% to other costs (personnel and other costs are sponsored by the French federal government). On the other hand, another US$65.2 million in funding came from local authorities (15.3%), other French public funds (16.2%), the European Union (29.5%), International organizations and foreign public funds (10.6%), and private funds (28.4%) (CIRAD 2004).

In summary, it is possible to say that there is considerable interest in international partnerships in the agricultural research area. This is true for the developed as well as developing countries. The main objective of the international institutions is to share knowledge and to work in the application of this knowledge in activities that complement the private and governmental investments and which bring solutions for the biggest challenges in improving world agriculture. This is broadly seen as the need to feed the population of the world without depleting existing natural resources (Janssen 2002).

In 1987, Vernon Ruttan said: *"I would argue that an effort should be made to ensure that the international system becomes a truly global system. The new international system has been effective in building communication between developing countries' national research systems. The linkages of the international centres with developed countries' research institutions are, however, generally filtered through the bilateral development assistance agencies. Direct linkages with the national research systems of the developed countries remain underdeveloped. The linkages between the national research systems of the developed countries are even less developed"* (Ruttan 1987).

Despite the enormous progress made by the international agricultural research system over the past 20 years, Ruttan's comments are still current. The difficulties in creating an effective partnership between the agricultural research centres in developed and developing countries still exists as a major challenge in respect of the involvement of the international research agencies and the main objective of attending to the research needs of all the countries involved in this process.

4.4. Public and private sector spending in agricultural research

In 2000, the global investment in agricultural R&D was estimated to be US$36.5 billion, representing an increase of 7.7% compared with the US$33.9 billion, invested in 1995. Of the total invested in 2000, developed countries invested US$22.8 billion (62.7% of the total), registering a small decrease in their percentage contribution of 1.3% from 1995 (64%) while developing countries' spending was US$13.6 billion (37.3% of the total) increasing their percentage of spending by 1.3% from 1995 (see Table 4.2).

Of the resources invested in agricultural research in 1995, US$21.7 billion (64%) was through public expenditure and only US$12.2 billion (36%) of the total came from the private sector. In 2000, the proportion of public investment decreased by 1 per cent (to 63%) and the percentage of private spending, therefore, increased by the same amount (to 37%). In addition, the data in Table 4.2 show that the investment in research by the public sector in developing countries increased by 2.7% in 2000. The investment in research made by the public sector from developed countries diminished by the same percentage in that year. Developing countries invested a considerably higher proportion of funds in public agricultural research institutions than developed countries in 1995 and in 2000, when the difference increased. Of the total invested in agricultural research by the private sector in 2000, about 94% was made by companies in developed countries, and only 6% of the investment was made by private companies in developing countries, showing almost no difference from the situation in 1995 (see Table 4.2).

Table 4.2 Global public and private investment in agricultural R&D by developed and developing countries: 1995 and 2000 (in millions of US dollars)

Year	Sector	Set of countries					
		Developed		Developing		Total	
		Values	%	Values	%	Values	%
1995 [a]	**Public**	10,200	47.0	11,500	53.0	21,700	64.0
	Private	11,500	94.3	700	5.7	12,200	36.0
	Total	**21,700**	**64.0**	**12,200**	**36.0**	**33,900**	**100.0**
2000 [b]	**Public**	10,189	44.3	12,811	55.7	23,000	63.0
	Private	12,690	94.0	810	6.0	13,500	37.0
	Total	**22,879**	**62.7**	**13,621**	**37.3**	**36,500**	**100.0**

a Values are reported in 1993 international dollars
b Values are reported in 2000 international dollars.

Source: Barton et al. *(2002) and Pardey* et al. *(2006a)*

Specifically in relation to public investment in agricultural R&D, Table 4.3 shows the investment made by developed and developing countries in 2000. The US, Japan, France, and Germany accounted for 66% of the total invested by developed countries, and 29.2% of the global public investment. On the other hand, a similar concentration was registered amongst developing countries, where just three countries, China, India, and Brazil, accounted for 47.1% of the total spending by developing countries, and 26.2% of the global public investment.

Table 4.3 Global public investment in agricultural R&D: 2000 (in millions of US dollars) *

	Countries/Regions	Public research investment		
		Values	Percent related to the category (developed or developing)	Per cent related to the Overall Total
Developed	Set of countries formed by United States, Japan, France and Germany	6,716	66.0	29.2
	Other developed countries	3,473	34.0	15.1
	Total (Developed countries)	10,189	100.0	44.3
Developing	West Asia and North Africa	1,380	10.8	6.0
	Sub-Saharan Africa	1,449	11.3	6.3
	China	3,151	24.6	13.7
	India	1,863	14.5	8.1
	Other countries of Asia & Pacific	2,530	19.7	11.0
	Brazil	1,012	8.0	4.4
	Other countries of Latin America & Caribbean	1,426	11.1	6.2
	Total (Developing countries)	12,811		55.7
	Combined Total (developed and developing countries)	***23,000***		***100.0***

* Values are reported in international dollars based on purchasing power parity. Conversions from local currency units made at 2000 prices.

Source: Pardey et al. *(2006a)*

4.4.1. Public investment in agricultural research

In many countries around the world, public investment in research and innovation has been declining and agricultural research is one sector of the economy most affected by the reduced level of government investment. This has occurred in spite of the high level of return that has characterized agricultural research in developed and developing countries (Bonelli and Pessôa 1998; Ruttan 1991).

Developed countries show rather different trends among themselves. While the spending on agricultural research by the public sector in the United States showed a substantial increase over the past 5 years, public spending on agricultural R&D in Japan was drastically reduced in the same period. Many European countries also reduced their investment in R&D. While this was not to the same degree as in Japan, it was still sufficient to bring down the overall total of public agricultural research spending by developed countries (Pardey *et al.* 2006a).

Another point to be noted is the importance of the universities in carrying out public research. About 43% of the public agricultural research in developed countries is carried out by universities, while in Latin America and Africa, the universities are responsible for 25% and 10% of the public agricultural research being conducted respectively. In developing countries, the majority of agricultural research projects are developed by government agencies and non-profit institutions (Pardey *et al.* 2006a).

A comparison of the investments made by the private and public sectors in agricultural research reveals many differences in focus. Of the total invested by the private sector, only 12% is dedicated to the development of farm-level technologies such as enhanced crop production. In Australia, New Zealand, and Japan between 30% and 90% of the private sector agricultural R&D investment is in the development of post harvest (or after the farm gate) technologies. In the United States and Germany about 40% and 75% respectively, of private agricultural research investment goes to research into agricultural chemicals, fertilizers, herbicides, and pesticides (related to before the farm gate activities) (Pardey *et al.* 2006a).

On the other hand, the majority of farm-level technologies are generated by public research institutions. As a consequence, these innovations are considered as public property, creating benefits to society but no financial return to the institution which generated the new technology or innovation. This is one of the main factors that make private sector investment in agricultural research so difficult. The other important point is the spillover effect. When new technology is created as a result of specific and concentrated effort by public institutions or, in a few cases, by public and private partnerships, it soon starts to be applied in other regions or countries. This occurs because one of the main characteristics of agricultural research is that it is not so specific that it cannot be transferred. Thus, agricultural technology can often be

applied by others who did not take part in the creation process as well as by those who developed the technology (Bonelli and Pessôa 1998). This has been the situation for such a long time that recent attempts to restrict the distribution of new crop varieties, for example, those contain unique intellectual property, have drawn a hostile reaction from people who believe that such developments should not be impeded in any way.

4.4.2. Private investment in agricultural research

In 2000, the private sector invested US$ 13.5 billion (37% of the global investment) in agricultural R&D; 94% of this total was spending by developed countries, and only 6% by developing countries. There is an enormous variation in the level of private sector participation in research among the developing countries. In Asian and Pacific Rim countries, the average proportion of private sector investment in 2000 was eight percent, while the level of private investment in R&D in the sub-Saharan African region was only two percent. In Latin American countries, private sector investment reached an average of about six percent. Table 4.4 shows that the average level of private sector spending on agricultural research in developed countries was 55.2% in 2000. Japan achieved one of the best performances in this area, with private investment rising from 48.4% in 1991, to 58.6% in 2000. On the other hand, the United States did not show much variation over the same period, and maintained almost the same proportion with a little over 54% of investment in agricultural research coming from private sources. Australia had a positive change of 3.3 percentage points, rising from a share of 20.2% from private funding in 1991 to 23.5% in 2000 (Pardey *et al.* 2006a).

Table 4.4 Private sector share of total agricultural R&D in developed countries: 1981 to 2000

Region	1981 (%)	1991 (%)	2000 (%)
Australia	5.9	20.2	23.5
Japan	36.6	48.4	58.6
United States	50.1	54.3	54.6
Other (19 countries)	45.7	48.5	56.9
Average	43.9	49.6	55.2

Source: Table adapted from Pardey et al. *(2006a, p. 7)*

In their report about private investment in agricultural research involving selected countries in Asia, Pray and Fuglie (2001) confirm that the application of new technologies created by private agricultural research can increase agricultural productivity and provoke a "positive spillover" capable of benefiting farmers and consumers in other countries. However, the fact is that the majority of agricultural technology directed at farm-level application (and with most spillover potential) is still generated by public research institutions. This helps to explain the difficulty in convincing private companies to invest in agricultural R&D and the suboptimal level of investment by agricultural industry stakeholders in this sector of the economy, which occurs in both developed and developing countries (Bonelli and Pessôa 1998; Pray and Fuglie 2001).

On the other hand, according to Pray and Fuglie (2006a), changes in areas such as size of input markets, appropriability of the technology, technological opportunity, and cost of research inputs can influence private sector investment in agricultural research positively.

In addition, Pardey *et al.* (2006b) define three situations that help to reduce the risk of technological spillover occurring:

- "*The types of technologies being developed in the developed countries may no longer be as readily applicable to less-developed countries as they were in the past.*

- *Those technologies that are applicable may not be as readily accessible because of Intellectual Property protection of privately owned technologies.*

- *Those technologies that are applicable and available are likely to require more substantial local development and adaptation, calling for more sophisticated and more extensive forms of scientific R&D than in the past."*

Pray and Fuglie (2001) noted several factors that affect investment in agricultural research by the private sector, but it is also influenced by broader public policies and incentives. Table 4.5 shows areas where the public policy makers have to act to encourage private sector investment in agricultural research, according to the study by Pray and Fuglie in various Asian countries (India, China, Thailand, Pakistan, Indonesia, Malaysia, and the Philippines) in 1998 (Pray and Fuglie 2001).

Table 4.5 Policies and incentives to encourage private sector agricultural research

Determinants of private research effectiveness	Factors affecting efficiency
General state of the economy	▪ Macroeconomic stability ▪ Public infrastructure ▪ General education and training ▪ Development of capital and insurance markets
Size of input markets	▪ Market share of state-owned enterprises ▪ Restrictions on foreign participation in input markets ▪ Trade restrictions on inputs ▪ Price interventions in input or product markets
Appropriability	▪ Intellectual property rights (patents, plant breeders' rights, trademarks, trade secrets protection) and enforcement ▪ Technology-licensing requirements and regulations affecting technology imports ▪ Competition and antitrust policies
Technological opportunities and cost of research inputs	▪ Public investment in agricultural research and education ▪ Trade restrictions on inputs and restrictions on foreign direct investment ▪ Registration and testing requirements on new seed and agricultural chemicals ▪ Biosafety requirements for biotechnology field trials ▪ Public subsidies for private research, including tax holidays, tax credits, research grants, and technology parks

Source: Table imported from Pray and Fuglie (2001, p. 11).

Despite the study having involved only some countries of Asia, the situation described above might easily be extended to other countries that are looking to stimulate investment by the private sector in agricultural research. The study demonstrates that countries have to be strongly motivated to change in order to increase participation by the private sector in agricultural research.

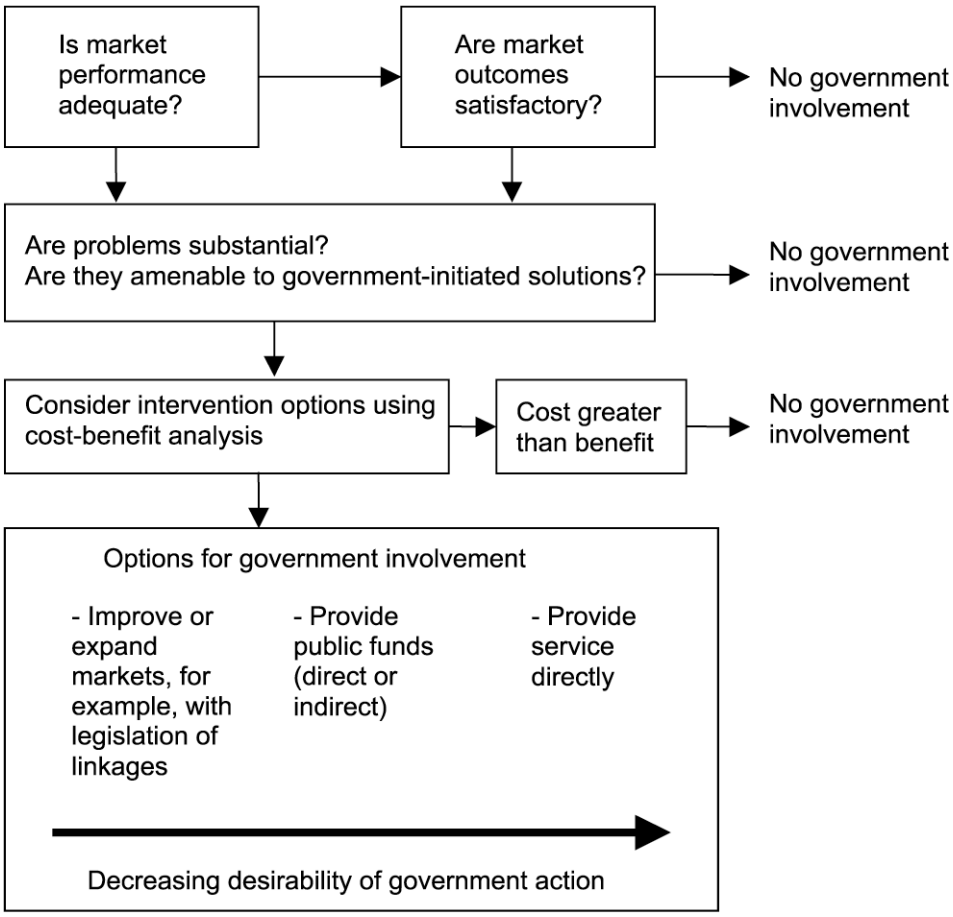
These countries must be prepared to invest in infrastructure (for example, create technological parks; create incentives to import equipment and chemical products for specific use in research). In education, they need to raise the standard and accessibility of basic, secondary and university education, and create better conditions for the professional formation of new scientists and upgrading the qualifications of existing scientists. This may involve creating and proclaiming laws to protect intellectual property resulting from research and innovation, as well as laws to diminish the state bureaucracy and to allow more flexibility in the management of research institutions. Laws to introduce more flexible working conditions and greater rewards for scientists and the creation of new mechanisms to facilitate the application of existing funds for research support and to allow the creation of others may also be necessary.

Finally, an increase in private sector participation in agricultural research requires a greater commitment and involvement from the government, in policy development in many sectors of the economy, to make this participation possible.

In this regard, the government needs to focus strongly on the issues to define where and when to invest and how to create policies to improve private sector investment in agricultural R&D. To help the government decision making process on these issues, a decision tree for research policy has been created (see Figure 4.2). It shows the problems to be analysed and to be addressed by government policies. It demonstrates, in the last stage of the tree, which sector of the economy will be affected by such government intervention (Alston *et al.* 2001a).

In these circumstances, many countries have decided to direct public financial resources into basic research, and to create mechanisms like tax concessions to attract private sector investment in applied research projects, with technological objectives based strongly on the needs reflected by national and international markets (Alston *et al.* 2001b).

In cases where the competitively allocated funds created by combining financial support from private and public sources became the subject of dispute between private and public R&D institutions, some public research and technology transfer institutions have been privatized, while others have been prepared to sell their services to the private sector. The creation of tax concessions, subsidized loans for investment in agricultural research infra-structure, changes in the stated period of contracts (from long term to medium and short term), flexible work contracts for researchers, and the creation of instruments for the development of international partnerships, have been implemented by national governments to improve private sector participation in agricultural research (Alston and Pardey 1999).



Source: Alston & Pardey (1999)

Figure 4.2 A decision tree for research policy

Ribeiro (1999) and (Pardey *et al.* 2006a) defined the relevant criteria to be observed in restructuring the roles of public agricultural research institutions, in general terms:

- Reduction in the size of the organizational structure (fewer buildings, laboratories, experimental centres, number of employees, and simpler administrative structure, etc in response to pressure from the rest of society to reduce public investment in agricultural research). This procedure was implemented in Germany, England, New Zealand, and Australia.

- Strengthening the partnership between private and public research sectors (France, the United State of America, Germany, and Australia present good results in this area); and

- An increase in autonomy and management flexibility (a transformation that occurred in Australia and New Zealand).

In some developed countries as well as in several developing countries, the private sector has assumed the role of main investor in agricultural research. In Australia, for example, the expenditure made by the private sector in agricultural research has jumped from nearly six percent at the beginning of the 1980s to 23.5% at the beginning of the 2000s. In the same period, in the OECD member countries, the spending by private sector companies in agricultural R&D has jumped from almost 44% to more than 55% on average (see Table 4.4). This extraordinary growth in private sector participation in agricultural research was a consequence of the expansion and regulation of intellectual property rights on biological technology, and of a change in approach implemented by public agricultural research institutions. They abandoned the old model of “science push” and adopted the market demand system to define the research projects to be developed (Alston *et al.* 2000; Alston *et al.* 1999a).

Section 4.5 of this chapter, where the experience of selected countries will be described, will show what is being done around the world to change and establish a new culture in the global agricultural research system.

4.4.2.1. Private funding of agricultural research by farmers

Farmer funding of agricultural research invites special attention in this study, specifically the establishment of public-private collaborative research partnerships, which is one of the important types of linkage between private and public sectors to fund research in developing countries. The other two potential types of linkage between the public and private sectors are private distribution of public technologies, and private purchase of public research services and technologies (Hall 2002). There can also be private sector participation in agricultural research projects implemented directly by private research companies or research departments in large companies.

The most common system that allows public-private collaborative research partnerships to develop is farmer financing through commodity levies, which some authors note occurs mainly in export crops. In this case, the farmers agree to pay a levy and, in return, participate in the research process as a whole, helping to define what will be researched, where the research will be implemented, and how to apply the results from these efforts. However this system is not financially viable for commodities with low market appeal (Brennan and Mullen 2002; Byerlee and Echeverría 2002),

There are many possible mechanisms for collecting and administering such levies but, in general, the levy is collected through a commodity board at the first point of trade. The levies can be based on value or quantity of production. Levies based on value of production are more stable, consequently more countries have this system of resource collection. The board that manages these resources can be private or public with management autonomy. Besides responsibility for deciding the allocation of resources to research projects, the board may also work in other parallel activities like political lobbying, promotion of the commodity in national and international markets, and carrying out the government regulatory processes for the sector. The majority of the boards formed to distribute these levies operate with substantial autonomy, although the producers have considerable influence in the decision-making process (Allegri 2002; Byerlee and Echeverría 2002; Estrada *et al.* 2002; Kangasniemi 2002).

Byerlee and Echeverría (2002); Brennan and Mullen (2002); Estrada *et al.* (2002); Kangasniemi (2002); and Allegri (2002) have described the experience of countries such as Australia, Colombia, Africa, and Uruguay and respectively defined

some lessons that should to be observed by countries with the intention of implementing their own system of research levies:

- *"Levies to support research must be combined with strong mechanisms to ensure ownership by farmers and others in the industry over how the resources are used. As a result, farmer funding can succeed only where there are strong farmer organizations that broadly represent farmers' interests and that are empowered to influence the research agenda and the governance of research institutions.*

- *A research levy is best separated from levies for other activities, such as market promotion.*

- *Research organizations funded through levies need to have a high degree of autonomy from government, combined with high standards of transparency in operations and accountability to clients who are their financiers.*

- *The implementation of a research levy and the associated institutional infrastructure to administer the levy and/or carry out the research may entail considerable start-up costs, which requires strong leadership from within the industry, and with influential allies in government.*

- *Farmer funding should be complemented by public funds, either through matching funds, or through other mechanisms to fund complementary activities that ensure that wider social objectives, especially those relating to equity and the environment, are sufficiently addressed."*

4.5. The experience of selected countries in reforming their agricultural research systems

In view of their current environment, many public agricultural research institutions from developed and developing countries have decided to change their way of operating in order to survive. They have started to adopt a more flexible management system, in order to respond to external demands with new agreements, joint-ventures, and contracting arrangements to employ specialists under new recruitment policies that create mechanisms to apply for intellectual property rights and to assume responsibility for dividing activities and income between partners (SallesFilho *et al.* 2000).

Similarly, each country's agricultural research system needs to have fully integrated and common objectives to secure public and private financial resources and reach its objective of carrying out multidisciplinary projects. Three groups of variables are important.

According to Trigo (1987), they include:

- *a policy of involving public and private sectors in environmental and agricultural research;*
- *the organizational structure for its agricultural research system to adjust to market necessities, with an adequate research budget, a flexible administrative structure, and management autonomy in decision making; and*
- *a set of basic operational processes, such as the setting of objectives and priorities for resource acquisition, and adequate scientific linkages.*

In this context, the experiences of some developed and developing countries in reforming their systems of agricultural research are described in the following sections. The countries were selected after considering their similarities with Brazilian agricultural production and market opportunities, as well as their innovative processes of reform.

4.5.1. Experience of Chile

From 1973 to 1992, Chile went through a structural transformation and rapid economic growth provoked mainly by a stable macroeconomic environment, a liberal trade regime, and restoration of intellectual property rights. In agriculture specifically, the technological innovations imported from other countries, and the efforts of well trained specialists, were fundamentally important to the development of the agricultural sector and the establishment of domestic research (Venezian and Muchnik 1995).

Agricultural research in Chile is coordinated by the Agricultural Research Institute (INIA). It was created in 1964 as a private, non-profit corporation linked to the Ministry of Agriculture. It has 10 Regional Research Centres, and since October 1998, each Centre has had a Board of Directors represented by external members from the public (three representatives) and private sector (four representatives), including the Director of the Centre as an executive secretary of the Board. The main task of the Board of Directors is to analyse and to approve research proposals from the Regional Centre to receive resources from the research support funds created by the government in partnership with the private sector (INIA 2006).

As has been the tendency worldwide, the Chilean government implemented many measures to keep the national agricultural research system functioning, in spite of decreased public financing, and to involve the private sector in the development of agricultural research projects (INIA 2006; Venezian and Muchnik 1995). These initiatives included:

- Granting flexibility to universities and INIA to permit staff to earn and retain external income through consultancies and other contract and part-time work;
- establishing competitive research funds contributed by public and private sponsors;
- Introducing tax benefits for private donations to higher education institutes;
- Creating a Board of Directors, with external members representing the public and private sectors, for each Regional Research Centre; and

- Promulgation of the Intellectual Property Rights Law, and the establishment of a strong and active team to manage intellectual property in INIA, serving the whole Chilean agricultural research system.

With the implementation of these changes, private sector investment in agricultural research programs in Chile has increased from almost zero in 1980, to 20% of the total budget in 1992. Currently it represents about 28 percent of the total research budget (INIA 2006; Venezian and Muchnik 1995).

4.5.2. Experience of the United State of America

The United States Department of Agricultural (USDA) through its research agencies, the Agricultural Research Service (ARS), the Forest Service, and the Economic Research Service, is responsible for coordinating the American agricultural research system. Created by the 1862 Establishment Act, the ARS is currently the largest and most active of the USDA agencies. It has more than 100 agricultural research locations within its structure, and 1,200 research projects within 22 National Programs, 2,100 researchers, 6,000 other employees, and an annual budget of US$1.3 billion (Fuglie *et al.* 1996; USDA 2006).

Since 1862 when the agricultural research system was institutionalized, the United States government has created a series of legal instruments and created a number of research funds in order to require the administration to regulate who are the suppliers and how these funds can be used, as well as defining the national agricultural research priorities to be addressed. The sequence of events that occurred in the United States was summarized by Williams (1991), Alston *et al.* (1999b) and Allred *et al.* (2003) and a condensed version is reproduced here.

The 1887 Hatch Act, created to stimulate the establishment of research stations, was described as the first federal government effort anywhere in the world to establish a continuous flow of financial resources for agricultural research activities. After that, many other government acts were passed to stimulate the development of education and information areas. Specifically, the most important of these for agricultural research have been the Smith-Lever Act of 1914 establishing federal resources for extension and research activities; the Purnell Act of 1925, authorizing a considerable increase in the federal financial resources for agricultural research; and

the Bankhead-Jones Act of 1935 that, besides other benefits, established a special research fund to support the regional agricultural research centres.

The Research and Marketing Act in 1946 allocated resources to promote agricultural commodities. The Hatch Act was revised in 1955, and replaced many acts concerned with education and research areas. The revision also strengthened the financial support for regional and state agricultural research centres. In 1990, the National Research Initiative (NRI) was created, the first competitive research grants program, which permitted considerable increase in the financial resources allocated to agricultural research. More recently the Agricultural Research, Education, and Reform Act of 1998 was created to maintain the Initiative for Future Agriculture and Food Systems (IFAFS) and established a competitive grants program for the Cooperative State Research Service.

The financial resources for agricultural research in the U.S.A. can come from both public and private sectors. The resources from the public sector can be Federal or State. In the case of Federal resources, there are two options for expenditure, direct and indirect. In the first case, the majority of the expenditures occur through the ARS agricultural research centres, and the indirect Federal spending occurs when Federal funds are invested in State agricultural research institutions. In this case, in addition to Federal funds, the State agricultural research centres also receive resources from the States and, in some cases, from the local municipality. The majority of the research funds offered by the US government through the USDA are allocated by a system of competitive grants and any institution, private or public, can compete for these resources (Alston *et al.* 2000; Alston *et al.* 2001a).

On the other hand, investment by the private sector in agricultural research may also occur through partnerships with universities and USDA's agricultural research centres (Federal and State), but a substantial part of the investment by the private sector is carried out by private companies. Of the total resources invested by the private sector in agricultural research, approximately 50% is invested in farm machinery and implements, and the agricultural chemical industry (before farm gate); 30% in food manufacturing and processing of agricultural products (after farm gate); and only about 20% is invested in farm level research (plant and animal breeding, for example) (Ribeiro 1999).

The growth of private sector participation in agricultural research in the USA has been the consequence of many factors (Fuglie *et al.* 1996; Pardey *et al.* 2006a; Ribeiro 1999).

- the well-designed and consistent structure of the law on intellectual property rights in relation to biological technology, beginning with the Plant Patent Act of 1930, and increased by the Bayh-Dole Act[23] or Patent and Trademark Law Amendments Act;
- the strength of the government's role in the process of defining research priorities;
- the competitive funds created with financial resources from private and public investment;
- market regulation, and growth of the domestic and international markets for agricultural commodities;
- Federal and State support for the national agricultural R&D infrastructure;
- the creation of tax concessions;
- subsidized loans for investment in agricultural research infra-structure;
- flexible work contracts for researchers;
- an increase in the number of international partnerships among agricultural research institutions and countries;

23 The Bayh-Dole Act, established on 12 December 1980, created a uniform patent policy among the many federal agencies funding research. The policy involves all the science and technology sectors, including agricultural research. It allows the research institutions to retain the property of the inventions developed with public funding. In contra part, research agencies are obliged to register the patents and to commercialize the new technology; to divide royalties with the inventors, and to invest the remaining financial resources in research and transference of technology.

- the development of grading standards for many food products; and
- regulation of agricultural biotechnology and chemical pesticides.

The traditional model of the relationship between public agricultural research institutions and private sector companies in the USA indicates that university departments are responsible for developing basic research, the State agricultural research centres and ARS research units assume the responsibility for implementing the strategic and generic research, State research centres and private companies working in applied research develop technologies for farmers and other segments of agribusiness, and lastly, the extension system has the responsibility of transferring the new technology (Pray 2001).

Of the total amount invested in agricultural research and development in the United States in 2000, 45.4% of funding came from government, including Federal, State, and Municipal authorities, and 54.6% from the private sector with a significant part of these resources due to tax incentives. It is important to note the strong and consistent role of the government in the definition of priorities and in making the huge investment in basic and strategic research under this system (Pardey *et al.* 2006a). There is also a culture of private enterprise in the US which is stronger than in other countries.

4.5.3. Experience of China

The first agricultural experimental station in China was established in Baoding, Hebei Province, in 1902, and in 1906 the government set up an agricultural experiment station as a central government agency in Beijing. In 1964, the South China Academy of Tropical Crops was established, in 1983 the Science and Technology Committee of the Ministry of Agriculture was established, and in 1985 the Chinese science and technology system was reformed (Fan and Pardey 1992).

The agricultural research system in China is almost totally dominated by public research conducted mainly in national and provincial academies, prefecture institutes of agricultural sciences, and agricultural universities. Private agricultural research is minimal. Such a structure is consistent with the country's socialist political culture (Fan and Pardey 1992).

China has approximately 60,000 scientists in 400 research institutes and 70 agricultural universities, and the largest publicly funded and administered agricultural research system in the world. Further, China has developed its own National Agricultural Technology Extension Service, formed under the auspices of the Ministry of Agriculture and focused at the regional and municipal levels (Fan *et al.* 2001).

The Chinese government has an ambitious long-term plan to build its innovation economy. A big part of this strategy is the provision of financial resources to support R&D activities. In 2005, China devoted only 1.2% of its GDP to R&D spending but the government has announced its intention to boost that figure to two percent by 2010, and to 2.5% by 2020, with the government contributing about 40% of the total funds, and the private sector the other 60% (Einhorn 2006).

The Chinese government is fully aware of the importance of investing in agricultural research, and of the necessity to maintain a good relationship with the international agricultural research community. However, returns to R&D are long-term and decisions about what to invest in are tricky because of the numerous competing demands for government investment. In 2000, the Chinese agricultural research system accounted for 40% of the agricultural researchers in developing countries and 24.6% of its research investment (Pardey *et al.* 2006a).

As occurred in many other countries, the Chinese agricultural research system underwent a series of reforms and a significant number of policies were created to restructure the sector.

The first of these created a system of competitive funding for agricultural research. Public funding agencies to finance research were established, creating a domestic system of competition for public resources, and stimulating a search for international resources through the development of collaborative research projects. Before this system was introduced, resources were allotted according to the number of research staff at each research centre, without concern for the institution's performance (Fan 2000; Ribeiro 1999).

The second reform, promoted to diminish the effect of cuts in the public budget for R&D activities, introduced the possibility of commercialization of products and services developed by public agricultural research centres. The commercialization option resulted in an increase in the income of the research units, and allowed close

cooperation between researchers and their final customers. On the other hand, the commercialization activities introduced by the new reforms may compete for the attention of staff to the detriment of research activities, diluting effort and diminishing the results (Fan 2000; Fan and Cohen 1999).

Another important adjustment to the agricultural research system in China was the reformulation of the payment and rewards system for researchers by which the individual or group performance was taking into account. Under this new system, the researcher can receive an additional payment based on his/her performance in the development of the project above his/her normal remuneration. The resources to pay this additional reward come from income raised by the project in which they are/were involved (Fan 2000; McWilliam *et al.* 1996).

Although some reforms have been implemented, the system of intellectual property in China still needs to be reformed to conform with international standards, and to make it easier for the private sector to invest. That would create the conditions to improve collaborative and cooperative agricultural research projects between Chinese research centres and overseas enterprises. Despite establishing a system of Intellectual Property Courts and the creation of many policies enforcing the IP regimen, it is still desirable to disseminate information about the necessity to use these institutions and how to apply the policies relating to this subject.

4.5.4. Experience of New Zealand

In 1984, New Zealand started a general program of economic reform in all the productive sectors of the country's economy. The execution of this program, with adjustments, was extended into the early 2000s. The concept of the plan and the particular way in which it was implemented attracted the attention of the world as an example to be followed. Strong financial market reforms, liberalized international trade, a deregulated labour market, privatized industry, agriculture, and service sectors, and reformed public finances characterized the New Zealand economic reform as one of the most comprehensive programs undertaken by any developed or developing country in recent decades (Evans *et al.* 1996; Johnson *et al.* 2005).

According to Duncan and Bollard (1992), the New Zealand government took the following principles as the basis for the reform of government organizations:

- *"Non-commercial functions ought to be divided from trading functions.*
- *The state should particularly contract with the enterprises to provide any non-commercial activities.*
- *Regulation and policy advice should be separated from trading functions.*
- *Managers should run trading organizations as business enterprises.*
- *The enterprise should operate without competitive advantages or disadvantages."*

In addition, the approach to implementing the reform had five characteristics outlined by Bale and Dale (1998):

- Determining clear positions of responsibility between government ministers and their departments;
- Defining performance in an unambiguous and measurable way;
- Delegating authority [and giving autonomy] to chief executives;
- Establishing incentives that reward or punish for results relative to the agreed outcome; and
- Reporting and monitoring performance.

Before the reform process, the economy in New Zealand, including the agricultural sector, was heavily regulated. By measures introduced from 1984, and specially those at the end of the 1980s and the beginning of the 1990s, the agricultural sector was totally transformed. The subsidies for outputs (for example, Supplementary Minimum Prices for agricultural commodities) and for inputs (for example, subsidies for fertilizers, irrigation, farm finance), were totally removed. Other changes included deregulation of the domestic market for agricultural

products, substantial reforms to the international marketing of agricultural products, and specific legislation to make the main agricultural industries (dairy, meat, and wool) more independent of government and more accountable to industry. This involved transferring many traditional activities of the Ministry of Agriculture to the private sector, privatizing the farm advisory services, and a dramatic change in the organization and financing of the agricultural R&D institutions, following a comprehensive restructuring of the research and development system (Scrimgeour and Pasour 1996).

Part of the reform process, financial deregulation, intended to reduce the public deficit and curb inflation, directly affected research funding. With the reduced level of public funding, the research agencies were directed to the private sector for support. The areas of policy advice, research funding, and research development, that were previously the responsibility of one department in the Ministry of Agriculture and Fisheries, were separated and many other actions were taken to change the agricultural research system. The main actions were based on the following principles defined by the Science and Technology Advisory Committee (STAC) in 1988 and cited by Jacobsen and Scobie (1999):

- *"there should be a clear separation of policy advice from the allocation of public funding and the provision of R&D;*

- *taxpayer funding should be allocated to public-good research and private groups should fund research where they capture the benefits;*

- *the government should purchase R&D services on a contestable basis; and*

- *public agencies should have the full range of commercial powers to act in a deregulated environment".*

On the basis of these principles, the actions described below were implemented to transform the agricultural R&D system in New Zealand (Evans *et al.* 1996; Jacobsen and Scobie 1999; Scrimgeour and Pasour 1996):

- Establishment of the Ministry of Research, Science and Technology, responsible for policy advice and defining national research priorities, thereby providing a framework for deciding where a foundation, established for the purpose, would allocate research funds.

- Establishment of the Foundation for Research, Science and Technology to manage a contestable public fund to invest in research projects for government needs and national priorities (with a majority of public funds), allowing competition among government-owned research agencies, research associations, and universities on a competitive basis.

- Privatization of the agricultural advisory system.

- Restructuring of the government's science agencies into 10 Crown Research Institutes (CRIs) under the ownership of the government but modelled on private companies. With a commercially oriented structure, the CRIs started to develop research projects to meet the requirements of industry customers and the priorities defined by the government.

- The passage of the Commodity Levies Act of 1992, by which the government enabled agricultural producers to levy themselves to fund research, as an alternative mechanism for funding research in industries like wool, meat, and dairy.

In the process of reform as a whole, it may be said that New Zealand had the advantage of having a strong and effective intellectual property rights regime, and an independent government free of corruption (Evans *et al.* 1996).

In 2005, New Zealand spent 1.17% of its GDP on research and development, about 28% of which was invested in agricultural research (Dann 2006).

4.5.5. Experience of Australia

The agricultural research system in Australia had its beginning in the 1850s with the creation of the first experimental farms. In the 1880s and early 1890s, the first three Agricultural Colleges were established: Roseworthy in South Australia (1885), Dookie in Victoria (1886), and Hawkesbury in New South Wales (1891). In Queensland, the Department of Agriculture and Stock was established in 1887, Gatton Agricultural College in 1897, and the Bureau of Sugar Experiment Station in 1900. All Australian states had experimental farms by that time. The first university Departments of Agriculture were founded in Sydney and Melbourne in the early 1900s (Algar *et al.* 2000; DPI 1980; Alston *et al.* 1998; Ribeiro 1999).

From 1916, the Australian government was involved in the process of co-ordination and building co-operation in research among all States of the country with the creation of the Advisory Council of Science and Industry. Its mission was to organize scientific research. In 1926 the Council for Scientific and Industrial Research (CSIR) was established. In the first 15 years of its existence, it devoted almost 80% of its total budget to looking for solutions to agricultural problems. In 1934, the Australian Agricultural Council and its Standing Committee on Agriculture were created, and in 1949 the Commonwealth Scientific and Industrial Research Organization (CSIRO) was established as a successor to the CSIRO (Algar *et al.* 2000; CSIRO 2006; DPI 1980; Alston *et al.* 1998; Ribeiro 1999; Harman 2001).

In spite of its having been created as a multidisciplinary research organization, CSIRO was the major single agency engaged in agricultural research in Australia until 1990, when the Cooperative Research Centre (CRC) Program was created (CSIRO 2006; DPI 1980).

In the beginning of the 1980s, the CSIRO had a structure composed of five Research Institutes (refer to Table 4.6), responsible for 43 research centres located in strategic places in all of the Australian states and territories, and 2,566 researchers. Of these, about 20 research centres and 1,270 researchers were directly involved in agricultural research and development (CSIRO 2006; DPI 1980).

Table 4.6 CSIRO Research Institutes and numbers of research centres and researchers: 1980

Research Institutes	Numbers of research centres / division	Numbers of researchers
Institute of Animal and Food Science	07	439
Institute of Industrial Technology	08	475
Institute of Earth Resources	10	510
Institute of Biological Resources	08	578
Institute of Physical Sciences	10	564
Total	43	2,566

Source: DPI (1980)

Besides the CSIRO, the Australian Government maintained two more institutions actively engaged in agricultural research and playing a national role, under the coordination of the Australian Department of Primary Industry: the Bureau of Animal Health, and the Bureau of Agricultural Economics. In addition, other Commonwealth organizations with national activities, including the Australian Government Analytical Laboratories, Australia Wool Corporation and Commonwealth Serum Laboratories, were also involved in agricultural research.

The largest agricultural research programs were under the control of the Australian States, involving the Departments of Agriculture, Departments of Lands, and services concerned with soil conservation and water resources, which together with universities, agricultural colleges, and many other state organizations developed the states' agricultural research programs. There were 247 research units including state research stations and university faculties or departments. The State of New South Wales had 66 research units, followed by Queensland with 59 units, Victoria (50), Westerns Australia (30), South Australia (25), the Northern Territory (9), and Tasmania with 8 research units (see Table 4.7).

In addition, another 49 private sector organizations carried out agricultural research, mainly in agricultural machinery (9 research units), agricultural and veterinary chemicals (25 research units), fertilizer manufacturing (4 research units), and other industries (11 research units) (DPI 1980).

Table 4.7 State organizations involved in agricultural research in Australia in the 1980s

State	Organizations involved in agricultural research	Number of state research centres/ Division	Number of university departments/ faculties	Total
New South Wales	▪ Department of Agriculture ▪ Soil Conservation Service of New South Wales ▪ Water Resources Commission ▪ Macquarie University ▪ The University of Newcastle ▪ University of New England ▪ University of New South Wales ▪ University of Sydney ▪ University of Wollongong	32	34	66
Victoria	▪ Department of Agriculture ▪ Soil Conservation Authority of Victoria ▪ State River and Water Supply Commission ▪ Vermin and Noxious Weeds Destruction Board ▪ La Trobe University ▪ Monash University ▪ University of Melbourne	31	19	50
Queensland	▪ Department of Primary Industries ▪ Bureau of Sugar Experiment Stations ▪ Queensland Water Resources Commission ▪ Department of Lands ▪ Griffith University ▪ James Cook University ▪ University of Queensland	35	24	59
South Australia	▪ Department of Agriculture ▪ The University of South Australia ▪ The University of Adelaide	16	09	25
Western Australia	▪ Department of Agriculture ▪ Government Chemical Laboratories ▪ Murdoch University ▪ The University of Western Australia	23	07	30
Tasmania	▪ Department of Agriculture ▪ River and Water Supply Commission ▪ University of Tasmania	07	01	08
Northern Territory	▪ Department of Primary Production ▪ Land Conservation Unit, Territory Parks and Wildlife Commission ▪ Water Division, Department of Transport and Works	09	--	09
	Total	**153**	**94**	**247**

Sources: CRCESC (1995); CSIRO (2006); DPI (1980); NSTAG (1991)

4.5.5.1. Rural Research and Development Corporations

With the main purpose of expanding the country's participation in international trade, and the desire to reduce the costs of maintaining this substantial research sector, the Australian government decided around 1975, to reorganize the national research system. In this period (1975 – 1976), about 87% of the total spent in agricultural research in Australia, was provide by government (48% by Federal and 39% by State governments), and only five percent by the private sector. The institutions of higher education and non-profit organizations were responsible for six percent and two percent respectively of the spending in agricultural research (Algar *et al.* 2000).

The main changes in the public agricultural research organizations that can be seen as part of the general economic reform had their beginnings in 1985. Competitive and independent funds with clear definitions of priorities to stimulate the generation of technologies for immediate application in the industrial sector were created. The competition for allocation of resources established the necessity for higher quality projects focusing more on results and the applicability of the new technology. A general policy of reducing agricultural subsidies was also established (Alston *et al.* 1999c; Richardson 2006).

For more than one hundred years, the private agricultural sector of Australia has been encouraged to help in the financing of agricultural research and administration. In the beginning, the models that guided private sector participation in the financing of agricultural research were not very rigid and some had an almost informal nature (Algar *et al.* 2000).

There are in Australia currently 55 Federal government grants and funding mechanisms (see Appendix 9), as a consequence of many measures created by the government to improve the system of collecting levies and involving other sectors of the economy in research.

One of the most important acts in this regard was establishing the Research Development Corporations (RDCs), created to finance R&D activities. The RDC model is a fund formed to direct research resources generated by production sector levies and corresponding dollar-for-dollar funding to be provided by the government, up to a limit of 0.5% of the total value of industry production, which is allocated competitively to finance R&D projects of interest to the industry concerned. There are

presently 14 of these funds (see Appendix 10), set up in Australian for all of the major commodities such as grains, wool, fisheries, forest and wood, grape and wine, meat, cotton, egg, pork, horticulture, dairy, and sugar. The Land and Water Research and Development Corporation and the Rural Industries Research and Development Corporation (RIRDC), complete the list. During 2002-03 the RDCs invested more than AU$454 million in research and development that has improved the productivity of the industries they support. The RDCs' priorities are defined by the government and industry through strategically planned R&D projects (DAFF 2006; RIRDC 2006).

4.5.5.2. Cooperatives Research Centres

The creation of Cooperative Research Centres (CRC) in 1990, involving research by government, universities, and the private sector, has promoted an increase in financial support for agricultural research and development in Australia (Waugh 2006). The CRC Program comes under the responsibility of the Minister for Education, Science and Training (MEST) in Australia and is managed by a CRC Committee comprised of 13 members approved by the Minister for a period of five years. Board members are selected for their expertise in research, commercialization, research management, government, and industry (CRC 2006).

The CRCs are created by an agreement involving government, university, and private sector participants (see Appendix 11). The CRC structure was created to maintain the Australian R&D system on the frontier of global technology evolution. Besides improving the linkage between private and public sectors, the CRCs must have the participation of a university, and seek to provide multidisciplinary solutions for technological problems, in a restricted period of time. The legislation setting up the CRCs defines seven years or less as the period of operation. The idea was tested in other sectors of the economy before the format was introduced into the agricultural system (CRC 2006; Janssen 2002).

The main reasons that led the Australian government to create the CRCs are described below (CRC 2006; Slatyer 1994):

- The research centres and the other scientific and technological resources existing at the time were dispersed institutionally and geographically, representing considerable duplication of effort. They were also having difficulty focusing the competencies in the scientific and technological area onto the development of the country.

- The majority of financial resources invested in research in Australia were provided by public institutions, and these resources were managed without much commitment to the application of results or clear identification with the priorities and necessities of the country. Moreover, the system had much difficulty in constructing multidisciplinary teams for joint efforts to reach common objectives. It was quite difficult to promote the ideal of involving researchers and representatives of industries and other sectors of the economy in the identification and solution of problems in the production sector.

- The low level of R&D in some industries and the consequent low level of sophistication of production systems hindered participation in technological innovations and adoption of research results.

By considering these issues, Slatyer (1994) argued that the CRC program adopted the concept defined by the following objectives:

- "*To create a system of world-class applications-oriented research centers by linking together outstanding research groups from the public and private sectors;*

- *to enable each participating group to retain its separate institutional affiliation, but each Centre to constitute a collaborative integrated research team;*

- *to focus the research on challenging research fields and areas which underpin existing or emerging industry sectors;*

- *to co-locate the groups participating in each Centre, wherever possible, to promote effective cooperation and to enable expensive facilities to be used efficiently and without unnecessary duplication;*

- *to locate the Centres on or adjacent to university campuses wherever possible, so as to encourage precinct development around universities and enable the Centres to contribute as fully as possible to the strengthening of educational programs;*

- *to involve research users in the planning and operation of each Centre so as to enhance the effective utilization of the research results; and*

- *to ensure that each Centre was led by a Director who would be an experienced and highly regarded researcher with appropriate management skills" (Slatyer 1994).*

In addition, the government agreed that funding to cover the CRC activities needed to follow some established guidelines (Slatyer 1994):

- *"Funding would be provided on a matching basis, so that the government would provide up to one dollar for every dollar provided by the participants.*

- *The matching funds provided by the participants could be either in money or in kind, with the in-kind contributions being valued at full cost so that participation in a CRC did not represent a subsidy by the institution to the Program and reduce its ability to continue its other activities.*

- *The Program funds would be totally flexible so that they could be used for salaries, plant and equipment, expendable research materials, or any other purpose."*

Since the beginning of the program, 158 CRCs have been established in six different industry areas and, in 2006, there were 57 CRCs in operation, eight being in manufacturing technology, five in information and communications technology,

seven in mining and energy, eight in medical science and technology, 14 in environment and tourism, and 15 specifically in agricultural research (CRC 2006). There has usually been a strong linkage between the Rural Research and Development Corporations and the agricultural CRCs. In many cases where both operate in a particular industry, the relevant RDC is a partner in the CRC and provides a mechanism for industry funding of CRC projects.

Many authors confirm that the CRC Program changed the research and development culture in Australia. For Janssen *(2002), this system created a peculiar situation:*

- *"This contributed to a shift in attitude in the scientific system, from a position based on curiosity to one based on problem solving, and from one rooted in an institutional position to one rooted in cooperation".*

4.5.6. Other changes

Besides the RDC and CRC systems, the reform of the agricultural research system implemented by the Australian government was in an environment where measures such as the 150% Taxation Concession Scheme, the Grants for Industry Research and Development (GIRD) Program, and the Australian Research Council (ARC) have been established for research funding, as well as the agricultural research and development corporations for raising, distributing and managing rural industry funds (Luke 2006).

Furthermore, to measure the quality of research conducted in research agencies and universities funded by public funds, the Australian Government announced the introduction of the Research Quality Framework (RQF) in May 2004, with strong similarities to the system established in the United Kingdom in 1986. The RQF measures will measure the benefits of these institutions to the wider society, and evaluate the performance of the R&D system (Roberts 2006).

The RQF in Australia is a new proposal but it has been introduced without a clear direction of its intent. Most observers therefore see some difficulties in its implementation and the government is working to define many issues to improve the system and to reach the intended objectives of the project.

As can be seen, many processes have been implemented since the general reform in the economy of Australia was initiated in 1975, and specifically, since the reorganization of the research and development system starting in 1984. The physical structure of the federal and state agricultural research centres has been reduced drastically but the researchers' salaries have been increased, and the research centres were provided with more flexibility to manage employees and administrative processes. The researchers' performance has been improved by national and international training.

Likewise, many funds to finance R&D activities in the agricultural sector have been created and the culture changed. Many multidisciplinary teams from the public and private sectors are now involved in research that industry requires and the evaluation of returns on the investments in research and the satisfaction of the final customer is now much more common.

Consequently the research system in Australia has been modernized, achieving excellent results, and making the country a reference point in the worldwide research system. But many things still have to be done to improve the Australian research system and to maintain or increase the investment in R&D that, over the past 10 years, has shown considerable and constant decline as a percentage of the Gross Domestic Product of the country. In this regard, it is important to note recent opinions from people involved directly or indirectly in the Australian research system:

- *"Australia cannot afford to lose any R&D investment or see our best technologies go offshore because the system is too complex or disadvantages smaller companies with good ideas but without the experience, funds, resources and time to present their cases. Regulations surrounding the tax-offset rules are too prescriptive and reform is needed. It seems unfair that a company can spend $1 million on R&D and get a 37.5% cash rebate but spends one more dollar and gets nothing" (Spurling 2006).*

- *"Australia has very little private R&D, only spending 0.89 per cent of our GDP in this area" (Jones 2006).*

- *"Australia is dangerously underperforming in the only input to economic and business success that really matters – innovation. Since 1996, the investment in R&D by the Australian government has been falling for much of the time before struggling back up to 1996 levels only recently" (Jones 2006).*

- *"For comparisons between countries, the percentage of GDP invested in R&D is the most widely used measure. Australia is usually in the top 10 OECD countries when comparing government-funded R&D as a percentage of GDP. Government investment dropped as low as 0.59% in 1989-90 and hit a high of 0.77% in 1995-96. In 2005-6, at 0.60% it's getting close to its historic low. AUSTRALIA RUNS THE RISK OF BECOMING A DERIVATIVE ECONOMY AS ITS CAPABILITY STAGNATES" (Spurling 2006).*

- *"Australia needed to boost its research spending by 25 per cent to bring it into line with OECD levels. If the government keeps with the intention to cut research funding, that would be a tragedy, and we would become the Luddites of the South Pacific" (Luke and Marginson 2006).*

- *"The only way to improve Australia's international competitiveness and the productivity of its well-educated, affluent people was to increase its focus on breakthroughs in science, engineering and technology" (Hall 2006).*

- *"Enhancing the link between private and public sector research is a crucial area of public policy. It is a widely held belief that commercialization of research is a persistent defect in the Australian innovation system. But in an increasingly knowledge-based economy, a key role of public sector research in industry innovation is transferring ideas, not commercialization of technologies" (Trigo 1987).*

- *"A Research Quality Framework (RQF) is vital for Australian universities if we are to improve our competitiveness as measured by the Shanghai Jiao Tong and other global research indexes (Hildebrand 2002).*

- *"The implementation of the RQF should be accompanied by a significant increase in block funding allocation as an outcome of the process. The proportion of GDP spent on research has declined as the economy has grown. And, the new research assessment formula will soon be unveiled" (Morris 2006a, 2006b).*

- *"Concerns about the future of research in Australia, under the Research Quality Framework (RQF): a major worry is the reduction in research diversity to which the RQF will probably lead. In an era where frontier fields of science are becoming highly multidisciplinary, reduced diversity is bound to have negative consequences" (Hall, P. 2006).*

While recognizing the importance of the experiences described above, and the complexity of the agricultural research system as well as the linkages necessary to develop and to improve the activities of this system, it is important to emphasize that it is impossible to say that a model in one country is better than that of another, or that the structure of the agricultural research system in one country can be adopted by another without the adjustments demanded by the peculiarity of that country. Therefore, there is no "best method" that can be copied exactly to organize the agricultural research system of another country. It is important to consider each country's history, culture, farming systems as a whole, economic and financial situation, and the social and political influences, in order to construct an agricultural research system with the attributes to match the country's internal peculiarities, and to assimilate and to adapt the innovations developed in research systems of other countries with success.

4.6. Summary

The global tendency in respect to investment in research and development shows a constant reduction of public sector participation and a consequent increase in the investments made by the private sector. The population increase and the budgetary difficulties faced by governments of developed and developing countries have provoked a consequent increase in the demands in areas such as social welfare, education, health, logistics, and basic infrastructure. That has caused the great majority of the countries to review their research systems, and then implement a strong and consistent set of policies to regulate the sector. Adequate legislation to protect intellectual property rights and a patents register to protect investors and to stimulate private sector spending in R&D have been essential features of the system.

Therefore, it is clear that in developing as well as developed countries, the system of research and development has to evolve to a situation where the private sector will start to have a greater and more effective influence on performance in R&D, while the role of governments will be strategic, mainly in the definition of priorities, in accepting the responsibility for financing basic research and conducting research with a social application.

In respect to agricultural research, governments have been the major investors. Of the total invested in the sector in 2003, 63% came from the public sector and only 37% from the private sector but this is changing. Developed countries have moved more quickly in the process of replacing public with private investment in agricultural research and development. Table 4.2 showed that of the total invested in agricultural research in developed countries, 44.3% came from the public sector and 55.7% from the private sector, while in developing countries, and the ratio was 94% from the public sector and only six percent from the private sector. Developed countries have achieved better performance in this process for the obvious reasons of having a stable economy, a well-structured industrial sector, consistent legislation linked to demands of national and international agricultural markets, and thus better conditions, over all, than developing countries, to stimulate private sector investments in agricultural research.

In this respect, international agencies such as CGIAR, JICA, JIRCAS, and CIRAD supported many developing countries to improve their agricultural research systems. In the same way, the experience of countries such as Chile, the United States of America, China, New Zealand, and Australia has served as examples of what can be achieved and what might be adapted and applied in other countries with the intention of developing their agricultural research systems.

Private sector investment in agricultural research in developing countries may increase if the environment is better. They should therefore strive for the establishment of policies to strengthen intellectual property rights, to regulate the agricultural sector, and develop better markets for agricultural inputs and agricultural commodities. On the other hand, public agricultural research is still needed to help maintain a private research structure and to provide technology for regions and products with small markets, which are less attractive to the private sector.

In addition to adopting measures to address the specific needs of the nation, the experience of other countries in the process of reforming their economies and their agricultural research systems is relevant. Partnerships with international agricultural research agencies aiming to develop adequate policies and research projects will also be extremely important to the Brazilian agricultural research system.

In conclusion, this chapter has described relevant parts of the international agricultural research system and the experiences of various countries. It supports the development of the recommendations presented in Chapter 8. The Brazilian government is concerned about this problem and has attempted to implement reforms within its government institutions to improve the agricultural research system, and to stimulate private sector investment in the development of this sector, so that this research should be an important contributor to that process.

CHAPTER 5

THE GLOBAL MARKET FOR AGRICULTURAL PRODUCTS

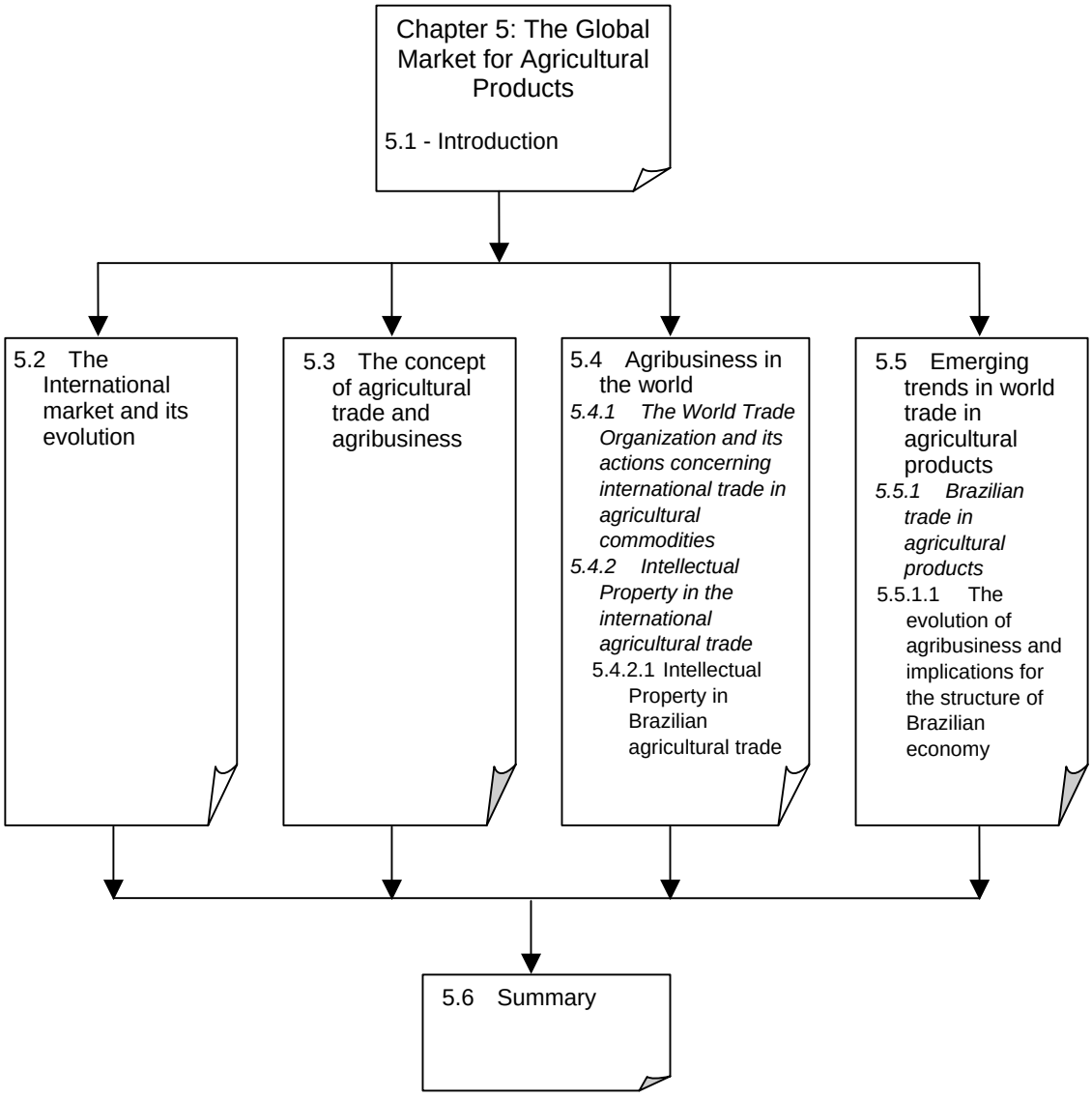


Figure 5.1 Structure of Chapter 5

5.1. Introduction

In the context of this thesis, analysis of the evolution of the international marketing of agricultural commodities is fundamental to recognising the importance of agricultural research and development activities in the process of economic growth in the world. Technology innovations integrated with mechanisms such as capital, labour, organizations/institutions, leaderships, and strategic ideas form the set of factors necessary to make the economy of countries grow (Buckley and Casson 1991; Solow 2000).

The current international situation in the marketing of agricultural commodities presents a series of economic, political, social, and legal challenges, which means that businesses and organisations wanting to trade agricultural products internationally need to be involved in a continuous search for knowledge and innovation in all of these areas. The last decades of the 20th Century were marked by rapid and significant changes in the world economic system, particularly described by the process called globalization. This phenomenon provoked a set of important responses, including the need for countries to review their policies in areas such as trading, intellectual property, science and technology, and the safe use of biotechnology (in particular GMOs), to change their production systems, and strengthen their participation in the global market (see a description of the Evolution of Globalisation in Appendix 9) (Santos 1998).

The agricultural sector is one of the most important in world trade. Indeed, given the continuing increase in world population, and the lack of capacity in many countries to produce enough food for their own population, trade in agricultural commodities and products is of vital importance in providing food, clothing, and other necessities of life for much of the world's population. As a consequence, in part because population growth, but more importantly as countries have recognised the benefits of trade, many new markets for agricultural commodities have opened or existing markets have expanded, for example in Asia, Africa, and Eastern Europe. Because of this process, there has been in recent years, a sharp increase in both the level of trade in agricultural commodities and competition among the major agricultural exporting countries of the world. This has forced the developed countries to review their protectionist policies – although most have relaxed restrictions very

slowly – and permitted many developing countries access to the world market of agricultural commodities, which, in 2004, represented about 8.6% of the total value[24] of exports in the world.

With the focus on the 'global agricultural market', in this chapter, some relevant literature is reviewed and a report on the current state of international trade in agricultural commodities is given, and the role of the World Trade Organization in international agricultural trade is outlined. The evolution of agribusiness and its impact on world trade in agricultural commodities and, specifically, its implications for Brazilian agricultural producers are also described.

5.2. The international market and its evolution

The internationalization of economic activities has a very long history, having commenced at the beginning of civilization when tribes exchanged belongings to satisfy their basic needs. It was in the Middle Ages in Europe that commercial activities started to take a systematic form, which saw the development of agreements, rules, and regulations within and between countries to regulate this trade. Private companies, with the support of the leaders of powerful states, negotiated business deals with other countries and companies in distant locations (Hirst and Thompson 1999).

As early as the fourteenth century, countries like Germany and England promoted events to encourage the sale of their products. Germany, through its merchants, defended the interests of the Western European countries, including trade in agricultural products, iron smelting, and general manufactured products. With the same objective, the Merchant Adventurers, in Britain, promoted sales of wool and cloth to the Low Countries of Europe and other places. In Italy, trading houses and Italian banks were influential in the process of internationalizing business activities among European countries in the period of the Renaissance. This participation was so aggressive that by the end of the fourteenth century, there were

24 In 2004, the world export of agricultural products reached US$783.1 billion in value, while the total value of merchandise exported worldwide in that year was US$ 9,153.0 billion (OMC 1997).

more than 150 Italian banking companies operating in other countries (Dunning 1992).

John Hutton, in his book "The World of the International Manager", presents an historical analysis of the internationalization of world commerce from 1500 to 1950. He described the process as having three phases. The first phase, in the period from 1500 to 1700, was characterized by challenges for many Western European countries, which sought to fortify themselves in cultural, commercial, and military terms, creating strong competition among themselves. One result was a huge expansion in international trade between European countries and impressive penetration of the markets in other countries around the world. In this period, Portugal, Spain, Holland, France, and England were recognised as the most important countries in the world economy.

The second phase (from 1650 to 1850), was characterized by the entry of the other European countries which, up till then, had not been a part of the process of worldwide economic expansion, the growth of political power, and commercial and territorial control by European countries, over most of the other continents – the Americas, Africa, Oceania, and parts of Asia. In this period, China and Japan remained independent from European economic domination.

Finally, the third phase, in the period from 1850 to 1950, saw the expansion of European economic power to the remaining parts of the world, political independence achieved by the majority of the former European colonies, and the incorporation of Japan and, to a much more limited extent, China into the international financial and commercial market (Hutton 1988).

With the advent of the Industrial Revolution, a strong international trading environment developed, mainly between the parent countries and their colonies. This period was characterised by large investments, mainly by British banks and other industrialists, in both North and South America, followed rapidly by investments in Africa and Australasia (Hirst and Thompson 1999; Vernon 1977).

The period between 1820 and 1870 created many great opportunities in the international market for other countries as well. Many nations stimulated the creation of the first multinational companies (MNCs) with freedom to choose where, when, and how to invest their efforts and financial resources (Dunning 1993; Hirst and Thompson 1999; Hutton 1988).

From 1870 until the beginning of the First World War, international trade increased strongly. Countries like the United States, Belgium, Germany, and France, which previously were obliged to buy industrialized products from The United Kingdom, had started to produce their own products to supply their own domestic markets and, consequently, they became big competitors in the international market (Dias 2002; Hirst and Thompson 1999; Hutton 1988).

The First World War created a peculiar situation for international trade, where countries were forced to define trading partnerships and choose on which side they would be fighting and against whom. The countries involved had created great commercial rivalry among themselves.

This situation was aggravated by the worldwide financial crisis of 1929, and again by the outbreak of the Second World War. This period was characterized by the total deterioration in the concept of free international trade. Most countries closed their markets, and created restrictive trading rules that established the protectionist period in the international market. It is characterized as one of the worst phases in international market history (Dunning 1992; Hutton 1988; Stiglitz 2002a).

Using this period to advantage, the United Kingdom promoted a series of agreements with its colonies and former colonies, trying to internationalize its action, and giving financial and technological support for the development and industrialization of countries like India, Australia, New Zealand, South Africa, and Canada. In many cases, multinational companies based in the United Kingdom made this financial and technological investment in these countries (Hutton 1988).

During and after the Second World War, the United States was one of the few countries that experienced rapid economic growth. The country's industrial and agricultural production structures, and its service industries, were not affected physically by the War. As a result, the US had suffered little loss in performance in its industrial and agricultural sectors and had therefore continued to supply its domestic market. It became one of the main suppliers of food, industrialized products, and services to meet the demand from European countries and from the other countries that were previously supplied by European production (Hirst and Thompson 1999).

In contrast, many European countries, whose industrial facilities were almost completely destroyed as a consequence of the Second World War, had many difficulties rebuilding their economies after the War and during the subsequent stage.

From this period until the beginning of the 1990s, the American economy grew steadily, fortifying the position of the American dollar as the strongest currency in the world, used by most countries as the standard of monetary reference (Herman 1999; Hirst and Thompson 1999).

From 1945 until the end of the 1970s, the world went through a process of rapid economic expansion. At the same time, a number of significant institutions for international action such as the International Bank of Reconstruction and Development (IBRD), and The International Monetary Fund (IMF), were established in 1944 and 1947 respectively, to promote the stability of the most badly affected European economies and to help the economies of the developing countries. The first institution with the objective of regulating relations in international commerce between countries was the General Agreement on Tariffs and Trade (GATT), the creation of which was planned in the Bretton Woods Agreement in 1944, and was established in 1947. The participating countries and their companies had apparently found an operating environment very favourable for promoting internal restructuring to supply their domestic markets, with new options for consumption, and complementary conditions to strengthen their external relations as well as expand their international commercial activities. In this period, Japan emerged as a powerful economy in the world, pushed by its alliance with the United States of America (Kim 1998).

Although in this period the world was generally divided into two significant economic blocs – the countries led by the United States on one side and those led by the Union of Soviet and Socialist Republics on the other – the worldwide economy for agricultural and industrial production reached rates of growth never before seen in the international context. This wave of growth was shaken in the early years of the 1970s decade by the first energy crisis and instability in the price of oil, created by the organization of Oil Producing and Exporting Countries (OPEC) (Hutton 1988).

This situation shocked the whole world, but mainly the economies of the developing countries. With the energy crisis, the development of the world's industries appeared to stop and most of the world's economies became involved in a process of rapid inflation, which was difficult to resolve. This entire crisis produced negative consequences for the world economy at the end of the 1970s, with adverse consequences such as a reduction in the output of manufactured products and growth

in public debt, mainly in the underdeveloped and developing countries. These conditions continued until the end of the 1980s. The worldwide economy was only able to manage this situation and to return to a more regular pattern of growth after agreement among the major powers of the world to negotiate economic, political, and social solutions (Hirst and Thompson 1999; Stiglitz 2002b).

Shortly after this, the world saw the end of the Cold War, the destruction of the Berlin Wall, the re-unification of Europe promoted by the break-up of the Soviet Union and the expansion of the European Union. It also saw the opening of the Chinese economy after the fall from power of Mao and his followers, the emergence of China as a force dominating economic growth in the world, and the creation of other several important economic trading blocs (see Appendix 10). In addition, the rules of the World Trade Organization (WTO) were strengthened and the evolution of communication processes (TV, radio, satellites, the internet, etc.) became a decisive factor in helping the world economy back to growth. New opportunities were created with the entry, in the form of marketable products, of activities belonging to the service sector of the economy, such as research and development (R&D) (Hutton 1988; Johnson, K. 2004; Vernon 1970).

5.3. The concept of agricultural trade and Agribusiness

Agribusiness is the name given to the economic and business system dealing with farm input supplies, farm production, processing systems, and associated consumer products. The development of the agribusiness system begins with farm inputs, which are combined with farmer-controlled land, labour, and management. These inputs are used to produce commodities and products that are then procured by private and public businesses to be used in the consumer products sector of the economic system (Walters 1999).

The term “agribusiness”[25] was conceived in the mid-1950s as a name for the extensive system of food and fibre trading described and depicted by Davis and

25 John H. Davis first used the word “agribusiness” publicly in a paper presented at the Boston Conference on Distribution, October 1955.

Goldberg in their 1957 book "A Concept of Agribusiness". They suggested the term "agribusiness" as a new word to describe the interrelated functions of agriculture and business.

The concept of agriculture as an independent industry or as a distinct part of the economy was appropriate 150 years ago when the related operations of crop and pasture growing, draft animal production, equipment and fertilizer production, the processing, the storage and the sale of products were functions of the farm. It was perfectly acceptable to include all of these activities within the meaning of the term "agriculture" (Davis and Goldberg 1957; Furtuoso 1998).

With the worldwide technological revolution in agriculture that has occurred in the period since World War II, agricultural activities expanded significantly and were subject to increasing specialization, decisively influenced by economic development and rising urbanization. These developments imposed a new agricultural order, characterized by the evolution of the term "agriculture" to "agribusiness", where the modern farmer is specifically involved with the plant growing and animal production operations, and the storage, processing, and distribution functions occur outside the farm business. In addition, the supply of farm inputs and factors of production have been transferred to organizations beyond the farm.

In contributing to a better understanding of existing relationships, particularly between on-farm and off-farm functions, Davis and Goldberg (1957) presented a list of changes that had occurred on and off the farm, over the past 150 years and which they believed contributed to the evolution of the term "agriculture" to "agribusiness". They described the technological revolution on the farm, starting in the nineteenth century, with the beginning of mechanization of agriculture and the way that this changed the basic concept of agriculture. Farmers experienced the advantages and benefits of new machines, which had appeared in the form of harrows, planters, and threshers. The adaptation of the steam engine, the internal combustion engine, and the electric motor as sources of power on farms, and more recently the use of electronics, ushered in successive new eras of progress in terms of mechanized farming. Simultaneously with the mechanization of agriculture, the application of research to other phases of farming, including plant and animal breeding, soil and water management, insect control, and commodity storage, contributed to the changes.

The technological revolution off the farm included the development of commercial facilities for handling, storing, processing, and distributing farm commodities. The mechanical production of textiles, which started in the early 1800s, and later developments in the processing and storage of food, allowed the release of workers from agriculture and their migration to industrial centres. This created a corresponding need to transport food and fibre from farms to urban areas. Other historical facts included the development of a commercial food processing and distribution industry and the evolution of the food distribution chain and supermarkets as techniques for mass merchandizing. Supplementing this growth, related businesses such as leather tanning, repair shops, rubber manufacturing, the petroleum industry, the commercial fertilizer industry, specialized seed production, and artificial insemination developed and expanded to meet the farmers' needs (Davis and Goldberg 1957).

Consequently, "farming" which previously focussed on self-sufficiency and meeting the basic needs of a rural family became commercialised. Farmers became engaged in the market economy, constructing new links with other segments in the food production system.

In this context and partly to explain the Davis and Goldberg research, Furtuoso (1998) confirms that this process resulted in the structuring of the modern industrial complex of supplies (equipment, fertilizers, etc) and other goods, called the before-the-farm sector, linked with the complex networks of storage, transportation, processing, industrialization and distribution, formed in the post-farm sector. Because of this integration, the traditional economic concept that classified the various activities into primary, secondary, and tertiary sectors, as separate and not integrated sectors, gave way to a concept that recognizes a linked system of production, processing, and commercialization of products of agricultural origin, the agro-industrial complex. Consequently, the necessity arose to deal with agricultural problems using a systemic approach (agribusiness) and not the previous more segmented approach (agriculture).

5.4. Agribusiness in the world

The majority of agricultural producers in the world are in the developing countries, and, although producers in the developed countries are highly subsidized, producers in the developing countries have generally been highly taxed. In addition, agricultural labour in the developed countries, currently, represents less than 10% of the economically active population but in the developing world, on average, 40% of the economically active population is employed in agriculture (Johnson, G. 1996).

On the other hand, the quality of agricultural life depends largely on the availability and quality of infrastructure (highways, railroads, power, water distribution, telecommunications, schools and health care), and on easy access to markets. Nevertheless, in a relatively large number of developing countries, the development of infrastructure in agricultural communities has been neglected, producing adverse consequences for the rural population. In developing countries, and even in developed countries like Australia, the quality of schools is poorer in rural areas than in the urban areas and they are less available. In many countries, rural roads are undeveloped or poorly maintained, contributing to the isolation of farmers and imposing unnecessary costs on agricultural production (Harzell 2003).

This situation is, in part, a result of the negligence of government, where it does not assume responsibility for those activities that complement and support rural life. It is also partly a consequence of the development of the worldwide market for agricultural commodities, mainly provoked by the competition generated among the developed countries trading their surplus agricultural products in the international market. The United States' experience in the world market for agricultural commodities is an example of the evolution of agribusiness in the world and could partly explain the situation described above.

Currently, the United States of America is the largest producer, importer, and exporter of agricultural products in the world (WTO 2005). To reach this place, the US adopted many radical positions in the domestic and in the international agricultural market.

In 1933 the United States introduced a set of policies to support its producers of agricultural commodities as part of the "New Deal" to fight the Great Depression. With "New Deal", three important elements were introduced. First was the control of

the volume of production, through a reduction of the area under cultivation, and control of the number of farms animals for production. Secondly, income guarantees promoting payments to agricultural producers for their cooperation in helping to control production and, later, the payment of other types of subsidies were established. The third element introduced at that time was commodity price guarantees, through the creation of the Commodity Credit Corporation (CCC), a government agency that bought commodities at prices fixed by law. In effect, the government programs introduced at that time had implemented and later expanded long-standing policies that had been used to restrict the expansion and to subsidize the export of agricultural products. These programs were continued almost unchanged up to 1995 through a succession of "Farm Bills" introduced into the US Congress. In that period of approximately 60 years, the number of farms in the U.S.A. declined from approximately 6 million to 2 million (Gardner 1996).

Although the GATT did not create exceptions for agricultural products, the concession, which the United States was granted in 1955, by which they did not have to meet any GATT requirements that interfered directly in their support of national prices policies, meant that in practice the GATT rules ceased to be applicable in world agriculture.[26] In addition, when the European Community decided, in 1957, to adopt even more protective agricultural policies, it did not have any difficulty in defending its position in the face of criticisms raised at the time. Once the European Community was established, the United States was determined to keep protection for those of its agricultural products that were vulnerable to imports, and to keep its support policies for agricultural products, disregarding the GATT rules (Dyamond 1996).

Consequently, a large number of countries that would normally adopt open commercial policies began to adopt a series of protectionist measures. Many developing countries also considered the possibility of ignoring the GATT rules in any sector and thus decided they were free to keep any protective legislation in order to implement their national agricultural policies.

26 From its creation until 1995, the GATT (now the World Trade Organization) did not include agriculture as part of the agenda of negotiations (WTO 2006b).

At the beginning of the 1980s, members of the Organization of Economic Co-operation and Development (OECD) completed an important study in which it was demonstrated that focusing on agricultural policies without taking into account the impact of various other national policies on foreign commerce would be counter-productive. The study concluded that a multilateral and multi-sectoral approach to trade negotiations was necessary, because many of the agricultural policies that were causing problems had been introduced to neutralize the effect of other policies (OECD 1997).

By the end of the 1980s, it was recognised that maintaining protective agricultural policies transformed the costs of the agricultural sector to an unsupportable degree. World market prices for some products began to collapse in the face of the enormous subsidies provided by the United States to their agricultural exports. These subsidies were introduced to neutralize the damage to US agribusiness created by the Common Agricultural Policies adopted by the European Community (Bard and Barry 2000; Dyamond 1996).

The past decade has seen some reduction in the level of intervention by governments in agricultural markets. This has been positive for the majority of agricultural producers in developing countries, since it can be argued that protection and government intervention in the market caused problems for producers, through the collection of export taxes, price controls, governmental acquisition of products, the protection of industrialized producers, and overvaluation of currencies (Schuh 1999).

Even though modernization of agriculture has progressed rapidly in the developing countries, the evidence provided by World Bank research, cited by Sidhu and Mudahar (1999b), indicates that the relative poverty of agricultural populations has persisted. It has been argued that incentives remain distorted against agriculture and that agriculture is still heavily taxed, directly or indirectly, resulting in slower overall economic growth in many developing countries.

Research carried out by the World Bank, which examined the extent and impact of agricultural price intervention in 18 developing countries during the period 1960-85, showed that agriculture in developing countries is generally being taxed more heavily, indirectly, through industrial protection and macroeconomic policies, than other industries (Sidhu and Mudahar 1999a).

This context started to change with the conclusion of the Uruguay Round of discussions in 1995, which resulted in some agreement on how to deal with agricultural commodities among member countries of the World Trade Organization (WTO). Despite the difficulties, the results achieved by the Uruguay Round were relatively successful, because a reasonably large number of countries, including the five Latin-American countries in the Cairns Group,[27] were not prepared to accept the outcome unless the results referring to agricultural questions were constructive and compensating. The Uruguay Round discussions established the importance of the process of adjustment to national agricultural policies, as well as encouraging the parties to continue the negotiations[28] (Dyamond 1996; OMC 1997).

In addition, the effect of the agreement on agricultural products achieved at the WTO talks helped to reverse the tendency to distort markets for agricultural commodities, providing the incentive for countries like China, Brazil, Argentina, India, and Mexico to implement internal reforms, creating more liberal agricultural policies. It also encouraged Japan, South Korea, and the European Union to become a little more flexible and make some minor adjustments to their barriers to imports of agricultural commodities (Johnson, I. and El-Ashry 2002).

The most surprising changes in the international market for agricultural products have occurred in the former socialist economies of Central and Eastern Europe, which deregulated agriculture, privatized many state-owned operations, established private ownership of farms, increased agricultural production, and opened their markets. Likewise, China has presented an astonishing reversal of

27 A group of representatives of 14 agricultural exporting countries, excluding the U.S.A. and the EC, had met for the first time in Cairns in Australia in 1986, aiming to produce substantial improvements in the results of trading commodities for the worldwide agricultural market. The five member countries from Latin America were Argentina, Brazil, Chile, Colombia, and Uruguay.

28 With its main objectives being to assist developing countries to increase exports of goods and services, to integrate into the multilateral trading system, and to benefit from liberalized trade and increased market access, the Doha Round of trade negotiations was originally due to be completed by 2001 but is now running five years behind schedule. After the meetings at Cancun in 2003, Geneva in 2004, and Hong Kong in 2005, the Doha Round known as “modalities” for trade in agriculture and industrial products was open again from 28 June to 1 July of 2006 at Geneva, again without success. The negotiations were suspended, without including any provision to restart (UPOV 2006).

direction, towards a market system that will guide its agricultural decisions. The majority of agricultural markets in China still suffer from intervention by the Government, but the evolution of China's agricultural market is evident if the current system is compared with the system that was operating in the early 1980s (Johnson, G. 1996).

It is also relevant to note that other important reforms in agricultural policies had been implemented, before the WTO agricultural agreement was signed as part of the Uruguay Round, by countries such as Australia, New Zealand, Chile, and as already mentioned, the countries of Eastern Europe, and the old Soviet Union, achieving excellent results. In these cases, the reform of agricultural policies was part of an extensive process, which included liberalization of both economic and social policies. Specifically in the cases of Chile and New Zealand, a series of economic and fiscal adjustments were made, and political difficulties were faced, mainly by implementing new programs. Thus, the agricultural sectors underwent substantial adjustment, without causing damage to consumers, and with substantially reduced cost to the governments (Gardner 1996; Johnson, G. 1996; Mudahar 1999).

5.4.1. The World Trade Organization and its actions concerning international trade in agricultural commodities

In the context of describing global agricultural trade, it is important to be clear about the actions of the World Trade Organization (WTO). The WTO was established formally by the Uruguay Round of trade talks in January 1995, but had its origin in 1947, when 23 countries signed the General Agreement on Tariffs and Trade (GATT), establishing basic rules prescribing international commercial relations in the period after the Second World War (WTO 2004a).

It is important to note that the WTO is the only global international organization dealing with the rules of trade between nations. At its heart are the WTO agreements, negotiated and signed by the bulk of the world's trading nations, and ratified by their parliaments. The main aim is to help producers of goods and services, as well as exporters and importers, to conduct their business more effectively.

During its period of existence, the institution known as GATT did not include agriculture as part of the negotiations. Agriculture was incorporated for the first time

into the discussion agenda during the Uruguay Round of negotiations, which began in January 1986 and which concluded in 1995 (OMC 1997).

Trade in agricultural products was excluded as a topic of discussion under the GATT agenda, because the GATT accepted a request from the United States, which argued that agriculture represented a special sector of the economy. For basic security reasons, it could not be treated in the same way as all the other sectors of the economy. In this regard, Vernon (1968) suggested that:

- *"The advanced countries no longer maintain tight licensing controls on their foreign trade, except on agricultural products. Most other goods may be exported or imported without express governmental consent. For such goods, the principal trade restraints take the form of tariffs on imports. Since the non-agricultural imports of the advanced countries come to nearly 50% of the world's imports of all sorts, the tariff structure of these countries is of considerable practical importance".*

The agreement explicitly authorized subsidies on exports in general, if they respected the contingencies of "equitable" markets. However, because of the difficulties involved in defining the meaning of equitable markets and the pressure from the constant increase in competitiveness in agricultural markets, subsidies on the export of agricultural products multiplied. Other mechanisms to protect trade in agricultural products, such as minimum price guarantees, and production and import controls, were not explicitly included in the GATT procedures and discussion (OMC 1997).

Thus, those responsible for the formulation of agricultural policies in their own countries have not hesitated to use such gaps in the WTO coverage to protect the sector to their own advantage when they desired to do so. Consequently, the levels of agricultural protection and incentives paid to farmers have increased significantly in the industrialized countries in particular, reducing market opportunities for many traditional suppliers.

The protectionist policies of the industrialized countries have created many distortions in world food markets. Countries with protectionist policies have tried to maintain their share of the international market, using export subsidy programs. These programs have created a climate of tension, since many developing countries

do not have the capacity to do the same thing and have lost much of their share of the world market and may have possibly lost part of their internal market as well (Stiglitz 2002a).

In contrast to other countries in the world, irrespective of whether they are members of the WTO or not, the countries of the European Community presented a different situation in regard to the production and commercialization of agricultural products.

In 1957, the Treaty of Rome established the European Community, and its position concerning agricultural trade was spelt out in Articles 38 to 47. A common market in agricultural products was created among its members, and between its members and other countries. Under its Articles, guarantees of regular supplies, minimum price guarantees, production and import controls, production and export subsidies, and all the other procedures that usually form part of the agricultural policies of modern states were set up (Vernon 1968).

In addition, The Lome Convention (Lome I), signed on 28 February 1975, became an international aid and trade agreement between 77 African, Caribbean, and Pacific Countries (ACP) and the European Union. Among other matters, the Convention was concerned with the environment, agriculture, food security and rural development, fisheries, commodities, industry, mining and energy, enterprise development, services, trade, cultural and social cooperation, and regional cooperation. It also had extensive provisions for cooperation in trade, which provided preferential treatment to exports from ACP countries to the EU. Four such conventions have been signed to date, in 1975, 1979, 1985, and 1995 respectively. The last Convention to be signed covered the five-year period between 1995 and 2000 and, until now, a new agreement has not been signed, despite the ACP countries' insistence that it should be (GFAR 2001; OMC 1997).

As a result of the Common Agricultural Policy, European agricultural production increased rapidly, but much of the agriculture in Europe is a high-cost activity unlikely to survive for long without heavy protection. Consequently, in spite of the European Union having laid down rules to implement agricultural trade, the negotiations among the members actually worked to create restrictions. The negotiation with other countries ended with a similar situation to that with the United States – restricted trade opportunities for the rest of the world. This also can

be observed in the restrictive market policies that the EU takes to these international treaty negotiations.

When the Uruguay Round opened in 1995, there was an expectation among member countries that the discussions would solve the problems and correct the worldwide market distortion, since the Uruguay Round included agricultural trading conditions on the agenda for the first time.

The following objectives were proposed for the agricultural area and were ratified on the first occasion (in 1995) that trade in agricultural products was included in the WTO agenda :

- *"To reach greater transparency of the international markets of products of agricultural origin, by full incorporation of agriculture in the multilateral commercial norm of the WTO"*
- *"To achieve greater freedom of trade in products of agricultural origin, through the reduction of barriers".*
- *"To correct the main distortions of prices and to establish bases for a more just competition in the international markets, through the reduction of the subsidies to the exportation of and the internal supports to agriculture."*

Box 5.1 WTO objectives for the agricultural area

The member countries also signed an agreement about agriculture that contains some of the objectives in Box 5.1, and as well as the agreement about trade and environment mechanisms related to the Trade Policy Review Mechanism (TPRM)[29]

29 The Trade Policy Review Mechanism was an early result of the Uruguay Round, being provisionally established at the Montreal Mid-Term Review of the Round in December 1988. Article III of the Marrakesh Agreement, agreed by Ministers in April 1994, placed the TPRM on a permanent footing as one of the WTO's basic functions and, with the entry into force of the WTO in 1995, the mandate of the TPRM was broadened to cover services, trade and intellectual property. The purpose of the Trade Policy Review Mechanism ("TPRM") is to contribute to improved adherence by all Members to rules, disciplines and commitments made under the Multilateral Trade Agreements and, where applicable, the Plurilateral Trade Agreements, and hence to the smoother functioning of the multilateral trading system, by achieving greater transparency in, and understanding of, the trade policies and practices of Members (www.wto.org)

and the Agreement about Trade-related Aspects of Intellectual Property Rights (TRIPS)[30] (OMC 1997; WTO 2006a).

The TRIPS agreement applies to all WTO member countries and its mandates over intellectual property, "trade in goods and trade in services", compound the three cornerstones of the Organization.

It was the first and most comprehensive agreement that introduced intellectual property law into global international trading. It contains requirements that the laws of WTO member countries must meet for rights over copyright, geographical indications, industrial designs, integrated circuit layout designs, patents, new plant varieties, trademarks, and confidential information.

5.4.2. Intellectual Property in international agricultural trade

In this study, intellectual property[31] will be considered in two situations where it has become more important *(ABSP 2004)*:

- in the discussion of the relationship between agricultural R&D institutes and agribusiness firms; and
- in the process of developing export commodities.

Intellectual property is becoming increasingly important in all segments of the production chains for agricultural products. The process of protecting intellectual property starts with seed or animal species that were developed through research and protected through some form of breeders' rights. It extends along the chain to reflect the increased level of competitiveness that, in recent years, has characterized the international market for agricultural products where the processes of differentiation

30 The WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), negotiated in the 1986-94 Uruguay Round, introduced intellectual property rules into the multilateral trading system for the first time (www.wto.org)

31 In this context, intellectual property can be defined as an idea that, when expressed in tangible form, can be protected by law. The owners of the idea have protection guaranteed by the state under different conditions and for diverse periods of time.

and innovation are basic factors that give particular agricultural producers an advantage. Consequently, the producers in countries that adopt and apply good policy in respect of intellectual property management can obtain an advantage in the international market, compared with those in countries that still do not have such policies (Asker and Stoeckel 1999; Medaglia and Hernández 2001).

In a similar vein, Vaver (1999) argues that:

- *"Intellectual property is a subject that has grown enormously within recent years. It has come to affect more and more of people's daily work and leisure activities. In doing so, it has moved from being largely the preserve of technical lawyers to engaging other disciplines and perspectives".*

Regimes for the protection of intellectual property began to evolve in the late 19th and early 20th century. However, it was not until the 1970s that, for most countries, including the USA and Europe, such protection became an important issue in evaluating opportunities for investment outside their own borders (See Box 5.2).

The process of protecting intellectual property is not recent. The first manifestations of protection given to the results of intellectual creation occurred in Europe, dating from about 300 years BC, when governments recognized and granted exclusive rights to the cooks who prepared special food of great quality (USA 2005; Simon 2000).

The modern legislation about intellectual propriety came originally from England. Specifically, in 1709, England instituted the Statute of Anne, with the objective of recognizing authors' rights and providing some incentives for innovation through the granting of limited monopolies. This principle was incorporated in the original version of the United States Constitution in 1787, where Article I, Section 8, Clause 8 defines the American Congress as being able to legislate about this subject (Vaver 1999). Some other important contributions to the evolution of intellectual property law were:

The **Paris Convention** of 1883 – for the protection of industrial property (inventions, trademarks, and industrial designs), and the **Berne Convention** in 1886 – for the protection of literary and artistic works (novels, short stories, poems, plays, songs, operas, musicals, and sonatas; as well as drawings, paintings, sculptures, and architectural works). These conventions were fundamental to improving the process of protecting intellectual property worldwide and, under them, the European countries protected ideas and granted patents for inventions through internal laws specific to individual nations. However, these conventions also discouraged and discriminated against foreign investments (WIPO 2003).

At the end of the 19th century, these internal laws had started to disappear, giving rise to bilateral treaties between countries, with clauses excluding discrimination and focusing minimum attention on the process of protecting intellectual property. In 1893, the United International Bureau for the Protection of Intellectual Property (BIRPI) was created by combining the activities of the Paris Convention and the Berne Convention Bureau. In 1970, the BIRPI was transformed into a dynamic entity, with 180 member States, named the World Intellectual Property Organization (WIPO). WIPO was created with two main objectives: to promote the protection of intellectual property throughout the world through cooperation among states and, where appropriate, in collaboration with any other international organization; and to ensure administrative cooperation among the member countries (1999).

Box 5.2 Evolution of intellectual property protection until WIPO was created

Previously, other factors such as availability of cheap labour and the abundance of natural resources, as well as privileged access to a defined domestic market, were considered as the fundamental issues. Questions about intellectual property did not figure prominently in the process of decision making by companies that had an intention to invest internationally (ABSP 2004; Buainain and Carvalho 2000).

On the other hand, the process of protecting intellectual property has undergone many changes in the past twenty years. The strength of scientific and technological progress, combined with a reduction in the time required for technological developments to be incorporated into the productive process, the shorter life cycle of many products in the market, and increasing research and development costs, has created a lot of instability in domestic and international markets. In addition, the emergence of the Internet, with its intensive use in market operations in international trade and the rapid transfer of information permitted by this innovation of the communication process, has increased the importance of intellectual property. Therefore, an appropriate mechanism for guaranteeing rights and stimulating investments is required (Buainain and Carvalho 2000; Medaglia and Hernández 2001; Vaver 1999).

There are many forms of intellectual property protection, including trade secrets, copyrights, trademarks, patents, and plant variety protection (See Box 5.3 for the three most important mechanisms).

In general, the three central pillars of the system of intellectual property rights were described by Vaver (2001), Medaglia and Hernández (2004) and ABSP (OMC 1997). They are:

- **Patents -** protect new, non-obvious, and useful inventions. In recent years, patents have come to be granted over the products of computer and genetic engineering, as well as mechanical products and processes. Once issued, a patent gives the inventor the legal right to create a limited monopoly by excluding others from creating, producing, selling or importing the invention. This right is limited to a period of 20 years from the date of filing the patent application.
- **Copyright -** which at first, protected books, but was later expanded to cover various forms of art, drama and music, and anything written, or drawn. It was designed to cover copying in any dimension, as well as public performances and broadcasting.
- **Trademarks -** for which, in the beginning, the law stopped only fraudulent imitations. Later, the use of trademarks was expanded to stop even innocently confusing imitations, and then even some non-confusing uses.

Box 5.3 The three central pillars of the system of intellectual property rights

The most frequently used types of protection in the agricultural industries are plant variety protection (PVP), and patents. PVP, also referred to as Plant Breeders Rights, allows one to protect a new variety that is different from commonly known varieties for a term of 20 years, and 25 years for tree crops. The variety must be homogenous, stable, and novel with respect to its commercialization, and have its own name (ABSP 2004; Medaglia and Hernández 2001).

In 1961, the Convention for the Protection of New Varieties of Plants, promoted by the United Nations, created the International Union for the Protection of New Varieties of Plants (UPOV), involving only European countries. The aim of UPOV was to provide and promote an effective system of plant variety protection, and to encourage the development of new varieties of plants for the benefit of society. The

convention was revised in Geneva in 1972, 1978, and 1991.[32] The 1991 Act came into effect on 14/04/1998 (UPOV 2006; WIPO 2001).

A modification to the UPOV Convention in 1978 permitted non-European countries to become signatories to the Convention, and in addition, recognized property rights over varieties of selected species listed as resulting from human intervention in breeding or selection. In 1991, the UPOV Convention was revised to allow double protection: the "sui generis"[33] regime for plant varieties, and patents for plants. From that moment, national governments have also been able to provide patents for plants (Barton *et al.* 2002; Seiler 1998; UPOV 1991).

UPOV activities are concerned with promoting international harmonization and cooperation between its 61 members (listed in Appendix 11), and with assisting member countries in the introduction of plant variety protection legislation. The legislation also prohibits the export of material of any protected variety, which would enable the propagation of that variety, into a country that does not protect varieties of the plant genus or species to which the variety belongs, except for cases where the exported material is destined for final consumption. In addition, the interests of UPOV extend beyond protection of rights over genera and species, to other areas such as national listing of protected species and seed certification (UPOV 2006).

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32 At each UPOV Convention, an Act was created with the improvements and modifications discussed and approved by members. Consequently, there are four Acts: 1961 Act; 1972 Act; 1978 Act; and 1991 Act. Brazil became a member of UPOV on 23 May 1999 under the Act established in 1978 to help manage its system of plant protection. On the other hand, Australia was a member since 1 March 1989 and adheres to the 1991 Act, so patenting for plant varieties is allowed in Australia, but not in Brazil.

33 "When reference is made to a "sui generis" regime in the TRIPS Agreement (Article 27.3.b), the expression is used in relation to the protection of plant varieties only, i.e., to some form of protection (such as breeders' rights) relating to that specific subject matter. "Sui generis" is, however, widely used in the literature and in many subjects, in a much broader sense to include different manifestations of indigenous/local communities' knowledge, relating to, for instance, medicinal uses of plants, cultivation practices, etc. This broad concept may include, but is not limited to, plant varieties. For instance, a sui generis system for plant varieties must comply with the basic principles of national treatment, meaning that member states are obliged to grant to non-nationals the same advantages as to its own nationals. Furthermore, all advantages that are granted to the nationals of other countries have to be applied immediately and unconditionally to the nationals of all the other member states. In order to be "effective", national sui generis legislation must provide for the implementation of jurisdictional procedures for PVP holders to execute their rights. By this, they can effectively exclude others from unauthorized use of the protected plant variety or obtain remuneration."

With regard to the commercialization of these products among member countries, the UPOV only has any influence when new varieties of plants or seeds are registered in the countries involved. Under the protection afforded by the register, the use and distribution of these products can be made only with the authorization of the authors. The period of protection for plant varieties cannot be less that 20 years, while in the case of trees and vines, the period of protection is 25 years. Therefore, according to Barton *et al.* (2002), developing countries have three options to protect plant varieties, and they can implement one or a combination of the three alternatives (UPOV 1991, 2006). The three options are:

- *"UPOV style legislation based on the 1978 or 1991 Convention (although the countries may now only join by following the 1991 Act);*

- *Another form of 'sui generis' system, whether they are landraces or not; and*

- *Patents on plant varieties."*

In December 2001, WIPO conducted the Second Session of the Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge, and Folklore in Geneva. During this event, the International Treaty on Plant Genetic Resources for Food and Agriculture was established with the objective of promoting the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of the benefits arising out of their use (WIPO 2001).

The Food and Agriculture Organization (FAO) promoted another important initiative in plant protection, by establishing the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The FAO Conference of 2001 approved the Treaty and, in June 2004, it entered into force with the objective of promoting the conservation and sustainable use of plant genetic resources for food and agriculture and the reasonable and impartial sharing of the benefits resulting from their use. With the intention of implementing the Treaty objectives, a

Multilateral System of Access and a Benefit-sharing Regime for an identified list of 64 of the most important food and forage crops essential for food security[34] were created. They stipulated that commercialisation of a new plant variety will trigger a financial contribution to the multilateral system (Barton *et al.* 2002; FAO 2006).

The other important point to improve and regulate domestic and international trading of agricultural commodities, and influence investment in agricultural research, was the Convention on Biological Diversity signed by 150 countries at the 1992 Rio Earth Summit. This Convention was the first comprehensive agreement to address all aspects of biological diversity, where the participants concluded that biological diversity comprises more than plants, animals and their ecosystems, but it is also about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live. The participants recognized that the conservation of biological diversity is a common concern of many nations and an essential component of countries development processes (CBD 2000).

As a result of discussions at this Convention, The Cartagena Protocol on Biosafety was adopted on 29 January 2000. As a consequence, many points contained therein have become part of the ever-growing body of international environmental law, with direct influences on the trading of agricultural commodities, and in the investment in agricultural research (CBD 2003).

In addition, following the principles established in The Cartagena Protocol on Biosafety, the parties to the Convention on Biological Diversity built their Biosafety regulatory system and their relationships with agricultural production, establishing a functional and efficient Biosafety structure where research, development and commercialization of GMOs can be implemented by both the private and public sectors.

34 Crops covered under the International Treaty on Plant Genetic Resources for Food and Agriculture are: apple, major aroids (including taro, cocoyam, dasheen, and tannia), asparagus, banana/plantain, barley, bean, beet, brassica complex (including cabbage, rapeseed, mustard, cress, rocket, radish and turnip), breadfruit, carrot, cassava, chickpea, citrus, coconut, cowpea, eggplant, fava bean/vetch, finger millet, grass pea, lentil, maize (corn), oat, pea, pearl millet, pigeon pea, potato, rice, rye, sorghum, strawberry, sunflower, sweet potato, triticale, wheat, yam and forages (including 15 genera of legume forages, 12 of grass and 2 genera of other forages).

5.4.2.1. Intellectual Property in Brazilian agricultural trade

The process of regulating Intellectual Property Rights in Brazil began with the introduction of legalization early in the 19th century. On 28 April 1809, the Emperor signed a law that exempted domestic factories from existing provisions over all of the raw materials they used and provided other benefits to the manufacturers. It was not until 1882, 73 years later, through Law Nº 3,129, passed on 14 October 1882, that the country started to regulate the granting of patents to the authors of inventions or of industrial discoveries (INPI 2006). After that, subsequent laws were created to regulate intellectual property in Brazil (See Box 5.4).

Brazil recognized the intellectual property rights applying to biotechnology and seeds through the Law of Industrial Property Nº 9,279 of 14/05/1996, which replaced Law Nº 5,772, and which was updated by Law Nº 10,194 of 14/02/2001. The protection of intellectual property referring to cultivars (plants) was established through the Law of Cultivars Nº 9,456 of 28/04/1997, and brought into effect through Decree Nº 2,366 of 5/11/1997. In addition, Law Nº 8,974 of 05/01/95 regarding Bio Security was created to control the use of genetic engineering techniques and the release of genetically modified organisms into the environment. It also created the National Technical Commission of Bio Security (Carvalho and Pessanha 2001; INPI 2006).

- **Law of 28 August 1830** - which defined privilege to discover, to invent or improve a new useful industry, and established a prize for the person who introduced a foreign industry. This law also regulated the concessions granted to such industries.
- **Decree Nº 16,254 of 19 December 1923** - which created the General Department of Industrial Property, with the responsibility to conduct the services relating to patents, and maintain a register of marks and inventions from industry and commerce.
- **Decree Nº 24,507 of 29 June 1934** - approved the regulations for the granting of patents or drawings of industrial models, for the registration of corporate names and titles of establishments, as well as preventing of unfair competition in the use of an individual's or organization's intellectual property.
- **Decree-law Nº 7.903 of 27 August 1945** - created the Industrial Property Code and extended this protection equally, to the domains of the **agricultural** and extractive industries, as to other industries.
- **Decree-law Nº 1005 of 25 April 1969** - This Law changed the industrial property code created by Law Nº 7,903 and suggested the reorganization of the National Department of Industrial Property.
- **Law Nº 5,648 of 11 December 1970** - created the National Institute of Industrial Property, in place of the National Department of Industrial Property, as well as other measures.
- **Law Nº 5,772, of 21 December 1971** - defined a new Code of Industrial Property, as well as other measures.
- **Law Nº 9,610, of 19 of February of 1998** - modified, consolidated, and brought the legislation on copyrights up to date, as well as other measures.
- **Law Nº 10,603 of 17 December 2002** - Introduced protection against inappropriate commercial use of information relating to the results of tests or other unpublished data presented to the relevant authorities as a condition of approval of or registration for the commercial use of pharmaceutical products for veterinary use, fertilizers, and similar products.

Source: (http://www.mct.gov.br/; http://www.presidencia.gov.br/legislacao)

Box 5.4 Laws created to regulate intellectual property in Brazil

In the context of this thesis, the International Treaty on Genetic Plant Resources for Food and Agriculture assumes an important role, mainly in its Articles five, seven, and eight where a number of rules in the areas of conservation, commercial exploitation, evaluation, international cooperation, and technical assistance are defined. The Brazilian Laws of Industrial Property, Cultivars and Bio Security, and

the Law of Innovation, will also be appropriate to consider in this study. These measures have the potential to affect the domestic and international trading of agricultural commodities in Brazil and more generally in the world.

5.5. Emerging trends in world trade in agricultural products

In 2004, the countries of the world traded goods to the value of about 9.15 trillion American dollars in exports and 9.49 trillion in imports. (In this study, the Standard International Trade Classification (SITC)[35] definitions of goods,[36] merchandise[37] and, specifically, agricultural products,[38] have been adopted.) A list of the most significant exporters and importers in the world is presented in Table 5.1. Germany occupied the first position among exporting countries in 2004 with 10.0% of the total value of goods and services exported in the world, followed by the United States with 8.9%, China 6.5%, Japan, and France with 6.2% and 4.9% respectively. In terms of imports, the United States is the greatest importer with 16.1% of the total. Germany is in second place with 7.6%, followed by China (5.9%), France (4.9%), the United Kingdom (4.9%), and Japan (4.8%) (UNO 2006; WTO 2005).

In terms of international trade, Australia and Brazil are in similar positions. Brazil occupies twenty-fifth position among the list of exporters, with 1.1% of the total goods exported, while Australia holds twenty-sixth place with 0.9%. In the list of

35 The Standard International Trade Classification (SITC) is the standard classification for the reporting of international trade statistics. It was considered and approved by the United Nations Statistical Commission in 1985, endorsed by the Economic and Social Council in its Resolution 1985/7 of 28 May 1985 and published by the United Nations in 1986. The SITC provides detailed categories for the classification of commodities and is arranged in a hierarchy of five levels, and is compatible with other international classifications of industries and products.

36 Goods can include all merchandise that either adds to or reduces the stock of material resources in a country by entering or leaving the country's economic territory.

37 Merchandise is a term, which covers all types of goods moved inwards or outwards through a country or territory, including movements through customs warehouses and free zones.

38 The SITC categorises agricultural products into two main areas: Food, and Raw Materials. Food refers to food and live animals; beverages and tobacco; animal and vegetable oils, fats and waxes; oilseeds and oleaginous fruit. Raw materials covers raw hides, skins and fur-skins, crude rubber (including synthetic and reclaimed), cork and wood, pulp and waste paper, textile fibres and their wastes, and crude animal and vegetable materials.

importers, Australia appears in nineteenth place with 1.1% of the total goods imported in the world, and Brazil occupies twenty-ninth position with about 0.7%.

Table 5.1 Leading exporters and importers in world merchandise trade: 2004 (in billions of US dollars, percentage share, and rank)

Rank	Exporters	Value	Share	Rank	Importers	Value	Share
1	Germany	912.3	10.0	1	United States	1525.5	16.1
2	United States	818.8	8.9	2	Germany	716.9	7.6
3	China	593.3	6.5	3	China	561.2	5.9
4	Japan	565.8	6.2	4	France	465.5	4.9
5	France	448.7	4.9	5	United Kingdom	463.5	4.9
6	Netherlands	358.2	3.9	6	Japan	454.5	4.8
7	Italy	349.2	3.8	7	Italy	351.0	3.7
8	United Kingdom	346.9	3.8	8	Netherlands	319.3	3.4
9	Canada	316.5	3.5	9	Belgium	285.5	3.0
10	Belgium	306.5	3.3	10	Canada	279.8	2.9
11	Hong Kong, China	265.5	2.9	11	Hong Kong, China	272.9	2.8
12	Korea, Rep. of	253.8	2.8	12	Spain	249.3	2.6
13	Mexico	189.1	2.1	13	Korea, Rep. of	224.5	2.4
14	Russian Federation	183.5	2.0	14	Mexico	206.4	2.2
15	Taipei, Chinese	182.4	2.0	15	Taipei, Chinese	168.4	1.8
16	Singapore	179.6	2.0	16	Singapore	163.9	1.7
17	Spain	178.6	1.9	17	Austria	117.8	1.2
18	Malaysia	126.5	1.4	18	Switzerland	111.6	1.2
19	Saudi Arabia	126.2	1.4	19	Australia	109.4	1.1
20	Sweden	122.5	1.3	20	Malaysia	105.3	1.1
…	…	…	…	…	…	…	…
25	Brazil	96.5	1.1	29	Brazil	65.9	0.7
26	Australia	86.4	0.9	…	….	…	…
…	…	…	…	…	…	…	…
--	Other countries	2,146.2	23.4	--	Other countries	2,276.9	24.0
	Total in the World	**9153.0**	**100**		**Total in the World**	**9495.0**	**100**

Source: Derived from Table 1.5 of the WTO International Trade Statistics 2005 Report (WTO 2005).

If the statistics concerning trade in agricultural products as part of the total worldwide trade in merchandise are examined, a constant decline in the share of agricultural products can be observed. In 1950, the value of agricultural exports

represented about 45% of total world exports. Since that time, the ratio has declined, to about 8.55% of the total value of world exports in 2004. However, while the share has declined, exports of agricultural products have still increased in absolute terms and reached US$783.1 billion in 2004, while the total value of exports, as shown in Table 5.2, was US$ 9,153.0 billion.

It is important to emphasize the difference in performance between agricultural products and other goods. It can be observed from Table 5.2 that exports of agricultural products increased by about 28 times (from $27.93 billion to $783.1 billion) in the past 54 years, while the growth in total world exports was nearly 148 times (from $61.86 to $9153.0 billion). At the same time, world exports, excluding agricultural exports, increased nearly 247 times (from $33.93 in 1950 to $8,369.9 in 2004). Therefore, it can be concluded that agriculture is an activity in relative decline, in the majority of countries of the world. Even in countries where growth in the agricultural sector has been significant, its importance was decreased compared to other activities.

The period since 1950 is characterized by a marked increase in worldwide trade in manufactured products,[39] in part because trade in these products has been regulated through agreements between countries and monitored by the GATT since 1947. However, the outcome is also partly influenced by the evolution in information technology and the development of faster communication tools. They have promoted growth in demand for new products and created new opportunities related to behavioural changes generated by the new technologies (Williamon 2002). Similar growth did not occur in the agricultural area.

39 The Standard International Trade Classification defines the following as manufactured products: iron and steel, chemicals (organic and inorganic products), pharmaceuticals, leather, leather manufactures, rubber manufactures, cork and wood manufactures, paper, non-metallic mineral manufactures, manufactures of metals, machinery and transport equipment, power generating machinery, other non-electrical machinery, office machines and telecommunications equipment, electrical machinery and apparatus, automotive products, other transport equipment, textiles, clothing, other consumer goods, other products.

Table 5.2 World exports of agricultural products, total exports of merchandise goods, and agricultural share in export trade (in billions of US dollars)

Year	Agricultural exports	Total exports	Agricultural Participation (%)	Year	Agricultural exports	Total exports	Agricultural Participation (%)
1950	27.93	61.86	45.15	1978	212.44	1321.28	16.08
1951	35.91	81.12	44.26	1979	261.31	1657.94	15.76
1952	30.92	80.11	38.60	1980	297.47	2019.92	14.73
1953	30.92	82.14	37.64	1981	291.91	1990.57	14.66
1954	31.92	86.16	37.03	1982	270.13	1863.20	14.50
1955	32.91	94.30	34.90	1983	266.26	1827.41	14.57
1956	33.91	102.42	33.11	1984	280.42	1932.93	14.51
1957	36.90	110.53	33.39	1985	264.48	1928.68	13.71
1958	34.91	106.47	32.79	1986	293.90	2112.42	13.91
1959	37.90	115.60	32.79	1987	337.83	2477.95	13.63
1960	39.89	130.81	30.50	1988	382.21	2810.92	13.60
1961	40.89	135.88	30.09	1989	398.63	3028.26	13.16
1962	40.89	143.99	28.40	1990	417.39	3420.78	12.20
1963	44.88	157.17	28.56	1991	420.93	3472.12	12.12
1964	47.87	175.48	27.29	1992	450.77	3705.45	12.17
1965	49.87	189.62	26.30	1993	432.10	3700.41	11.68
1966	51.86	206.86	25.07	1994	500.20	4204.03	11.90
1967	51.86	218.02	23.79	1995	586.95	5018.74	11.70
1968	53.86	241.34	22.32	1996	604.23	5239.15	11.53
1969	57.85	276.83	20.90	1997	596.22	5416.27	11.01
1970	63.83	316.38	20.18	1998	568.39	5346.26	10.63
1971	68.82	354.91	19.39	1999	547.48	5556.27	9.85
1972	82.78	419.81	19.72	2000	552.25	6266.31	8.81
1973	120.68	582.05	20.73	2001	554.13	6021.29	9.20
1974	147.61	847.73	17.41	2002	582.53	6272.31	9.29
1975	149.61	887.28	16.86	2003	673.90	7503.0	8.98
1976	165.56	1,004.90	16.48	2004	783.10	9153.0	8.55
1977	187.51	1,140.78	16.44				

Source: WTO (2005) data provided by Brazilian Ministry of Agriculture, Livestock and Food Supply

Table 5.3 shows the ranking of the ten countries that, in 2004, were the largest exporters and importers of agricultural products. The European Union (EU) countries, with US$344.52 billion, and the United States of America (USA), with

US$79.57 billion, dominated world exports of agricultural commodities with approximately 54.1% (44% and 10.1% respectively) of the total volume (US$783.10 billion) sold on to the world market. Brazil occupied the fourth ranking with 3.9% of the worldwide market followed by China and Australia with 3.1% and 2.8% respectively.

Table 5.3 Leading exporters and importers in world agricultural trade, 2004 (in billions of US dollars)

Exporters				Importers			
Ranking	**Countries**	**2004 Values**	**Participation (B/A)**	**Ranking**	**Countries**	**2004 Values**	**Participation (B/A)**
			(%)				*(%)*
---	**World total**	**783.10 (A)**	**100.0**	---	**World total**	**782.8 (A)**	**100.0**
		(B)				**(B)**	
1	European Union	344.52	44.0	1	European Union	373.78	47.8
2	United States	79.57	10.1	2	United States	88.11	11.2
3	Canada	40.10	5.1	3	Japan	65.43	8.4
4	Brazil	30.85	3.9	4	China	42.28	5.4
5	China	24.12	3.1	5	Canada	19.37	2.5
6	Australia	22.10	2.8	6	Russian Fed.	16.17	2.1
7	Argentina	17.08	2.2	7	Korea, Rep. of	16.04	2.1
8	Thailand	16.27	2.1	8	Mexico	15.44	2.0
9	Russian Fed.	13.84	1.8	9	Hong Kong–China	11.18	1.4
10	Malaysia	13.13	1.7	10	Taipei, Chinese	9.01	1.1
	Top 10 countries	**601.58**	**76.8**		**Top 10 countries**	**656.81**	**84.0**

Sources: FAO – Food and Agricultural Organization www.fao.org and www.wto.org/english/res_e/statis_e/its2005_e.pdf and WTO (2005).

Likewise, European Union countries (47.8%) and the United States (11.2%) also dominated the import of agricultural products in the world, with almost 60% of the total in 2004, followed by Japan and China, which imported about 8.4% and 5.4% respectively, of the agricultural products traded in the world.

Despite the countries of the European Union and the United States being the greatest exporters of agricultural products in the world, Table 5.4 shows that the volume of trade represented by these products amounted to only 9.3% and 9.7%, respectively, of the total merchandise exported by these countries in 2004. On the other hand, agricultural product exports from Brazil (32%) represent approximately one third of the total merchandise exported by that country. In Australia's case, exports of agricultural products declined slightly over the past 10 years when compared to total merchandise exports, from 27.7% in 1995 to 22.8% in 2004.

These statistics demonstrate that agricultural exports remain a strong part of the Brazilian and Australian economies, in contrast to the worldwide tendency, where the trade in manufactured goods has developed at an exponential rate, but the agricultural market, which has specific limitations and peculiarities, has grown much more slowly. In Australia and Brazil, agriculture continues to expand, meeting the demands of the domestic and international markets, while the production of manufactured goods in these two countries has still not reached the same evolutionary stage in the development of their economies as presented by other developed countries.

Table 5.4 Exports of agricultural products from selected countries: 1990, 1995, 2000, and 2004 (in millions of US dollars; and percentage share)

Countries	Value				Percentage share in economy's total merchandise exports			
	1990	1995	2000	2004	1990	1995	2000	2004
Australia	11,628	14,717	16,446	22,101	--	27.7	26.6	22.8
Brazil	9,779	15,673	15,567	30,853	--	33.7	28.1	32.0
Canada	22,339	32,214	34,789	40,100	--	16.8	12.6	12.7
China	10,060	14,997	16,384	24,121	--	10.1	6.6	4.1
European Union (15)	--	238,990	229,313	344,523	--	11.5	9.4	9.3
Japan	3,298	4,656	4,395	5,468	--	1.1	0.9	1.0
Mexico	3,466	7,189	9,100	11,358	--	9.0	5.5	6.6
New Zealand	5,966	8,306	7,642	12,157	--	60.9	57.6	59.7
Russian Federation	--	4,349	7,855	13,836	--	5.4	7.4	7.5
United States	59,404	80,435	71,408	79,567	--	13.8	9.1	9.7

Source: Report of international trade statistics 2005 (WTO 2005).

Table 5.5 shows that, over the past ten years, the value of agricultural products imported into selected countries has continued to increase but the share of total imports has generally declined. The Brazilian position, with a 45% reduction in the share represented by agricultural products imported, followed by the Russian Federation with a 44% reduction and China with a 38.5% reduction, is worth noting. In the Brazilian case, the reforms in agriculture implemented by 1991, and the great investment in agricultural R&D (from the beginning of the 1970s decade until the end of the 1990s decade) contributed to this situation. Agriculture reform removed subsidies and opened the Brazilian market for agricultural commodities, while the agricultural R&D system created technologies that, among many other changes, allowed food production to occur in ecosystems previously unproductive like Cerrados and Semiarid regions. In addition, agricultural R&D improved productivity and expanded production of commodities such as coffee, soybean, sugar, meat, orange, and alcohol, helping Brazil to reduce its need to import agricultural products (Alves 1989; Coes and Welch 2005).

Table 5.5 Imports of agricultural products in selected countries: 1990, 1995, 2000, and 2004 (in millions of US dollars; and percentage share)

Countries	Value				Percentage share in economy's total merchandise exports			
	1990	1995	2000	2004	1990	1995	2000	2004
Australia	2,707	3,794	4,234	5,930	--	6.6	5.9	5.6
Brazil	2,690	6,491	5,162	4,446	--	12.1	8.8	6.7
Canada	9,009	12,204	15,272	19,374	--	7.4	6.4	7.1
China	7,855	16,099	19,544	42,279	--	12.2	8.7	7.5
European Union (15)	--	267,194	252,289	373,779	--	13.0	9.9	9.9
Japan	50,762	74,772	62,185	65,427	--	22.3	16.4	14.4
Mexico	5,374	6,250	10,989	15,440	--	8.6	6.3	7.8
New Zealand	756	--	1,204	1,855	--	--	8.7	8.0
Russian Federation	--	18,378	8,831	16,171	--	30.2	19.8	16.8
United States	39,966	53,056	69,115	88,112	--	6.9	5.5	5.8

Source: Report of international trade statistics 2004 and 2005 (WTO 2004b, 2005).

5.5.1. Brazilian trade in agricultural products

With almost 13% of all the fresh water available in the world and about 388 million hectares of agricultural lands, of which 90 million hectares have still not been exploited, Brazil has the advantage of being in an extremely favourable situation in regard to the development of agriculture and all of the activities related to the agricultural industries. In 2005, the Brazilian Agro-Industrial Complex (AIC)[40] generated approximately 28% of the country's Gross Domestic Product (GDP) and 36.9% of its total exports, while approximately 37% of all jobs were offered by the sector. Table 5.6 shows how the 17.7 million workers in agriculture were distributed within the sector (Agricommerce 2005).

Table 5.6 Distribution of employment in Brazilian agro-industrial sector (in thousands of people; and percentage)

Economic Sectors	Employment	
	Numbers	**Percentage**
▪ Farming production activities (inside the farm gate)	11,097.90	62.7
▪ Industrial and service activities (after the farm gate)	6,407.40	36.2
▪ Input supply and machinery activities (before the farm gate)	194.70	1.1
Total for Brazilian Agro-industrial Complex	**17,700.00**	**100.0**

Sources: DPIA/SRI/MAPA (2006); Nunes& Contini (2001)

40 Furtuoso (1998) defined the term "agro-industrial complex", considered the most inclusive term and the one best suited to concrete analytical use, which will be adopted in this thesis. The Agro-industrial Complex, AIC, represents a group formed by: a) the industrial sectors that supply goods and services to agriculture, that is called the agriculture industry (before the farm gate); b) agricultural production proper (inside of the farm gate); c) industrial sectors that have in agriculture their supplying markets, that we will call basic agricultural industry (after the farm gate); and d) the sector of distribution, that involves the segments of transport, commerce and services (also after the farm gate).

It is necessary to note here that various estimates of the contribution by the agribusiness sector to Brazilian Gross Domestic Product (GDP) are reported in the literature. The inadequacies of the available data contribute to the discrepancies found in some of the estimates and discourage a more refined analysis. Despite spectacular growth of the Agro-Industrial Complex in Brazil, the staffs of academic organisations, the economic policy analysts, the decision-makers in the government, and private enterprise managers have had a lot of trouble analysing the data from the Brazilian agricultural industries. Scientists in research institutions, in particular, still do not have a realistic understanding about the output of the Agro-industrial Complex, its contribution to the Gross Domestic Product (GDP), or its impact on the other sectors of the economy.

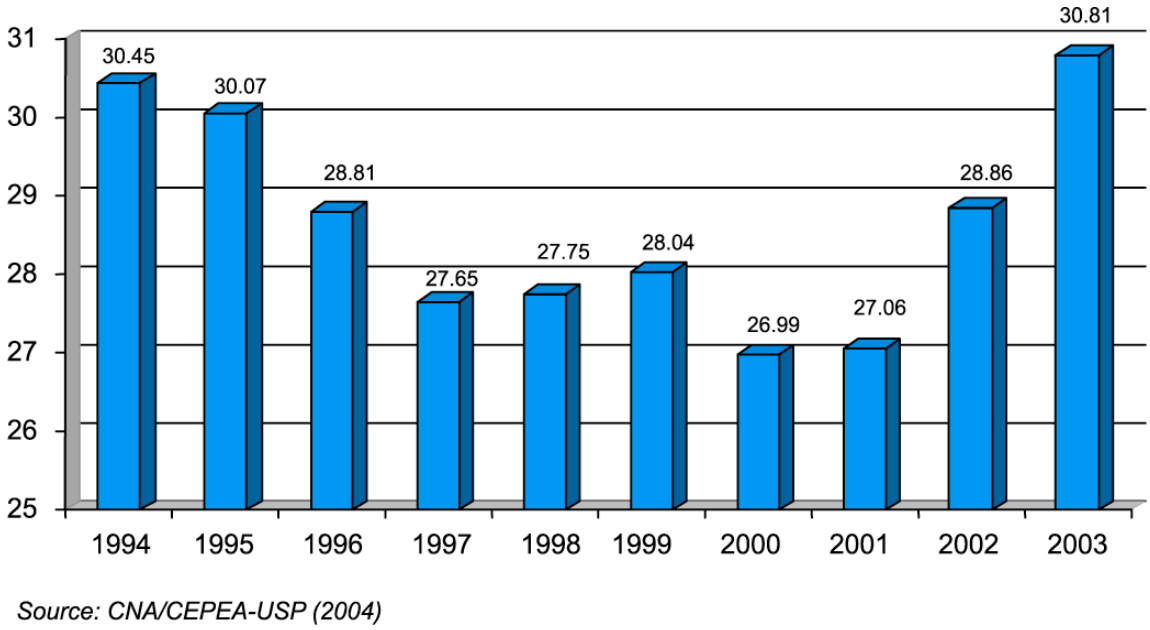
As an example, consider the differing results from three different attempts to calculate the contribution of the Agro-Industrial Complex to the Brazilian GDP. Nunes and Contini, in a study carried with 1996 statistical data, defined a method to calculate the level of participation by the various agricultural sectors. When applied, this methodology indicated that the value of economic activities “before the farm gate” represented 4.7%, the value of activities, “after the farm gate” represented 53.1%, and the values produced on the farm represented 42.3% of the Gross Domestic Product of the total Agro-industrial Complex, (AIG-GDP). In 1996, the GDP of the Agro-Industrial Complex contributed 20.6% of the total Brazilian GDP (Nunes and Contini 2001).

Using a different methodology, Furtuoso in her PhD thesis (completed in 1998) arrived at different values for the AIC-GDP, its sectors, and its contribution to the total GDP. Her results indicated that, in 1996, of the AIC-GDP, “before farm gate” production activities represented 7.6%; the “on farm” production, 32.8%; and agro-industrial and services production in the “after the farm gate” area, 59.6%. Furtuoso also considered that the GDP of the Agro-industrial Complex represented 32% of the total Brazilian GDP in the same year (1996) (Furtuoso 1998).

In Figure 5.2 another value for this statistic is provided. The graph shows the contribution by the Agro-industrial Complex to Brazilian Gross Domestic Product over the period 1994 to 2001, as reported by the National Agricultural Confederation and the University of São Paulo through its Centre for Advanced Studies in Applied

Economy (CNA/CEPEA-USP). In that study, the contribution by the Agro-industrial Complex to Brazilian GDP in 1996 is shown as 28.81% (see Table 5.9).

In 2005, the methodology applied by the CNA/CEPEA-USP Agreement defined the AIC-GDP as 27.87%. The indicators employed in this methodology are the official statistics reported by the Brazilian Federal Government, and are used throughout this thesis.



Source: CNA/CEPEA-USP (2004)

Figure 5.2 Contribution (in percentage) of the agro-industrial complex GDP to the Brazilian total GDP: 1994 to 2001

5.5.1.1. The evolution of agribusiness and implications for the structure of the Brazilian economy

Brazilian agriculture has followed the typical developmental process of agriculture in the rest of the world. From the 1950s, agricultural activities have been redirected and modernized. For example, previously, the majority of tractors and other agricultural machines had been imported from Europe and the United States, but the Brazilian government adopted a policy of industrialization through import substitution. An important aspect of this policy consisted of ignoring agriculture in terms of development policies and using the greater part of the public investment to stimulate the economic development of the highly protected industrial or manufacturing sector.

This economic policy, besides neglecting agriculture, imposed a form of indirect tax on the sector (Schuh 1996).

Despite all of these factors, the modernization process in agriculture entered a more advanced phase in the period after 1965, with significant changes in the technical base underpinning agriculture. In this period, inorganic fertilizer production reached significant volumes, the production of heavy tractors and agricultural implements began, and it has continued growing at an average rate of 18% a year on average since then (Furtuoso 1998).

Furthermore, Brazil started to invest heavily in agricultural research from the beginning of the 1970s, with the creation of Embrapa. With Federal Government resources, Embrapa quickly became one of the best agricultural research institutions in any of the developing countries. It invested heavily in the training of its scientists and, at the same period, the Government also invested large resources in the development of post-graduate education through national programs in the agricultural sciences.

At the end of the 1980s and the beginning of the 1990s, Brazilian agriculture developed enormously, with help from the National Agricultural Credit System, through credit subsidies. The industry registered significant increases in productivity, and regional expansion of the agricultural frontiers, especially in the Central Region of Brazil (Alves 1989). The Brazilian economy experienced a period of high inflation and much government intervention in production activities at this time. At that time, Brazil was a closed, isolated country in relation to other countries in the world.

Suddenly, in a period of 7 years (1990 to 1996), this scene changed dramatically, as a result of the Collor I and Collor II Plans[41] (1990 and 1991 respectively), and the

41 The “Collor Plan (1990)” consisted of removing 80 percent of the liquidity from the financial system by freezing it in an account at the Central Bank for 18 months (the money would be gradually returned to investors only after eighteen months), promoting a profound fiscal reform which included institution of a wealth tax, widespread privatization of public enterprise, and trade liberalization. In 1991, came the sequel: Collor Plan II; besides the usual freezing of prices, this plan involved indexation: all short-term financial transactions (which paid interest daily) were prohibited. Collor Plan II failed, largely because the President - who was impeached in 1992 - had weak political support.

Real Plan[42] in 1994/95. Inflation decreased to levels below 10% a year, the Agricultural Law was created, the economy was opened without reserve to investment and trade, and the government lost much of its capacity to intervene in the private economy (Coes and Welch 2005; Franco 1995; Presidência da República do Brasil 1990a; 1995).

This incredible and rapid change provoked two significant effects in the Brazilian agricultural sector. The first was the wave of exclusion, which eliminated thousands of producers, especially the small ones who had lost their patronage and millions of workers who had lost their jobs. This was all a result of the abolition of credit facilities and guaranteed agricultural prices paid under the economic stabilization plans that had been popular. The second wave was the "quiet revolution", promoted by the agricultural institutions who had paid their debts or the ones that did not have them, which, in order to compete in an organized market, had promoted extraordinary transformation, either in the technological area, or in the managerial area. These organisations saw the advantages of incorporating the production chain concept into their activities (Rodrigues 2001).

This process consolidated the form of the agro-industrial complex, where production features as a strong part of the chain and depends on the dynamics of the industry, promoting increased integration of agriculture with other sections of the chain, and as a consequence, eliminating the separation that existed between the farm and non-farm sectors (Furtuoso 1998).

Nowadays, the main farming supplies, such as fertilizer, crop protect ants, animal rations, fuel and other inputs, as well as the machinery used, are predominantly acquired from the industrial sector, or that part specialized in farming products. In the same way, the agricultural products are specifically destined for the agro-industrial sectors specialized in raw material processing and manufactured food, whether consumed by the urban domestic market or exported (See Table 5.7).

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42 Law Nr. 9,069 of 29/06/95 instituted the Real Plan, launched by Force of a Provisional Measure in July 1st 1994. According to Gustavo Franco (1995), the Real Plan comprised a fiscal strategy centred of the approval of a Constitutional Amendment creating the Social Emergency Fund. This monetary reform process took place during a few months of voluntary adoption of a new unit of account, named the REAL, which later became the national currency. Aggressive trade liberalization and a new foreign exchange policy opened the economy.

The important recent contribution of the agricultural sector was to maintain the stability of the Brazilian currency. The fall in prices for the main agricultural commodities, in the years 1994 and 1995, together with the abundant harvests on offer in those years, meant that agribusiness had become the "green anchor" of the economy, recognized by the large effort made by the private agricultural sector (Rodrigues 2001).

Table 5.7 shows participation by Brazilian agribusiness in the national economy (1994-2005), and demonstrates how this sector has proved to be most resistant to the adverse effects and external turbulence of the worldwide economy. It has overcome the protectionist barriers and persistent subsidies in the industrialized nations and, in spite of the factors just mentioned, has grown at a rate that is seven times that of the whole economy. The Brazilian agro-industrial sector, in recent years, has found new markets beyond the traditional European and North American markets, and every year has gained a greater share of the markets in China, Russia, the Middle East, India, Indonesia, and other countries in Latin America.

From Table 5.7, it is relevant to note the average contribution to Gross Domestic Product by the categories that comprise the Agro-industrial Complex. These numbers reflect the tendency described by Goldberg in 1990, by which worldwide growth in the agro-industrial complex will continue to proceed in different ways at different levels in the vertical integration chain. However, projections calculated for the worldwide agro-industrial complex until the year 2028 show that the functions of processing and distribution (after farm gate activities) will represent about 82% of the total value of the agro-industrial complex, against 62% and 50%, in 1980 and 1950 respectively. Agricultural production (on the farm) will be reduced from 32.4% in 1950 to 9.6% in 2028, while the suppliers of production factors (before the farm gate) will also see their contribution reduced in the same period from 17.6% for 8.8% (Furtuoso 1998; Goldberg 1990).

Table 5.7 Brazilian Total Gross Domestic Product; and Agro-industrial Gross Domestic Product (AIC-GDP) with its component contributions: 1994 to 2005 (in millions of US dollars)

Year	Total GDP		Agro-industrial Gross Domestic Product (AIC-GDP)							
	Values(a)	Annual Variation	Total AIC-GDP (B)	Annual Variation	Supplying Machinery (C)	C/B	Agricultural Production (D)	D/B	Industry Services (E)	E/B
		(%)		(%)		(%)		(%)		(%)
1994	451,414	5.81	137,448	--	6,371	4.64	38,792	28.22	92,285	67.14
1995	470,481	4.22	141,465	2.92	6,111	4.32	39,493	27.92	95,861	67.76
1996	482,989	2.66	139,169	-1.60	6,213	4.47	38,234	27.47	94,722	68.06
1997	498,789	3.27	137,939	-0.89	6,131	4.45	37,691	27.32	94,117	68.23
1998	499,447	0.13	138,738	0.58	6,479	4.67	40,040	28.86	92,219	66.47
1999	503,371	0.79	141,295	1.84	7,572	5.36	39,995	28.31	93,728	66.33
2000	525,321	4.36	141,433	0.09	8,053	5.69	39,636	28.03	93,744	66.28
2001	532,216	1.31	143,904	1.74	8,336	5.79	41,467	28.82	94,101	65.39
2002	542,471	1.93	156,579	8.81	9,713	6.20	46,418	29.65	100,448	64.15
2003	541,385	-0.20	166,811	6.53	10,961	6.57	51,919	31.12	103,931	62.31
2004	618,951	14.30	185,065	10.90	13,177	7.12	64,255	34.72	107,633	58.16
2005	633,187	2.30	176,445	-4.80	10,357	5.87	55,439	31.42	110,649	62.71
Participation average in the AIC-GDP, in monetary terms and as a percentage					8,289	5.43	44,448	29.32	97,786	65.25

Note: The values were transformed from Brazilian Real to US dollars, using the exchange rate quoted on 03/08/04 (1BRL=0.328192 US$ or 1US$=3.04700 BRL).

Source: CNA/CEPEA-USP (2006); and Agricommerce (2005).

Another point that can be observed in Table 5.7 is the substantial decrease in Brazilian AIC-GDP in 2005 when there was a decline of 4.8% from that of 2004. The agricultural sector recorded a fall of 5.3% of the total area planted and a reduction of approximately 39% in agricultural machinery purchases. This reduced profitability of the agricultural sector was caused by, among other less relevant factors, the current rate of exchange imposed on the country, which places the Brazilian currency ("real") stronger in relation to the American dollar than it was previously (Agricommerce 2005; CNA/CEPEA-USP 2006; DPIA/SRI/MAPA 2006).

However, despite this generally expansive scenario, Brazilian participation in the worldwide agricultural market is still very small, not even reaching 4%. This can be seen in Table 5.3 when, in 2004, Brazilian agricultural exports reached $US30.85 billion, comprising 3.9% of worldwide exports of agricultural products. Even so, Brazil occupies an especially important position in the production of commodities such as soybean, beef, sugar, coffee, orange juice, and other crops, as shown in Table 5.8.

Table 5.8 Production and export ranking of selected Brazilian agricultural products, based on export quantities in 2003/2004

Products	Production ranking	Export ranking
Alcohol (non food purpose)	1	1
Banana	2	34
Beef	1	1
Cashew nut	1	2
Cacao	4	6
Chicken meat	2	1
Coffee	1	1
Maize	3	4
Orange	1	15
Orange Juice	1	1
Pig meat	4	10
Soybean	2	2
Soy bran	2	1
Soy Oil	2	2
Sugar	1	1
Sugarcane	1	

Source: Extracted from FAO – Food and Agricultural Organization www.fao.org; and Agriculture, Cattle and Supplying Ministry (MAPA).

With respect to the Brazilian agricultural trade balance (imports and exports of agricultural products), it showed a growing trade surplus of 11.8% in 2005 over the previous year. Brazil exported $US43,601 million of agricultural products, and

imported only $US5,184 million, achieving a trade surplus of $US38,417 million, while the surplus in 2004 was $US34,135 million (DPIA/SRI/MAPA 2006).

All of the 27 states of Brazil contribute to the total value of commodities exported by the Brazilian Agro-Industrial Complex. The smallest contribution comes from the State of Roraima with 0.02% of the total value exported, but with a growth of 60% in relation to the year 2004. Table 5.9 shows the ranking of the top 10 states in the value of agricultural products exported in 2004 and 2005. It can be observed that São Paulo is the State with the biggest contribution to the Brazilian AIC trade balance with 24.6%, followed by Paraná with 13.7%, Rio Grande do Sul (13.6%), Mato Grosso (9.5%), Minas Gerais (8.6%), Santa Catarina (8.4%), Goiás (3.7%), Bahia (3.6%), Mato Grosso do Sul (2.4%), and Espírito Santo with 2.4%. The top 10 States, together, contributed 90.6% of Brazilian agricultural exports, while the other 17 States contributed only 9.4% to the total trade in 2005.

Table 5.9 Top 10 States in Brazilian agricultural exports: 2004 and 2005

Ranking	States	Exports by Agro-Industrial sector			
		2004	**2005**	**Increase/decrease in contribution**	**Contribution to total exports in 2005**
		($US million)	*($US million)*	*(%)*	*(%)*
1	São Paulo	9,104	10,711	17.7	24.5
2	Paraná	6,514	5,959	-8.5	13.67
3	Rio Grande do Sul	6,214	5,930	-4.6	13.6
4	Mato Grosso	3,093	4,131	33.6	9.5
5	Minas Gerais	2,599	3,735	43.7	8.6
6	Santa Catarina	3,159	3,657	15.8	8.4
7	Goiás	1,238	1,599	29.2	3.67
8	Bahia	1,247	1,555	24.7	3.57
9	Mato Grosso do Sul	585	1,060	81.2	2.43
10	Espírito Santo	976	1,051	7.7	2.41
Total from top 10 States		34,729	39,388	13.415	90.35
Total from remaining 17 States		3,506	4,213	16.5	9.65

Source: Adapted from Secretariat of Foreign Trading, Ministry of Industrial and Commercial Development (SECEX/MDIC) (DPIA/SRI/MAPA 2006).

Table 5.10 shows the main agricultural products exported by the Brazilian agro-industrial sector in the years 2004 and 2005. Despite registering a significant drop of 5.7% in value in 2005 compared to the results from 2004, soybean remained the most important agricultural product, contributing 21.7% of total exports by the Brazilian agro-industrial sector. Meat maintained second position among the most important products with a contribution of 18.3% of total exports in 2005, followed by sugar and alcohol with 10.7%, paper and cellulose (7.8%), hides, skins and leather products (7.0%), timber (7.0%), coffee (6.6%), tobacco (3.9%), fruit juices (2.7%), and fruits (1.6%).

There can also be observed, in Table 5.10, a sharp increase, in 2005, in the contributions of sugar and alcohol (by 49.3%), coffee (by 42.2%) and meats (by 29.8%) as all of these industries increased export performance.

Table 5.10 Top 10 agricultural products exported by Brazilian agro-industrial sector: 2004 and 2005 (in millions of US dollars)

Ranking	Product	2004	2005	Increase/decrease in contribution	Contribution to total exports in 2005
		($US million)	*($US million)*	*(%)*	*(%)*
1	Soybeans	10,048	9,477	-5.7	21.7
2	Meats	6,144	7,977	29.8	18.3
3	Sugar and alcohol	3,138	4,684	49.3	10.7
4	Paper and cellulose	2,909	3,405	17.1	7.8
5	Leather and its products	2,897	3,069	5.9	7.0
6	Timber	3,044	3,031	-0.4	7.0
7	Coffee	2,025	2,879	42.2	6.6
8	Tobacco	1,426	1,707	19.7	3.9
9	Fruit juices	1,141	1,185	3.9	2.7
10	Fruits	592	677	14.4	1.6

Source: Secretariat of Foreign Trading, Ministry of Industrial and Commercial Development (SECEX/MDIC) (SPA 2005)

It is important to note the development of the trade balance for the Brazilian agro-industrial sector over the past five years. The period from 2001 to 2003 was characterized by increased participation of Brazilian agricultural products in new and diversified markets, such as in Asia, the Middle East, and Eastern Europe. A rapid rise was recorded in the volume of Brazilian agricultural products exported to all of the main economic blocs: Mercosul, 40%; NAFTA, 17%; the European Union, 22.4%; Eastern Europe, 26.8%; Asia 33.3%; the Middle East, 34.3%; and Africa, 9.7%. Considering countries individually, it is important to note Israel's growth as an export destination (approximately 122.9%) and Rumania's (114%). In the same time, exports to China rose by 66.2%, and to Turkey (67%), Ukraine (35.9%), Hong Kong (35.9%), Taiwan (67.3%), Iran (71.7%), and South Africa 56.8%. China has become an important destination for exports from the Brazilian agro-industrial sector, absorbing exports to the value of $US2.2 billion and occupying third position as a trading partner, being surpassed only by the United States, with $US4.8 billion and the Netherlands, with $US3.1 billion (Agricommerce 2005).

The most important buyers of Brazilian agricultural products in 2004 and 2005 are shown in Table 5.11. The European Union (EU) continues to be the main destination, absorbing 32.5% of the total Brazilian agro-industrial exports. The United States (US) was in second place with 13.7%, followed by China with 7.1%, Russia (6.2%), Japan (3.9%), Argentina (2%), Saudi Arabia (1.8%), Iran (1.8%), Hong Kong (1.5%), and South Korea with 1.4%.

In the past two years, the EU, US, and China (the leading importers in 2003) regularly increased their imports of Brazilian agricultural products. Russia increased its share of Brazilian exports by 76.7% from 2004 to 2005, and Saudi Arabia, in the same period, raised its participation by 32.4%. Iran, however, reduced its agricultural imports from Brazil by 19.7%.

Brazil currently exports approximately 20% of all its agricultural production. With a population in excess of 185 million, Brazil has one of the biggest domestic markets in the world, consuming approximately 80% of the agricultural products produced in the country, but in the past 15 years, the Brazilian agro-industrial sector has undergone a huge expansion.

The grain harvest jumped from 57.8 million tonnes in 1990/1991 to 123.2 million tonnes in 2002/2003. Poultry production more than tripled, rising from 2.3 million to 7.8 million tonnes in the same period. Bovine meat production increased 85%, from 4.1 million to 7.6 million tonnes, while pork production increased by 173.3%, jumping from 1 million to 2.87 million tonnes of meat. In 2006, Brazil has the biggest bovine herd in the world, with approximately 183 million head of cattle. The country is the biggest producer of sugarcane in the world, with a planted area of 5.4 million hectares and a harvest of approximately 354 million tonnes, producing approximately 25 million tonnes of sugar and 15 billion litres of ethanol (DPIA/SRI/MAPA 2006).

Table 5.11 The most important importers of Brazilian agricultural products: 2004 and 2005 (in millions of US dollars)

Ranking	Country	2004	2005	Increase/decrease in participation	Share of total imports in 2005
		($US million)	*($US million)*	*(%)*	*(%)*
1	European Union 15 member countries	13,429	14,174	5.5	32.5
2	United States	5,756	5,965	3.6	13.7
3	China	2,963	3,089	4.3	7.1
4	Russia	1,540	2,721	76.7	6.2
5	Japan	1,376	1,720	25.0	3.9
6	Argentina	772	880	14.0	2.0
7	Saudi Arabia	608	805	32.4	1.8
8	Iran	966	776	-19.7	1.8
9	Hong Kong	647	653	0.9	1.5
10	South Korea	500	619	23.8	1.4

Source: Secretary of Foreign Trading, Ministry of Industrial and Commercial Development (SECEX/MDIC) (Boddey et al. 2003; CNA/CEPEA-USP 2002; Paterniani 2000b; Schuh 1996)

This tremendous expansion has been underpinned by agricultural research, which had the basic role of developing new products and different production technologies. With almost of all the financial support coming from the Federal and States governments (95% of the total invested in agricultural R&D), the agricultural research institutions developed a strong and very useful portfolio of technologies to

meet the specific needs of Brazilian agribusiness(WTO 2005). However, the question whether this will be adequate for the future needs to be asked.

5.6. Summary

In a globalized world where cultural, social, and economic changes are likely to affect both rich and poor households, all social classes of people appear to have some engagement with the International market. More than $US13 trillion worth of goods were exchanged in international trade in 2004, although agricultural products represented a small segment (about 8.55%) of the total goods traded in the world. Agricultural markets, however, still represent a significant sector of the world economy, and a very important one for Brazil.

Despite the high-ranking position that Brazilian agricultural products have reached in the international market in recent years, the results achieved in 2005 raised the alert to review the Brazilian agricultural system and all its segments. In 2005, the contribution from Brazilian agriculture to national GDP fell to 28%, from 30% in the previous year. In world trade in agricultural commodities, Brazil is responsible for only 1% of the total value of commercial transactions, occupying 25th place in the ranking of exporting nations. Therefore, it appears that although Brazil has already constructed a commercial bridge with the world, it is not strong enough.

Brazil needs to do more to match the elite members of the world's most commercial agricultural producers. It is essential that changes occur, such as more investment in agricultural research and development, and those steps be taken to implement the basic elements of intellectual property law, the Biosafety regulatory framework, and to develop new methods to increase the involvement of the private sector in the development of agricultural research projects and in providing financial support for them. It is also important to review the agricultural deregulation process started in the 1990s, with a focus on the actual needs of the agricultural market. To do this, it may be necessary to take government action to reduce the influence of the bureaucracy, to create new mechanisms to manage the agro-industrial sector, and to make it easy for the segments of the sector to access the financial and technical information needed as part of the productive process.

CHAPTER 6

DATA COLLECTION AND ANALYSIS: COTTON AND DAIRY INDUSTRY STAKEHOLDERS' VIEWS

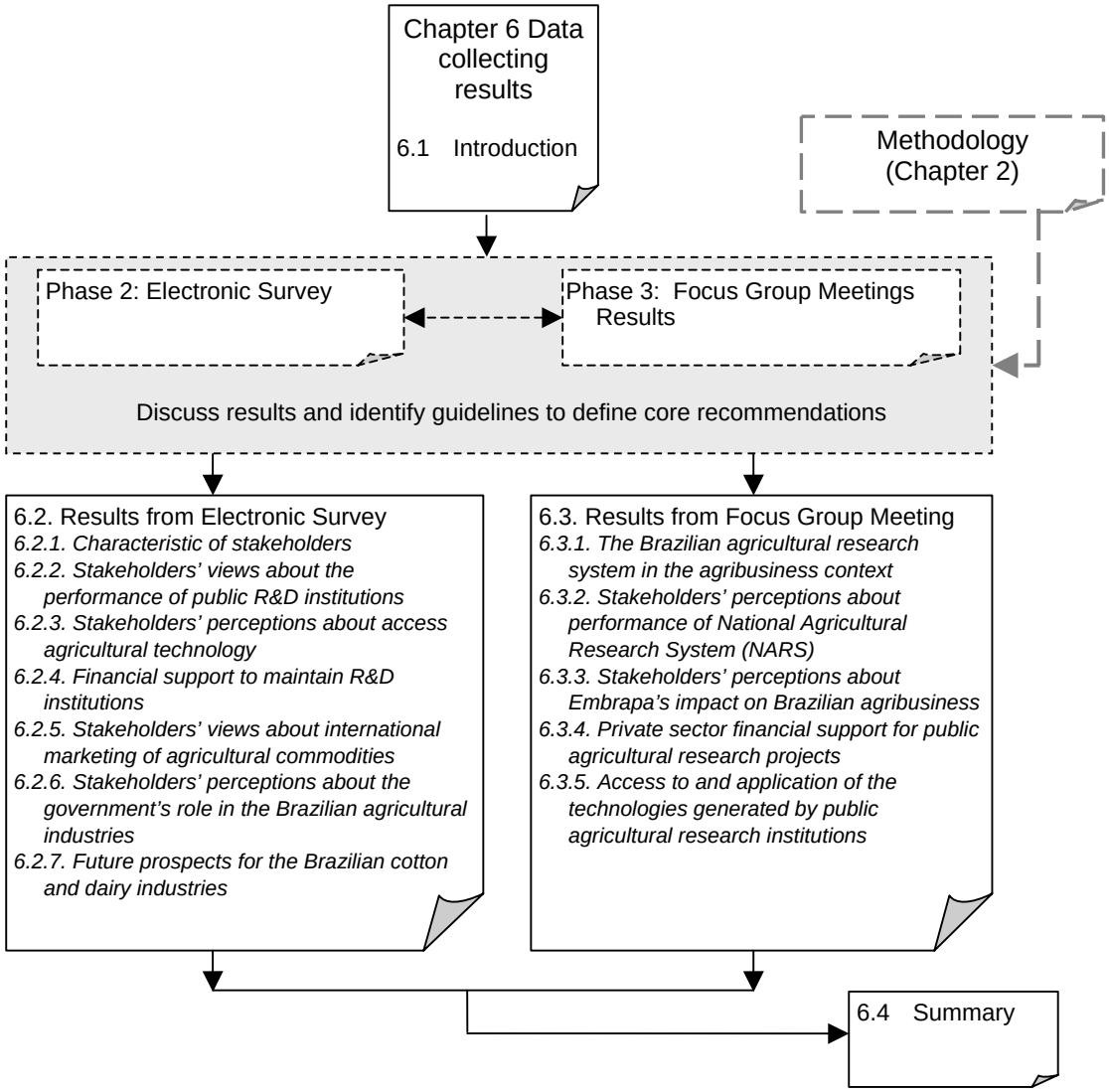

Figure 6.1 Structure of Chapter 6

6.1. Introduction

The objective of this chapter is the documentation and description of the data from the electronic survey (questionnaires) and from a series of focus group meetings involving the stakeholders of the cotton and dairy industries in Brazil. In Chapter 7, the results from the three phases of data collection – defined in Chapter 2 – were analysed in an integrated way to respond to the research questions and objectives of this study.

The data presented in this chapter are the results of research to find the opinions of representatives of all segments of the cotton and dairy industries in Brazil about the performance of public agricultural research institutions in that country. The research was also designed to discover the nature of the relationship between those public institutions and private industry. As foreshadowed in Chapter 2, in which the methodology of this study was described, the data had been obtained in three distinct phases, and the people invited to take part in this research had been selected with a view to engaging a number of people from each sector of these industries, in order to gather a wide range of views. In this chapter, the results from the second and third phases of the research will be organized and described.

The second phase of data gathering began with a survey by questionnaire, conducted via the Internet, of all of the selected representatives of the cotton and dairy industries. The aim was firstly to characterize the respondents, and then to gather stakeholders' views and perceptions about the performance of the public agricultural research institutions in Brazil. It was also important to find out their opinions of the experience of other countries involved in the international agricultural market, their attitudes towards financial support for agricultural research projects, and the government's role in supporting Brazilian agribusiness. The data collected in this phase were sufficient to allow a valid statistical analysis of the responses from cotton and dairy industry stakeholders, and to identify many important and strategic points to answer the other research questions in this study as well as to support, strongly, the conclusions that were later reached.

In the third phase of data gathering, three Focus Group Meetings were conducted, two with dairy industry representatives, and one with representatives of the cotton industry. In these meetings, the results obtained in the first and second

phase of data collection were reported back to stakeholders and discussed, in order to focus the discussion on to the most important strategic points regarding the future direction of agricultural research in Brazil.

6.2. Results from Phase 2 research – Electronic Survey

The data were collected from a sample of stakeholders in the cotton and dairy industries, with a computerized self-administered questionnaire. The design of the electronic survey [using the Survey Said software (Masters 1999)] allows a secure reception of answers from the respondents, and provides the facility for basic statistical analysis of the data. To take part in this survey, each respondent received a pin number following the invitation to participate. The answers to the questionnaire were provided directly on the Internet.

The study was conducted in the Brazilian states of Mato Grosso, Minas Gerais, Goiás, and Bahia. The work to identify and select representatives from all segments of the cotton and dairy industries was accomplished with the assistance of Embrapa Dairy Cattle, Embrapa Cotton, and the Brazilian Cotton Producers Association (ABRAPA). In total, 730 stakeholders considered eligible to answer the questionnaire were identified. Therefore, 350 representatives from the cotton industry and 380 dairy industry representatives were invited to participate in the survey (see the number per professional group in Table 2.2, Chapter 2). From this total, 246 completed questionnaires from cotton and 238 from dairy industry groups were received, making a total of 484 questionnaires returned, or a response rate of 66.3%. This is considered a very good response in view of what is reported in the literature, for example, Stevens (1996), de Vaus (2002) and Babbie (2005).

From the total of 484 replies received, 112 questionnaires were discarded owing to technical/operational problems (such as Internet connection drop-outs, partially completed questionnaires, or questionnaires sent in duplicate), leaving 372 usable replies. To this total, 33 more responses that were completed directly by the producers who were interviewed as part of this study were added. Therefore, results presented in this study were based on 405 answers to the questionnaire, 232 from the cotton and 173 from the dairy industry.

6.2.1. Characteristic of stakeholders

Of the total of 405 usable replies, 23.2% came from the public sector and 76.8% came from the private sector. In terms of the origin of respondents, 9.6% came from farm input suppliers, 7.9% from managers of logistics companies, 30.9% from producers, 21.2% from the managers of producer associations and traders (cooperatives, syndicates, foundations and associations), 19.3% from agricultural researchers and University lecturers, 8.1% from service providers (technical consultants), and 3.0% from government authorities (Federal, State and municipal).

Table 6.1 shows that public sector participation in Brazilian agribusiness, taking the cotton and dairy production chains as an example, is small, with the exception of the agricultural researchers and university lecturers group. In this group, government participation is quite high, with 78.2% of researchers and lecturers working in public institutions and only 21.8% in private institutions. Another important point is the proportion of technical consultants linked to public institutions (27.3%), compared to those in the private sector (72.7%). These data confirm the significant changes that have been occurring in Brazil in this segment of the agricultural production sector since the closure of the EMBRATER (the Brazilian Agricultural Extension Company), and the disintegration of the structure and poor performance of the extension and technical assistance services in the state administrations, a process started in 1991 as part of the deregulation of Brazilian agriculture.

Table 6.1 Professional groups of respondents and their sectoral links

Industry	Sector	Respondents' employment category							
		Farm input suppliers	Logistics company managers	Producers	Managers of producers' associations	Agricultural researchers and lecturers	Technical consultants	Government authorities	Total
Cotton	Public	2	4	3	3	27	6	8	53
	Private	18	16	3	22	13	16	n.a.*	88
	Owner/elected representative	5	4	67	13	0	2	n.a.	91
	Total	25	24	73	38	40	24	8	232
Dairy	Public	0	0	0	0	34	3	4	41
	Private	8	6	0	24	4	5	n.a.	47
	Owner/elected representative	6	2	52	24	0	1	n.a.	85
	Total	14	8	52	48	38	9	4	173
	Grand Total	**39**	**32**	**125**	**86**	**78**	**33**	**12**	**405**

* n.a. = not applicable

It is important to emphasize the high overall educational level of the representatives of the diverse segments of the production chains studied. This is a feature of the significant change that has been occurring in the Brazilian agro-industrial sector. Table 6.2 shows that only 1.5% of the respondents had no more then primary school education, 18.3% attained high school level, 33.6% have a university degree, while 13.3% include a relevant specialization[43], 16.8% have a Master's degree, and 16.5% were educated to PhD level. These are impressive statistics, indicating the high level of education of the respondents, but they are to be expected since professional groups such as agricultural researchers and lecturers, managers of production associations, and technical consultants are included in these statistics.

43 Specialization is generally equated to holding postgraduate qualifications (post-graduation, "lato sensu" general knowledge, not specific), mainly aimed at the training of the technician-professional in a fairly restricted area of knowledge, but not covering the total knowledge about the area of which the specialty forms a part. The courses of specialization are directed at academic and professional improvement, with a minimum of 360 hours of study accomplished in a maximum of two years. In this category, there are the training in selected areas, and courses such as MBA (Master of Business Administration) or its equivalents. To apply for these courses, the student must to have the relevant university degree.

On the other hand, an analysis of the farm producers' statistics on their own shows that 32.8% have a university degree, 18.4% have a university degree with a specialization, Master's degree, or PhD, 44% have high school level education, and only 4.4% of the producers who responded to the survey have only a primary school education. It is important to note that one cannot generalize from these data that have been obtained from the cotton and dairy industries, but it is appropriate to note the change that is occurring in the education profile of Brazilian agricultural producers who are steadily searching for better academic foundations and looking to improve their performance by adopting new technologies relevant to production, aiming for both the domestic and international markets.

Table 6.2 Stakeholders' education levels

	Respondents' employment category															
	Farm input suppliers		Logistics company managers		Producers		Managers of producers' associations		Agricultural researchers and lecturers		Technical consultants		Government authorities		Total	
	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D
Primary school	0	0	0	0	3	3	0	0	0	0	0	0	0	0	3	3
High School	2	1	1	2	28	27	7	6	0	0	0	0	0	0	38	36
University Degree	13	7	13	4	27	14	15	16	6	2	16	1	3	1	93	43
Specialization	3	3	2	0	9	6	9	2	0	2	1	2	3	2	27	27
Master's degree	4	3	8	2	5	0	4	13	17	4	4	3	0	1	42	26
PhD	3	0	0	0	1	2	3	1	17	32	3	3	2	0	29	38
TOTAL	**25**	**14**	**24**	**8**	**73**	**52**	**38**	**48**	**40**	**38**	**24**	**9**	**8**	**4**	**232**	**173**

Note: C = Cotton and D = Dairy

6.2.2. Stakeholders' views about agricultural research and their perceptions about the performance of public agricultural research institutions

Firstly, the study sought to learn the respondents' opinions about agricultural research in the general context of agribusiness in Brazil and in the world as a whole. About 68% of respondents confirmed the view that agricultural research was "extremely important", 25% said that it was "very important", and 4% defined agricultural research as "important" to ensure the efficiency and competitiveness of

Brazilian agricultural industries. Therefore, 97% of the stakeholders considered agricultural research and development activities important and, in addition, 61% of the respondents considered the support from agricultural technology generated by the research institutions "extremely important" or "very important" to improve the returns from the Brazilian agricultural commodities in international markets (see Table 6.3).

Table 6.3 Importance of agricultural research in the development of the cotton and dairy industries

Issues	Answers											
	Extremely Important		Very important		Important		Moderately important		Not important		Do not know	
	C	D	C	D	C	D	C	D	C	D	C	D
Importance of research and development activities to ensure the efficiency and competitiveness of Brazilian's cotton and dairy industries	173	103	44	59	8	8	2	2	1	0	4	1
Importance of support for agricultural technology to improve international marketing of cotton and dairy commodities	3	73	63	69	12	22	8	4	3	2	3	3

Note: C = Cotton and D = Dairy

Table 6.4 demonstrates that approximately 68% of the people who answered the questionnaire used or had used technology generated by the agricultural research institutions. This proportion rises to 96%, if the 127 respondents who said that the question did not apply to them, are excluded from the statistics. On the other hand, it is worth noting that, despite almost all of the remaining respondents confirming that they apply the technologies generated by the research institutions, only 23% of the 402 respondents to this question have, or have had, past contracts or partnerships with research institutions to develop collaborative research projects.

Excluding the respondents who answered that this question did not apply to them, and considering only the 277 respondents with potential capacity to use new agricultural technology in their activities, we find this proportion rises to 33%. This is still a low level of collaboration when we consider that 96% of this group confirmed that they used some kind of agricultural technology to improve their production.

Table 6.4 Respondents using technology and having research agreements

Questions	Answers					
	Yes		No		Not applicable	
	C	D	C	D	C	D
Have you adopted some technology created by and available from the cotton and dairy research institutions?	166	108	6	4	66	61
Do you have or have you had a partnership agreement with any agricultural research and development institution with the objective of implementing and/or financing a research and development project?	72	20	101	84	56	69

Note: C = Cotton and D = Dairy

Table 6.5 shows the opinions of the 67% of respondents who said they had never had a contract with an agricultural research institution. They were asked what makes it difficult or hinders the development and confirmation of these partnership agreements. It can be seen that 32.5% of respondents said that the agricultural R&D institutions do not get involved in the process of showing companies how to implement technical and commercial partnerships. About fifteen percent alleged that information about how to form these partnerships was not available, or that there was not enough information to facilitate decision making. Another 30.4% believed that the agricultural research institutions were not prepared to join with partners, and their involvement in the process to show potential partners how to implement technical and commercial partnerships was lacking. Fifteen percent of respondents considered that it was unnecessary to sign a contract because the majority of the agricultural technologies were available from the research institutes without cost. Finally, 10.4% said that they had difficulties in getting finance for this kind of

partnership and 8.4% said that the existing laws, rules, and procedures created to define the research institutions' activities were not sufficiently inclusive or clear enough to allow these partnerships to develop. Therefore, from the respondents' opinions, it was clear that communication problems existed between the segments of the agricultural sector, and deficiencies in the departments of the research institutions responsible for contractual research were the main problems hindering the development of research agreements between public and private sectors.

Table 6.5 Factors hindering the development of partnership agreements with agricultural research and development institutions

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
The majority of the relevant agricultural technologies are freely available	49	16.6	33	13.1	82	15
The information about how to form these partnerships is not available or is inadequate	92	31.2	86	34.3	178	32.5
The research and development institutions do not get involved in the process of showing companies how to implement technical and commercial partnerships	83	28.1	82	32.7	165	30.4
The laws, rules, and procedures created to define the research and development institutions' activities are not inclusive and clear enough to allow partnerships with private sector companies to develop	18	6.1	28	11.2	46	8.4
It is difficult to obtain finance to improve this kind of partnership agreement	45	15.3	12	4.8	57	10.4
Other reasons	8	2.7	10	4.0	18	3.3

6.2.2.1. Stakeholders' opinions about performance of public agricultural research institutions

The results obtained in this section of the research revealed a significant level of dissatisfaction with the performance of the public agricultural research institutions in Brazil. This dissatisfaction was registered by representatives of all the segments of the agricultural production chain in the cotton and dairy industries, including the agricultural researchers who work in these institutions. This may indicate a lack of support for the concept of public research institutions, or for the way in which they operate at present.

Table 6.6 shows that only 4% of the respondents considered that the performance of the public agricultural research institutions in Brazil was excellent, 15.3% said they were very good, around 43.7% considered the performance of the public institutions only good, and the surprise was the number of people who considered that the activities of these institutions were only fairly good or bad. The responses show that approximately 36% of the respondents are not satisfied with the performance of public agricultural R&D institutions in Brazil. Approximately fifteen years ago, the level of satisfaction was very close to 100% (EMBRAPA 2002b, 2002a).

Table 6.6 Stakeholders' opinions about the performance of public agricultural research institutions

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
Very bad	0	0	0	0	0	0
Bad	10	4.3	3	1.7	13	3.2
Fairly good	62	26.6	72	41.6	134	33.1
Good	102	43.9	75	43.4	177	43.7
Very good	46	20	16	9.3	62	15.3
Excellent	9	3.9	7	4	16	4.0
Do not know	3	1.3	0	0.0	3	0.7
Total	**232**	**100.0**	**173**	**100.0**	**405**	**100.0**

Further, in considering the opinion of each professional group in the cotton industry separately, it can be observed that the cotton producers are not satisfied with the performance of the public agricultural research institutions that work with cotton. The research showed that of the total of 73 producers (which included cotton mill proprietors, cotton suppliers, cotton producers, and cotton producers who are also cotton mill proprietors), approximately 40% defined the performance of the research institutions in the cotton industry as fairly good or bad, 42.6% considered it good, 15% believed that the performance of these institutions was very good, but only 2.7% defined the performance of the public research institutions as excellent. Another curious point to be observed concerns the opinions of the agricultural researchers who also work in these institutions. Their answers revealed that 22.5% considered the performance of the public R&D institutions as fairly good, 35% said that their performance was good, 32.5% considered it very good, but only 10% defined it as excellent (see Figure 6.2).

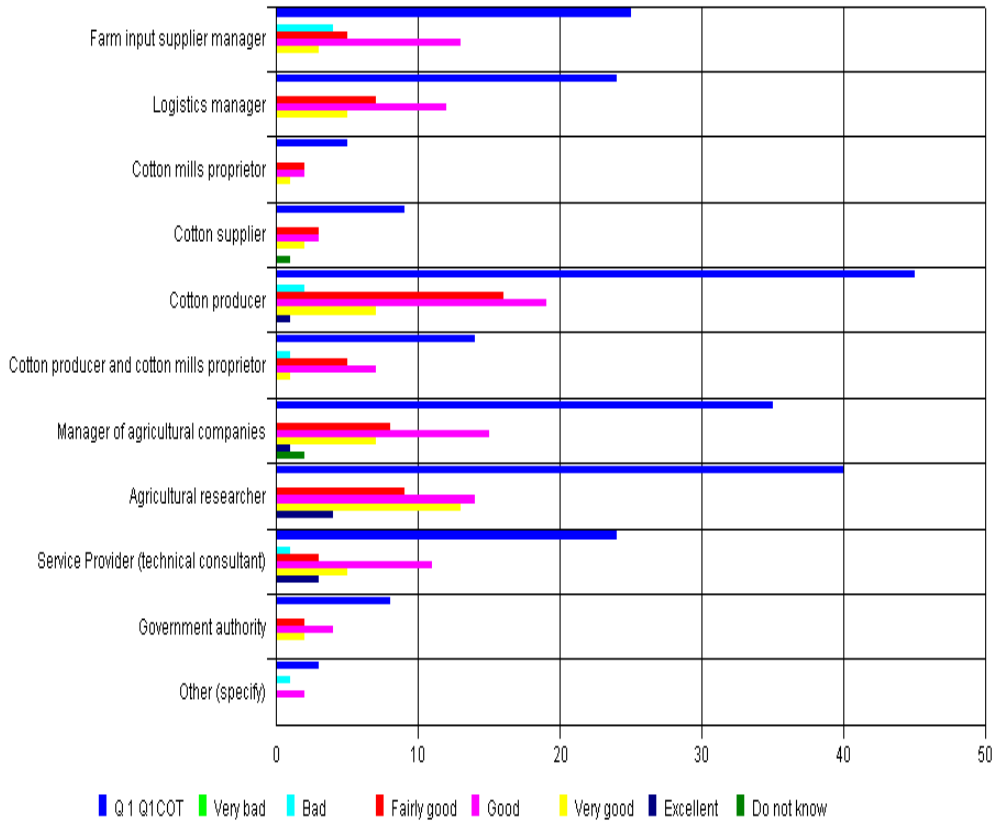

Figure 6.2 Opinions of cotton industry stakeholders about public agricultural research institutions

An examination of the responses to this question by the dairy industry stakeholders reveals that 52 producers answered it and 50% of the respondents considered the performance of public research institutions as bad or fairly good, 46% considered it good, and only 4% classified their performance as very good. Of the agricultural researchers who work in dairy projects, 34% indicated that the performance of the research institutes was only fairly good, 26% considered it good, about 29% defined the performance as very good, but only 11% defined the performance of the research institutes as excellent (see Figure 6.3).

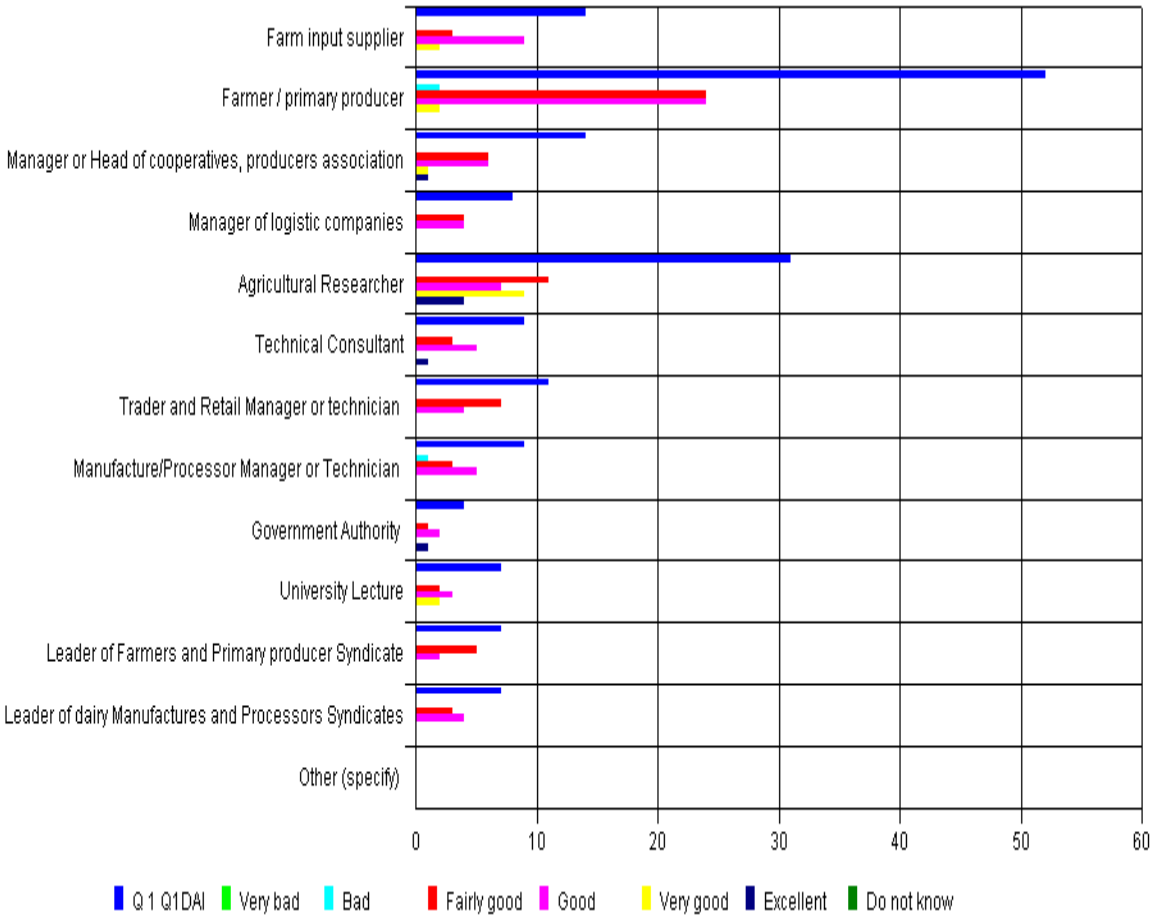

Figure 6.3 Opinion of dairy industry stakeholders about public agricultural research institutions

These results indicate that, in the opinion of its stakeholders, the current agricultural research model is not working in accordance with the agricultural market demands. The results show that many of the agricultural researchers working in public institutions are not satisfied with the institutions' performance and with the results they provide to society which, directly or indirectly, depends on the good performance of these institutions.

When asked to identify what was missing and, consequently, where the public research institutions need to improve, the cotton and dairy industry stakeholders' opinions were split among a range of issues, as presented in Table 6.7. About 17.6% of respondents believed that an integrated system of research and extension needed to be created to interact with and to service the agricultural industries, while 17.2% recognized that the public agricultural research institutions needed to be able to have technicians work in Brazilian agribusinesses to involve the private sector in productive partnerships. Another 15.1% realized that it was necessary to increase the investment in research projects but, on the other hand, 14% saw the need to create legal instruments to implement the existing laws that control the formation of partnerships between private companies and the public sector. Another point is that 12.2% of the respondents said it is necessary to expand the range of activities of the public agricultural research institutions, creating new projects that involve all of the segments along the supply chains. Finally, about 12.6% said that it is necessary to facilitate access to existing and to new information.

They referred to the need for the agricultural research institutions to expand their research capabilities so that they can respond adequately to the increasing and more complex needs of their clients and the market. In addition to carrying out research projects, they need to develop the capacity to work in concert with the productive sector and deliver what it requires, forming strategic partnerships, as well as investing in training of their technicians to enable them to work in the business or marketing or economics part of the production chain.

Table 6.7 Cotton and dairy stakeholders' opinion about what the public research and development institutions need to do to improve their performance

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
Increase investment in research projects	98	13.5	172	16.3	270	15.1
Increase investment in training research staff	51	7	115	10.9	166	9.3
Allow easy access to information	97	13.3	128	12.1	225	12.6
Create new projects involving all segments of the agricultural supply chain	84	11.6	134	12.7	218	12.2
Create a system of research and extension capable of interacting with the agricultural industries to meet demands and transfer solutions to the diverse sectors	141	19.4	173	16.4	314	17.6
Create legal instruments to regulate partnerships with the private sector, considering the existing laws covering this subject	106	14.6	144	13.6	250	14
Enable technicians to work in the business/marketing/economics part of the production chain in Brazilian agribusiness with the objective of developing partnerships involving the public and private sectors	135	18.5	172	16.3	307	17.2
Other issues	15	2.1	18	1.7	33	2

6.2.3. Stakeholders' perceptions about access to agricultural technology and the results of its application in the agricultural sector

With the intention of trying to find how stakeholders were gaining access to agricultural technology, the study attempted to identify whether the production sector had been accessing the technologies created by the public agricultural research institutions. It also attempted to ascertain what the producers' perceptions were about how well the technology was performing in those cases where technology, created by the public institutions, was applied. Table 6.8 demonstrates the results: approximately 79% of the respondents reported that there were many technologies created as a result of research carried out in the public institutions but not applied

because the production sector did not know about these technologies. On the other hand, the research also indicates that about 78% of the stakeholders were of the opinion that the export of Brazilian agricultural products would be increased above current levels, if the existing and available agricultural technologies were known and applied by the various industry segments.

Table 6.8 Stakeholders' perceptions about technology access and application

Questions	Answers								
	Cotton			Dairy			Total		
	Agree	Disagree	No opinion	Agree	Disagree	No opinion	Agree	Disagree	No opinion
There are many technologies created and made available by the research and development institutes that Industry does not know about and, as a consequence, loses the opportunity to apply.	67	45	17	152	13	7	319	58	24
If the existing available technologies resulting from the research and development projects were known and applied by the industries' segments, the export of Brazilian agricultural products would be better than it is now.	70	44	15	146	19	8	136	63	23

These results provide evidence of a situation where technologies are created as part of the Brazilian agricultural system, but knowledge about them is limited and they are not used. Also, there is substantial agreement on the part of the production sector that if they had knowledge of and applied all of the technology available, then the position of Brazilian agriculture, in the domestic and international market, would be better through increases in the productivity and quality of agricultural production, and by reducing the prices of agricultural products on the domestic market, which would raise the farmers' incomes, for example. Therefore, these results indicate that the system needs to be improved and to become more efficient in the definition of what to research (demand identification), how to communicate the results of this research, and how to apply the generated technologies (transference of technology).

In this regard, Table 6.9 shows the opinions of the respondents on what is hindering the application of new technologies and the consequent improvements to the performance of Brazilian agricultural products in the market. It can be seen that the majority of respondents registered their opinion that the public agricultural research institutions need to improve their performance as part of the agricultural supply chain. About 29% of the respondents said that the research institutions are not adequately prepared to divulge information and to guide the producers on how to apply the new technologies they create. Another 25% alleged that these institutions are prepared to do the research but not to introduce the new technologies adequately into the domestic or the international market, while 21% believe that the technologies are not widely applied owing to limited financial resources and difficulty in securing the necessary financing. Finally, 20.8% recognize that the production sectors are not organized, in terms of structure, to avail themselves of the benefits that the new technologies created by the public sector research institutions could generate.

Table 6.9 Stakeholders' opinions about factors hindering application of technology that could improve Brazil's position in the international agricultural market

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
Research and development institutions are not totally prepared to divulge information and to help potential users apply new technologies	159	28.5	141	30.3	300	29.3
Industry segments have difficulty accessing the financial resources necessary to apply and to implement new technology	118	21.2	98	21	216	21.1
Producers are not organized in terms of structure to receive and to apply new technology	107	19.2	105	22.5	212	20.8
Research and development institutes are organized to develop new technology but not prepared to introduce these technologies adequately to the market (commercialise them)	150	26.9	103	22.1	253	24.7
Other (specify)	23	4.1	19	4.1	42	4.1

It was important in this study, to identify those areas of the agricultural supply chain to which the research institutions should have to dedicate more of their effort. In the respondents' views about which segments of the production chain need attention and support from technology, farm production was identified as deserving special attention by 32.7% of respondents. This was followed by the logistics area with 20.5%, and information access with about 19.1% (see Table 6.10).

Table 6.10 Stakeholders' opinions about which segments of the production chain need attention and support from technology

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
Farm production	173	30.4	155	35.7	328	32.7
Input supplies	72	12.7	33	7.6	105	10.5
Processing/Manufacturing/Machinery	92	16.2	62	14.3	154	15.4
Logistics (transport, discharge, delivery, etc.)	126	22.1	80	18.4	206	20.5
Information access	96	16.9	96	22.1	192	19.1
Other issues	10	1.8	8	1.8	18	1.8

6.2.4. Financial support to maintain R&D institutions

It became evident through the survey results, that in the respondents' opinion, financial support to maintain the public research and development institutions in the Brazilian agricultural system should come from both the private and government sectors. Table 6.11 records that approximately 93% of the respondents said that financial support to maintain R&D institutions must come from a combined private and government financial source. Only 6% thought that R&D activities should be supported by government funding alone and just one per cent said that the financial resources for research institutions should come only from the private sector.

Table 6.11 Stakeholders' opinions about who should provide financial support to maintain the R&D institutions' activities

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
Private Sector funding only	2	0.9	2	1.2	4	1.0
Government Sector funding only	12	5.3	13	7.5	25	6.2
Combined private and government sector funding	214	93.8	158	91.3	372	92.8

The respondents were then asked to define the proportion to be supported by the private sector. Table 6.12 reveals that 66.7% of the respondents believed that the private sector should contribute substantially, between 21% and 60% (with a median value of 40.5%), leaving the government with the responsibility of providing the balance (from 79% to 40%). The results also show that 11.6% of stakeholders considered that the private sector needs to assume responsibility for providing between 61% and 80% of the cost of running research institutes in the cotton industry, while approximately 14% said that only a small fraction (5% to 20%) should came from the private sector and almost all (80% to 95%) from the government sector. So while there is general consensus that government and private funding of research is appropriate, there is a wide divergence of views about how much each partner should contribute.

Table 6.12 Proportion of private and government funding for research

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
From 05% to 20% by private sector and from 80% to 95% by government sector	24	10.7	31	18.7	55	13.9
From 21% to 40% by private sector and from 79% to 60% by government sector	55	24.6	53	30.8	108	27.3
From 41% to 60% by private sector and from 59% to 40% by government sector	98	43.8	58	33.7	156	39.4
From 61% to 80% by private sector and from 39% to 20% by government sector	30	13.4	16	9.3	46	11.6
From 81% to 95% by private sector and from 05% to 19% by government sector	9	4	1	0.6	10	2.5
No opinion	8	3.6	13	7.6	21	5.3

Finally, Table 6.13 presents the stakeholders' opinions about the possibility of their industry supporting a fund to increase investment in the research and development institutions that are working on agricultural projects. The answers showed that 67% of the stakeholders in the cotton industry agreed to support the agricultural research projects financially, 9.9% disagreed, and 23.1% of respondents did not have an opinion about this subject. Support from dairy industry stakeholders was higher (76.3%), but so was disagreement with the proposal (11%). Fewer of dairy stakeholders (12.7%) had no opinion on this question. Overall, 71.2% of the stakeholders supported the proposal.

Table 6.13 Stakeholders' position on supporting a fund to improve investment in research and development institutions

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
Agree	142	67	132	76.3	274	71.2
Disagree	21	9.9	19	11	40	10.4
No opinion	49	23.1	22	12.7	71	18.4
Total	212	100.0	173	100.0	385	100.0

6.2.5. Stakeholders' views and perceptions about international marketing of agricultural commodities

Another important aspect considered in this research was with respect to the respondents' opinions about the international market for agricultural commodities, the experience of other countries that had been successful in this arena and the implications of this for the development of Brazilian agribusiness. Table 6.14 shows that 78.7% of the respondents overall, when considering the current situation of the cotton and dairy industries, answered that the international market represents a great opportunity for the growth and development of Brazilian agribusiness. On the other hand, 11% considered the international market a threat.

Table 6.14 Cotton and dairy stakeholders' opinions about the international market, considering the actual situation of the cotton and dairy industries in Brazil

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
Opportunity	169	74.8	145	83.8	314	78.7
A menace	29	12.8	15	8.7	44	11.0
Indifferent	16	7.1	6	3.5	22	5.5
Do not know	12	5.3	7	4	19	4.8
Total	226	100	173	100	399	100

The perceptions of the cotton and dairy industry stakeholders, reported in Table 6.15, about the importance, for Brazil, of the successful experience of other countries, shows that 46.1% of them consider it very important, others (29.2%) believe it is important, and 13.5% judge it extremely important. Thus, approximately 89% of the respondents considered that the successful techniques used by other countries in developing international markets for agricultural commodities was relevant to help Brazil in developing activities aimed at increasing market share of Brazilian agricultural products in the domestic and international markets.

Table 6.15 Importance of other countries' successful experiences in helping the Brazilian agricultural industries

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
Not important	3	1.3	4	2.3	7	1.7
Moderately important	15	6.6	13	7.5	28	7
Important	110	48.2	75	43.4	185	46.1
Very important	59	25.9	58	33.5	117	29.2
Extremely important	34	14.9	20	11.6	54	13.5
Do not know	7	3.1	3	1.7	10	2.5
Total	**228**	**100**	**173**	**100**	**401**	**100**

The study subsequently sought to identify the best strategies to implement partnerships between Brazil and other countries with similar characteristics and objectives for their agricultural sectors. Respondents were asked to identify the importance of a number of strategies as shown in Table 6.16 and a comparative analysis was made using the number of respondents who identified a strategy as being "very important" or "extremely important".

In this context, the respondents considered "the action of Brazil in alliances with other countries in winning new markets for their agricultural products" as the most important strategy. The second most favoured strategy was "to participate in integrated research projects with other countries, involving multidisciplinary teams with common objectives", followed by the "necessity to increase the interchange of technology among countries of similar production characteristics and markets". Finally, the strategy “to import new technologies and genetic resources adaptable to Brazilian agricultural products” was considered the least important of the strategies presented to respondents in the questionnaire.

These results registered significant concern by the cotton and dairy stakeholders about the agricultural research process and with exploiting the international market for agricultural commodities. It was clear that partnerships for the development of new technology to improve Brazilian agricultural product quality and to extend the penetration of Brazilian agricultural products into the international market are considered necessary. On the other hand, the stakeholders demonstrated that they are not interested in pre-packaged agricultural technologies from other countries without Brazilian participation in their development.

Table 6.16 Opinion of cotton and dairy stakeholders about various strategies to improve relationships with other countries and develop Brazilian agricultural industries

Issues	Industries	Answers					
		Not important	Moderately important	Important	Very important	Extremely important	Do not know
Increase technological interchange among countries of similar production characteristic and markets	Cotton	6	18	75	64	61	4
	Dairy	1	15	45	68	43	1
	Total	7	33	120	132	104	5
Participate in integrated research projects involving multidisciplinary teams with common objectives	Cotton	0	19	57	79	68	6
	Dairy	3	12	42	57	56	3
	Total	3	31	99	136	124	9
Joint efforts in the conquest of new markets for the cotton and dairy industries	Cotton	1	11	41	67	106	2
	Dairy	3	9	36	53	68	4
	Total	4	20	77	120	174	6
Import new technologies and genetic resources adaptable to Brazilian agriculture characteristics	Cotton	11	38	58	62	55	4
	Dairy	21	60	44	29	18	1
	Total	32	98	102	91	73	5

Moreover, the stakeholders from the cotton and dairy industries reported that their industries are not organized sufficiently to expand export of Brazilian products onto the international market. Table 6.17 reveals that 86% of the respondents said that their industries are only partially equipped to allow the expansion of exports. Others (10%) reported that the cotton and dairy industries were totally disorganized, and a minority (4%) said these industries were totally organized.

Thus, while the respondents consider the world market for agricultural products an opportunity, and the success of other countries important in helping Brazil to increase its participation in external markets, the stakeholders believe that the agricultural supply chains need to re-structure and to build competence in strategic areas.

Table 6.17 Stakeholders' opinions about the structure of Brazilian agriculture

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
Totally disorganized with regard to allowing the expansion of the Brazilian agricultural products' participation in the international market	12	5.3	28	16.2	40	10
Partially organized to allow the expansion of Brazilian agricultural products' participation in the international market	200	87.7	144	83.2	344	86
Totally organized to allow the expansion of Brazilian agricultural products' participation in the international market	16	7	1	0.6	17	4

In order to identify which segments of the cotton and dairy industries need to be improved to increase the share of the international market supplied by Brazilian agricultural products, the stakeholders' perceptions were sought and these are reported in Table 6.18. The results show that the respondents believe that the priority task is to invest in and improve marketing activities, with 14.4% suggesting that option, followed by logistics with 14.0%. Then, rated next in importance are producers (13.5%), research institutions (13.0%), service providers (12.5%), and traders with 10.5%.

Table 6.18 Stakeholders' opinions about which segments of the cotton and dairy industries need to be improved

Industry Segments	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
Input Suppliers	75	7	40	4.5	115	6
Service Providers	114	10.7	132	14.9	246	12.5
Producers	122	11.4	142	16	264	13.5
Traders	122	11.4	85	9.6	207	10.5
Processors/mills	99	9.3	51	5.7	150	7.7
Manufacturers	67	6.3	69	7.8	136	7
Research institutions	123	11.5	134	15.1	257	13
Marketing	165	15.4	117	13.2	282	14.4
Logistics	169	15.8	103	11.6	272	14
Others	13	1.2	15	1.7	28	1.4

6.2.6. Stakeholders' views and perceptions about the government's role in Brazilian agricultural industries

The aim of this part of the research was to identify the stakeholders' views and perceptions about the government's role in the Brazilian agricultural sector. Stakeholders were asked to rate its importance, from "Not important" to "Extremely important", or to respond "Do not know". The results in Table 6.19 show that approximately 80% of the respondents recognize the government's role in the agricultural sector as being either important, very important, or extremely important in improving the performance of Brazilian agricultural products in domestic and international markets.

Table 6.19 Stakeholders' opinions about the importance of the government's role in Brazilian agricultural industries

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
Not Important	7	3.1	8	4.6	15	3.7
Moderately Important	33	14.5	19	11	52	13
Important	63	27.8	42	24.3	105	26.3
Very Important	53	23.3	57	32.9	110	27.5
Extremely Important	64	28.2	42	24.3	106	26.5
Do not know	7	3.1	5	2.9	12	3
Total	227	100.0	173	100.0	401	100.0

On the other hand, the survey answers indicated that while government activities in some segments of the cotton and dairy industries support the private sector's efforts, they sometimes hinder the growth of specific segments. In this regard, this study sought to identify the respondents' opinions about which of the cotton and dairy industry segments the government should be assisting and which it should not, and in addition, whether the government should be acting in partnership with the private sector in some segments.

The data presented in Table 6.20 reveal the private sector's intention to assume partial or total responsibility for activities that were previously the government's sole responsibility. When asked about who would have to assume the responsibility for international trade (exports and imports), 63% said that the government and the private sector would have to act together, 29% believed that the government would have to continue acting alone in this area, and only 8% said that the private sector would have to assume all responsibility for Brazilian products in the international marketplace.

Regarding the activities of research and development institutions, 82.7% of the respondents said that the private sector would have to work together with the government in the implementation of agricultural research projects, 16% declared that the government would have to act alone in this area, and only 1.3% suggested

that the private sector would have to act alone in the development of agricultural research.

Another result that showed a difference in understanding about the changing roles that the private sector and the government might play in the supply chain was the position of the agricultural sector with respect to logistics. No longer is the provision of roads, power, etc considered the sole responsibility of the government. While 42% of respondents believed that the government would have to continue providing these activities alone, another 53% of the respondents registered the opinion that the private sector would have to work in partnership with the government in the development of logistics activities to service the agricultural sector.

The results shown in Table 6.20, for the segments of domestic marketing, production, and input suppliers, did not present any novel solutions considering the current situation with these activities in Brazilian agribusiness. They show, therefore, that the respondents largely agreed to maintain the *status quo* in these segments.

Table 6.20 Stakeholders' opinions about in which segments the government should be active

Issues	Stakeholders	Answers		
		Government should be the only agent	Government should not be involved	Government should be involved in partnership with private sector
International trade (export and import)	Cotton	58	21	144
	Dairy	56	13	104
	Total	114	34	248
Research and development	Cotton	37	4	182
	Dairy	27	1	145
	Total	64	5	327
Domestic market development	Cotton	63	74	86
	Dairy	19	77	77
	Total	82	151	163
Production	Cotton	16	139	69
	Dairy	17	108	48
	Total	33	247	117
Input supplies	Cotton	23	119	81
	Dairy	13	100	60
	Total	36	219	141
Logistics (transport, discharge, delivery, roads, storage, etc.)	Cotton	87	11	124
	Dairy	78	10	85
	Total	165	21	209

6.2.6.1. Stakeholders' views and perceptions about the segments of Brazilian agricultural industries that need to be changed

Part of the background for the study was a review of the process of adjustment and restructuring in the agricultural industries promoted by the Brazilian Government (involving the closure of public institutions and agricultural research organizations, elimination of subsidies, and the creation of fiscal incentives, etc.) which started at the beginning of the 1990s. The aim was to ascertain whether the restructuring process was addressing the new demands created for agriculture as major industries moved from supplying only the domestic market and became more involved with international markets. Therefore, the opinions of cotton and dairy industry

stakeholders were sought regarding those segments of the agricultural supply chain that should be reviewed by the government in order to increase production and improve the share of the international market supplied by Brazilian agricultural products.

The results from this question, which are shown in Table 6.21, indicate that respondents thought the government needs firstly to review the segments involved in "International trade (import and export)", and "Science and technology in the agricultural sector" with 24% and 23.8% respectively of the answers indicating this. The next topics nominated were "Tax exemptions and tax incentives" with almost 20% of the replies, "Domestic market arrangements" with 15.9%, and lastly, "Rural production" with 14.9%. Thus industry stakeholders see that the emphasis for government activity should be focused away from production and onto activities designed to strengthen the performance of Brazilian products in the export market. Another possible interpretation is that government should invest more in "science and technology" which could refer to the use of biotechnology and related sciences.

Table 6.21 Cotton and Dairy stakeholders' opinions about segments of the agricultural supply chains that need to be reviewed by the government

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
International trade (imports and exports)	185	24.4	133	23.6	318	24
Tax exemptions and tax incentives	160	21.1	103	18.3	263	19.9
Science and technology in agricultural sector	175	23.0	139	24.7	314	23.8
Rural production	113	14.9	84	14.9	197	14.9
Domestic market arrangements	116	15.3	95	16.9	211	15.9
Other issues	11	1.4	9	1.6	20	1.5

6.2.6.2. State and Federal Government Laws to stimulate private sector participation in R&D projects

In this part of the study, the views of cotton and dairy industry stakeholders were sought with respect to State and Federal Government laws that have been created to stimulate private sector participation in research projects. These projects could be developed in partnership with universities, or state and federal agricultural research and development institutions.

The research results presented in Table 6.22 show that the majority of the respondents, approximately 56%, do not know about these laws. However, when the replies from the groups including producers and researchers only were considered, the position was reversed, with a slim majority, around 51%, having knowledge about the State and Federal government laws passed to stimulate private sector participation in research projects.

Table 6.22 Cotton and Dairy stakeholders' knowledge about State and Federal laws to stimulate private sector participation in R&D projects

Stakeholders	Answers											
	Cotton				Dairy				Total			
	Yes	%	No	%	Yes	%	No	%	Yes	%	No	%
Farm input suppliers	9		16		3		11		12		27	
Logistics managers	6		17		4		4		10		21	
Producers	38		35		26		26		64		61	
Managers of producers associations	14		17		19		29		33		46	
Agricultural researchers and lecturers	25		15		15		23		40		38	
Technical consultants	8		14		5		4		13		18	
Government authorities	1		7		2		2		3		9	
Total	101	*45.5*	121	*55.5*	74	*43*	99	*57*	175	*44.3*	220	*55.7*

For those respondents who had answered that they knew about the State and Federal laws created to stimulate private sector participation in the development of agricultural research projects, the next question in the study sought to identify those who had already used or are using the incentives provided by these laws.

As shown in Table 6.23, it was revealed that only 39% have, or have had, partnership contracts with agricultural research institutions, using the incentives provided by this legislation for the development of research projects. Furthermore, when the results from cotton and dairy industry stakeholders are considered separately, it can be observed that in the case of cotton, 52% of the respondents who answered that they knew about these laws, had used, or are using these incentives. In the case of the dairy industry stakeholders who knew about the laws, only 22% had used or are using these incentives designed to stimulate partnership arrangements between the private sector and universities or agricultural research institutions for the development of collaborative research projects.

Table 6.23 Cotton and dairy industry stakeholders' use of the state and federal incentives created to stimulate private sector participation in R&D projects

Stakeholders	Answers								
	Cotton			Dairy			Total		
	Yes	No	Not applicable	Yes	No	Not applicable	Yes	No	Not applicable
Farm input suppliers	3	7	10	2	1	11	5	8	21
Logistics managers	4	3	12	2	2	4	6	5	16
Producers	18	19	33	3	24	25	21	43	58
Managers of producers associations	9	4	10	5	15	28	14	19	38
Agricultural researchers and lecturers	13	11	6	2	15	21	15	26	27
Technical consultants	6	3	0	1	4	4	7	7	4
Government authorities	0	1	6	1	1	2	1	2	8
Total	53	48	77	16	62	95	69	110	172

Table 6.24 shows the opinions of the cotton and dairy industry stakeholders about the factors that hinder the use of incentives provided by the state and federal laws. According to 15.1% of the respondents, the main reason that hinders the establishment of partnership arrangement between the private sector and public agricultural research institutions is the lack, on the part of the government, of communication and encouragement to use the existing laws in developing partnerships. The other point which was emphasized, with 13.3% of opinions, was the

difficulty, experienced by those partners who became involved in these arrangements, in understanding correctly how the laws define the partners' rights and obligations in fulfilling partnership contracts. It seems that the laws are not sufficiently clear to ensure how they can be applied easily, and do not necessarily address market demands.

In addition, in the opinion of 10.3% of the respondents, the government agencies are not adequately prepared to assist and guide those interested in gaining the benefits provided by the legislation. Another 7.9% said that the laws impose requirements that are difficult to meet for small and medium-sized companies interested in accessing the offered benefits. The complexity of the application instruments required to present projects was identified by 5.2% of respondents as another point making it difficult to access the incentives provided by the laws. Finally, 4.5% of the respondents said that the value of incentives provided in the laws was not sufficient to justify private sector participation.

Table 6.24 Stakeholders' opinions about what hinders the use, by the private sector, of incentives provided in current legislation

Issues	Answers					
	Cotton		Dairy		Total	
	Number	%	Number	%	Number	%
It is difficult to understand what are the real advantages, rights, and obligations involved in the partnership	27	12.0	37	14.5	64	13.3
The value of the incentives provided by the Laws is small and not sufficient to justify private sector participation	10	4.4	11	4.3	21	4.5
Communication and encouragement by the government to use the existing laws in partnership development are lacking	30	13.3	43	16.8	73	15.1
Application instruments necessary to present projects are complex, making it difficult to access the incentives provided in the legislation	13	5.8	12	4.7	25	5.2
Government agencies responsible for guiding interested parties in accessing the benefits are not aware of private sector requirements	25	11.1	25	9.8	50	10.3
The laws impose difficult requirements on small and medium-sized companies wanting to access the offered benefits.	21	9.3	17	6.6	38	7.9
Other issues	9	4.0	3	1.2	12	2.5
Not applicable	90	40.0	108	42.2	198	41.2

6.2.7. Future prospects for the Brazilian cotton and dairy industries

When asked for their views about the future of the Brazilian cotton and dairy industries, taking into account likely developments in domestic and international markets in the next five to ten years, the respondents from these two industries were shown to be optimistic, with the majority answering either "Excellent" and "Good". However, on the other hand, a significant number of respondents registered some concern about the future for both of these industries, believing that in the next five to ten years, the future for the cotton and dairy industries would be somewhere between "much the same" and "bad".

In this context, Figure 6.4 shows a graphic representation of the cotton industry stakeholders' opinions about their economic future. It can be seen that 10.7% of the respondents said that the future of the cotton market will be excellent, and 57.1% reported that the future position will be good, i.e., approximately 68% of respondents were confident about the industry. On the other hand, approximately 30% of the respondents revealed that they were worried about the situation of the Brazilian cotton industry in domestic and international markets and they indicated that they believe the future for this product will only be fairly good or could even be bad or very bad.

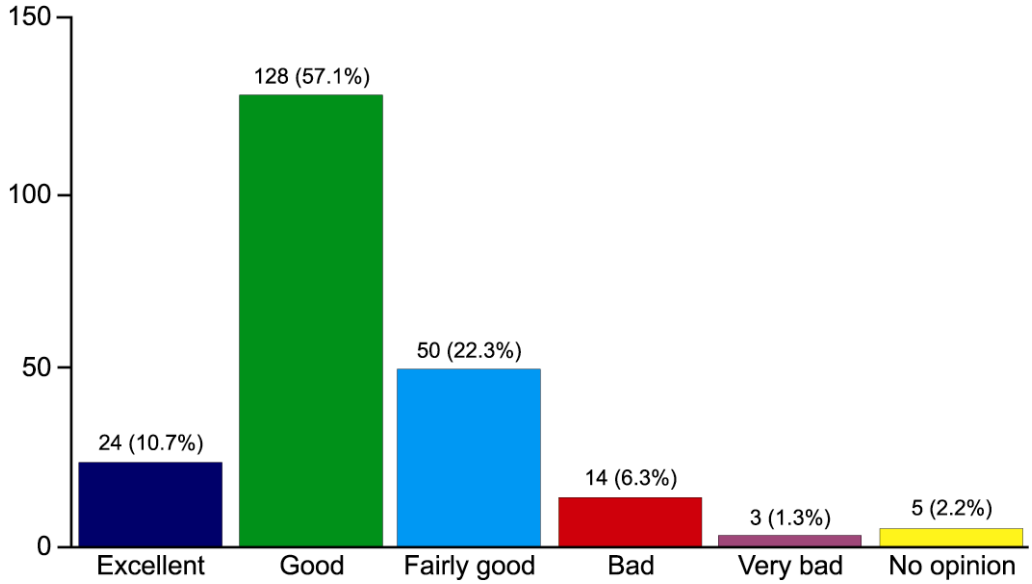

Figure 6.4 Stakeholders' opinions about the economic future of the Brazilian cotton industry

The results presented for dairy industry stakeholders were very similar to those of the cotton industry respondents. The graphic representation in Figure 6.5 shows that approximately 69% of respondents consider that the economic future for the dairy industry in the domestic and international markets will be excellent or good, while 30% considered it will be fairly good, bad, or very bad.

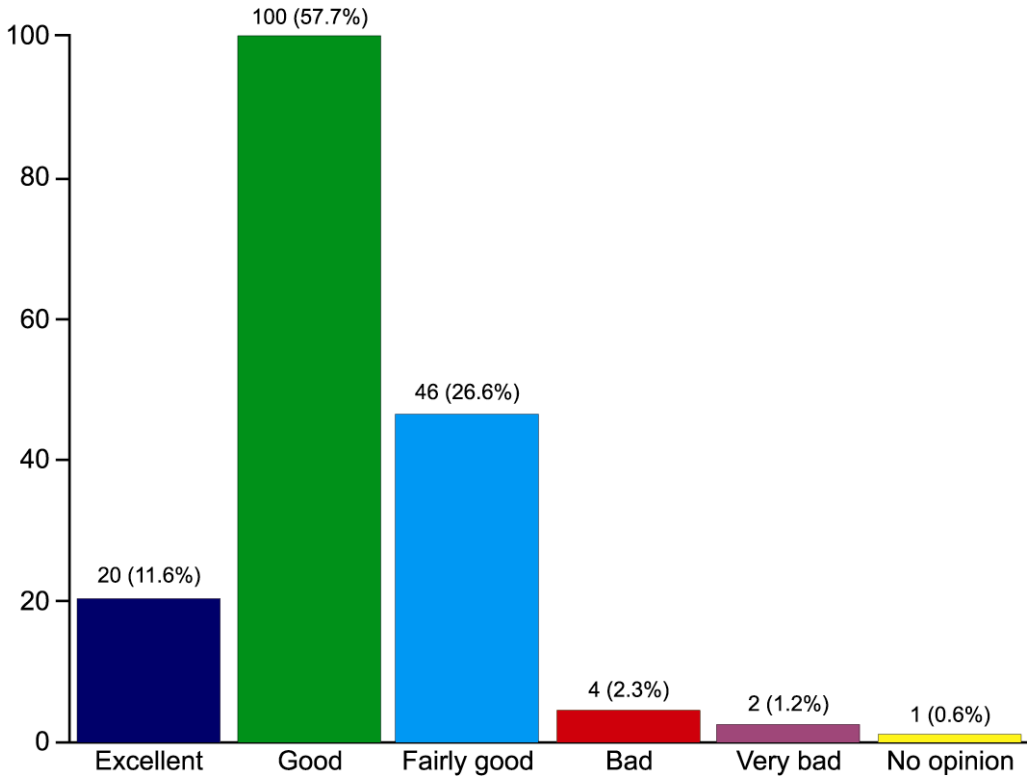

Figure 6.5 Stakeholders' opinions about the economic future of the Brazilian dairy industry

6.2.7.1. Stakeholders' views about structural change in the Brazilian cotton and dairy industries

Information was sought from cotton and dairy industry representatives about the ideal structure to be achieved in the Brazilian production system for these products in the next 5 to 10 years.

The results of questions about structural change in the Brazilian cotton and dairy industry outlined in Table 6.25 show that a significant group of the cotton industry's respondents, about 22.3%, consider that the structure of cotton production

in Brazil in the next 5 to 10 years will be based on big farms producing on a large scale. Another 21.9% said that Brazil will have a modern and integrated cotton production system, while 17.9% saw the situation where Brazilian cotton will be produced by the proprietors of processing and manufacturing mills on large farms, which they own themselves. In contrast to that, another 17% of the respondents suggested that Brazil is going to produce cotton based on a system of farms using modern production systems and operating in a cooperative and integrated way.

The dairy industry's stakeholders' perceptions of the future production system are shown in Table 6.26, which demonstrates that the largest group, 28.1% of respondents, think that the situation in the dairy industry in Brazil is going to change, and the country will become a large exporter of dairy products. About 27.1% assumed the position that, in the future, milk production will be based on small farms organized as cooperatives of producers, others (17.2%) answered in a similar way, saying that milk production will be based on a modern and integrated production system. In contrast to that, 12.6% of the respondents said that production of milk in Brazil is going to be based on large farms and big herds of cows to take advantage of large-scale production methods.

Table 6.25 Stakeholders' perceptions about the future structure of the Brazilian cotton industry in 5 to 10 years

Stakeholders	Cotton industry system in the future						
	Based on big farms and large scale production	**Based on cooperative farms with modern cotton production systems**	**Big manufacturers producing their own cotton on large farms**	**Big manufacturers producing their own cotton on rented farms**	**All the segments of cotton supply chain linked via internet**	**A modern and integrated cotton production system**	**Other structural forms**
Farm input supply managers	18	5	17	2	10	18	1
Logistics managers	15	14	9	4	7	14	2
Cotton mill proprietors	3	2	3	0	3	5	0
Cotton suppliers	3	7	2	2	3	5	0
Cotton producers	27	19	22	5	21	27	2
Cotton producers and cotton mill proprietors	10	6	11	3	7	6	0
Managers of agricultural companies (farm, cooperative, foundation, etc.)	25	17	18	7	10	16	0
Agricultural researchers	23	20	15	5	14	27	1
Service providers (technical consultants)	11	9	10	4	10	4	0
Government authorities	5	6	5	2	4	4	1
Other positions	1	2	1	0	2	2	0
Total	**141**	**107**	**113**	**34**	**91**	**138**	**7**

Table 6.26 Stakeholders' perceptions about the structure of the Brazilian dairy industry in 5 to 10 years

Stakeholders	Dairy industry system in the future						
	Based on large farms and big herds with large scale production methods	**Based on small farms working in a cooperative form of production**	**Large manufacturers producing their own milk on large farms**	**All the segments of dairy supply chain linked by internet**	**A modern and integrated dairy production system**	**The country transformed into a great exporter of dairy products**	**Other**
Farm input suppliers	4	8	1	1	6	11	0
Farmers/primary producers	21	34	8	8	20	35	5
Managers or Heads of cooperatives, producers associations or creators associations	4	7	1	4	8	10	0
Managers of logistics companies (transport in general, milk collection and distribution)	2	4	2	2	1	5	0
Agricultural researchers	7	24	1	6	16	20	1
Technical Consultants	2	5	0	1	4	4	1
Traders or Retail managers or technicians	4	8	1	3	2	6	2
Managers or Technicians in manufacturing / Processing	3	5	6	1	4	6	2
Government authority	0	3	0	1	2	3	1
University lecturers	2	6	0	0	0	3	0
Leaders of farmers and primary producer syndicates (CNA, federations and rural organizations)	2	4	0	2	2	7	1
Leaders of dairy manufacturing and processing syndicates (SINDLEITES)	1	4	3	2	5	6	1
Others	0	0	0	0	0	0	0
Total	52	112	17	31	71	116	14

6.3. Results from Phase 3 research – Focus Group Meetings (FGMs)

In the second phase of data collection in this study, three focus group meetings (FGMs) were held in Brazil in July 2005. After considering the characteristics of the Brazilian cotton and dairy production systems, and the resources available to the study, meetings were organized in the states of Goiás, Mato Grosso, and Minas Gerais.

The first FGM was held in Goiânia (capital of Goiás state), on 01.07.2005, in the headquarters of The Goiâna Regional Development Agency (AGDR), involving a broad range of dairy industry stakeholders from the Goiás region. The group comprised 7 people, with one representative from each of the following groups: Embrapa dairy cattle researchers, agricultural research managers, government policy makers, farmers, technical consultants, a dairy industry syndicate, and a milk producers' syndicate. They spent 3 hours, starting at 9:00am and finishing 12:10pm, discussing a range of issues.

The second FGM took place on 21.07.2005 in the headquarters of the Mato Grosso Seeds Producers Association (APROSMATE), located in the city of Rondonópolis, state of Mato Grosso. Six stakeholders from the cotton industry discussed the issues suggested for two and a half hours. The meeting started at 6:0pm, and finished at 8:30pm. Among the participants, 2 were farmers; one was a representative from Mato Grosso Cotton Producers Association (AMPA), another one was from the Support Fund for Cotton Production (FACUAL), one representative was from APROSMATE, and there was one owner of an input supply company.

The third and last meeting was conducted on 29.07.2005 in the head office of Embrapa Dairy Cattle, located in Juiz de Fora, in the state of Minas Gerais. A total of 10 people took part in this meeting, and all of them were technicians working in a range of areas in the dairy industry, such as rural extension, research and development, rural communication, and research project management. The meeting ran for two and a half hours, beginning at 10:00am and ending at 12:30pm.

For a number of reasons, some people, invited to participate in the focus group meetings, could not be at the meetings and they agreed to be interviewed personally. In their case, the same questions posed in the FGMs, were asked of the interviewees.

The questions employed in all the FGMs, and in the complementary interviews, were developed largely from the results obtained in the first phase of the data collection process, through the electronic survey. There was also the specific intention to evaluate Embrapa's situation in the context of Brazilian agribusiness, bearing in mind the focus of this research, where Embrapa's structure and operations are a central issue.

The following questions were presented for discussion in the FGMs and the individual interviews conducted in this phase of the study:

01 In your opinion is the Brazilian agricultural research system structured adequately to permit (or to act on...) a partnership with private agribusiness companies, particularly in the process of defining and carrying out research projects?

02 In your opinion, does the national agricultural research system, coordinated by EMBRAPA, work in an adequate way, being participative and productive in the context of Brazilian agribusiness?

03 Do you agree or disagree with the following assertion: "In the case that EMBRAPA (or any other public agricultural research institution) does not promote structural change and adapt to the new demands of the market, including substantial participation by business enterprises in the definition and execution of research projects, it runs the risk of losing its position and influence in Brazilian agribusiness".

04 The information obtained in the first phase of this research indicated that 80% of the cotton and dairy industry stakeholders agreed with supporting the public agricultural research institutions financially. However, public institutions like EMBRAPA have, in the past 10 years, received a contribution involving only about 5% of the total budget of the organization from private companies. Because of this contradictory situation, please give your opinion about what is actually stopping or making it difficult for the private companies to supply financial resources for the development of research projects in partnership with public agricultural research organizations.

05 Another point found in Phase 1 of this research was that around 75% of the cotton and dairy industry stakeholders said that the technologies generated by the agricultural research institutions are not being utilized fully. It seems that, if these technologies were being applied more widely, Brazil would be better equipped to take a larger share of the international market for a range of agricultural commodities. In your opinion, what could be done to improve the access to and application of the technologies generated by research, in order to permit better use of these technologies by the various segments of the production chain for Brazilian agricultural products?

Although the level of education and professional experience of the participants in the focus group meetings was quite diversified, the results of the FGM discussions revealed a certain convergence of opinion and perceptions, in relation to the subjects presented and discussed.

In general, all the participants agreed that the current situation in the Brazilian agricultural research system must be changed, to allow the evolution of a more participative and less bureaucratic system. The transformed system should define and base its main activities on demands identified and discussed with stakeholders in the agricultural supply chain, without, however, abandoning other research projects with public benefit – projects which seek new technologies and better conditions for the development of family farms (small, poorer farms) and which are aimed mainly at providing social assistance.

While the private sector has made it clear that agricultural research activities are very important to the development of agribusiness, and it agrees to the financing of and collaborating in agricultural research projects developed by public institutions, it is on the condition that the private sector stakeholders can participate effectively in all the stages of the process (definition, execution, and introducing the new technology into the market).

The following results have been presented with the objective of showing the consensus position of each one of the professional groups involved, about the subjects discussed in the FGMs and the interviews. Moreover, some citations from the participants will be translated and transcribed in their original form, with the

intention of conveying directly the sentiments expressed and to help in the final process of analysis.

6.3.1. The Brazilian agricultural research system in the agribusiness context

Table 6.27 shows the stakeholders' position on the structure of the Brazilian agricultural research system (composed of public and private agricultural research institutions) and the ability of these institutions to improve their relationships with agribusiness companies. As can be observed, there is a consensus among the professional groups involved that the Brazilian agricultural research system is not working satisfactorily and, consequently, is not in a condition to enter into viable partnerships with other agricultural industry segments. Therefore, the stakeholders were unanimous that the agricultural research institutions need to change, and create better conditions to address the new demands created by the agricultural commodity market in Brazil and in the rest of the world.

Table 6.27 Stakeholders' positions about the performance of the Brazilian Agricultural Research System in the context of Brazilian agribusiness

Professional groups	Consensus of group
Farmers	The Brazilian Agricultural Research System is well equipped to do research and has been doing very well in this area. But the System does not have a strategy to promote its integration with the private sector.
Managers/Leaders of associative institutions	The Brazilian Agricultural Research System is finished; it's disappeared, with only Embrapa remaining, which in its turn needs to reorganize its planning system. We are looking for a research program in the main lines of agriculture, developed completely in partnerships with the other agribusiness segments, and financed by the two parts – the government and the private sector
Managers of agricultural research institutions	The Brazilian Agricultural Research System is not structured to make partnerships or mobilize resources or to organize integrated work between the Federal, State, and Municipal agricultural research institutions, much less with the private sector. The Brazilian System still needs, in its structure and its actual operations, to allow the public and private sectors to work together
Researchers/Academics	Federal, State and municipal laws, agricultural and scientific sector policies, administrative and bureaucratic resolutions, and budgetary difficulties are some of the items that have hindered and still are hindering effective functioning of the Brazilian Agricultural Research System. On the other hand, the private sector does not know that the System exists and also it does not know that it is part of this System.
Policy makers	The System is not functioning adequately, in part because the public institutions, in general, are under a series of legal and bureaucratic limitations imposed by the federal government. On the other hand, the private sector in Brazil does not have a tradition of co-participating in the generation of agricultural knowledge.

Several comments made at the focus group meetings and in individual interviews were considered significant to characterize the cotton and dairy stakeholders' opinion about the performance of the Brazilian agricultural research system. The following are some characteristic statements made by individual participants, and revealed by the content analysis:

- *"The Brazilian agricultural research system still does not have the appropriate mechanisms in its structure so that the public and private sectors can work together."*

- *"It is not enough to change the laws; we should also change the culture. We don't have a culture that accepts the participation of both sectors in projects that would give us profit."*

- *"The system is not even structured to do the articulation, the mobilization, and the organization of an integrated project between the Federal, State, and municipal institutions. Thus it is not structured for private sector participation."*

- *"It lacks strategies for integration with the private sector."*

- *"It lacks managers that are capable of searching for such partnerships and of developing projects overall."*

- *"... on the other hand, the entrepreneurs are not well structured to do this type of partnership either: they are completely disorganized. The majority of them do not have a strategic vision of the importance of researching inside the agricultural industries."*

- *"Embrapa cannot know how to sell its products. It does not seek the private sector components. And, it does not maintain a productive relationship with the entrepreneurs in the agricultural industries'."*

- *"It lacks a vision and enterprise action from the managers of Embrapa."*

- *"Embrapa should have a group of people who are well versed in the subject "laws of incentive for partnership with private enterprise", and who can show the production sector how to build these partnerships."*

- *"The private sector is not well enough structured to take advantage of the benefits that Embrapa provides. The market presents itself as completely disorganized. As a consequence, it creates individual and specific demands [rather than demands for widely-applicable*

solutions], creating a situation that does not work in relation to the people involved (Embrapa and the private sector).”

6.3.2. Stakeholders’ perceptions about performance of the National Agricultural Research System (NARS)

The second subject discussed by the meetings’ participants was the performance of the National Agricultural Research System institutions (described in Chapter 3), supposedly under coordination by Embrapa. Specifically, the participants were asked whether the system is working effectively, meaning whether it is participative and productive, particularly in how it relates to Brazilian agribusiness.

The consensus about this subject, including the perceptions of all professional groups, was that the National Agricultural Research System worked for a few years when it was introduced, but nowadays it does not work any more. The state research organizations, which are an important part of the NARS, do not function well, with rare exceptions (São Paulo, Paraná, and Santa Catarina). They have not been as good as expected. The State and Federal Universities performed well in the beginning, creating good postgraduate courses and educating good professionals, but nowadays they are almost completely disconnected from both the State and Federal agricultural research institutions.

According to the stakeholders involved, NARS was a success many years ago because Embrapa was responsible for the coordination and financial resources for agricultural research in the country. The system no longer functions well, mainly because Embrapa lost its financial capacity to invest in components of the NARS. Two other factors influencing this decline were the creation of Municipal, State, and Federal laws creating more administrative control and allowing an increase in bureaucracy, restricting the capacity of managers in the research institutions to administer their activities, and the total obsolescence of prevailing policies affecting agricultural research and science and technology. This combination of factors resulted in a loss of administrative flexibility, and made it difficult for any partnerships to be formed between the public research institutions and private sector companies.

6.3.3. Stakeholders' perceptions of Embrapa's impact on Brazilian agribusiness

After analysing the agricultural research system in Brazil and its impact on Brazilian agribusiness, the FGM participants were asked for their opinions about the following assertion: *In the case that EMBRAPA (or any other public agricultural research institution) does not promote structural change and adapt to the new demands of the market to permit substantial participation by private enterprise in the definition and execution of research projects, it runs the risk of losing its position and influence in Brazilian agribusinesses.*

The results of this discussion can be seen in Table 6.28, where a consensus position for each professional group is presented. It can be observed clearly that all stakeholders agree with the assertion presented to them, and they are also clear that Embrapa must make many and significant changes to its original structure, mainly in the areas where the private sector needs to be involved. This should include the definition of research programs and projects to be developed, and the choice of the best strategy to introduce new products into the domestic and international market for agricultural products.

Table 6.28 Stakeholders' perceptions about Embrapa's impact on Brazilian agribusiness

Professional groups	Consensus of group
Farmers	The agricultural research institutions must change. They need to be constantly linked with the demands and evolution of the market, to change their current system of identifying demand, to create a system that allows clear identification of the producers' needs and to provide a more adequate response to the specific needs of the market.
Managers/Leaders of associative institutions	Embrapa needs to be reorganized into a different form, and it will require much more capacity in terms of organization and coordination between the public and private sectors, than financial investment.
Managers of agricultural research institutions	Society has new and different expectations in respect to Embrapa's actions and activities and these expectations have to be considered and attended to. For this reason, we need to change.
Researchers/Academics	Embrapa needs to change, but it is not sufficient to change only administrative structures. It is necessary to create better leadership in the institution's staff, and to stimulate and create leadership in the agricultural private sector. That, also, is not structuralized to make the necessary demands, adequately, on the agricultural research institutions.
Policy makers	Embrapa has to adapt to the new reality of our times, and look to adjusting its structure, creating ways to eliminate the rigidity imposed by the existing legislation and the current public administration.

There is a need for Embrapa to apply the resources provided in its budget in better ways. This may include a review of the number of its employees, and the ratio of support workers to the number of researchers. It may need to contract new professionals, and to qualify its managers and a considerable number of its technicians to work with the private sector. These were among the issues which, according to the individual views expressed by some of the stakeholders, as illustrated by the comments below must be addressed. It would have been desirable to identify the position and occupation of the speakers but this was impossible from the recorded discussion, because this would have compromised the anonymity of the participants.

- *"Embrapa, with fewer resources, needs to generate more results for society. And for that, it will have to open itself more and more each time."*

- *"Embrapa still lacks managers. It trains only a few people in management. On the other hand, Embrapa cannot bring a manager or managers from the private sector. It does not have the ability to pay the salaries that the private sector pays."*

- *"Embrapa has a lot of people. The number of employees in Embrapa should be reduced. It needs to invest more in researchers and managers, hiring more qualified people each time. It needs to change its process to become more efficient, decrease its experiments and change its way of doing the research."*

- *"Embrapa has practically 78% of its budget committed to paying the employees' salaries; that system is wrong. It can't keep going like this."*

- *"...There are new expectations by society about Embrapa' actions and these expectations have to be met. That is why Embrapa needs to change."*

- *"Embrapa has to improve its structure and its planning a lot. Embrapa has to be able to manage with this new challenge, because the demands are very big and evident. And if it keeps going the way it does, it will have no chance."*

- *"Losing its leadership: I wouldn't say that. But it has a risk of declining in status, because continuing like this, the model starts to be questioned and the results do not satisfy the demand."*

- *"There has to be a radical change in the structured areas of the business and technology transference by Embrapa."*

- *"Embrapa has to try to mobilize the production sector in some way. It needs a more effective relationship between the technology producers and the knowledge users."*

- *"The technologies are available, and yet do not solve the problems. Some of Embrapa's units are outdated. They are old fashioned and will vanish if changes are not made."*

- *"It has to change focus. Embrapa still does not understand that the producers are its clients."*

- *"The research companies have to change a lot - maybe by being a bit more linked with the market, especially the managers who make the decisions."*

- *"The research institutions are unapproachable: no one has access to them. And the researchers do what they want and not what the market needs."*

- *"The researcher works with a very academic focus, forgetting that the result of his/her experiment has to be useful for the producer who is in the market."*

6.3.4. Private sector financial support for public agricultural research projects

Historically, financial support from the private sector for public agricultural research projects has been very small in Brazil and the participation of private enterprise in the activities of the public agricultural research institutions has been insignificant. In contrast to this situation, the preliminary results obtained from the first phase of this research indicated that approximately 70% of the stakeholders from the dairy and cotton industries who responded to the survey agreed in principle to support the public agricultural research institutions financially. However, institutions like EMBRAPA, for example, have recorded an average private sector contribution of approximately only 5% of the total budget over the past ten years.

Because of this apparently contradictory situation, the focus group participants were asked to give their opinion about what is actually stopping or making it difficult for private businesses to contribute financial resources for the development and conduct of research projects in partnership with public agricultural research institutions. A summary of their responses is presented in Table 6.29.

Table 6.29 Stakeholders' views on factors hindering private sector financial support for projects in public agricultural research institutions

Professional groups	Consensus of group
Farmers	Producers have to be an effective part of the research program by investing in agricultural research projects. The public institutions have to have intellectual property rights very well defined. In addition the intellectual property rights for new products developed from collaborative research need to be appropriately recognized, and the profits shared in proportion to the investments made by the parties.
Managers/Leaders of associative institutions	The private sector will only put money into those research programs which are market-driven and which have been discussed and evaluated. They will invest when a decision has been reached that investing in these programs is important and a priority issue to maintain or extend the performance of the private sector.
Managers of agricultural research institutions	Private sector investment in public agricultural research institutions is very small, because these institutions are not structured to allow private sector participation in the definition, execution, and extension of results of the research process. This is aggravated by the fact that the public research institutions do not have a group of employees properly prepared to attract investment from the agricultural industries in research activities.
Researchers/Academics	Embrapa knows how to do research, but does not know how to negotiate with stakeholders about its research projects. Besides the laws and many bureaucratic policies which prevent it, Embrapa staff is not prepared to work in the domestic or international agribusinesses.
Policy makers	There is a culture in Brazil that the Government has the responsibility to do research. To change this culture, the government created some laws that, when implemented, can be a good tool to modify this culture.

Two important points that became evident through the focus group discussions were the public agricultural research institutions' inability to identify and carry out collaborative research in partnership with the private sector, and that the producers seemed insecure when asked to invest in research projects developed by these institutions. The following comments reveal the individual participants' concern about this subject, and the public institutions' recognition that they lack the capacity to make public and private sector partnerships in research happen.

- *"If the private sector gets the conditions under which it can define what is going to be done, it will put money into research."*

- *"It is fundamental that the implementation of the Innovation Law happens as quickly as possible, defining the rules about public and private sector partnerships."*

- *"Embrapa needs to advance in the area of drawing up contracts, on the question of intellectual property, and in the competence of its staff in negotiations with the private sector."*

- *"There are no career business people in Embrapa. It does not have professionals of this sort: neither does it have the ability to pay for such good professionals at salary rates that exist in the market."*

- *"Another very big problem is the government budget system that does not create an advantage for research institutions which secure some financial resources from the private sector. There is no incentive for them to attract such resources."*

- *"Nowadays, the public institutions budget model punishes those who have the competence to make some money in the market."*

- *"Embrapa is going back in time. The company was created to solve the problem of total administrative stagnation and inflexibility of management presented by the old National Agricultural Research Department (DNPEA) in 1973. Now the company faces the same problems that DNPEA had in 1973, with the aggravating factor that Embrapa is much bigger than the Department, the demands are much greater and very much more diversified than before."*

- *"Embrapa does not work with the institutions that represent Brazilian rural producers (Syndicates, Cooperatives, National Agricultural Confederation (CAN), Brazilian Cooperatives Organization (OCB), etc.). It has never discussed the national problems and strategies that might effect the development of the main agricultural products in Brazil with such institutions."*

- *"The market requires a more aggressive strategy by Embrapa, in the search for partnerships, in the definition, in the financing, in the execution of research projects."*

- *"Embrapa must move out of its research centres even more, to create competence in the business area, searching for specialist personnel in marketing and business with the capability to understand the domestic and international markets for agricultural products."*

- *"Trying to create a business agency with the same rules that the researchers have today will not work."*

- *"The research institutions have a lot of inertia when compared to an entrepreneur, because the entrepreneur usually wants a very quick answer. We have so much bureaucracy, so many ties, and so many laws that we are not capable of being as agile as is necessary to make partnerships possible."*

- *"Actually, we are not prepared to do business with the private sector. They are in a stage of negotiation that is way above ours, so far ahead that it is as if we were back in the Stone Age."*

- *"Bureaucracy and the other difficulties are important, but the main thing is that Embrapa does not have a culture of working that focuses on products or on results. That culture has to be established internally."*

- *"The question is culture: Embrapa is not prepared to do business."*

- *"How will private enterprise put in more money if the criteria that control the choices of the decision-makers and other people are merely political?"*

- *"The contracts with public institutions have to be managed very well and also have to give security to both sides. They cannot be subject to political changes or controllers' wishes."*

- *"The public institution has to have control of intellectual property, it needs to be very well defined, so that the property rights over the products resulting from partnerships with the private sector are properly acknowledged, and division of profits, from the introduction of any new product to the market, must to be proportional to the investment made by all parties."*

6.3.5. Access to and application of the technologies generated by public agricultural research institutions

Another point that emerged in the course of the electronic survey was the perceived position of the cotton and dairy industries with respect to access to and application of new technology by the agricultural industries. Around 75% of the participants said that the technologies generated by the agricultural research institutions had not been fully utilized. Furthermore, if these technologies were totally applied, Brazilian agricultural businesses would be better positioned in the domestic and international markets. Following this line of investigation, the focus group participants were asked for their opinions about what could be done to make access to the new technologies easier and to permit these new technologies to be applied more widely to improve the performance of Brazilian agribusinesses.

Table 6.30 shows the consensus position of the professional groups on this subject, revealing that the process of identifying demand used by the agricultural research institutions to define new projects was slowed by a series of problems. As a consequence, much new technology has been created but not used because it does not address market requirements. On the other hand, when new technology was created expressly to address real market necessities, it was often difficult to get it applied. In some cases, this occurred because the technology was not available to the producers since Brazil does not currently have a technology transfer system which can take new knowledge and guide producers on how to apply it and get benefits from new ideas.

Table 6.30 Stakeholders' perceptions about access to and application of new technology by producers

Professional groups	Consensus of group
Farmers	There is much technology and many new products created by the research institutions that do not interest the various segments of Brazilian agribusiness.
Managers/Leaders of Associative institutions	There is fundamental and urgent need for a radical revision of the system of identifying demand by the public agricultural research institutions, to try to apply the researchers' efforts in the creation of new technology and products really necessary for the Brazilian production sector. There is so much research being done that the production sector has no knowledge of it or of the results.
Managers of agricultural research institutions	Embrapa's mission is to generate technology, knowledge and information, solutions for the problems of Brazilian agriculture, but it is not its responsibility to do extension work or to give technical assistance.
Researchers/Academics	Embrapa has to start to define priorities, to decrease the number of projects and to develop strategic and important projects for Brazilian agribusiness.
Policy makers	The government has to leave the agribusiness segments where the private sector is already established and is proving its competence.

The following is a synthesis of the perceptions expressed individually by focus group participants:

- *"Brazil destroyed the structure of its technology transfer system and also destroyed its technical assistance system."*

- *"There are researchers who are very frustrated that the production sector does not have access to the results of their research."*

- *"When Embrapa was created, it was just "R", and later on the "R&D" was created. The speech was developing but the minds weren't. Nowadays, we have the "R", the "D", the "I" and the "I". Research, development, innovation and implementation (in Portuguese, Empreendedorismo), but almost every one of the employees of Embrapa is still thinking in the 70's."*

- *"Nowadays Embrapa is a lot more respected by the urban population, than by the rural public."*

- *"Embrapa has to start to define its priorities - Reduce the number of projects, change its culture, and define strategic themes of importance to Brazilian agribusiness."*

6.4. Summary

The study showed that the majority of respondents consider that "research and development" is one of the most important segments in the production chain, and they believe that good performance in this basic segment can support the Brazilian agricultural industries in enhancing quality and competitiveness of agricultural commodities in the domestic and international market.

Almost 100% of the producers use technology generated by research institutions, but only 40% have or have had some agreement with a public research institution to develop a research partnership. The other 60% allege that the reasons hindering the development of any type of partnership with a research institute are all the responsibility of the public institutions. They assume that Brazilian government institutions are not prepared to change and improve this relationship.

Considering that 96% of the respondents from the cotton and dairy industries believe that combined resources from private and public sectors should finance agricultural research, then more effort needs to be put into achieving this. Moreover, respondents indicated their intention to contribute with an average level of 50% of the total investment in cotton and dairy research suggested. In order to carry out this intention, they propose that the government gets organized and creates ways to allow more secure participation by the various agricultural industry segments in the agricultural research process.

Another important point relates to the credibility of the public research institutions. Ten years ago, institutions like Embrapa were highly regarded in relation to their ability and excellence in agricultural research. Nowadays, at least in the opinion of representatives of the cotton and dairy industries, this view has changed. About 30% of the respondents consider that the public research institutions have a poor image, and only 4% still consider their performance to be excellent.

On the other hand, both the cotton and dairy industries' respondents agree with the fact that the Brazilian agricultural research system is not working optimally and, therefore, it does not respond adequately to the demands created by the private sector, making any relationship between them difficult to achieve. In this regard, there is consensus among the respondents about the necessity of the Brazilian government to change policies for the agricultural sector as a whole and, specifically, to create conditions for the Brazilian agricultural research institutions to act in the agricultural market.

Specifically about Embrapa, the cotton and dairy stakeholders confirm that the company must make many significant changes to its current structure, management performance, and its culture[44] (Mathur and Kenyon 2001). The respondents agreed that the government must create conditions to allow Embrapa to coordinate the Brazilian agricultural research system with more flexibility to conduct its administrative processes, and the autonomy to manage its human resources and budget. In their opinions this will create the necessary conditions to improve private sector participation in the evolution of agricultural research in Brazil.

T[44]TCorporate culture is the collective mental climate in which a business arrives at its decisions, rather than how it implements them (Mathur and Kenyon 2001, p. 20).

CHAPTER 7

DISCUSSION OF RESULTS

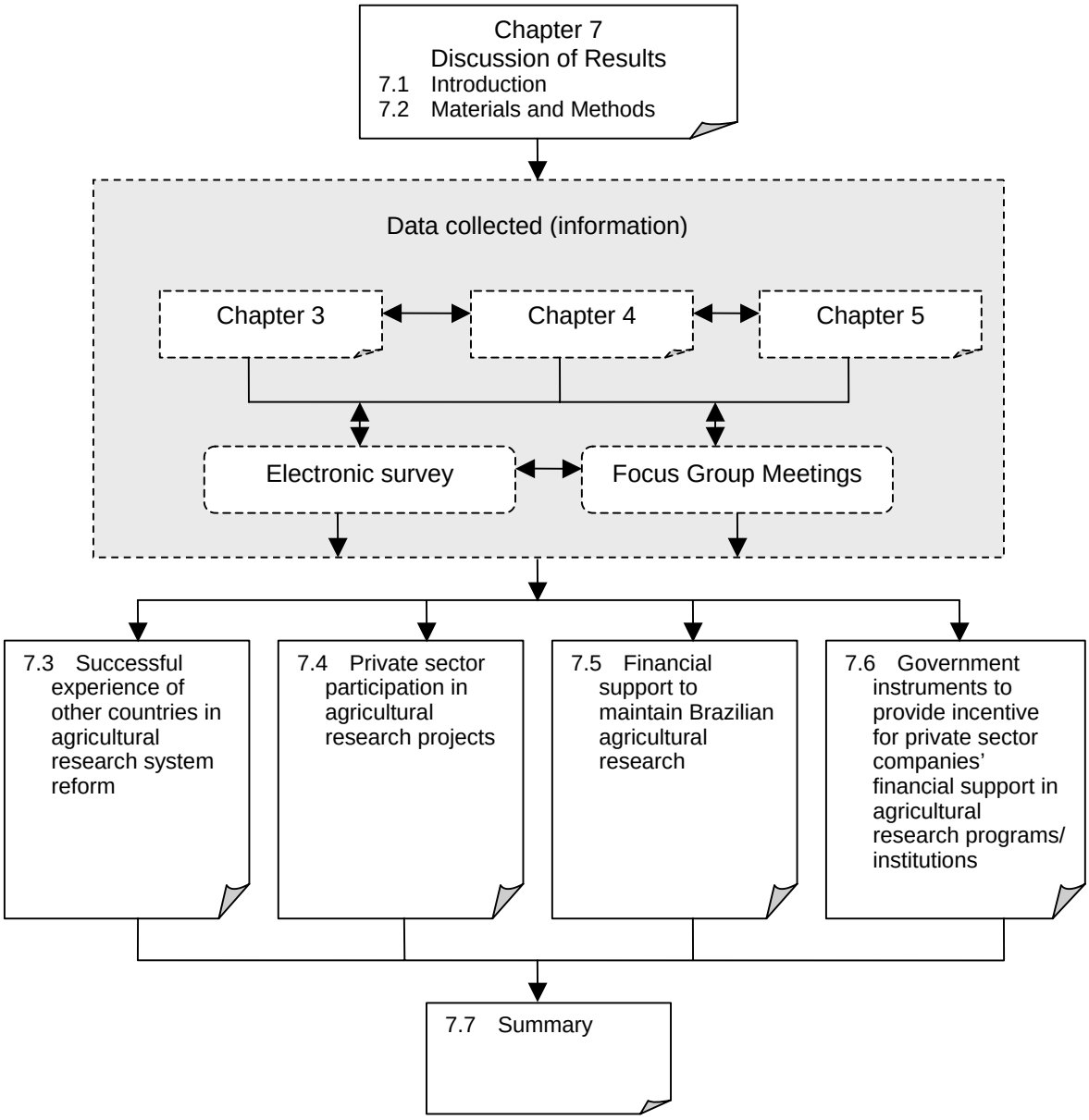

Figure 7.1 Structure of Chapter 7

7.1. Introduction

This chapter presents a discussion based on the results from the statistical analysis of data collected in the three phases of the research, described in Chapter 2, about private sector participation in public agricultural research in Brazil.

The main aim in this chapter is to respond to the research questions defined in Chapter 1 by integrating the information from all the previous chapters (see Figure 7.1). To answer these questions, the information described in Chapter 3 (The Brazilian agricultural research system), Chapter 4 (The international agricultural research system and the experience of other countries in reforming their agricultural research systems), and Chapter 5 (The global market for agricultural products) was integrated with the data collected in the second and third phases of the process of data collection involving the stakeholders of the cotton and dairy industries through the electronic survey and a series of three focus group meetings.

7.2. Materials and methods

The analysis of the data collected for this thesis was developed in two stages. The first stage, a comprehensive analysis, question by question, of responses to the survey and in the FGMs was reported in Chapter 6. In this chapter, the second stage data are presented and discussed.

To develop this second stage of the analysis, the information from Chapters 3, 4, and 5, and the stakeholder opinions collected by the questionnaires and FGMs were selected and grouped in relation to the research questions addressed in this thesis. Thus, the analysis and discussion of each research question is supported by a group of answers and information from the three phases of data collection.

The questions, with answers involving importance scales (not important, moderately important, important, very important, and extremely important), or quality scales (very bad, bad, fairly good, good, very good, and excellent) were grouped in three levels, with the objective of diminishing the details of the answers and facilitating interpretation of the results. The answers “not important and moderately important” were grouped under “less important” and the answers “very important” and “extremely important” under “very important”. In the case of quality

scales, the answers “very bad”, “bad” and “fairly good” were classed under “bad”, and the responses “very good” and “excellent” under “very good”.

The results for each question analysed in this phase were calculated considering only the number of people who had answered the question. Therefore, the number of non-respondents, and the stakeholders who had opted for answering “do not know” or “not applicable” was subtracted from the total sample number.

The software SAS System® (Statistical Analysis System)[45] was used for statistical analysis (Gravely 1998). The Pearson Chi-Squared test was used to compare proportions within groups or to compare differences between groups: a level of significance of $p<0.05$ was used.

7.3. Successful experiences from other countries in agricultural research

Research Question 1 was based on the premise that the successful experiences of other countries in restructuring their agricultural research systems can help to improve the Brazilian agricultural research system and the agricultural industries in Brazil as a consequence. The results from the questionnaires revealed that there was no significant difference of opinion between the industries’ respondents (Pearson χ^2 test = 1.34 p = 0.5130). Thus, both cotton and dairy industries’ stakeholders considered the international agricultural experience important to help Brazilian agriculture. About 91% of the respondents regarded the successful experience from other countries as important or very important and only 9% think that it is less important in assisting Brazil in its process of agricultural research system restructure (Table 7.1).

45 SAS Institute Inc, SAS Campus Drive, Cary, North Carolina 27513.

Table 7.1 Stakeholders' opinions about the importance of other countries' experience in helping Brazilian agricultural industries

Industry	Less important		Important		Very important		Total
	Number	%	Number	%	Number	%	Number
Cotton	18	8.1	110	49.8	93	42.1	221
Dairy	17	10.0	75	44.1	78	45.9	170
Total	35	9.0	185	47.3	171	43.7	391

To put the importance of other country's experience into context, it is important to register the Brazilian experience. In Chapter 5, it was described that the Brazilian government has been doing almost the same things as the other countries have implemented to restructure their agriculture sectors, including their agricultural research systems. Successive Brazilian governments, over the past 30 years, looking to improve the agricultural sector, have implemented many reforms, creating and reformulating policies for the sector as a whole (Coes and Welch 2005; Furtado 2002; Rodrigues 2001).

The Brazilian agricultural research system, as described in Chapter 3, has been submitted to a series of transformations and adjustments to meet the expected demand from the domestic and worldwide economy. Laws and Decrees designed to stimulate and to increase the investment in R&D activities carried out by government-financed agencies and the private sector, and to support actions and programs that strengthen and consolidate an enterprising culture of investment in the country, have been created. For their part, the public agricultural research institutions have developed a process of adapting to the new reality of the market, promoting changes in their administrative structures and strategic management areas, and creating internal mechanisms to increase private sector participation in the development of their R&D activities.

Despite all these initiatives, participation by the private sector in most areas of agricultural research was suboptimal. However, because of its natural resources, the strength of its agribusiness, and the quality of its scientists, Brazil has the potential to increase significantly its share the global agricultural market. To achieve this, it needs

to make adjustments to its agricultural research system, and adapt some of the strategies and instruments that have been used successfully in other countries to Brazilian conditions.

The most important lesson to be learnt from the experience of other countries is the need for an integrated approach to reform. All the ministries of government, the legislature, the private sector and the agricultural research institutions (federal, state, and universities) must be involved in the reform process. There needs to be strong motivation to change with common objectives to improve agricultural research. This is necessary to ensure that a streamlined system for agricultural research is created.

As a result of this integrated approach, the countries studied have focussed their efforts on certain strategic areas, a strategy which may be useful to Brazil. These areas are:

- **Infrastructure -** with the creation of technological parks, creation of incentives to import equipment and chemical products for specific use in research;

- **Education -** to strengthen basic and university education, and create better conditions for the professional formation of new scientists and upgrading of the qualifications of existing staff;

- **Policy system -** to put effort in the creation and regulation of laws to protect the intellectual property of technology and innovation, to diminish the state bureaucracy, to allow more flexibility in the management of research institutions, and introduce flexible working relations. There is a need to create conditions to maintain the agricultural research budget at a guaranteed level.

- **Organizational structure –** to reduce the size of the agricultural research institutions (buildings, laboratories, experimental units, administrative structure, number of employees, etc) and privatize public research and technology transfer (extension) institutions or prepare them to sell their services to the private sector. Finally, the old model of “science push” management for science and technology should be abandoned, and a market demand system (to define the

research projects to be developed) named “demand pull” should be adopted. Part of this system should involve manager autonomy in decision-making.

- **Funding research –** to create new methods to facilitate the application of the already existing funds for research support. This could involve creation of specific competitive funds to meet the needs of agricultural research organisations with financial support from private and public investment as well as tax concessions and subsidized loans for investment in agricultural research infra-structure; and

- **Strategic planning -** to centralize the activities of coordination and basic operational processes such as the setting of objectives and priorities, resource acquisition, and the creation of instruments for the development of international partnerships

In addition to the common characteristics outlined above, the study of the experience of other countries in agricultural research systems identified certain national measures that may help to improve the Brazilian agricultural system. These included the experience of Chile, the United States of America, China, New Zealand, and Australia.

- **Chile’s experience**: Chile introduced some flexibility into universities and INIA by permitting staff to earn and retain external income earned through consultancies and other contracts and part-time work. The government created a Board of Directors, with external members from public and private sectors, for each of their Regional Research Centres, to define research priorities and investment (Venezian and Muchnik 1995)

- **The United States of America’s experience**: Besides maintaining its consistent policy to protect intellectual property rights applying to biological technology, and a comprehensive system of patents and trademarks, the United States has strengthened the

government's role in the process of defining priorities and the development of grading standards for many food products. In addition, the traditional model of the relationship between public agricultural research institutions and private sector companies in the USA in defining the responsibility for each actor in the agricultural research system (ARS, universities, state research centres, and private research departments/companies) is important and must be considered for countries thinking of reforming their research structure (Fuglie *et al.* 1996; USDA 2006).

- **China's experience**: An important adjustment introduced into the Chinese agricultural research system was the reformulation of the researchers' payment and rewards system to take into account individual or group performance, using capital collected in the project in which they are involved to pay this additional remuneration (Fan and Pardey 1992).

- **New Zealand's experience**: The main contributions from New Zealand were the principles defined by the Science and Technology Advisory Committee (STAC) and followed by the government to implement agricultural sector reform. This involved the creation of separate institutions to develop non-commercial functions and trading functions and the privatization of technology transfer (extension) activities. They reduced the number of research institutions and established the Crown research institutes (CRIs) under the ownership of the government but modelled on private companies and created the opportunity for agricultural producers to levy themselves to fund research, as an alternative mechanism for funding research industries (Duncan and Bollard 1992; Evans *et al.* 1996).

- **Australia's experience**: The Australian government has created some very important instruments to improve its agricultural research system. Among them is a unique system of competitive and

> independent funds formed to direct research resources generated by production sector levies with corresponding dollar-for-dollar funding from the government up to a limit of 0.5% of the total value of industry production. They also established the Cooperative Research Centres program (CRCs) that, besides improving the linkage between private and public sectors, must have the participation of a university, and seek to provide multidisciplinary solutions to technological problems, in a restricted period of time (Algar *et al.* 2000; CRC 2006).

When all the information reported above is considered, it can be concluded that the experience of R&D institutions in other countries in streamlining their administrative structure and modifying research activities can provide relevant guidelines and a potential framework to define the best way to improve the relationship between public agricultural R&D institutions and private sector companies in Brazil.

7.4. Private sector participation in public agricultural research institutions

In Chapter 3, in which the Brazilian agricultural research system was described, private sector participation was shown to be less than five percent (see Table 3.4). The information reported in Chapter 4 confirmed the low participation by the private sector in developing countries, where the average level of participation was only six percent (see Table 4.2). While there are no concrete studies in the literature to confirm that a high level of investment in R&D means a higher level of development of a country's economy, Chapter 5 showed that the countries who had invested in R&D are in the top ranked groups in the global agricultural market (Ruttan 1991). Research Question 2 was designed with this scenario in mind, and the results from the questionnaires and the focus groups meeting were analysed and applied to identify the factors hindering private sector participation in agricultural R&D in Brazil.

To answer this question, it is important to note that almost 97% of stakeholders in both the cotton and dairy industries have used or are using technologies created and made available by the agricultural research institutions. However, on the other hand, Table 7.2 reveals a significant variation between cotton and dairy respondents' opinion when the questionnaires asked if they have or have had a partnership agreement with any agricultural research institution (Pearson χ^2 test = 14.676, $p<0.0001$). 58.4% of cotton industry stakeholders answered "*No*", while 80.8% of dairy industry respondents said "*No*"; they have not had a contract with any agricultural research institution.

Table 7.2 Stakeholders' partnership agreements with agricultural research institutions

Answer	Cotton		Dairy		Total
	Number	%	Number	%	Number
Yes	72	41.6	20	19.2	92
No	101	58.4	84	80.8	185
Total	173	100.0	104	100.0	277

The results in Table 7.2 show that the cotton industry is much more involved with agricultural research, while the dairy industry seems to be having more difficulty in becoming involved in R&D activities. Some reasons for this situation, and what, in the opinion of the stakeholders, is hindering private sector participation agreements with public R&D institutions, are shown in Table 7.3. The results of the research showed that there was no significant difference (Pearson χ^2 test = 0.2354, $p<0.6275$) between cotton and dairy industry opinions about the issue concerning the availability of agricultural technologies. Both industries considered the fact that the majority of the relevant agricultural technologies are freely available, but they do not think that this is not the most significant factor hindering the development of agreements with the private sector. In their opinion, what really makes participation by the private sector in projects developed by public agricultural research institutions difficult is the lack of information about how to form these partnerships, and the lack

of involvement by the agricultural research institutions in the process of showing companies how to implement technical and commercial partnerships.

Table 7.3 Cotton and dairy stakeholders' opinions about what is hindering the private sector participation in projects developed by agricultural research institutions

Issues	Cotton		Dairy		Total
	Number	%	Number	%	Number
The majority of the relevant agricultural technologies are freely available	49	21.0	33	19.1	82
The information about how to form these partnerships is not available or is inadequate	92	39.5	86	49.7	178
The research and development institutions do not get involved in the process of showing companies how to implement technical and commercial partnerships	83	35.6	82	47.4	165
The laws, rules, and procedures created to define the research and development institutions' activities are not inclusive and clear enough to allow partnerships with private sector companies to develop	18	7.7	28	16.2	46
It is difficult to obtain finance to implement this kind of partnership agreement	45	19.3	12	6.6	57

Table 7.4 shows the disappointment of the dairy industry respondents with public agricultural research institutions. Their concern can be seen when the results from cotton and dairy responses are compared. In addition to confirming the importance of the issues cited above, the statistics revealed that there were significant differences between dairy and cotton industry representatives' views, considering the number of responses for each issue: "*the information about how to form these partnerships is not available or is inadequate*" (Pearson χ^2 test = 4.2168, $p<0.0400$); "*the research and development institutions do not get involved in the process of showing companies how to implement technical and commercial partnerships*" (Pearson χ^2 test = 5.7077, $p<0.0169$); "*the laws, rules, and procedures created to define the research and development institutions' activities are not inclusive and clear enough to allow partnerships with private sector companies to*

develop" (Pearson χ^2 test = 7.0725, p<0.0078). The situation changed when respondents considered the issue, *'it is difficult to obtain finance to implement this kind of partnership agreement"* (Pearson χ^2 test = 12.6023, p<0.0004), when cotton respondents registered more concern with financial difficulties.

Table 7.4 Cotton and dairy industry stakeholders' views about performance of public agricultural research institutions

Performance	Cotton		Dairy		Total
	Number	%	Number	%	Number
Bad	72	31.4	75	43.4	147
Good	102	44.5	75	43.4	177
Very Good	55	24.0	23	13.3	78

Table 7.4 shows also, the opinion of cotton and dairy industry stakeholders about the performance of public agricultural research institutions. It can be seen that both cotton and dairy industries are not totally satisfied with the actual situation of these institutions, returning a large number of comments in the categories "Bad". A comparison of cotton and dairy stakeholders' points of view shows there is no significant difference between the groups for the option "Good", but there are significant differences for the options "Bad" and "Very Good". In this category, dairy respondents showed that they were more disappointed than cotton stakeholders with the services and technologies received from public agricultural research institutions.

Likewise, cotton and dairy stakeholders believed that involvement by public agricultural research institutions was necessary to advance their industries, supporting the suggestions presented in Table 7.5. Significant differences were registered in cotton and dairy respondents' opinions on the issues: *"Increase investment in research projects"* (Pearson χ^2 test = 13.1427, p<0.0003); and "*Increase investment in training research staff*" (Pearson χ^2 test = 16.2288, p<0.0001). Cotton industry stakeholders supported both these proposal more strongly than did dairy industry stakeholders. With respect to the other suggestions

described in Table 7.5, there were no significant differences between the two groups of respondents.

Table 7.5 Cotton and dairy industry stakeholders' suggestions to improve the agricultural research institutions

Issues	Cotton		Dairy		Total
	Number	%	Number	%	Number
Increase investment in research projects	172	73.8	98	56.7	270
Increase investment in training research staff	115	49.4	51	29.5	166
Allow easy access to information	128	54.9	97	56.1	225
Create new projects involving all segments of the agricultural supply chain	134	57.5	84	48.6	218
Create a system of research and extension capable of interacting with the agricultural industries to meet demands and transfer solutions to the diverse sectors	173	74.3	141	81.5	314
Create legal instruments to regulate partnerships with the private sector, considering the existing laws covering this subject	144	61.8	106	61.3	250
Enable technicians to work in the business/marketing/economics part of the production chain with the objective of developing partnerships involving the public and private sectors	172	73.8	135	78.0	307

These results indicate that, both cotton and dairy stakeholders believe that the public agricultural research institutions need to be better prepared to encourage private sector partnerships. In this context, three points were highlighted and supported by the respondents.

- Firstly, the agricultural research institutions have to be more involved with the other segments of the agricultural sector, creating conditions to adequately identify the demands of the sector, and to deliver pertinent solutions in return.

- Secondly, the research institutions need to develop the ability to negotiate with the private sector. They have to train their technicians to work competently in the business and marketing areas of the production chain with agribusiness, at the same level of competence, and in concert with the private sector's technicians.

- Thirdly, the government has to create more adequate instruments (i.e. laws, decrees, etc.) to make the formation of partnerships between the private sector and public agricultural research institutions easier to achieve.

The points described above about the changes that need to be made indicate another reason why partnerships with the private sector are difficult to form: public agricultural R&D institutions are not prepared to form these partnerships, because they do not have adequate administrative instruments to make this agreement possible. Their technicians are not well prepared to undertake competent negotiations and the laws and regulations need to be improved, within the context of the marketplace characteristics, to allow private sector participation without restrictions.

Another relevant point in this context is the cotton and dairy stakeholders' perceptions about why the technologies created by agricultural research institutions have not been applied by farmers and other segments of the agricultural sector (see Table 7.6). There were significant differences between cotton and dairy respondents

about the issues "*Research and development institutions are not totally prepared to divulge information and to help potential users apply new technologies*" (Pearson χ^2 test = 9.0522, p<0.0026), and "*Producers are not organized in terms of structure to receive and to apply new technology*" (Pearson χ^2 test = 8.6817, p<0.0032). The responses showed dairy industry stakeholders more emphatic in affirming that the agricultural R&D institutions are not organized to divulge and transfer technologies, and that dairy industry producers are not prepared to receive and incorporate new technologies into their production systems.

In addition, both cotton and dairy stakeholders agreed that the public agricultural research institutions have the competence to develop new technologies, but they are not prepared to introduce these new technologies into the market. This situation reinforces the previous statement that reported the lack of competence by public agricultural research institutions to work with the other agricultural industry segments, and identifies a new factor that adds to the difficulty of achieving private sector participation in agricultural research activities. And neither the dairy or cotton producers are organized in terms of structure to receive and to apply new technologies.

Table 7.6 Cotton and dairy industry stakeholders' perceptions about why more of the technologies created by agricultural research institutions have not been applied

Issues	Cotton		Dairy		Total
	Number	%	Number	%	Number
Research and development institutions are not totally prepared to divulge information and to help potential users apply new technologies	159	68.2	141	81.5	300
Industry segments have difficulty accessing the financial resources necessary to apply and to implement new technology	118	50.6	98	56.7	216
Producers are not organized in terms of structure to receive and to apply new technology	107	45.9	105	60.7	212
Research and development institutes are organized to develop new technology but not adequately prepared to introduce these technologies to the market	150	64.4	103	59.5	253

The perception of the lack of industry organization was echoed by the results presented in Table 7.7, where it can be seen that there is no significant difference between cotton and dairy respondents' opinions about how organized they are to encourage the expansion of Brazilian agricultural products in the international market ($p<0.05$). Both dairy and cotton respondents confirmed that they are "partially organized" to improve participation by Brazilian cotton and dairy products in the global agricultural market.

Table 7.7 Cotton and dairy industry stakeholders' opinions about their structural ability to participate in the international market

Issues	Cotton		Dairy	
	Number	%	Number	%
Not in any way organised to allow the expansion of the Brazilian agricultural products' participation in the international market	12	5.3	28	16.2
Partially organized to allow the expansion of Brazilian agricultural products' participation in the international market	200	87.7	144	83.2
Totally organized to allow the expansion of Brazilian agricultural products' participation in the international market	16	7.0	1	0.6
Total	**228**	**100.0**	**173**	**100.0**

The concern, reported earlier, by the cotton and dairy industry representatives about the performance of the public agricultural research institutions, was expressed once more in their responses shown in Table 7.8. When they were asked which segments of their industry needs to be reviewed by the government to improve production and participation in the international market by the cotton and dairy industries, both groups of respondents strongly agreed that government needs to improve the segment of "science and technology in the agricultural sector". There was no significant difference in cotton and dairy stakeholders' opinions (Pearson χ^2 test = 1.1045, $p<0.2933$), nor about the necessity to improve "international trade (export and import)" (Pearson χ^2 test = 0.1590, $p<0.6901$).

Table 7.8 Cotton and dairy industry respondents' opinions about which industry segments needs to be reviewed by Brazilian government to improve export performance

Issues	Cotton		Dairy		Total
	Number	%	Number	%	Number
International trade (export and import)	185	78.5	133	76.9	318
Tax exemption and tax incentives	160	68.7	103	59.5	263
Science and technology in the agricultural sector	175	75.8	139	80.4	314
Rural production	113	48.5	84	48.6	197
Domestic marketing	116	49.8	95	54.9	211

Finally, the focus group meetings held in Brazil, involving the cotton and dairy stakeholders, brought out more information to help in the process of identifying what is hindering private sector participation in agricultural research. The list of reasons below represents a consensus among the participants from the cotton and dairy industries:

- The agricultural research institutions are not structured to develop integrated research projects among themselves. In some research areas, it is possible to identify competition between state and federal agricultural R&D institutions developing similar research projects, and trying some times, to involve the same customers from the private sector.
- There is no central coordination to define the main priorities, or to integrate the efforts of state and federal agricultural research institutions, making it difficult for private sector companies to understand how to apply for research partnerships and to identify which institutions they should approach.

- The priorities for the agricultural research program, defined by public agricultural research institutions, are not chosen to address to the needs of the main lines of production for the agricultural market.
- The agricultural industries present themselves as a disorganized sector, without the ability to make integrated demands. This creates individual and specific demands, which make it difficult for the agricultural research institutions to work with them.
- The Brazilian government does not have a policy defining how the research institutions should manage the science and technology areas.
- Intellectual property rights are still not totally regulated in Brazil and, in the majority of agricultural research institutions, the existing laws are not being applied.
- The employees of agricultural research institutions are not prepared to trade their products and ideas.
- The managers of agricultural research institutions are not linked with the agricultural market as part of their role. They are much more academic than market oriented.

It is important to note that the situation of the Brazilian agricultural research system now, as characterized by the cotton and dairy industries' stakeholders in this study is, in some ways, similar to the situations operating in the countries studied in Chapter 4, before they decided to reform their agricultural research systems.

These countries used to have inadequate laws on intellectual property rights in the areas of biological technology and poor registration of plant patents. The model of "science push" was the main way on developing agricultural research in all of these other countries. Specifically in New Zealand and Australia, the agricultural sectors were under heavy regulation with their main agricultural industries very dependent on government decisions. Their agricultural research institutions used to be larger (more buildings, laboratories, experimental fields, excessive numbers of employees etc.), and practice strong administrative corporatism. Consequently the agricultural

research sector in these two countries was represented by high cost and low efficiency institutions at the time when they were reformed (Algar *et al.* 2000; Alston *et al.* 1999b; Pardey *et al.* 2006; Ribeiro 1999; Scrimgeour and Pasour 1996). Furthermore, these countries have since implemented a variety of legal and financial measures to encourage private sector participation in agricultural research.

After a consideration of the Brazilian agricultural research system and the experiences of other countries, described in Chapter 3 and Chapter 4 respectively, and of the reasons presented by the cotton and dairy stakeholders for the lack of private sector participation in agricultural R&D in Brazil, it can be concluded that the Brazilian public agricultural research institutions are not structured adequately and are not prepared to permit the development of partnership arrangements with private agribusiness companies.

7.5. Financial support to maintain Brazilian agricultural research institutions

Another important aim in this study was to identify who should provide financial support to maintain the activities of the agricultural research institutions in the Brazilian agricultural sector. The results from the relevant questions in the electronic survey and from the focus group meetings were analysed to ascertain the opinions of cotton and dairy industry stakeholders. There was no significant difference (Pearson χ^2 test = 0.9442, $p<0.6237$) between the opinions of the two groups of stakeholders in the survey. Thus, both cotton (93.9%) and dairy (91.3%) industries agreed almost unanimously that combined private and public sector funding should be used to provide financial support for the agricultural research institutions in Brazil (see Table 7.9).

Table 7.9 Cotton and dairy industry respondents' opinions regarding who should finance agricultural research institutions in Brazil

Issues	Cotton		Dairy		Total
	Number	%	Number	%	Number
Private sector funding only	2	0.9	2	1.2	4
Government sector funding only	12	5.3	13	7.5	25
Combined private and public sector funding	214	93.9	158	91.3	372

In addition, a comparison of the opinions of cotton and dairy stakeholders on whether they agree or do not agree to contribute to funding agricultural research projects, in Table 7.10, shows that there was no significant difference (Pearson χ^2 test = 0.0064, $p<0.9364$). So, approximately 87% of cotton and dairy respondents agreed to support financially the agricultural R&D programs developed by public institutions.

Table 7.10 Cotton and dairy industry stakeholders' position about their willingness to participate in the financing of agricultural research

Opinion	Cotton		Dairy		Total
	Number	%	Number	%	Number
Agree	142	87.1	132	87.4	274
Disagree	21	12.9	19	12.6	40

As a complement to this information, the questionnaires sought the opinion of cotton and dairy industry stakeholders about what percentage of investment in agricultural research institutions they would consider ideal to be contributed by the private sector. Cotton and dairy stakeholders showed a significant difference in opinion (Pearson χ^2 test = 13.4930, $p<0.0091$), with the results indicating that the cotton industry stakeholders would want to invest more in agricultural research than the dairy industry stakeholders. Table 7.11 shows that the cotton industry was

represented more in the categories where the proposed investment by the private sector exceeded public investment; while in contrast, the dairy industry was represented more in the options where the proposed investment by government was larger than private sector investment. However, the majority of both cotton and dairy industries stakeholders identified their intentions to invest between 41% and 60% of the cost of public agricultural research projects.

Table 7.11 Cotton and dairy stakeholders' opinions about how much of the agricultural research investment should be contributed by the private sector

Issues	Cotton		Dairy		Total
	Number	%	Number	%	Number
From 05% to 20% by private sector and from 80% to 95% by government sector	24	11.1	31	19.5	55
From 21% to 40% by private sector and from 79% to 60% by government sector	55	25.5	53	33.3	108
From 41% to 60% by private sector and from 59% to 40% by government sector	98	45.4	58	36.5	156
From 61% to 80% by private sector and from 39% to 20% by government sector	30	13.9	16	10.1	46
From 81% to 95% by private sector and from 05% to 19% by government sector	9	4.2	1	0.6	10

Cotton and dairy industry stakeholders agreed that agricultural research projects must be developed in partnership with the government, and the majority also agreed to contribute to the funding of these research projects, with the predominant view being that 41 to 60% of the total investment should be contributed by the private sector. However, the information reported previously in Chapter 3 and Chapter 4 has shown that private sector participation in agricultural research is not happening in Brazil, at least not in an ideal form, with very low levels of participation recorded when compared to the results in this area presented by developed countries (EMBRAPA 2005; OECD 2006).

Therefore, Brazil presents a peculiar and conflicting situation, where the private companies believe that they must participate and have expressed their firm intention to finance agricultural research projects (Table 7.10), but their participation has encountered difficulties (Table 3.4).

Besides the factors identified in Item 7.4 of this chapter that hinder private sector participation in agricultural research institutions, the focus group meetings brought out some more arguments that were being considered by the private sector before deciding if they were going to invest, or not, in agricultural research projects. These arguments help to explain why these institutions have experienced difficulties in convincing private sector companies to be partners in agricultural research projects. These arguments, presented by the various professional groups of cotton and dairy industry stakeholders, are different to those already described above, and are listed below.

Farmers:

- New products developed from collaborative research need to be appropriately identified so that the profits that they generate can be shared in proportion to the investment made by the parties; and
- Farmers will invest in agricultural research projects if they have some input into what research is going to be done.

Managers/Leaders of associative institutions:

- The private sector will fund agricultural research projects designed to meet market demands, and the results must be useful to maintain or to extend the participation of the agricultural sector in domestic or international markets;
- the agricultural research institutions need to develop expertise in drawing up contracts and their staff need to built their competence in negotiating with the private sector; and
- The private sector has difficulty in investing in public agricultural research institutions because the criteria that control the choices of the decision-makers and other people are solely political.

Managers of agricultural research institutions:

- There is no incentive for agricultural research institutions to take financial resources from the agricultural industries, because the institutions cannot increase their budget by doing so; and
- Public agricultural research institutions have so much bureaucracy and so many laws with which to comply, that they have a lot of inertia when compared to private sector companies, which want speed and flexibility in decision making and action.

In summary, the results reported in this section confirm the view that *"the private sector companies believe that the government of Brazil must finance the agricultural research projects, and, therefore, they do not have the intention to increase their participation in projects developed by public agricultural research institutions"* is not true. On the contrary, the private sector, in this study, not only expressed its interest in funding agricultural research projects, but also confirmed its desire to participate in the definition of what will be researched, and play its part in the process of introducing new products – the results of these partnerships – into the market. Indeed, the research has shown that the public agricultural research institutions need to change, and create appropriate conditions to attend to the new demands of the market.

7.6. Government instruments to provide incentive for private sector companies' financial support in agricultural research programs or institutions

A set of initiatives implemented by the Brazilian government with the objective of stimulating investment by the private sector in science and technology, and specifically in agricultural research, was described in Chapter 3 (Sections 3.5 and 3.6). Many federal and state laws establishing fiscal incentives to raise the standard of technological qualifications in industry and agriculture, creating incentives to support university and company interaction in innovation, and creating incentives for

innovation in scientific and technological research in the production sector were created (Presidência da República do Brasil 2000, 2001, 2004; PROALMAT 2006).

Despite all these legal instruments put in place by the Brazilian government, private investment in agricultural research in Brazil is still too small, matching the level of investment in the majority of developing countries (see Table 3.4 and Table 4.2). On the other hand, the experience of other countries (described in Chapter 4) demonstrated that laws establishing incentives to increase investment in agricultural research have been relatively successful in the majority of countries where their agricultural research systems have been restructured. This background begged the question: Why are the laws created by successive Brazilian governments to stimulate private sector participation in agricultural research projects developed by public R&D institutions not working?

The electronic survey involving cotton and dairy industry stakeholders sought to identify the level of knowledge about these laws, for example, if the respondents have used or are using them and if not, why not. Table 7.12 shows that the majority of the respondents did not know about Federal and State laws establishing fiscal incentives to raise the standard of technological qualification in all the segment of agriculture. Consequently fewer than half of the cotton and dairy industry stakeholders knew about government laws with this objective. Furthermore, there was no significant difference between cotton and dairy respondents' answers about their knowledge of laws designed to stimulate private sector participation in agricultural research institutions (Pearson χ^2 test = 0.2596, $p<0.6104$).

Table 7.12 Cotton and dairy industry stakeholders' knowledge about government laws to provide incentives for investment in agricultural research

Issue: Knowledge of incentive laws	Cotton		Dairy		Total
	Number	%	Number	%	Number
Yes	102	45.3	74	42.8	176
No	123	54.7	99	57.2	222
Total	225	56.5	173	43.5	398

In contrast, Table 7.13 shows a significant difference in the cotton and dairy stakeholders' use of the incentives provided by these laws (Pearson χ^2 test = 18.4918, $p<0.0001$). Of those respondents that have knowledge about the incentives, almost 52% of the cotton stakeholders confirmed that they had used or are using these incentives, while only 20.5% of the dairy stakeholders said the same thing. One reason for the low number of dairy stakeholders' use of incentives may be the absence of specific laws [such as Law 6.683, investment incentives in cotton research (see Chapter 2, Section 2.2.1.1)] in states with significant levels of milk production such as Minas Gerais, Goiás, Rio Grande do Sul, Paraná and São Paulo. Although almost 1.3 million dairy producers are spread over all the States of the country, the questionnaire was sent to stakeholders in the two largest production states of the country, Minas Gerais and Goiás. A greater level of participation by stakeholders in these states could have been expected.

Table 7.13 Cotton and dairy industry stakeholders' response to the use of incentives to investment in agricultural research

Opinion	Cotton		Dairy		Total
	Number	%	Number	%	Number
Yes	53	52.0	16	20.5	69
No	49	48.0	62	79.5	111
Total	102	56.7	78	43.3	180

Finally, the electronic survey shed more light on what is hindering the use of laws created by State and Federal governments to provide incentives to the private sector to encourage participation in agricultural research institutions. Table 7.14 shows that there were significant differences between cotton and dairy respondents' points of view about two of the issues: "*It is difficult to understand what are the real advantages, rights, and obligations involved in the partnership*" (Pearson χ^2 test = 7.1798, $p<0.0074$), and "*Communication and encouragement by the government to use the existing laws in partnership development is lacking*" (Pearson χ^2 test = 9.6621, $p<0.0019$). These responses showed dairy stakeholders are more concerned

about these two issues. There were no significant differences in the results pertaining to the other issues. Thus, both cotton and dairy industry stakeholders agreed that in spite of the existence of state and federal laws created to encourage partnerships between the private sector and public agricultural research institutions, these laws are not totally adequate to deal with the private agricultural sector's demands and, to make the problem worse, the government agencies responsible for divulging information and giving guidance on how to use these instruments are not prepared to accept their responsibilities.

Table 7.14 Cotton and dairy industry stakeholders' views on why the opportunities created by the government for private sector participation in agricultural research are not being used

Issues	Cotton		Dairy		Total
	Number	%	Number	%	Number
It is difficult to understand what are the real advantages, rights, and obligations involved in the partnership	27	11.6	37	21.4	64
The value of the incentives provided is small and not sufficient to justify private sector participation	10	4.3	11	6.4	21
Communication and encouragement by the government to use the existing laws in partnership development are lacking	30	12.9	43	24.9	73
Application instruments necessary to present projects are complex, making it difficult to access the incentives provided in the legislation	13	5.6	12	6.9	25
Government agencies responsible for guiding interested parties in accessing the benefits are not aware of private sector requirements	25	10.7	25	14.5	50
The laws impose difficult requirements on small and medium-sized companies wanting to access the offered benefits	21	9.0	17	9.8	38

In summary, the results presented in this item showed that the laws exist, but nearly half of the cotton and dairy stakeholders did not know about them. In addition, it may be inferred that the laws were drafted without adequate involvement by potential beneficiaries. When a law is passed, it does not involve a communication

process to make interested parties aware of when and how the laws can be used. The government agencies in Brazil responsible for the administration of the laws are not adequately qualified to instruct those interested in using the provisions of the laws. Normally, the staff responsible for the application of the laws may have a conflict of interest and could be involved in a series of activities that hinder their ability to provide helpful advice.

In addition, cotton and dairy industry stakeholders have the opinion that the laws created by the government to reward the formation of partnerships between private sector companies and public agricultural research institutions are complex, and difficult for the industries' stakeholders to understand and apply. The values of the incentives are not sufficient to justify the private sector investment.

In the light of all these arguments, it can be suggested that the State and Federal laws created in Brazil, to provide incentives for the development of partnerships between the private sector and public agricultural research institutions, are deficient and not adequate to address the agricultural sectors' demands in this area.

7.7. Summary

The purpose of this chapter was to answer the research questions and test the hypotheses of this thesis described in Chapter 1. The information described in Chapters 3, 4 and 5, and the data collected through the electronic survey, focus group meetings, and interviews involving the cotton and dairy industry stakeholders were used to do this. As a result, Hypotheses 1, 2, and 4 were confirmed and, in contrast Hypothesis 3 was not confirmed.

The results demonstrated that the experiences of other countries in the process of restructuring of their agricultural sectors, including their agricultural research systems, could be helpful to Brazil. The strategies which these other countries employed and the results they demonstrated are fundamental to help in defining what the Brazilian agricultural research system should achieve and in designing and implementing its restructure.

This chapter has also shown that despite the State and Federal governments' initiatives seeking to encourage collaboration between the private and public sector, and to increase private sector spending on agricultural research projects, the

measures implemented to date are considered inadequate and have shown poor results. This situation was mainly provoked by the decrease in federal and state government funding for agricultural research. At the same time, the excessive bureaucracy added to the cumulative loss of administrative flexibility and managerial autonomy in decision making faced by the public agricultural research institutions in the conduct of their activities. In addition, cotton and dairy industry stakeholders declared that the agricultural production sector was not sufficiently organized to make appropriate demands on public agricultural research institutions. The study showed the dairy industry was more concerned about this subject than the cotton industry.

A number of other reasons that, according to the study's participants, contributed to this situation have been listed in this chapter, and were used to help develop the recommendations in Chapter 8.

Likewise, the cotton and dairy industry stakeholders recognized the importance of agricultural research institutions, and they indicated their intentions to share in equal parts (on average) the funding of research. They also demonstrated their interest in participating in the whole process of research and development. In contrast, they were not confident, under present conditions, about investing in research, knowing that the public agricultural research institutions cannot give the necessary guarantees to support the agreements contracted, let alone provide adequate strategies for the development of partnerships.

This Chapter has revealed the necessity for a comprehensive restructure of the Brazilian agricultural research system. It took into account the present situation as reported by the literature and stakeholders in two significants Brazilian industries, the successful experiences from other countries, the theory about this subject, and the domestic and international market demands.

The new system needs to involve all sectors of the Brazilian economy, and must be coordinated by both the public and private sectors, with administrative flexibility and autonomy to manage human and financial resources. It requires a specific group dealing with the commercialisation of technology and also, it must be supported by a comprehensive and modern intellectual property rights system.

CHAPTER 8

CONCLUSION AND RECOMMENDATIONS

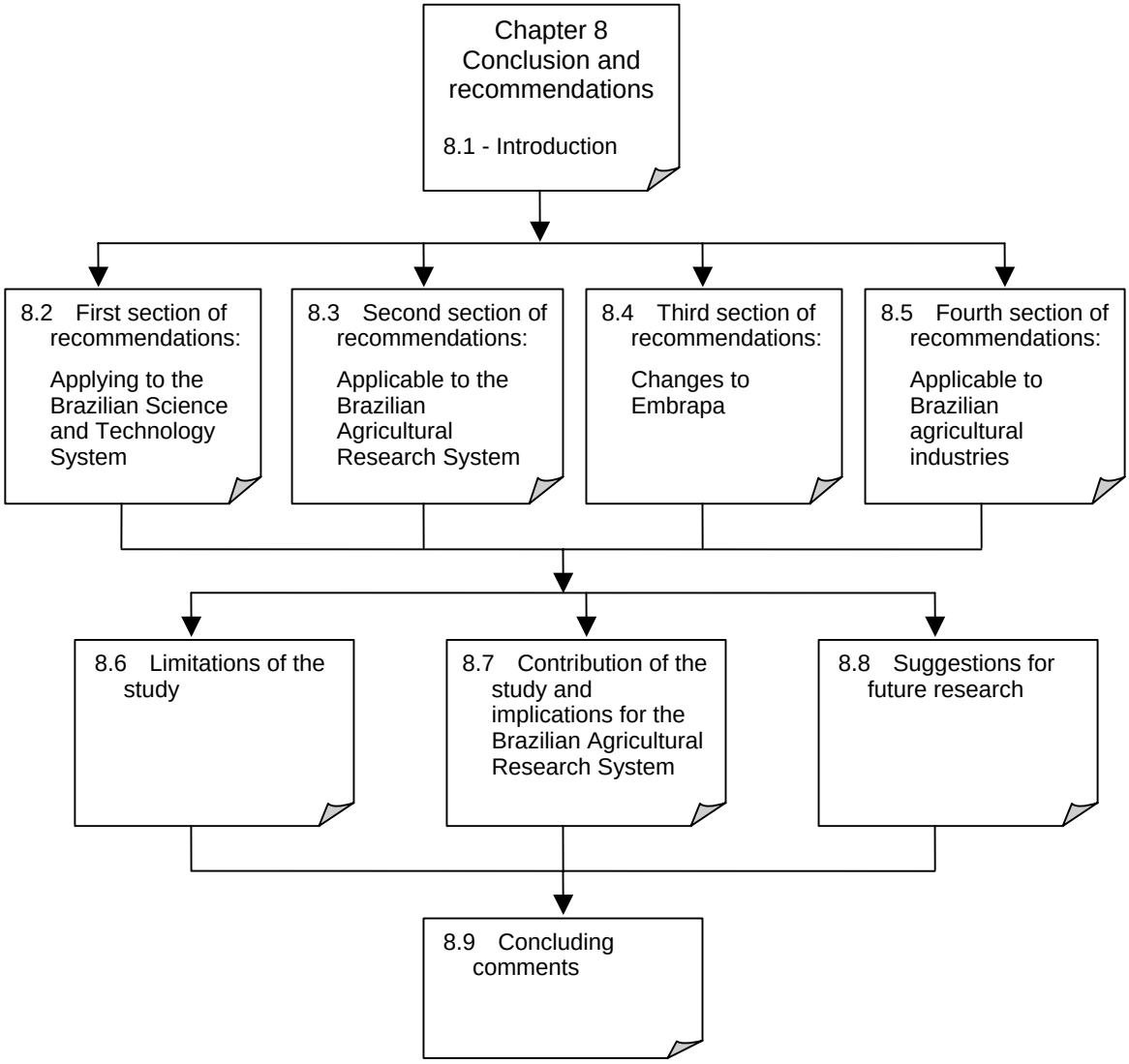

Figure 8.1 Structure of Chapter 8

8.1. Introduction

Private sector participation in agricultural research projects in developing countries accounts for only six percent of the total invested, while government provides the other 94% (Pardey *et al.* 2006a). In Brazil, private sector spending in agricultural R&D has shown an average level just below five percent over the past 10 years. In addition, the agricultural research system has shown unequivocal signs of stagnation, exhaustion, and inefficiency, arriving at the point where the federal and state agricultural research institutions' missions and activities are compromised. It has been demonstrated many times that agricultural research is an important factor in determining a country's competitiveness in worldwide trade in agricultural commodities, and globalization, which has intensified in recent years, encourages competition within and between countries. The vulnerability of the agricultural industries to both internal and external forces is growing in Brazil due to the increasing demands for new products with high quality and production, and therefore Brazil's needs in research and innovation are increasing in size, complexity and urgency (see Chapter 6, Sections 6.3.1.1, 6.3.1.2, and Chapter 7, Sections 7.4 and 7.5).

The existing agricultural research institutions, including Embrapa, clearly need to change and this chapter summarises those changes and sets out a series of recommendations for the government and agribusiness to follow to achieve these changes.

The Brazilian agricultural R&D system, its role in the development of new products for agricultural markets, and the role of R&D in improving the efficiency of production systems for existing products have been examined in this study. In this context, it has been possible to observe that the Brazilian Agricultural Research System has been submitted to a series of transformations and adjustments (which were made in consideration of Brazilian Federal government requirements concerning financial support, administrative structure, and management viability), in order to respond to expected demands from the domestic and worldwide markets. It has also been concluded that the Brazilian agricultural sector is not as organized as it could be, and both public and private sectors need to implement a further series of changes to be adequately structured, and sufficiently organized to identify effectively their needs in research. They also need to be able to justify their claims. For the most

part, the agricultural research system in Brazil is operated by public institutions, which have clearly experienced some changes, but both the system and the institutions need to change further. These institutions have been faced with problems of management and administrative instability, and the constant decline in financial support from State and Federal governments, which has been aggravated by the small contribution from the private sector to their budgets (Specific Objective 1).

As background to this study, the international agricultural R&D system has been described with a focus on the relationship between public institutions conducting agricultural R&D and agribusiness companies in selected countries. It was found that of the total amount invested worldwide in agricultural research, 63% came from the public sector and only 37% from the private sector. However, the global tendency with respect to investment in agricultural R&D shows a constant decline in public sector contributions and a consequent increase in investment made by the private sector.

The majority of developed countries have reviewed and restructured their research systems in recent years, and implemented a generally consistent set of policies to stimulate private sector spending in agricultural R&D and regulate these activities (see Chapter 4, Sections 4.3 and 4.4). As a consequence, 45% of the total amount invested in agricultural research in developed countries came from the public sector and 55% from the private sector. Developed countries have achieved a better performance in this process by having stable economies, well-structured industrial sectors, and consistent legislation linking the main research activities to the demands of national and international agricultural markets. Thus, they have better conditions over all, than developing countries to stimulate private sector investment in agricultural research. Therefore, knowledge gained from the experience of these countries, added to what is happening in the international agricultural research agencies, may help Brazil (like other developing countries) to restructure its agricultural research system appropriately (Specific Objective 2).

The evolution of the international markets for agricultural commodities and the importance of agricultural research and development activities in the process of economic growth in individual countries were also described. The international market for agricultural commodities presents a series of economic, political, social, and legal challenges, which mean that organizations wanting to trade agricultural

products successfully in international markets need to be involved in a continuous search for knowledge and innovation in all areas of agricultural industries. This situation creates the need among trading nations to review their policies in areas such as trading, science and technology, and intellectual property in order to change their production systems and strengthen their participation in the global market.

The Brazilian agricultural sector has achieved a good performance in international market for some agricultural products in recent years (see Chapter 5, Section 5.5.1) but the results achieved in 2005 raised an alert to review the Brazilian agricultural system and all its segments. Brazil needs to do more to match the elite members of the world's most commercial agricultural producers. It is essential that changes occur to bring about more investment in agricultural R&D. The review of the agricultural deregulation process, which started in the 1990s needs to be revived, with a focus on the needs of the agricultural market, and to achieve a reduction of the influence of the bureaucracy with a view to creating new mechanisms to increase private sector participation in the conduct of agricultural research projects and to provide financial support for them (Specific Objective 3).

This analysis of the global agricultural scenario, and Brazil's place in it, combined with the results from the electronic survey and focus group meetings, has led to the development of a set of recommendations presented in this thesis. These recommendations are primarily based on the main concerns, needs, and expectations of the cotton and dairy industry stakeholders with respect to the Brazilian agricultural research system and its relationships with the private sector.

The main concern of the cotton and dairy industry stakeholders is that the Brazilian agricultural research system needs to change to allow and facilitate private sector participation, and have the capability that would enable it to respond to market demands with the necessary agility to increase the competitiveness of Brazilian agricultural commodities in domestic and international markets. The cotton and dairy industry participants' main expectations are that the Brazilian government will recognise that the agricultural research system in Brazil needs to change and that, when taking the measures necessary to change this system, it needs to do this in an inclusive and participative way, with the involvement of all the sectors of the government (for example: those concerned with agriculture, economic, education,

social areas, and legislation sector), and including public and private agricultural research institutions, producers, marketing organizations, and consumers.

In addition, the recommendations suggested here have been made after consideration also of the present situation in the Brazilian agricultural research system (described in Chapter 3), the international agricultural research system, and other countries' experiences in reforming their agricultural research systems (reported in Chapter 4). Using the potential capacity of this information to help guide the reform of the Brazilian agricultural research system is an essential part of the whole process to achieve the necessary links between agricultural research and the other agribusiness segments (discussed in Chapter 5). Consequently, this framework for change constitutes the main part of this chapter. The recommendations therefore, directly reflect the findings of the research undertaken in this thesis. As a result, the concept demonstrated in this thesis is that the Brazilian Agricultural Research System needs to be submitted to a comprehensive and participatory process of change, following the principles defined below, that should serve as base to guide the main actions that will make possible the implementation of the recommendations suggested in this chapter:

- Public agricultural research institutions should have a full range of commercial powers to act in a deregulated environment;
- The public agricultural research institutions should then withdraw from any areas which the private sector can handle competently;
- The government should support non-market basic agricultural Research on a contestable basis;
- The research implemented by the public agricultural research institutions must be developed in a participatory decision making process, involving public and private sector representatives;
- Agricultural research institutions established in partnership, should invest in market-oriented research, and be efficient in the use and allocation of human, financial and infrastructure resources.

In addition, and as part of this process of change, an action plan to implement the proposed recommendations should consider that the whole Brazilian Science and Technology System needs to be reviewed in order to incorporate some of the

worldwide trends that are driving science policy in other countries to meet the specific needs of Brazil in this area. This should involve Federal and State governments, research institutions, and private sector companies as well as the users and consumers of research.

Recommendation 1 – Review the Brazilian Science and Technology System

1 The Brazilian government must include the development of science and technology as a national strategy. The strategy must define comprehensive and up-to-date policy, and involve private and public segments of the economy in the discussion. The science and technology policies must have their execution focussed on integrated action, with the focus of continuing interactions between all the spheres of government, as well as between the government and the private sector.

Recommendation 2 – Reform the Brazilian Agricultural Research System

2 The Brazilian Agricultural Research System should be reformed with integrated involvement of all the public and private sectors of the economy, strengthening an associative culture, and establishing research, development and innovation as basic elements driving the growth of the Brazilian agricultural sector.

Following these two major recommendations, it is a further objective in this chapter to present detailed recommendations which have the potential to help the government and the private sector institutions in Brazil in the process of reforming the Brazilian science and technology system, and specifically, in the reform of the agricultural research system.

The recommendations will be presented in four separate sections.

- The first section sets out general recommendations characterized as the responsibility of the Federal government to help in the process of reforming the Brazilian science and technology system.

- The second section presents recommendations directed to the Federal and State governments to help the Brazilian Agricultural Research System improve its ability to attend to its clients' demands, involving public agricultural research institutions, universities, and the agricultural industries.
- The third sets out specific recommendations for change in Embrapa and the state agricultural research institutions.

The fourth section presents supplementary recommendations to be considered by all those involved in the process to reform the Brazilian agricultural research system, but they mainly include items that the private sector segments of the Brazilian agricultural industries should consider.

With respect to the recommendations presented by the cotton and dairy stakeholders in the course of this research, it should be noted that this chapter includes only those recommendations that are considered pertinent in the context of the overall findings of this thesis.

8.2. Review of the Brazilian Science and Technology System

In the change process proposed, the Federal government would take responsibility for implementing the recommendations defined in this section. The proposed changes are comprehensive and their implementation needs to involve all segments of the public sector.

3. All Brazilian research and development institutions (including those involved in agricultural research) should be brought together under the administration of the Science and Technology Ministry, which should extend its responsibility to achieve equity and efficiency in publicly funded R&D, and include the setting of national research priorities in every science and technology area.

4. The Federal government should designate R&D as a national priority, introducing an understanding of the importance of research and innovation in the process of the country's development into the government departments responsible for defining national economic policies.

5. Education and training infrastructure for R&D needs to be aligned and integrated with long term national goals and industry policy for technology infrastructure for the development of internationally viable industries in Brazil.

6. The Federal government should increase its investment in science and technology, raising it from the current level of just under 1% to 2% of the GDP in the next five years, and reaching 2.5% in ten years.

7. The Federal government should revise its existing policies in the field of international scientific cooperation, inviting participation by other countries in common research activities, and facilitating the international mobility of researchers to Brazil or from Brazil to other countries.

8. The Federal government should create a specific policy to provide incentives for the installation of international laboratories in some states, establish infrastructure, provide funding (fiscal facilities), and stipulate that the laboratories must include Brazilian researchers in their projects.

9. The Federal government, in conjunction with State governments, should create technology parks, making investments in infrastructure (buildings and part of cost of the equipment) at appropriate locations, and provide fiscal incentives for the companies interested in investing in R&D and innovation.

10. With low salaries and poor operating conditions in Brazil, it has become difficult to attract and keep good scientists while still trying to remain at the cutting edge of science. Therefore, the Federal government should create specific career opportunities and a salary system for researchers working in public research institutions, similar to those that already exist for lawyers working in the Federal Government.
11. The Federal government should adopt a system of incentives for the public universities that offer post graduate programs (Masters and PhD), allowing these institutions to receive through public or private funding, the same or equivalent value as the fees paid to private universities in the country, or to universities located in other countries, for each student educated by the faculties of these universities. These resources should be applied directly in the Faculties responsible for appropriate courses, to improve the quality of their courses (by investing in equipment, raising professorial qualifications, funding student research, etc.), and to give incentives for and to facilitate participation, by the lecturers and students, in seminars, conferences, and scientific and technological interchange.
12. The Federal government should create a program for Cooperative Research Units (CRUs) with the aim of improving the usefulness of the overall Brazilian research and development effort by bringing together researchers from several institutions to create the concentration of resources, which are needed in many research fields. The CRUs could bring together outstanding groups of researchers, from both public and private sectors, as well as the users of the research, who must participate actively in the planning and operation of the research activities.
13. The Federal government should set up competitive research and development funds sourced from statutory levies collected from the various segments of the industries, and from matching Brazilian government funds limited to no more than either the total of the industry levy contributions to eligible R&D activities or to 0.5% of the gross value of production, whichever is the lower amount.
14. The Brazilian government should establish an agency specifically for the management of funds to be collected for the purpose of R&D that would not be funded by the private sector.
15. The Ministry of Science and Technology should develop a coordinated publicity strategy for the RCU Program and for the competitive research and development funds, to allow a general understanding of their role and potential benefits, targeting information that is relevant for potential participants engaging in private sector.

16. The Federal government should review its intellectual property rights system, addressing the new requirements of the market, stimulating private sector participation in the process of research, development, and innovation, and establishing a clear government position related to the intellectual property of inventions or results of research projects contracted and financed with public resources.
17. The Federal government should consider the measures established in the Law of Innovation, and create agencies for technology trading, linked to the public research institutions and universities. They could trade the information/inventions produced by them, and be responsible for the registration and protection of intellectual property rights.

The recommendation regarding the need to incorporate all of the public research and development institutions, including the agricultural research institutions, under the responsibility of the Ministry of Science and Technology, is made with the intention of strengthening the research sector's position in the economic structure of the country, and to allow the inclusion of science and technology activities as a strategy of government. This should mean that all government departments would consider research as a fundamental factor in Brazilian economic and social development. This framework could create synergies between different sectors and lead to the establishment of coherent operational practices that may help to prevent omissions, such as those noted recently in the structure of the Law of Innovation. This Law provides for the creation of a Central Committee, for the permanent monitoring of its operation, formed of members from the Ministries of Science and Technology, of Development, Industry and International Trade, and Education, but it does not have a representative from the Ministry of Agriculture with which Embrapa, one of the largest research institutions in Brazil, is linked. This framework may help to create legal instruments to prevent the diverting of existing funds to the government reserve of contingency. Such diversions have been making it impossible to use these funds for the objectives for which they were created.

Any reduction in public sector investment in R&D, and the necessary growth of private sector participation in this area, requires essential and immediate changes in the Brazilian government system. This study has revealed that the private sector has

the desire to increase its participation in agricultural research, and has also shown that the Brazilian government has implemented some measures with the aim of improving this participation, but without success. Therefore, the recommendations suggest that the government needs to implement an efficient strategy to promote changes in its policies about intellectual property, in the management of science and technology, and in its system of spending on research and innovation projects.

The recommended creation of the Cooperative Research Units (CRUs) follows the model implemented in Australia, and it is expected that these research units will be created and managed with active participation of the private sector. In the same way, the industry research funds should be created as a priority and be administered mainly by private initiative with minority participation by government in management. On this point, however, it is important to stress that the continuing financial support from the government is essential to meet the basic expenditures of Brazilian public agricultural research institutions, which are at risk of deteriorating and even of annihilation in some cases. Brazil used to have a strong public research base, constructed during the past decades, which has now been allowed to decline. The other essential provisions are increases in the investment in science and technology infrastructure, and the establishment of incentives for national and international companies to invest in the sector, which many developed and developing countries have already implemented with success (see Chapter 4, Sections 4.4 and 4.5).

Policies in regard to intellectual property have assumed an important role in the process of expanded private sector participation in research and development activities, and the government needs to be prepared to allow this to happen. The Brazilian government must review its policies, and the agencies responsible for managing science and technology need to change their rules about the appropriation of intellectual property rights over the creations financed by them, in order to stimulate the transfer of technology, as occurs in the USA and Australia. Furthermore these agencies and the universities need to include professional training and postgraduate courses in managing intellectual property rights among their priorities.

8.3. Review of the Brazilian Agricultural Research System

The recommendations presented in this section were based on the cotton and dairy stakeholders' claims about performance of the Brazilian Agricultural Research System, and on the information described in the previous chapters. It is proposed that the Federal and State governments would be responsible for implementing the recommendations defined in this second section.

In summary, it can be said that Brazil was capable of constructing a solid agricultural research structure in the past 30 years, with good results achieved by some areas of Brazilian agribusiness in domestic and international markets. However, Federal and State laws, agricultural and scientific sector policies, administrative and bureaucratic resolutions, and budgetary difficulties are some of the items that are perceived to be hindering effective functioning of the Brazilian Agricultural Research System at the present time. Consequently there are many things to do to complement and to perfect the Brazilian Agricultural Research System and the public sector has a crucial role in this process, assuming the responsibility to expand its investment in agricultural research, development, and innovation, and establishing ways to increase private sector participation in this area of activity.

18. The government should strengthen the position of the Secretariats of Science and Technology in the states in the process of defining research priorities, support the creation of technology parks, and provide incentives for the development of public and private research.
19. The governments of the Brazilian states should increase the investment in state foundations of research and development, from 1% to 1.5% of the state GDP in the first five years, increasing to 2% of the GDP in 10 years. The states should expand their capacity to invest in research, development, and innovation, and include, in their priorities, support for the initiatives of agricultural extension and technical assistance, and for the creation of innovative companies.

20. The governments of the Brazilian states should gradually close the remaining state agricultural research institutions, and stimulate the creation of cooperative research units (CRUs) involving the private sector, State and Federal universities, and Federal agricultural research institutions for the solution of specific industry or discipline problems. The state governments should facilitate the transfer of researchers from the closed research institutions to the state universities and to ownership of private companies of science and technology.

21. The Brazilian government should promote the privatization of rural advisory and technical assistance activities through incubated companies* or the creation of business-oriented agencies by offering tax concessions for initiatives with this aim.

22. The Brazilian government should create a national fund specifically to stimulate and finance (through competitive projects) the creation of technical assistance companies and projects in rural extension. This fund should have the financial support of the Federal government, the State governments, and cooperatives of agricultural producers.

23. The Brazilian government should establish departments/agencies to be responsible for the management of claims regarding intellectual property rights and to be able to register and deposit patents into the state secretariats of science and technology and in the state foundations of research and development support.

24. The Brazilian government should create competitive agricultural research and development funds sourced from statutory levies collected from agricultural products and/or agricultural regions or areas, and from matching Brazilian government funds limited to no more than either the total of industry levy contributions to eligible agricultural R&D activities or to 0.5% of the gross value of production, whichever is the lower amount. Concomitantly with the creation of the fund, there must be created a company responsible for its administration. It is a high priority that these funds be managed by private sector initiative, with the consensus of the government sectors involved (Federal and/or State).

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* An incubator for businesses, just like an incubator for eggs or newborn infants, provides a safe, supportive, protective, and nurturing environment that promotes growth. It is also a dynamic centre with continuing contact with fellow entrepreneurs. Incubators typically provide spaces for businesses to operate, just at or slightly below market rates. They provide an array of services that nourish start-up entrepreneurs, such as business counselling, mentoring, and access to essential services and to potential investors. Incubators can also furnish shared services allowing incubator residents to cooperate with one another and reduce costs, critical needs during the start-up phase of a company (www.rivervalleycenter.com).

25. The government should maintain Embrapa's status as a Federal research institution and strengthen the corporation so that it can carry out its responsibilities for the definition of national priorities in agricultural research and coordinate the renewed Brazilian Agricultural Research System.
26. Based on the measures established in the Law of Innovation, the Brazilian government should create an agency for commercialization of technology, linked within Embrapa, and responsible for all of the commercial aspects of research for the company and its partnerships with the private sector. In its administrative structure, this agency must have well-trained staff in the intellectual property area, technicians with specific knowledge in trading technological products, and a competent manager.
27. Any reform of the Brazilian Agricultural Research System by the Brazilian government should be based on the following principles: a) the public agricultural research institutions should not become involved in business; they are purely research institutions; and b) there is no role for government institutions where the private sector has been acting with competence and achieving good results.

In the restructuring of the Brazilian agricultural research system, it will be necessary to strengthen the secretariats of science and technology in the states and the state foundations for research support, expanding their responsibilities and, including departments for intellectual property management and trade within their administrative structures. The increase in the State governments' investment in science and technology, and the involvement of this level of government in activities to provide incentives for private sector participation in research and development projects are also necessary.

The closing of the state agricultural research institutions and the privatization of the rural extension services and agricultural technical assistance, are suggested as appropriate strategies because the capacity of these institutions to develop their activities appears to be exhausted (with a few notable exceptions). This recommendation was provoked by many peculiar factors, including the specific conditions of each institution and understanding of each State government. However, the common underlying reason was the difficulty that most of these institutions face is to receive aid from Federal public institutions or even from the private sector. This condition is imposed by the set of Federal and State laws that apply to public

institutions in Brazil. The suggestion to transfer researchers from these institutions to the State universities follows a worldwide trend seeking to strengthen the research activities in public and private universities. The creation of a specific fund to finance and to stimulate the emergence of technical assistance companies and projects in rural extension with financial support from the Federal government, the State governments, and the cooperatives of agricultural producers was suggested in recognition of the value of these activities and to allow the changes to happen effectively.

The creation of competitive funds for agricultural products and/or strategic agricultural research areas, and the concomitant creation of companies with a majority participation of private sector representatives on their boards of governance to manage these funds, was suggested following the worldwide tendency for investment in the R&D process to be made in this way. Agricultural research should receive incentives proportional to its importance within the Brazilian economy and the least distorting way to do that is for government to support research.

The role of Embrapa within the Brazilian Agricultural Research System needs to be reviewed, and its leadership in the System must be re-established. The information raised in this study has clearly indicated that Embrapa is still regarded as extremely important in the context of agriculture in Brazil, but, on the other hand, its performance has been restricted by a series of legal and bureaucratic measures that have eliminated almost completely, its administrative flexibility and autonomy in decision-making.

It is recommended that an agency for commercialization of technology linked to Embrapa should be created; this agency would be responsible for all of the commercial aspects related to research for the company. Embrapa could then concentrate its efforts on the reorganization of the Brazilian Agricultural Research System, involving itself in the process of making the changes suggested in this study and the development of research in strategic areas for the Federal government and private sector.

8.4. Changes to Embrapa

The recommendations presented in this section were based on the cotton and dairy industry stakeholders' opinions about the need for Embrapa to improve its performance and on the worldwide tendency to restructure agricultural research institutions to meet the new demands of the national and international market.

28. Embrapa should concentrate its efforts on the revitalization of the Brazilian Agricultural Research System and on the development of research in strategic areas for the Federal government and private sector.
29. Embrapa should develop, as one of its priorities, an agency for commercialization of technology, which would be responsible for all of the commercial aspects of research for the company.
30. While the commercialization agency is being developed, Embrapa should begin transferring its current commercialization activities to the private sector so as not to compete with the private sector in this area. Embrapa should then withdraw from any areas, which the private sector can handle competently with good results.
31. Embrapa should promote the formation of industry groups for the main agricultural products in Brazil and willingly work together with these groups in the definition, execution, and dissemination of research programs and results. As part of this process, it should work together with industry groups to develop proposals for the formation of collaborative research funds. These proposed funds should be managed by the private sector.
32. Embrapa should develop a program to promote the formation of incubator companies for technology transfer and technical assistance, which would gradually take on Embrapa's current responsibilities in these areas. This process would create private sector competence in technology transfer and technical assistance and could be jointly financed from industry levies and the Federal and State governments.
33. Embrapa should have a greater involvement in all segments of Brazilian agribusiness through participating in discussions relating to industry policies, domestic and international markets, and not just in areas relating to agricultural research. All of these sectors are interlinked so that Embrapa can make meaningful contributions to policy and generate more relevant research through this involvement.

33. Embrapa should have a greater involvement in all segments of Brazilian agribusiness through participating in discussions relating to industry policies, domestic and international markets, and not just in areas relating to agricultural research. All of these sectors are interlinked so that Embrapa can make meaningful contributions to policy and generate more relevant research through this involvement.
34. Embrapa should reduce the size of its research infrastructure (e.g. farms, buildings, and number of livestock), which is currently draining resources away from core research priority activities. It should also initiate an evaluation of the physical infrastructure necessary for each of the research units to function effectively.
35. Embrapa should make greater use of private production units in the process of validation and adaptation of technology.
36. Embrapa should implement measures to reduce its number of employees. Almost 78% of its budget is committed to paying the employees' salaries.
37. The ratio of researchers to support staff should gradually be increased over the next ten years with an aim of achieving one support person for each researcher in the next five years, and one support person for each two researchers in ten years. This could be achieved by increasing the number of new contracts for researchers, decreasing the number of new contracts for support staff, and promoting the participation of university students in Embrapa research projects.
38. Embrapa should include training in research and business management as one of the priorities of its program of professional qualification.
39. Embrapa should follow the international tendency with respect to research and development, recognising the necessity to move from the "science push" paradigm where basic research is considered the leading force responsible for progress, to the "demand pull" paradigm in which the demands of the market define the research programs to be developed.
40. Embrapa should create a Virtual Laboratory (LABEX) in Australia to promote opportunities for institutional cooperation in agricultural research and monitor scientific advances, trends, and activities of interest to agribusiness in Oceania and Asia.
41. Embrapa must include intellectual property specialists within its administrative structure, technicians with specific knowledge useful in the negotiation of technological products, and competent managers.

These recommendations were defined to address the cotton and dairy industry stakeholders' claims about Embrapa, as revealed in this study. In their opinion, Embrapa must change. It needs to be constantly aware of market demands and to create a system that allows clear identification of producers and consumers' needs that will provide a more adequate response to the specific needs of the market. With respect to this point, it is important to emphasize that all the changes must be implemented without harming the company's activities in the development of projects that concern social questions but which have no commercial appeal. Embrapa must continue developing projects in areas of family farm agriculture and natural resource management among many others, and be able to increase its investments, in this area, from part of the profits derived from the business agency of the company.

Embrapa needs to reduce the size of its research infrastructure, and review its research units' structures, considering that some of these research units are outdated, and will vanish if changes are not made. It needs to implement measures to reduce its number of employees. But it is not sufficient to change only administrative structures. It is necessary to create better leadership qualities among Embrapa's staff, and to stimulate and create leadership in the agribusiness sector.

This means that Embrapa needs to be reorganized into a different structure, and it will require much more capacity in terms of organization and coordination between the public and private sectors, than financial investment.

8.5. Reviews of the Brazilian agricultural industries

The first three recommendations presented in this section correspond to the evaluations of their own industries made by cotton and dairy stakeholders. The other recommendations were derived after considering the information described in the previous chapters and also from the recommendations in the previous sections of this chapter.

42. Producer groups (cooperatives, associations, and syndicates) should develop steering committees related to their principal commodities and work together with Embrapa to develop proposals for the creation of research and development funds for each of these commodities.
43. The agricultural industries should be more involved with the definition of agricultural R&D problems. They should be involved in the research process as a whole.
44. The agricultural industry should be better structured and more organized to take advantage of the benefits that the agricultural research institutions provide.
45. Producer groups (cooperatives, associations, and syndicates) should employ technicians with specific knowledge about intellectual property who are able to undertake partnership negotiations with agricultural research institutions.
46. The Brazilian agricultural industries should be prepared to be involved in the privatization of rural extension and technical assistance activities, and in the creation of national funds specifically to stimulate and finance the creation of technical assistance companies.

The private sector is not structured well enough to take advantage of the benefits that the agricultural research institutions provide. The industries present themselves as completely disorganized. As a consequence, instead of identifying demands important to an industry as a whole, or a large section of it, individual and specific demands are created, resulting in a situation that does not work properly in relation to the organisations involved (public agricultural research institution and the private sector).

8.6. Limitations of the study

The results obtained in this research were sufficient for the achievement of the objectives of this study. However, there are some limitations, the majority of which are related to the process of data collection. Firstly, of all the commodities produced in Brazilian agriculture, the study worked only with cotton and dairy industries.

Secondly, the research was carried out with the cotton and dairy industry stakeholders located in the two states which are the largest producers of cotton (Mato Grosso and Bahia) and in the two states, which are the largest producers of milk (Minas Gerais and Goiás). Moreover, the participants in the research were selected from amongst the largest producers, after considering the specific characteristics of each chosen industry, whose members have electronic addresses. Therefore, small producers who are very numerous but account for a very small proportion of production were not involved in this study.

Thirdly, the experience of only five countries in the process of reforming of their agricultural research systems was described in this study. Factors considered in the selection of these countries were similarities in the commodities they produced in the agricultural market, the status of their public agricultural research systems before the process of reform was implemented, and the situation in respect to the countries' economies at that time. Certainly there are many other countries which have successfully reformed their agricultural research systems such as Holland, The United Kingdom, and France, but none of them were as relevant to the Brazilian situation as the countries selected for this study.

The fourth limitation of this study arises from the fact that in spite of there being other public research institutions in Brazil engaged in research in cotton and dairy, the study focussed on Embrapa's relationship with cotton and dairy industry stakeholders. The decision to involve only Embrapa was based on the fact that Embrapa is responsible for almost 80% of the research undertaken with the cotton and dairy industries in Brazil.

The fifth limitation of this study relates to the cotton and dairy industry stakeholders' profiles (characteristics, personality). The participants in this research were the larger producers. Small producers might have different profiles, which may return different responses. Thus, this study does not provide a comprehensive view of all stakeholders in the cotton and dairy industries.

8.7. Contribution by the study and implications for the Brazilian Agricultural Research System

The practical significance of this study lies in its potential to provide a comprehensive framework to assist the Brazilian government and private agricultural companies to create the appropriate environment for agricultural research in that country, and to develop specific procedures to promote productive interaction between public agricultural research institutions and agribusiness companies. The recommendations, if implemented, will put agricultural research in public R&D institutes on a sustainable basis, with the long-term national interest of improving the profitability of Brazilian agribusiness.

The study provides a substantial set of recommendations (considered relevant for government and the cotton and dairy industries' researchers, farmers, and managers of agribusiness companies) to develop and to implement a plan to improve private sector participation in the agricultural R&D system in Brazil and to create better prospects for the agricultural industries they service as the output of more commodities and products expand beyond the domestic market and then need to be traded on international markets open to Brazilian agricultural products.

Four important points were revealed in this study. The first was, there has been no previous research involving the stakeholders of the cotton and dairy industries with regard to private sector participation in agricultural research in Brazil. Their participation was sought through the electronic survey and FGMs.

Secondly the study identified cotton and dairy industry stakeholders' intentions to be part of the Brazilian agricultural research system, and that they are prepared to finance half of the investment in agricultural research projects. This is the same level of private sector participation as occurs in developed countries, but will only occur as long as the Brazilian government creates appropriate conditions for them to do so.

Thirdly, the cotton and dairy industry stakeholders registered their opinions about the current state of the Brazilian Agricultural Research System. These opinions were mainly about the public agricultural research institutions (in this case, Embrapa), and they indicated that their segments of Brazilian agribusiness are not satisfied with current levels of performance of the public agricultural research institutions and they are demanding changes.

Fourthly, the analysis of the experiences of Chile, China, the United States of America, New Zealand, and Australia in the reform of their agricultural research systems has identified approaches and measures adopted in these countries, which have relevance for Brazil. The investigation focussed on the relationships between the public and the private sectors in these countries which can help the government and the industries to work together to change the Brazilian agricultural research system.

The recommendations developed in this study were presented in four sections, for convenience, and to define clearly the actors that have to be involved in implementing them. Thus the Federal government may use the recommendations defined in Section One to elaborate and to implement policies necessary to improve the Brazilian science and technology system and to involve the entire government sector in this process.

The recommendations defined in Section Two of this chapter have to be taken up by both Federal and State governments, but also involve private agricultural companies in the necessary processes of restructuring the Brazilian Agricultural Research System.

The recommendations dealing with the restructure of Embrapa are set out in Section Three. According to the cotton and dairy industry stakeholders, Embrapa will re-establish its role as Brazilian Agricultural Research System coordinator by adopting these recommendations and establish good conditions for improving private sector participation in its research projects.

Section Four presents some recommendations directed at the Brazilian agricultural industries. These recommendations are few in number, but very important to initiate the process of re-organization of the agricultural sector, and to establish the necessary conditions for these industries to participate and to take advantage of the benefits that the agricultural research institutions can provide.

8.8. Suggestions for future research

The limitations of this study have highlighted the need for further research to build on the understanding generated in this study of the relationships between the private and public sectors in the Brazilian Agricultural Research System. The objective was to find ways to increase private sector participation in public agricultural research. That has been achieved but only the opinions of the largest producers in the cotton and dairy industries and the experiences of five countries around the world were considered in developing the recommendations presented in this chapter. Therefore, further research is needed to complement the results of this study:

- The small producers of cotton and dairy products may present a different view and they may not be well served by the recommendations in this report. They should also be surveyed to find which sort of research system will meet their needs.

- There are a significant number of important agricultural commodities in Brazil serviced by public agricultural research institutions (including: soybean, maize, wheat, beef, poultry, pigs, sugarcane, orange, cocoa, rice, coffee, grapes and wine, fruit culture, horticulture, etc in addition to cotton and dairy). Each one of them presents a different situation and a different level of participation in spending of agricultural R&D. Thus, it is important to involve the stakeholders from all of these commodities in further investigations to consider and evaluate their roles in the process of Brazilian agricultural research system reform.

- As mentioned in Section 8.6, further research involving countries with different production characteristics and markets, such as Holland, France, Spain, and the United Kingdom may provide further information to help the Brazilian agricultural research system in its reform process.

Further research is also needed to consider the agricultural industries' stakeholders profile (characteristics, personality, etc.). So, the composition of producers in a particular industry changes so well their needs. The producers' positions about a specific subject may change, depending on size (small, medium, and large producer), commodities (as they become more or less important in the domestic and/or international markets), and location in the country.

8.9. Concluding comments

The participation of the private sector, in most areas of Brazilian agricultural research, has been revealed as suboptimal to date. However, because of its natural resources, the strength of its agribusiness, and the quality of its scientists, Brazil has the potential to increase significantly its share of agricultural commodities traded in the global agricultural market. To achieve this, it needs to make adjustments to its agricultural research system, and consider and adapt to Brazilian conditions some of the strategies and processes that have been used successfully in other countries.

The most important lesson to be learnt from the experience of other countries is the need for an integrated approach to reform. All the ministries of government, the legislature, the private sector and the agricultural research institutions (federal, state and universities) must be involved in the reform process along which the producer and other group in the production chain. There needs to be strong motivation to change and common objectives to improve the quality of agricultural research. This is necessary to ensure that a streamlined system of agricultural research is created.

Therefore, the Brazilian government must adopt R&D as a national priority, introducing into those government sectors responsible for defining national economic policies, an understanding of the importance of research and innovation in all sectors, including agriculture, in the process of the country's development.

Although the findings of this study are based in part on views expressed by cotton and dairy industry stakeholders, the principles are applicable generally in the Brazilian agricultural industries.

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APPENDICES

Appendix 1

The Invitations To Participate In The Research (Portuguese And English)

(INVITATION TO PARTICIPATE IN THE FGMs – VERSION IN PORTUGUESE)

THE UNIVERSITY OF QUEENSLAND

Brasília - DF ____/ ____/ ____

Prezado(a) Senhor(a),

Meu nome é Lucio Brunale, sou empregado da Embrapa – Empresa Brasileira de Pesquisa Agropecuária, e no momento estou fazendo curso de doutorado em agronegócio na Universidade de Queensland em Brisbane, Austrália. O projeto de pesquisa que estou desenvolvendo, tem por objetivo avaliar o relacionamento das instituições de pesquisa com as demais entidades integrantes do agronegócio brasileiro com vista a formular recomendações relevantes para o futuro do agribusiness no Brasil e o papel das instituições de pesquisa neste contexto.

Por considerá-lo uma pessoa chave dentro do agronegócio do leite brasileiro, gostaria de convidá-lo para participar da fase 2 da pesquisa, que consiste em uma REUNIÃO GRUPO FOCAL, para discutir os resultados da pesquisa eletrônica desenvolvida na primeira fase do processo de coleta de dados, da qual possivelmente você tenha participado respondendo o questionário. O produto destes questionários apresentou situações interessantes que muito vão nos ajudar no objetivo deste trabalho, porém, gostaria de melhorá-los e ajustá-los contanto mais uma vez com a sua participação, desta vez na referida reunião.

A presente pesquisa foi elaborada em estreita observância dos parâmetros definidos no Código de Ética da Universidade de Queensland. Portanto, sinta-se a vontade para discutir a sua participação neste estudo comigo (s4045118@student.uq.edu.au ou +61 07 3365-7407) ou com o meu supervisor Dr. Malcolm Wegener (+61 07 3365-2939 ou malcolm.wegener@uq.edu.au). Caso você queira falar com alguém da Universidade que não esteja envolvido na pesquisa, você pode contatar a Professora Helen Ross (+61 07 5460-1648 ou em 0408-195324, ou hross@uqg.uq.edu.au).

Assim sendo, se você concorda em participar da segunda fase desta pesquisa, terei um imenso prazer em recebê-lo no local, data e horário abaixo

Data:
Horário:
Local:

Atenciosamente
Lucio Brunale
NRSM – The University of Queensland

(INVITATION TO PARTICIPATE IN THE FGMs – VERSION IN ENGLISH)

THE UNIVERSITY OF QUEENSLAND

Brasília - DF ____/ ____/ ____

Dear,

My name is Lucio Brunale, I am an employee in the Embrapa – Brazilian Agricultural Research Company, and at the moment I am working on a PhD degree in Agribusiness at the University of Queensland in Brisbane, Australia. The research program I am developing has the purpose of evaluating the relationship of the research institutions and the several integrant companies of agribusiness in Brazil, in order to formulate relevant recommendations for the future of agribusiness in Brazil and the research institutions' place in that context.

Considering you as one of the key people in the Brazilian dairy agribusiness, I would like to invite you to participate in Phase 2 of my research, which consists of a FOCUS GROUP MEETING, to discuss the results of the electronic research developed in the first phase on the process of data collection, which you possibly were part of, by answering the questionnaire.

The results of the questionnaires presented interesting situations that will help us a lot in achieving the objective of this job, although, I would like to better them and adjust them, but I am counting once more on your participation, referred to as "the meeting".

The present research was elaborated under the observation of the parameters defined in the Ethics Code of the University of Queensland. Therefore, feel free to discuss your participation in this research with me (s4045118@student.uq.edu.au or +61 07 3365-7407) or with my supervisor, Dr. Malcolm Wegener (+61 07 3365-2939 or malcolm.wegener@uq.edu.au). Or in case you want to talk to someone from the University who is not involved in the research, you can contact Professor Helen Ross (+61 07 5460-1648 or on 0408-195324, or hross@uqg.uq.edu.au).

Thus, if you agree to participate in the second phase of this research, I will be very happy to see you there; date and time are as follows:

Date:
Time:
Place:

Thank you,

Lucio Brunale
NRSM – The University of Queensland

(INVITATION TO PARTICIPATE IN THE ELECTRONIC SURVEY – VERSION IN PORTUGUESE)

Prezado(a) Senhor(a),

Meu nome é Lucio Brunale, sou empregado da Embrapa – Empresa Brasileira de Pesquisa Agropecuária, e no momento estou fazendo curso de doutorado na Universidade de Queensland em Brisbane, Austrália.

O projeto de pesquisa que estou desenvolvendo, tem por objetivo avaliar o relacionamento das instituições de pesquisa com as demais entidades integrantes do agronegócio brasileiro com vista a formular recomendações relevantes para o futuro do agribusiness no Brasil e o papel das instituições de pesquisa neste contexto. Diante do exposto, gostaria de contar com a sua valiosa colaboração no sentido de participar da presente pesquisa, mediante o preenchimento do questionário cujo o link é mencionado ao final desta correspondência.

A presente pesquisa foi elaborada em estreita observância dos parâmetros definidos no Código de Ética da Universidade de Queensland. Portanto, sinta-se a vontade para discutir a sua participação neste estudo comigo (s4045118@student.uq.edu.au ou +61 07 3365-7407) ou com o meu supervisor Dr. Malcolm Wegener (+61 07 3365-2939 ou malcolm.wegener@uq.edu.au). Caso você queira falar com alguém da Universidade que não esteja envolvido na pesquisa, você pode contatar a Professora Helen Ross (+61 07 5460-1648 ou em 0408-195324, ou hross@uqg.uq.edu.au).

Informo que, o tempo estimado para responder o questionário é de aproximadamente 25 minutos. Você pode voltar às perguntas anteriores e avançar novamente, mas se fechar a pesquisa você não poderá voltar ao mesmo questionário parcialmente respondido, uma vez que o sistema abre um novo questionário vazio a cada início do processo. Concluído o preenchimento do questionário é só clicar em **'ENVIAR"** e o questionário será automaticamente encaminhado.

Assim sendo, se você concorda em participar desta pesquisa, acesse o questionário clicando com o botão esquerdo do mouse no link abaixo:

http://www.nrsm.uq.edu.au/luciobrunale/Cotton.htm

http://www.nrsm.uq.edu.au/luciobrunale/Dairy.htm

(INVITATION TO PARTICIPATE IN THE ELECTRONIC SURVEY – VERSION IN ENGLISH)

Dear

My name is Lucio Brunale, I am an employee of Embrapa – Brazilian Agricultural Research Company, and at the moment I am working on my PhD at the University of Queensland in Brisbane, Australia.

The project of research that I am developing has the objective of evaluating the relationship between the research institutions with the other companies of the Brazilian agribusiness, to formulate relevant recommendations to the future of the agribusiness in Brazil and the place of the research institutions on that context. Therefore, I would like count on your valuable participation in this research, regarding the questionnaire that is linked at the bottom of this correspondence.

The present research was elaborated under the observation of the parameters defined in the Ethics Code of the University of Queensland. Therefore, feel free to discuss your participation in this research with me (s4045118@student.uq.edu.au or +61 07 3365-7407) or with my supervisor, Dr. Malcolm Wegener (+61 07 3365-2939 or malcolm.wegener@uq.edu.au). Or in case you want to talk to someone from the University who is not involved in the research, you can contact Professor Helen Ross (+61 07 5460-1648 or on 0408-195324, or hross@uqg.uq.edu.au).

I would like to inform you that the estimated time it takes to answer this questionnaire is approximately 25 minutes. You can go back to the previous questions and go to the next ones, but if you close it, you won't be able to go back to the previously filled questionnaire; once the system is closed and opened again, it opens an empty questionnaire every time. When you are finished, you only need to click on **"SEND"** and the questionnaire will be automatically sent.

Therefore, if you agree to participate in this research, access the questionnaire by clicking with the left button of your mouse on the following link:

http://www.nrsm.uq.edu.au/luciobrunale/Cotton.htm

http://www.nrsm.uq.edu.au/luciobrunale/Dairy.htm

(REMINDER TO PARTICIPATE IN THE ELECTRONIC SURVEY)

Dear,

At the beginning of this month, I sent you a message informing you about the research I am doing on my PhD course in the University of Queensland in Brisbane, Australia, with the objective to investigate the relationship between the research institutes and the other institutions that are part of the Brazilian Agribusiness, in order to formulate relevant recommendations for the future of agribusiness in Brazil, and the place of the research agricultural institutions in that context. On that same occasion, I requested your special attention to participate by filling in a questionnaire, but now, I would like to ask you again to respond to the questionnaire.

Your participation for this research is of vital importance because the analysis and evaluation of your answer, with those of the other participants of the sugarcane industry, will help the elaboration of the important recommendations, which I'm sure, will result in benefits for the Brazilian sugarcane Agribusiness.

Therefore, once again, I would like to solicit your valuable collaboration by participating in the present research, by filling in this questionnaire that the link mentions at the end of this paragraph.

To access the questionnaire, click on the left button of the mouse on the following link:

http://www.nrsm.uq.edu.au/luciobrunale/Cotton.htm

http://www.nrsm.uq.edu.au/luciobrunale/Dairy.htm

In case you have already filled in this questionnaire, I ask you to ignore this message, and I thank you for your participation.

Once again, thank you very much.

Lucio Brunale
PhD Scholar

Appendix 2

Support Letter from the Heads of the EMBRAPA Dairy Cattle and EMBRAPA Cotton, as well as from the Director Executive of ABRAPA

(LETTER FROM Dr. ROBÉRIO FERREIRA DOS SANTOS, GENERAL CHIEF OF EMBRAPA COTTON – VERSION IN PORTUGUESE)

C.CGE.Nº 196 /2005

Campina Grande, 10 de junho de 2005

Prezado Senhor

O Dr. Lúcio Brunale é pesquisador da Embrapa e, atualmente, realiza seu curso de Doutoramento na Universidade de Queensland, na Austrália. Ele está avaliando o relacionamento de instituições de pesquisa com as demais entidades integrantes do agronegócio brasileiro. Serão consideradas instituições que têm interesses relacionados a dois produtos: algodão e leite.

Você foi indicado pela Embrapa Algodão para responder um questionário, dado o seu envolvimento com os assuntos pertinentes ao setor algodoeiro.

Sabemos de sua pouca disponibilidade de tempo. Mas, por favor, sua opinião será de profunda relevância, já que esta Unidade de pesquisa aguarda os resultados do levantamento para incorporá-los na formulação de suas estratégias de conduta.

O Dr. Lúcio Brunale já deve ter lhe remetido uma correspondência encaminhando o questionário. Caso isso não tenha ocorrido, ou ainda não tenha sido possível o seu preenchimento, por favor acesse o mesmo no endereço a seguir, já que o preenchimento é on line.

http://www.nrsm.uq.edu.au/luciobrunale/Cotton.htm

Por sua atenção, a pesquisa agropecuária brasileira agradece.

Robério Ferreira dos Santos
Chefe Geral da Embrapa Algodão
chgeral@cnpa.embrapa.br

(LETTER FROM Dr. ROBÉRIO FERREIRA DOS SANTOS, GENERAL CHIEF OF EMBRAPA COTTON – VERSION IN ENGLISH)

C.CGE.Nº 196 /2005
Campina Grande, 10 de junho de 2005

Dear,

Mr. Lucio Brunale is a researcher for Embrapa and at the moment he is working on his PhD at the University of Queensland, in Australia. He is evaluating the relationship of the research institutions with the other companies that are part of the Brazilian agribusiness. Institutions that have interest in the two following products: cotton, and dairy, will be researched.

You were nominated by the Embrapa Cotton to answer a questionnaire, given that you are involved with the subject of the cotton industry.

We know about your low availability at the moment, but please, your opinion will be deeply relevant, since that research Center waits for the results of the research to incorporate them into the formulation of their strategic planning.

Mr. Lucio Brunale has probably already sent you a correspondence with the questionnaire. In case he hasn't, or it hasn't been possible for you to fill it, please access the following web address since it is an online questionnaire.

http://www.nrsm.uq.edu.au/luciobrunale/Cotton.htm

The Brazilian agricultural research thanks you for your attention,

Robério Ferreira dos Santos
General Chief of Embrapa Cotton
chgeral@cnpa.embrapa.br

(LETTER FROM Dr. PAULO DO CARMO MARTINS, GENERAL CHIEF OF EMBRAPA DAIRY CATTLE – VERSION IN PORTUGUESE)

Senhor(a)

O Dr. Lucio Brunale é pesquisador da Embrapa e, atualmente, realiza seu curso de Doutoramento na Universidade de Queensland, na Austrália. Ele está avaliando o relacionamento de instituições de pesquisa com as demais entidades integrantes do Agronegócio brasileiro. Serão consideradas instituições que têm interesses relacionados a dois produtos: algodão e LEITE.

Você foi indicado pela Embrapa Gado de Leite para responder um questionário, dado o seu envolvimento com os assuntos pertinentes com setor leiteiro.

Sabemos de sua pouca disponibilidade de tempo. Mas, por favor, sua opinião será de profunda relevância, já que esta Unidade de pesquisa aguarda os resultados do levantamento para incorporá-los na formulação de suas estratégias de conduta.

O Dr. Lucio Brunale já deve ter lhe remetido uma correspondência encaminhando o questionário. Caso isso não tenha ocorrido, ou ainda não tenha sido possível o seu preenchimento, por favor acesse o mesmo no endereço a seguir, já que o preenchimento é on line.

http://www.nrsm.uq.edu.au/luciobrunale/Dairy.htm

Por sua atenção, a pesquisa agropecuária brasileira agradece.

Paulo do Carmo Martins
Chefe-geral
Embrapa Gado de Leite
chgeral@cnpgl.embrapa.br

(LETTER FROM Dr. PAULO DO CARMO MARTINS, GENERAL CHIEF OF EMBRAPA DAIRY CATTLE – VERSION IN ENGLISH)

Dear,

Mr. Lucio Brunale is a researcher for Embrapa and at the moment he is working on his PhD at the University of Queensland, in Australia. He is evaluating the relationship of the research institutions with the others companies that are part of the Brazilian agribusiness. Institutions that have the interest with the two following products: cotton, and dairy, will be researched.

You were nominated by Embrapa Dairy Cattle to answer a questionnaire, given your involvement in the subjects regarding the dairy industry.

We know how little free time you have at the moment, but please, your opinion will be deeply relevant, since that Research Centre waits for the results of the research to incorporate them into the formulation of their strategic planning.

Mr. Lucio Brunale has probably already sent you a correspondence with the questionnaire. In case he hasn't, or it hasn't been possible for you to fill it, please access the following web address since it is an online questionnaire.

http://www.nrsm.uq.edu.au/luciobrunale/Dairy.htm

The Brazilian agricultural research thanks you for your attention,

Paulo do Carmo Martins
Chefe-geral
Embrapa Gado de Leite
chgeral@cnpgl.embrapa.br

(LETTER FROM Dr. HÉLIO TOLLINI, EXECUTIVE DIRECTOR OF ABRAPA – BRAZILIAN COTTON PRODUCERS ASSOCIATION – VERSION IN PORTUGUESE)

Caros Presidentes de Associações Estaduais

O Senhor Lucio Brunale é um conhecido meu da EMBRAPA que está fazendo pós-graduação fora do Brasil. Ele está interessado no caso do algodão brasileiro e gostaria de contar com nosso apoio para desenvolver sua dissertação. Tempos atrás eu passei a todos os senhores o questionário que o Lucio gostaria de usar em seu levantamento de dados. Ele, de forma atenciosa, enviou o questionário com antecipação para que todos pudessem verificar o teor das perguntas e fazer sugestões.

O Lucio e seu professor orientador estão prestes a iniciar uma viagem ao Brasil no final de junho/começo de julho. Eles estarão conversando comigo na tarde do dia 2 de julho, e entrarão em contato com as estaduais para programar as visitas aos Estados.

Conhecendo o Lucio e a seriedade com que se desempenhou na EMBRAPA, estou seguro de fará um trabalho relevante. Agradeceria toda a atenção que sua associação puder dar a ele.

Atenciosamente,

Hélio Tollini

(LETTER FROM Dr. HÉLIO TOLLINI, EXECUTIVE DIRECTOR OF ABRAPA – BRAZILIAN COTTON PRODUCER ASSOCIATIONS – VERSION IN ENGLISH)

Dear State Association Presidents,

Mr. Lucio Brunale is a friend of mine who works for EMBRAPA and is doing post-graduate research out of Brazil. He is interested in the situation of the cotton industry in Brazil and would like to count on our support to develop this dissertation.

Some time ago, I sent all of you a questionnaire that Lucio would like to use in order to collect the needed data. Very attentive, he sent a questionnaire with anticipation so that all could verify what kind of questions it has and make any suggestions.

Lucio and his supervisor Dr. Malcolm Wegener are about to travel to Brazil at the end of June or beginning of July. I will be meeting them on the 29th July, in the afternoon, and they will contact the State Associations to program their visit to the different states.

Knowing Lucio and the seriousness in which he works for EMBRAPA, I am confident that he will do a relevant job. I would be grateful if your Association can give him all the help they can.

Thank you,

Hélio Tollini
Executive Director of Brazilian Cotton Producers Association

Appendix 3

Cotton Industry Questionnaire (Portuguese and English)

This survey was provided online at: *http://www.nrsm.uq.edu.au/luciobrunale/PORTCotton.htm*

and *http://www.nrsm.uq.edu.au/luciobrunale/ENGLISHCotton.htm* *

* Links were current in mid-2006, but may not be available at the time of reading.

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO ALGODÃO NO BRASIL Page 1

Instructions:
❍ - select ONLY ONE Choice ❑ - select ALL that apply.

1 Dentro da cadeia produtiva de algodão no Brasil, a que grupo profissional você pertence? (Se você estiver relacionado a mais de um grupo listado, por favor, escolher o que você tenha maior envolvimento)

❑ Proprietário(a) de empresas de insumos (sementes, fertilizantes, embalagens, outros insumos)
❑ Empresário(a) na área de captação e distribuição de algodão (logística da captação, distribuição, centr
❑ Proprietário(a) de usina de beneficiamento de algodão
❑ Fornecedor(a) de algodão
❑ Produtor de algodão
❑ Produtor de algodão e proprietário de usina de beneficiamento de algodão
❑ Administrador(a) de empresa, cooperativa, fundação e associação
❑ Pesquisador(a) técnico/científico
❑ Extensionista, consultor(a) ou assistente técnico
❑ Autoridade de governo local, regional, estadual ou federal
❑ Outros (por gentileza, indique) _____

2 Se você se enquadrou no grupo profissional de "Pesquisador(a), Administrador(a) ou Extensionista", indique o seu vínculo de trabalho atual. Se você se enquadra em uma das outras opções vá para a questão 3.

❍ Empregado(a) de instituição pública municipal, estadual ou federal
❍ Empregado(a) de empresa privada
❍ Empregado(a) de Organização Não Governamental
❍ Não se aplica

3 Qual é o seu grau de instrução mais alto?

❍ Primeiro grau incompleto
❍ Primeiro grau completo
❍ Segundo grau incompleto
❍ Segundo grau completo
❍ Terceiro grau/Curso superior
❍ Especialização
❍ Mestrado
❍ Doutorado

4 Se você é produtor rural (fazendeiro) por favor responda qual é o tamanho da sua área total cultivada na última safra (incluir área própria e área arrendada)? (Se não for o seu caso, siga para a questão 05)

❍ Menos de 500 ha
❍ De 501 a 1000 ha
❍ De 1001 a 3000 ha
❍ De 3001 a 5000 ha
❍ De 5001 a 8000 ha
❍ De 8001 a 10000 ha
❍ De 10001 a 15000 ha
❍ De 15001 a 20000 ha
❍ Mais de 20001 ha

5 Se você é proprietário de empresa que atua dentro da cadeia produtiva do algodão (exemplo: fazenda, usina de beneficiamento, prestadora de serviço, empresa de insumos, agencia de negócio, etc.), considere as opções abaixo e indique quantos empregados você tem na sua empresa. (considerar como referência o período de entresafra)

❍ De 01 a 50 ❍ De 51 a 80 ❍ De 81 a 100 ❍ De 101 a 200 ❍ Mais de 200 ❍ Não se aplica

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO ALGODÃO NO BRASIL Page 2

6 Se você é administrador(a) de cooperativa, fundação ou associação, favor informar quantos produtores e/ou instituições você representa? (no caso de cooperativas, favor considerar apenas os produtores ativos)

❍ Menos de 20 produtores/instituições
❍ De 21 a 40 produtores/instituições
❍ De 41 a 50 produtores/instituições
❍ De 51 a 100 produtores/instituições
❍ De 101 a 200 produtores/instituições
❍ Mais de 200 produtores/instituições
❍ Não se aplica

7 Na sua opinião, qual é a importância da pesquisa agropecuária para aumentar e garantir a eficiência e competitividade da cadeia produtiva do algodão?

❍ Sem importância ❍ Importante ❍ Extremamente importante
❍ Moderadamente importante ❍ Muito importante ❍ Não tenho opinião formada

8 Na sua opinião, qual a importância das tecnologias desenvolvidas pelas instituições de pesquisa para o crescimento do mercado interno e externo do algodão?

❍ Sem importância ❍ Importante ❍ Extremamente importante
❍ Moderadamente importante ❍ Muito importante ❍ Não tenho opinião formada

9 Considere as opções abaixo e indique, como as tecnologias desenvolvidas pelas instituições de pesquisa têm sido importantes para desenvolver o mercado internacional do algodão brasileiro. (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Desenvolvimento de variedades de plantas resistentes a doenças, pragas e às diversas condições eda
❑ Desenvolvimento de software de gerenciamento agrícola
❑ Introdução de técnicas de controle do custo agrícola e cálculo da relação custo/benefício
❑ Introdução de técnicas de controle de pragas e doenças
❑ Introdução de novos métodos de conservação de solos
❑ Desenvolvimento de inovações nas áreas de máquinas, equipamentos e implementos de produção, col
❑ Desenvolvimento de produtos derivados com alto índice de produção e qualidade
❑ Desenvolvimento de produtos que atendem às diversificadas demandas do mercado
❑ Expansão do consumo no Mercado nacional
❑ Expansão da participação do produto brasileiro no mercado externo
❑ Outros (Favor especificar) _____

10 Você tem adotado as tecnologias geradas e disponibilizadas pelas instituições de pesquisa que trabalham com o algodão?

❍ Sim ❍ Não ❍ Não se aplica

11 Você tem ou já teve contrato de parceria com alguma instituição de pesquisa agropecuária com o objetivo de desenvolver e/ou financiar projetos de pesquisa e desenvolvimento?

❍ Sim (Se a sua resposta for sim, vá para a questão 13)
❍ Não
❍ Não se aplica

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO ALGODÃO NO BRASIL Page 3

12 Se a sua resposta à questão anterior tiver sido não, indique abaixo, na sua opinião, o que impediu ou está impedindo a efetivação da sua parceria com instituição de pesquisa agropecuária. (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ acesso gratuito à maioria das tecnologias disponíveis no mercado;
❑ Ausência de informação orientando a realização destas parcerias
❑ Fraco/insuficiente atuação das instituições de pesquisa na identificação e orientação dos potenciais pa
❑ As leis, normas e procedimentos que definem a estrutura e orientam a atuação das instituições de pesc
❑ Dificuldade na obtenção de financiamentos para desenvolver este tipo de parceria;
❑ Outros (favor especificar) _____

13 Qual é a sua opinião sobre o desempenho das instituições de pesquisa privadas que trabalham com o algodão no Brasil? (Ex.: Fundação Mato Grosso, Fundação Centro Oeste, Fundação Bahia, CODETEC e outras cooperativas)

❍ Péssimo ❍ Bom ❍ Excelente
❍ Ruim ❍ Muito bom ❍ Não tenho opinião formada
❍ Regular

14 Considere as opções abaixo e indique, na sua opinião, o que as instituições de pesquisa da iniciativa privada precisam implementar para melhorar seu desempenho. (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Aumentar a aplicação de recursos financeiros na execução de projetos de pesquisa
❑ Investir mais na capacitação técnica do seu quadro de pesquisadores
❑ Facilitar o acesso às informações existentes
❑ Expandir a área de atuação atendendo a todos os segmentos da cadeia produtiva do algodão
❑ Criar um sistema de pesquisa e extensão capaz de interagir e captar as demandas da cadeia produtiva
❑ Outros (favor especificar) _____

15 Qual é a sua opinião sobre o desempenho das instituições de pesquisa dos governos estaduais e federal que trabalham com o algodão no Brasil? (E.g. Embrapa Algodão; IAC, IAPAR, EPAMIG, EBDA,, etc.)

❍ Péssimo ❍ Bom ❍ Excelente
❍ Ruim ❍ Muito bom ❍ Não tenho opinião formada
❍ Regular

16 Considere as opções abaixo e indique, na sua opinião, o que as instituições de pesquisa dos governos estaduais e federal precisam implementar para melhorar seu desempenho. (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Aumentar a aplicação de recursos financeiros na execução de projetos de pesquisa
❑ Investir mais na capacitação técnica do seu quadro de pesquisadores
❑ Facilitar o acesso às informações existentes
❑ Expandir a área de atuação atendendo a todos os segmentos da cadeia produtiva do algodão
❑ Criar um sistema de pesquisa e extensão capaz de interagir e captar as demandas da cadeia produtiva
❑ Criar instrumentos, e dar ampla divulgação, regulando o processo de parceria com a iniciativa privada d
❑ Capacitar seus técnicos para atuarem no agronegócio brasileiro na captação e desenvolvimento de pa
❑ Outros (favor especificar) _____

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO ALGODÃO NO BRASIL Page 4

17 Você concorda ou discorda da seguinte afirmação: Existem tecnologias geradas e disponibilizadas pelas instituições de pesquisa mas que os segmentos da cadeia produtiva do algodão desconhecem e por isso, perdem a oportunidade de aplicá-las e usufruir de seus benefícios?

❍ Concordo ❍ Discordo ❍ Não tenho opinião formada

18 Você concorda ou discorda da seguinte afirmação: Se todas as tecnologias geradas até o momento e disponibilizadas pelas instituições de pesquisa fossem conhecidas e aplicadas por todos os segmentos da cadeia produtiva do algodão, a situação econômica do setor seria melhor?

❍ Concordo ❍ Discordo ❍ Não tenho opinião formada

19 Na sua opinião, as tecnologias já geradas e disponíveis não estão sendo aplicadas devido a: (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Deficiência das instituições de pesquisa no processo de divulgação e na orientação de como aplicar un
❑ Dificuldades, por parte do produtor/empresário, de acesso a recursos financeiros necessários para apli
❑ Ausência, por parte do produtor/empresário, de estrutura adequada para receber e aplicar as novas tec
❑ Falta de preparo das instituições de pesquisa na negociação e colocação de novas tecnologias no agro
❑ Outros (favor especificar) _____

20 Na sua opinião, qual o segmento da cadeia produtiva do algodão que mais necessita suporte tecnológico? (por favor, escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Produção do algodão
❑ Insumos e implementos
❑ Indústria de processamento do algodão e produtos derivados
❑ Logística (transporte, distribuição, escoamento etc.)
❑ Acesso a informações
❑ Outros (favor especificar) _____

21 Em que área as instituições de pesquisa deveriam concentrar seus esforços para implementar a produtividade e a qualidade do algodão e seus derivados no Brasil? (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Manejo dos solos
❑ Manejo cultural
❑ Desenvolvimento de novas variedades
❑ Desenvolvimento de novos produtos através biotecnologia (Ex.: algodão colorido).
❑ Controle de pragas
❑ Controle de doenças
❑ Controle de plantas daninhas
❑ Melhoria e desenvolvimento de máquinas e implementos
❑ Técnicas de gestão agropecuárias
❑ Tecnologias de processamento e manufatura
❑ Qualidade dos produtos derivados do algodão
❑ Outros (favor especificar) _____

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO ALGODÃO NO BRASIL Page 5

22 Na sua opinião, as atividades das instituições de pesquisa que trabalham com o algodão deveriam ser: (favor escolher apenas uma opção)

❍ Totalmente financiada com recursos da iniciativa privada; (Se você escolheu esta opção, vá para a que
❍ Totalmente financiada com recursos dos governos estaduais e federal; (Se você escolheu esta opção,
❍ Financiada com recursos provenientes de ação conjunta entre a iniciativa privada e os governos estadu

23 Se a sua opção foi "financiada com recursos provenientes de ação conjunda entre a iniciativa privada e os governos estaduais e federal" por favor responda, qual seria a proporção adequada de participação do setor privado e do setor público no financiamento da pesquisa desenvolvida pelas instituições dos governos estaduais e federal.

❍ Setor privado de 05% a 20% ; e setor público de 80% a 95%
❍ Setor privado de 21% a 40% ; e setor público de 79% a 60%
❍ Setor privado de 41% a 60% ; e setor público de 59% a 40%
❍ Setor privado de 61% a 80% ; e setor público de 39% a 20%
❍ Setor privado de 81% a 95% ; e setor público de 05% a 19%

24 Você concordaria em apoiar financeiramente projetos de pesquisa desenvolvidos por instituições de pesquisa que trabalham com algodão?

❍ Concordo ❍ Discordo ❍ Não tenho opinião formada

25 Considerando a situação atual do Agronegócio do algodão no Brasil, como você vê o mercado internacional para o desenvolvimento do algodão e seus derivados?

❍ Uma oportunidade ❍ Uma ameaça ❍ Indiferente ❍ Não tenho opinião

26 Na sua opinião, que importância você daria à experiência de sucesso de outros países no processo de desenvolvimento da indústria do algodão no Brasil?

❍ Sem importância ❍ Importante ❍ Extremamente importante
❍ Moderadamente importante ❍ Muito importante ❍ Não tenho opinião formada

27 Considerando as estratégias listadas abaixo, indique que nível de importância você daria a cada uma delas, para promover o relacionamento com outros países e ajudar no desenvolvimento da indústria do algodão no Brasil. 1 = Sem importância; 2 = Moderadamente importante; 3 = Importante; 4 = Muito importante; 5 = Extremamente importante; 6 = Não tenho opinião formada De acordo com as opções acima, digite o número correspondente à sua opinião para cada estratégia, podendo dar o mesmo número para vários itens.

___ Incrementar o intercâmbio tecnológico entre países com características de produção e de mercado si
___ Participar de redes de pesquisa internacional em temas de interesse mútuo, envolvendo equipes mul
___ Estabelecer alianças estratégicas para conquistar novos mercados para o algodão e seus derivados;
___ Importar novas tecnologias e recursos genéticos adaptáveis à características específicas do Brasil

28 Qual das opções abaixo define melhor a situação da cadeia produtiva do algodão em relação ao processo de expansão da participação do Brasil no mercado internacional do algodão e seus derivados?

❍ Totalmente desorganizada para permitir a expansão da participação do Brasil no mercado internaciona
❍ Parcialmente organizada para permitir a expansão da participação do Brasil no mercado internacional
❍ Totalmente organizada para permitir a expansão da participação do Brasil no mercado internacional

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO ALGODÃO NO BRASIL Page 6

29 Qual o segmento da cadeia produtiva do algodão que precisa ser melhorado para que a participação brasileira no mercado internacional seja ampliada? (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Insumos básicos (sementes, adubos, etc.)
❑ Serviços de técnicos à produção e beneficiamento do algodão
❑ Produtores de Algodão
❑ Agências de negócios
❑ Usinas de beneficiamento
❑ Indústria de processamento de produtos derivados em geral
❑ Instituições de pesquisa e desenvolvimento
❑ Agências de marketing e de valorização do algodão e seus derivados
❑ Logística (coleta, transporte, distribuição, etc.)
❑ Outros (favor especificar) _____

30 Você concorda ou discorda que um fluxo contínuo de informações entre os diferentes segmentos da cadeia produtiva garante a eficiência e a competitividade do agronegócio do algodão no Brasil?

❍ Concordo ❍ Discordo ❍ Não tenho opinião formada

31 Argumenta-se que a manutenção de um fluxo contínuo de informações entre as instituições de pesquisa e as empresas que participam do agronegócio do algodão é fundamental para o bom desempenho do produto. 1 = Sem importância; 2 = Moderadamente importante; 3 = Importante; 4 = Muito importante; 5 = Extremamente importante; 6 = Não tenho opinião formada De acordo com as opções acima, digite o número correspondente à sua opinião para cada estratégia, podendo dar o mesmo número para vários itens.

___ Treinamentos promovidos pelos diversos segmentos da cadeia produtiva com a participação de repre
___ Participação em seminários e congressos de representantes de todos os segmentos da cadeia produ
___ Participação de todos os segmentos da cadeia no processo de definição dos projetos de pesquisa a s
___ Estímulo ao uso de tecnologias da informação em todos os segmentos da cadeia produtiva
___ Criação de um portal com informações técnico científicas sobre algodão desenvolvidas por instituiçõe
___ Abertura de um canal de comunicação com outros países com características de produção e mercad

32 Na sua opinião, qual é o grau de importância das ações do Governo Brasileiro no desenvolvimento do mercado internacional para o algodão e seus derivados?

❍ Sem importância ❍ Importante ❍ Extremamente importante
❍ Moderadamente importante ❍ Muito importante ❍ Não tenho opinião formada

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO ALGODÃO NO BRASIL Page 7

33 Argumenta-se que a atuação do governo em alguns segmentos da cadeia produtiva do algodão concorre com os esforços da iniciativa privada ou até impede o crescimento de determinados segmentos. Na sua opinião em quais segmentos da cadeia produtiva do algodão o Governo deveria estar presente, em quais ele não deveria estar, e em quais ele deveria atuar em parceria com a iniciativa privada? - Indique com o número 1 os segmentos que o Governo deveria estar presente; - Indique com o número 2 os segmentos que o Governo não deveria estar presente; - Indique com o número 3 os segmentos que o Governo deveria atuar em parceria com a iniciativa privada.

___ Comércio exterior (importação e exportação)
___ Pesquisa agropecuária
___ Comércio Interno (doméstico)
___ Produção de algodão
___ Insumos básicos (adubos, sementes/mudas, etc.)
___ Logística (rodovias, transporte, armazenagem, escoamento de produção, etc.)
___ Indústria de máquinas e implementos
___ Processamento/manufaturas

34 Argumenta-se que o processo de ajuste da agricultura promovido pelo Governo Brasileiro (extinção de empresas públicas e institutos de pesquisa, eliminação dos subsídios, criação de leis de incentivo fiscais, etc.), que teve o seu ponto alto no início da década de 90, precisa ser revisto para atender as demandas atuais criadas pelo mercado interno e internacional. Considerando as opções listadas abaixo, indique quais políticas de Governo deveriam ser implementadas ou fortalecidas para que haja expansão dos mercados interno e externo do algodão e derivados no Brasil. (Por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Comércio exterior (exportação e importação)
❑ Isenção e incentivos fiscais
❑ Ciência e tecnologia no setor agropecuário
❑ Produção agrícola
❑ Mercado e consumo interno
❑ Outros (favor especificar) _____

35 Você tem conhecimento das Leis estaduais e federais, criadas pelo governo para estimular a participação da iniciativa privada em projetos de pesquisa agropecuária desenvolvidos em parceria com o setor público (Universidades, Embrapa e instituições estaduais de pesquisa)?

❍ Sim
❍ Não (Se a sua resposta for não, vá para a questão 38)

36 Se a sua resposta à questão 35 foi sim, por favor informe se você já usou ou está usando os incentivos previstos nestas Leis.

❍ Sim (Se a sua resposta for sim, vá para a questão 38)
❍ Não

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO ALGODÃO NO BRASIL Page 8

37 Se a sua resposta à questão 36 foi não, indique abaixo, o que impede a sua empresa de usar os incentivos previstos nestas Leis. (Por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Ausência de clara definição das vantagens, direitos e obrigações dos envolvidos nestas parcerias;
❑ Os valores dos incentivos previstos nestas leis são baixos e não estimulam a participação do setor priv
❑ O processo de divulgação destas leis é precário e insuficiente para atrair a iniciativa privada nestas par
❑ Os formulários utilizados para a apresentação de projetos são complexos e dificultam o acesso aos inc
❑ As agências do governo não estão suficientemente preparadas para atender e orientar os interessados
❑ Para ceder os benefícios previstos, as leis impõem uma série de exigências que dificultam o acesso da
❑ Outros (favor especificar) _____

38 Qual das opções abaixo representa a sua expectativa em relação à situação econômica do agronegócio do algodão no Brasil nos próximos 5 a 10 anos?

❍ Excelente ❍ Regular ❍ Muito ruim ❍ Não tenho opinião
❍ Boa ❍ Ruim

39 Se você tivesse que opinar sobre a situação estrutural do agronegócio do algodão no Brasil nos próximos 5 a 10 anos, quais das opções abaixo expressariam melhor a sua opinião? (Por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Baseada em grandes fazendas com grandes produção em escala
❑ Baseada em cooperativas de produtores fornecedores de algodão para usinas
❑ Usinas processando algodão produzidos em grandes fazendas próprias
❑ Usinas processando o seu próprio algodão em terras arrendadas
❑ Todos os segmentos da cadeia produtiva do algodão ligados através de um sistema de comunicação v
❑ Indústria de algodão com sistema de produção moderno e integrado
❑ Outros (favor especificar) _____

40 Qual a probabilidade da sua empresa (fazenda, usina, agência de negócios, empresas de insumos, indústria de máquinas e implementos etc.) continuar atuando na cadeia produtiva do algodão nos próximos 5 a 10 anos?

❍ Nenhuma probabilidade ❍ Provável ❍ Altamente provável
❍ Pouca probabilidade ❍ Muito provável ❍ Não tenho opinião formada

QUESTIONNAIRE OF BRAZILIAN COTTON INDUSTRY Page 1

Instructions:
❍ - select ONLY ONE Choice ❑ - select ALL that apply.

1 In the context of cotton industries in Brazil, to which professional group do you, belong? (If you are related to more than one option, please indicate the one that represents your gratest involvement)

❑ Farm input supplier manager
❑ Logistics manager
❑ Cotton mills proprietor
❑ Cotton supplier
❑ Cotton producer
❑ Cotton producer and cotton mills proprietor
❑ Manager of agricultural companies (farm, cooperative, fundation, etc.)
❑ Agricultural researcher
❑ Service Provider (technical consultant)
❑ Government authority
❑ Other (specify) _____

2 Who do you work for?

❍ Public institution employer
❍ Private company employer
❍ Non Government Organization employer
❍ Not applicable

3 What is your highest education level?

❍ Primary school incomplete
❍ Primary school
❍ High school incomplete
❍ High school
❍ University degree
❍ Specialization course
❍ Masters
❍ PhD

4 Which is the size of your farm? (including the rented area)

❍ Less than 500 ha
❍ From 501 to 1000 ha
❍ From 1001 to 3000 ha
❍ From 3001 to 5000 ha
❍ From 5001 to 8000 ha
❍ From 8001 to 10000 ha
❍ From 10001 to 15000 ha
❍ From 15001 to 20000 ha
❍ More than 20001 ha
❍ Not applicable

5 If you are an owner of the company in the cotton chain (E.g. farms, mills, Harvester contractors, farm input supplier, retail companies etc), please consider the following issues and indicate how many employees you have in your property.

❍ From 01 to 50
❍ From 51 to 80
❍ From 81 to 100
❍ From 101 to 200
❍ More than 200
❍ Not applicable

6 If you are a manager or head of cooperatives, producers association or creators association please inform how many producers/institutions do you represent? (In the cooperatives case, please consider only the active members)

❍ Less than 20 producers/institutions
❍ From 21 to 40 producers/institutions
❍ From 41 to 50 producers/institutions
❍ From 51 to 100 producers/institutions
❍ De 101 to 200 producers/institutions
❍ More than 200 producers/institutions
❍ Not applicable

QUESTIONNAIRE OF BRAZILIAN COTTON INDUSTRY Page 2

7 In your opinion, how important are the research and development activities to ensure an efficient and competitive Brazilian cotton industry?

❍ Not important ❍ Important ❍ Extremely important
❍ Moderately important ❍ Very important ❍ Do not know

8 In your opinion has the agricultural technology support been important to improve the international market in the cotton industry?

❍ Not important ❍ Important ❍ Extremely important
❍ Moderately important ❍ Very important ❍ Do not know

9 Consider the following issues and indicate in your opinion how the agricultural technology support has been important to improve the international cotton market. (Please choose as many alternatives as you like from the list below)

❑ Development of new varieties of plants increased pest and disease resistance and high productivity
❑ Agricultural manager software development
❑ Lowered cost of production (smaller production cost, high profit/gain)
❑ Introduction of pest and disease control techniques
❑ Introduction of new methods of soil conservation
❑ Innovation development in the machine and equipment production, harvest and processing areas
❑ Improvement in the cotton and derivate products quality
❑ Development of products to attend the diversified market demands
❑ Adaptability of the product based in the market requirement
❑ Expanding the domestic consumption
❑ Enlargement of the external market
❑ Other (specify) _____

10 Have you adopted the technologies created and made available by the cotton research institutions?

❍ Yes ❍ No ❍ Not applicable

11 Do you have or have you had a partnership agreement with any agricultural research and development institution, with the objective to develop and/or to finance research and development project?

❍ Yes (go to question 13) ❍ No ❍ Not applicable

12 If not, please consider the following issues and indicate in your opinion what does hinder your partnership agreement with some agricultural research and development institute? (Please choose as many alternatives as you like from the list below)

❑ The majority of the cotton technologies available in the market present free access
❑ The information about how to make this partnership is not available and if it is, it is no adequate
❑ The research and development institutions involvement in the potential partners' orientation process, sh
❑ The laws, rules, and procedures created to define the research institutes activities are not inclusive and
❑ Difficulty to obtain financing to improve this kind of partnership agreement
❑ Others (specify) _____

QUESTIONNAIRE OF BRAZILIAN COTTON INDUSTRY Page 3

13 What is your opinion about the private research and development institutes' performance working with cotton in Brazil? (E.g. Fundação Mato Grosso, Fundação Centro Oeste, Fundação Bahia, CODETEC and others cooperatives)

❍ Very bad ❍ Fairly good ❍ Very good ❍ Excellent ❍ Do not know
❍ Bad ❍ Good

14 Consider the following issues and indicate in your opinion what the private research and development institutes need to do to improve their performance? (Please choose as many alternatives as you like from the list below)

❑ To increase the investment in research projects
❑ To increase the investment in training the research staff
❑ Make it easy to access information
❑ To create new projects expanding to involve all the cotton industry
❑ To create a system of research and extension capable to interact and meet the cotton industry demands
❑ Others (specify) _____

15 What is your opinion about the government research and development institutes' performance working with cotton segments in Brazil? (E.g. Embrapa Cotton; IAC, IAPAR, EPAMIG, EBDA; etc)

❍ Very bad ❍ Fairly good ❍ Very good ❍ Excellent ❍ Do not know
❍ Bad ❍ Good

16 Consider the following issues and indicate in your opinion what the government research and development institutions need to do to improve their performance? (Please choose as many alternatives as you like from the list below)

❑ To increase the investment in research projects
❑ To increase the investment in training the research staff
❑ Make it easy to access information
❑ To create new projects expanding to involve all the cotton industry segments
❑ To create a system of research and extension capable to interact with the cotton industry and meet its d
❑ To create instruments, and give ample divulgation, regulating the partnership with the private sector pro
❑ To enable technicians to work in the Brazilian agribusiness looking to attract and develop partnerships i
❑ Other (specify) _____

17 Do you agree or disagree with the statement that there are many cotton technologies created and made available by the research and development institutes, that the cotton industry segments do not have knowledge of, and, as a consequence, they lose the opportunity to apply and make a good use of the technologies.

❍ Agree ❍ Disagree ❍ Do not know

18 Do you agree or disagree with the statement that if the existent and available cotton technologies resulting from the research and development projects were known and applied by the cotton industry segments, the Brazilian cotton and derivate products export would be better than now?

❍ Agree ❍ Disagree ❍ Do not know

QUESTIONNAIRE OF BRAZILIAN COTTON INDUSTRY Page 4

19 Please consider the issues listed below and indicate, in your opinion, what hinders the technologies to be applied and help to improve the Brazilian cotton position in the international market? (Please choose as many alternatives as you like from the list below)

❑ The research and development institutions are not totally prepared to divulge and to orientate about hov
❑ The cotton segments' difficulty to access the financial resources necessary to apply and to implement th
❑ The producers are not organized in terms of structure to receive and to apply the new technologies;
❑ The research and development institutes are prepared to develop new technologies but not to introduce
❑ Others (specify) _____

20 Please consider the issues listed below and indicate, in your opinion, which part of the segments of the cotton chain needs more attention from technology support to improve the Brazilian cotton export position in the international market? (Please choose as many alternatives as you like from the list below)

❑ Farm production
❑ Input suppliers
❑ Processors/Manufacturers
❑ Logistics (transport, discharge, delivery, etc.)
❑ Information access
❑ Other (specify) _____

21 In your opinion in which area should the research and development institutes put more effort in order to improve the cotton production? (Please choose as many alternatives as you like from the list below)

❑ Soil handling
❑ Crop handling
❑ New varieties development
❑ Development of new products through biotechnology
❑ Pest control
❑ Disease control
❑ Weed control
❑ Machinery performance
❑ Manager practices
❑ Cotton manufacture technology
❑ Cotton and derivates products quality
❑ other (specify) _____

22 In your opinion, who should provide the financial support to maintain the Research and Development institutions in the cotton industry? (Please choose only one option)

❍ Private Sector financial funds only (go to Question 24)
❍ Government Sector financial funds only (go to Question 25)
❍ Combined private and government sectors financial funds (go to Question 23)

23 If your answer was C (combined private and government sectors financial funds), which percentage do you consider ideal to be supported by the private sector?

❍ From 05% to 20% by private sector and from 80% to 95% by government sector
❍ From 21% to 40% by private sector and from 79% to 60% by government sector
❍ From 41% to 60% by private sector and from 59% to 40% by government sector
❍ From 61% to 80% by private sector and from 39% to 20% by government sector
❍ From 81% to 95% by private sector and from 05% to 19% by government sector
❍ Not applicable

QUESTIONNAIRE OF BRAZILIAN COTTON INDUSTRY Page 5

24 Would you agree or disagree to support finacially a fund to improve the investmens in Research and Development institutions which are working with cotton?

❍ Agree ❍ Disagree ❍ Do not know

25 Considering the actual situation of the cotton segments in Brazil, how do you see THE INTERNATIONAL MARKET for the cotton industry?

❍ Opportunity ❍ A menace ❍ Indifferent ❍ Do not know

26 In your opinion, how important do you consider the other countries' success experiences to help the Brazilian cotton industry development?

❍ Not important ❍ Important ❍ Extremely important
❍ Moderately important ❍ Very important ❍ Do not know

27 Please consider the issues listed below and indicate, in your opinion, to what extent do you consider important each of the strategies listed below to improve the relationship with other countries and help the Brazilian cotton industry development? 1 = Not important; 2 = Moderately important; 3 = Important; 4 = Very important; 5 = Extremely important; 6 = Do not know Type a number to indicate your choice, you may give the same level of importance to more than one issue.

___ to increase the technological interchange among countries of similar production characteristics and m
___ to participate in integrated research projects involving multidiscipline teams with common objectives;
___ to join efforts in winning new markets for the cotton industry;
___ to import new technologies and genetic resources adaptable to the Brazilian characteristics.

28 In your opinion, which option defines better the cotton industry situation, in relation to the Brazilian participation expansion, in the cotton international market.

❍ Not, in any way, organized to allow the expansion of the Brazilian cotton industry participation in the inte
❍ Partially organized to allow the expansion of the Brazilian cotton industry participation in the internationa
❍ Totallly organized to allow the expansion of the Brazilian cotton industry participation in the international

29 Please consider the following issues and indicate in your opinion which segments of the cotton chain need to be improved so that the Brazilian international cotton market will get better? (Please choose as many alternatives as you like from the list below)

❑ Input Suppliers
❑ Service Providers
❑ Producers and suppliers of cotton
❑ Traders
❑ Processors mills
❑ Manufacturers
❑ Research and Development institutes
❑ Marketing agencies and cotton importance improvement
❑ Logistics
❑ Other (specify) _____

30 Do you agree or disagree that a good information flow between all the different cotton segments is also necessary to ensure that the Brazilian cotton industry remains efficient and competitive?

❍ Agree ❍ Disagree ❍ Do not know

QUESTIONNAIRE OF BRAZILIAN COTTON INDUSTRY Page 6

31 It is argued that a good strategy to improve the information flow between R&D cotton institutes and cotton agribusiness companies is very important to the success of cotton production chain. To what extent do you consider important each of the strategies listed below to improve the information flow between cotton agricultural research institutes and cotton agribusiness companies? 1 = Not important; 2 = Moderately important; 3 = Important; 4 = Very important; 5 = Extremely important; 6 = Do not know Type a number to indicate your choice, you may give the same level of importance to more than one issue.

___ Training promoted by the diverse segments of the cotton industry with;
___ Participation of representatives from all cotton industry segments in seminars, congresses and confere
___ Involving all the cotton industry in the decisions process to define research projects to be developed b
___ Stimulating the use of information technologies across the whole chain;
___ Creating web portal specific to all segments of cotton industry developed for Brazil and other countries
___ Opening channels of communication considering the experiences of other countries, like Australia.

32 In your opinion how important are the government procedures to improve the international marketing of cotton production?

❍ Not important ❍ Important ❍ Extremely important
❍ Moderately important ❍ Very important ❍ Do not know

33 It is argued that the government performance in some cotton industry segments concurs with the private sector efforts, and some times it hinders that specific segment growth. In your opinion, in which cotton industry segment should be the government present, in which it should not be, and in which it should be acting in partnership with the private sector? - type the number 1 beside the segments that the government should be the only entity involved; - type the number 2 beside the segments that the government should not be involved in; - type the number 3 beside the segments where the government should be in partnership with private sector;

___ International trade (export and import)
___ Research and development institutions
___ Domestic market
___ Cotton production
___ Input suppliers
___ Logistics (transport, discharge, delivery, roads, storage, etc.)
___ Industries of machinery and equipment
___ Processors and manufacturing industries

34 It is argued that the process of agricultural industries adjustment promoted by the Brazilian Government (established public companies and research institutes extinction, subsidies elimination, fiscal incentive laws created, etc.) started in the beginning of 90s decade, needs to be reviewed to attend to the new domestic and international markets demands created. Please consider the following issues and indicate in your opinion which cotton industry segments need to be reviewed by the government to improve the production and the international market in the cotton chain. (Please choose as many alternatives as you like from the list below)

❑ International trade (export and import)
❑ Tax exemption and tax incentives
❑ Science and Technology in the agricultural sector
❑ Rural production
❑ Domestic market
❑ Others (specify) _____

QUESTIONNAIRE OF BRAZILIAN COTTON INDUSTRY Page 7

35 Do you have knowledged of the States and Federal Government laws, created to stimulate the private sector participation in research projects developed in partnership with universities, and state and federal research and development institutions?

❍ Yes ❍ No (Go to question 38)

36 If yes, have you ever used the incentives provided in these laws?

❍ Yes (go to question 38) ❍ No ❍ Not applicable

37 If not, please consider the following issues and indicate in your opinion what hinders the use of the incentives provided in these laws on the part of your company? (Please choose as many alternatives as you like from the list below)

❑ It is difficult to understand which are the real advantages, rights and obligations involved in the partnersl
❑ The incentives values provided in the Laws are small and not enough to justify the private sector particip
❑ The communication and encouragement, on the part of the government, to use the existing laws in the p
❑ The application instruments necessary to present projects are complex, making difficult the access to th
❑ The government agencies attendance with the responsibility to guide the interested parties in using the
❑ To access the offered benefits, the laws impose requirements difficult for small and median companies
❑ Others (specify)
❑ Not applicable _____

38 If you would describe the future of the economic situation of the Brazilian cotton industry in 5 to 10 years time, which statements from the list below would best express what you think?

❍ Excellent ❍ Fairly good ❍ Bad ❍ Very bad ❍ No opinion
❍ Good

39 If you would describe the future of the structural situation (scope) situation of the Brazilian cotton industry in 5 to 10 years time, which statements from the list below would best express what you think. (Please choose as many alternatives as you like from the list below)

❑ Based on big farms of large scale producers
❑ Based on cooperative farms with modern cotton production systems
❑ Big manufacturers producing their own cotton in large farms
❑ Big manufacturers producing their own cotton in rented farms
❑ All the segments of cotton chain linked by internet system
❑ A modern and integrated cotton production system
❑ Other (specify) _____

40 What is the probability of your company (farm, mills, business agency, supply companies, of machines and equipment industry, etc.) continuing to active in the cotton industry in the next 5 or 10 years?

❍ Not probable ❍ Probable ❍ Extremely probable ❍ No opinion
❍ Less probable ❍ Very probable

Appendix 4

Dairy Industry Questionnaire (Portuguese and English)

This survey was provided online at: *http://www.nrsm.uq.edu.au/luciobrunale/PORTDairy.htm*

and *http://www.nrsm.uq.edu.au/luciobrunale/ENGLISHDairy.htm* *

* Links were current in mid-2006, but may not be available at the time of reading.

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO LEITE NO BRASIL Page 1

Instructions:
❍ - select ONLY ONE Choice ❑ - select ALL that apply.

1 Dentro da cadeia produtiva do leite no Brasil, a que grupo profissional você pertence? (Se você estiver relacionado a mais de um grupo listado, por favor, escolher o que você tenha maior envolvimento)

❍ Proprietário(a) de empresas de insumos (sementes, fertilizantes, rações, prestação de serviços, etc.)
❍ Produtor (a) de leite
❍ Dirigentes de cooperativas, associação de criadores ou associação de produtores
❍ Empresário(a) ou administrador(a) na área de captação e distribuição de leite (logística da captação e t
❍ Pesquisador(a) técnico/científico
❍ Extensionista, consultor(a) ou assistente técnico
❍ Empresário(a) ou adinistrador(a) da área de mercado (atacadista, varejista, exportadores e importadore
❍ Empresário(a) ou administrador(a) de indústria laticinista
❍ Autoridade de governo municipal, estadual ou federal
❍ Professor Universitário
❍ Lider sindical patronal rural (CNA, Federações e Sindicatos Rurais)
❍ Lider sindical da indústria laticinista (SINDLEITESs)
❍ Outros (favor especificar) _____

2 Se você se enquadrou no grupo profissional de "Administrador(a), Pesquisador(a) ou Extensionista", indique o seu vínculo de trabalho atual? Se você se enquadra em uma das outras opções vá para a questão 3.

❍ Empregado(a) de instituições pública municipal, estadual ou federal
❍ Empregado(a) de empresa privada
❍ Empregado (a) de cooperativa
❍ Empregado(a) de Organização Não Governamental
❍ Profissional autônomo de assistência técnica
❍ Não se aplica

3 Qual é o seu grau de instrução mais alto?

❍ Primeiro grau incompleto
❍ Primeiro grau completo
❍ Segundo grau incompleto
❍ Segundo grau completo
❍ Terceiro grau/Curso superior
❍ Especialização
❍ Mestrado
❍ Doutorado

4 Se você é produtor de leite (fazendeiro) por favor responda, qual é o número total de vacas do seu rebanho, incluindo as vacas secas? (Se não for o seu caso, siga para a questão 06)

❍ Menos de 50 vacas
❍ De51 a 100 vacas
❍ De 101 a 200 vacas
❍ De 201 a 300 vacas
❍ De 301 a 400 vacas
❍ De 401 a 500 vacas
❍ De 501 a 1000 vacas
❍ Mais de 1000 vacas

5 Qual a produção de leite diária do seu rebanho? (considere a média do último ano)

❍ Menos de 200 litros
❍ De 201 a 500 litros
❍ De 501 a 1000 litros
❍ De 1001 a 2000 litros
❍ De 2001 a 5000 litros
❍ Mais de 5001 litros

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO LEITE NO BRASIL Page 2

6 Se você é empresário ou administrador de empresa que atua dentro do agronegócio do leite (exemplo: fazenda, usina de beneficiamento, prestadora de serviços, empresa de insumos, agencia de negócio, etc.), indique abaixo quantos empregados você tem na sua empresa.

❍ Menos de 10 ❍ De 11 a 20 ❍ De 21 a 40 ❍ De 41 a 100 ❍ Mais de 100 ❍ Não se aplica

7 Se você é administrador(a) de cooperativa ou associação de produtores, quantos produtores e/ou instituições você representa? (no caso de cooperativas, favor considerar apenas os produtores ativos)

❍ Menos de 20 produtores/instituições
❍ De 21 a 40 produtores/instituições
❍ De 41 a 50 produtores/instituições
❍ De 51 a 100 produtores/instituições
❍ De 101 a 200 produtores/instituições
❍ Mais de 200 produtores/instituições
❍ Não se aplica

8 Na sua opinião, qual é a importância da pesquisa agropecuária para aumentar e garantir a eficiência e competitividade da cadeia produtiva do leite?

❍ Sem importância ❍ Moderadamente importante ❍ Importante ❍ Muito importante ❍ Extremamente importante ❍ Não tenho opinião formada

9 Na sua opinião, qual a importância das tecnologias desenvolvidas pelas instituições de pesquisa no processo de crescimento do mercado interno e externo do leite?

❍ Sem importância ❍ Moderadamente importante ❍ Importante ❍ Muito importante ❍ Extremamente importante ❍ Não tenho opinião formada

10 Considere as opções abaixo e indique, na sua opinião, como as tecnologias desenvolvidas pelas instituições de pesquisa têm sido importantes para desenvolver o mercado internacional do leite Brasileiro? (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Desenvolvimento de novas variedades de forrageiras resistentes a doenças, de alta produtividade e co
❑ Desenvolvimento de animais resistentes a doenças e de alta produtividade;
❑ Desenvolvimento de software de gerenciamento agrícola;
❑ Introdução de técnicas de controle do custo de produção e cálculo de rentabilidade;
❑ Introdução de técnicas de controle de pragas, doenças e de manejo sanitário do rebanho;
❑ Introdução de novos métodos de manejo animal e novas técnicas de ordenha e controle de qualidade d
❑ Construções rurais;
❑ Nutrição e alimentação animal;
❑ Reprodução animal;
❑ Desenvolvimento de inovações nas áreas de máquinas e equipamentos de produção e processamento
❑ Desenvolvimento de novos produtos láteos com alto valor agregado;
❑ Desenvolvimento de produtos que atendem às demandas diversificadas do mercado;
❑ Expansão do consumo no mercado nacional
❑ Expansão da participação do produto Brasileiro no mercado externo
❑ Outros (Favor especificar) _____

11 Você tem adotado as tecnologias geradas e disponibilizadas pelas instituições de pesquisa que trabalham com o leite?

❍ Sim ❍ Não ❍ Não se aplica

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO LEITE NO BRASIL Page 3

12 Você tem ou já teve contrato de parceria com alguma instituição de pesquisa agropecuária com o objetivo de desenvolver e/ou financiar projetos de pesquisa e desenvolvimento?

❍ Sim (Se a sua resposta for sim, vá para a questão 14)
❍ Não
❍ Não se aplica

13 Se você respondeu não à questão anterior, indique abaixo, na sua opinião, o que impediu ou está impedindo a efetivação da sua parceria com instituição de pesquisa agropecuária? (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ acesso gratuito à maioria das tecnologias disponíveis no mercado;
❑ Ausência de informação orientando a realização destas parcerias
❑ Fraco/insuficiente atuação das instituições de pesquisa na identificação e orientação dos potenciais pa
❑ As leis, normas e procedimentos que definem a estrutura e orientam a atuação das instituições de pesc
❑ Dificuldade na obtenção de financiamento para desenvolver este tipo de parceria;
❑ Outros (favor especificar) _____

14 Qual é a sua opinião sobre o desempenho das instituições de pesquisa privadas que trabalham com o leite no Brasil? (Ex.: Cooperativas, Fundações de empresas privadas, etc.)

❍ Péssimo ❍ Bom ❍ Excelente
❍ Ruim ❍ Muito bom ❍ Não tenho opinião formada
❍ Regular

15 Considere as opções abaixo e indique, na sua opinião, o que as instituições de pesquisa da iniciativa privada precisam implementar para melhorar seus desempenhos? (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Aumentar a aplicação de recursos financeiros na execução de projetos de pesquisa
❑ Investir mais na capacitação técnica do seu quadro de pesquisadores
❑ Facilitar o acesso às informações existentes
❑ Expandir a área de atuação atendendo a todos os segmentos da cadeia produtiva do leite
❑ Criar um sistema de pesquisa e extensão capaz de interagir e captar as demandas da cadeia produtiva
❑ Outros (favor especificar) _____

16 Qual é a sua opinião sobre o desempenho das instituições de pesquisa agropecuário dos governos estaduais e federal que trabalham com o leite no Brasil? (exemplos: Embrapa Gado de Leite; Embrapa Pecuária Sudeste, ESALQ, EPAMIG, UFV, etc.)

❍ Péssimo ❍ Bom ❍ Excelente
❍ Ruim ❍ Muito bom ❍ Não tenho opinião formada
❍ Regular

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO LEITE NO BRASIL Page 4

17 Considere as opções abaixo e indique, na sua opinião, o que as instituições de pesquisa dos governos estaduais e federal precisam implementar para melhorar seu desempenho? (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Aumentar a aplicação de recursos financeiros na execução de projetos de pesquisa
❑ Investir mais na capacitação técnica do seu quadro de pesquisadores
❑ Facilitar o acesso às informações existentes
❑ Expandir a área de atuação atendendo a todos os segmentos da cadeia produtiva do leite
❑ Criar um sistema de pesquisa e extensão capaz de interagir e captar as demandas da cadeia produtiva
❑ Criar instrumentos, e dar ampla divulgação, regulando o processo de parceria com a iniciativa privada,
❑ Capacitar seus técnicos para atuarem no agronegócio brasileiro na captação e desenvolvimento de par
❑ Outros (favor especificar) _____

18 Você concorda ou discorda da seguinte afirmação: Existem tecnologias geradas e disponibilizadas pelas instituições de pesquisa mas que os segmentos da cadeia produtiva do leite desconhecem e por isso, perdem a oportunidade de aplicá-las e usufruir de seus benefícios?

❍ Concordo ❍ Discordo ❍ Não tenho opinião formada

19 Você concorda ou discorda da seguinte afirmação: Se todas as tecnologias geradas até o momento e disponibilizadas pelas instituições de pesquisa fossem conhecidas e aplicadas pelos segmentos da cadeia produtiva do leite, a situação econômica do setor seria melhor?

❍ Concordo ❍ Discordo ❍ Não tenho opinião formada

20 Na sua opinião, as tecnologia já geradas e disponíveis não estão sendo aplicadas devido a: (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Deficiência das instituições de pesquisa no processo de divulgação e na orientação de como aplicar un
❑ Dificuldades, por parte do produtor/empresário, de acesso a recursos financeiros necessários para apli
❑ Ausência, por parte do produtor/empresário, de estrutura adequada para receber e aplicar as novas tec
❑ Falta de preparo das instituições de pesquisa na negociação e colocação de novas tecnologias no agro
❑ Outros (favor especificar) _____

21 Na sua opinião, qual o segmento da cadeia produtiva do leite que mais necessita suporte tecnológico? (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Produção de leite
❑ Insumos em geral
❑ Máquinas e implementos
❑ Indústria de processamento de produtos láteos
❑ Logística (transporte, distribuição, escoamento etc.)
❑ Acesso a informações
❑ Outros (favor especificar) _____

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO LEITE NO BRASIL Page 5

22 Em que área as instituições de pesquisa agropecuária deveriam concentrar seus esforços para incrementar a produtividade e a qualidade do leite e seus derivados no Brasil? (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

- ❑ Manejo de pastagem
- ❑ Desenvolvimento de novas variedades de forrageiras
- ❑ Desenvolvimento de novos produtos através de técnicas nas áreas de genética e biotecnologia (Ex.: ra
- ❑ Controle de pragas e doenças
- ❑ Desenvolvimento de novas espécimes de animais adaptados à condições específicas de cada região p
- ❑ Melhoria e desenvolvimento de máquinas e implementos
- ❑ Técnicas de gestão agropecuária
- ❑ Tecnologias de ordenha e resfriamento do leite
- ❑ Tecnologias de processamento de leite e derivados
- ❑ Qualidade do leite e seus derivados
- ❑ Caracterização e avaliação de sistemas de produção de leite das principais regiões brasileiras;
- ❑ Elaboração de modelos referenciais de produção de leite para as distintas regiões do País;
- ❑ Outros (favor especificar) _____

23 Na sua opinião, as atividades das instituições de pesquisa que trabalham com o leite deveriam ser: (favor escolher apenas uma opção)

- ❍ Totalmente financiada com recursos da iniciativa privada; (Se você escolheu esta opção, vá para a que
- ❍ Totalmente financiada com recursos dos governos estaduais e federal; (Se você escolheu esta opção,
- ❍ Financiada com recursos provenientes de ação conjunta entre a iniciativa privada e os governos estadu

24 Se a sua opção foi "financiada com recursos provenientes de ação conjunta entre a iniciativa privada e os governos estaduais e federal", por favor responda, qual seria a proporção adequada de participação do setor privado e do setor público no financiamento da pesquisa desenvolvida pelas instituições dos governos estaduais e federal.

- ❍ Setor privado de 05% a 20% ; e setor público de 80% a 95%
- ❍ Setor privado de 21% a 40% ; e setor público de 79% a 60%
- ❍ Setor privado de 41% a 60% ; e setor público de 59% a 40%
- ❍ Setor privado de 61% a 80% ; e setor público de 39% a 20%
- ❍ Setor privado de 81% a 95% ; e setor público de 05% a 19%

25 Você concordaria em apoiar financeiramente projetos de pesquisa desenvolvidos por instituições de pesquisa que trabalham com leite?

❍ Concordo ❍ Discordo ❍ Não tenho opinião formada

26 Considerando a situação atual do Agronegócio do leite no Brasil, como você vê o mercado internacional para o desenvolvimento do leite e seus derivados?

❍ Uma oportunidade ❍ Indiferente ❍ Não tenho opinião formada
❍ Uma ameaça

27 Na sua opinião, que importância você daria à experiência de sucesso de outros países no processo de desenvolvimento da indústria do leite no Brasil?

❍ Sem importância ❍ Importante ❍ Extremamente importante
❍ Moderadamente importante ❍ Muito importante ❍ Não tenho opinião formada

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO LEITE NO BRASIL Page 6

28 Considerando as estratégias listadas abaixo, indique que nível de importância você daria a cada uma delas, para promover o relacionamento com outros países e ajudar no desenvolvimento da indústria do leite no Brasil. 1 = Sem importância; 2 = Moderadamente importante; 3 = Importante; 4 = Muito importante; 5 = Extremamente importante; 6 = Não tenho opinião formada De acordo com as opções acima, digite o número correspondente à sua opinião para cada estratégia, podendo dar o mesmo número para vários itens.

___ Incrementar o intercâmbio tecnológico entre países com características de produção e de mercado si
___ Participar de redes de pesquisa internacionais em temas de interesse mútuo, envolvendo equipes mu
___ Estabelecer alianças estratégicas para conquistar novos mercados para o leite e seus derivados;
___ Importar novas tecnologias e recursos genéticos adaptáveis às características específicas do Brasil

29 Qual das opções abaixo define melhor a situação da cadeia produtiva do leite em relação ao processo de expansão da participação do Brasil no mercado internacional do leite e seus derivados?

❍ Totalmente desorganizada para permitir a expansão da participação do Brasil no mercado internaciona
❍ Parcialmente organizada para permitir a expansão da participação do Brasil no mercado internacional
❍ Totalmente organizada para permitir a expansão da participação do Brasil no mercado internacional

30 Qual o segmento da cadeia produtiva do leite que precisa ser melhorado para que a participação brasileira no mercado internacional de leite e derivados seja ampliada. (por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Insumos básicos (rações, produtos veterinários, etc.)
❑ Serviços de suporte técnico à produção e beneficiamento do leite
❑ Produtores de leite
❑ Agências de negócios
❑ Usinas de beneficiamento
❑ Indústria de processamento de produtos derivados em geral
❑ Instituições de pesquisa e desenvolvimento
❑ Agências de marketing e de valorização do leite e seus derivados
❑ Logística (coleta, transporte e distribuição de leite)
❑ Outros (favor especificar) _____

31 Você concorda ou discorda que um fluxo contínuo de informações entre os diferentes segmentos da cadeia produtiva garante a eficiência e a competitividade do Agronegócio do leite no Brasil?

❍ Concordo ❍ Discordo ❍ Não tenho opinião formada

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO LEITE NO BRASIL Page 7

32 Argumenta-se que a manutenção de um fluxo contínuo de informações entre as instituições de pesquisa e as empresas que participam do Agronegócio do leite é fundamental para o bom desempenho do produto. Indique que nível de importância você daria a cada estratégia listada abaixo, para promover este fluxo de informações no Brasil. 1 = Sem importância; 2 = Moderadamente importante; 3 = Importante; 4 = Muito importante; 5 = Extremamente importante; 6 = Não tenho opinião formada De acordo com as opções acima, digite o número correspondente à sua opinião para cada estratégia, podendo dar o mesmo número para vários itens.

___ Treinamentos promovidos pelos diversos segmentos da cadeia produtiva com a participação de repre
___ Participação em seminários e congressos de representantes de todos os segmentos da cadeia produ
___ Participação de todos os segmentos da cadeia no processo de definição dos projetos de pesquisa a s
___ Estímulo ao uso de tecnologias da informação em todos os segmentos da cadeia produtiva
___ Criação de um portal com informações técnico científicas sobre leite desenvolvidas por instituições de
___ Abertura de um canal de comunicação com outros países com características de produção e mercad

33 Na sua opinião, qual é o grau de importância das ações do Governo Brasileiro no desenvolvimento do mercado internacional para o leite e seus derivados?

❍ Sem importância ❍ Importante ❍ Extremamente importante
❍ Moderadamente importante ❍ Muito importante ❍ Não tenho opinião formada

34 Argumenta-se que a atuação do governo em alguns segmentos da cadeia produtiva do leite concorre com os esforços da iniciativa privada ou até impede o crescimento de determinados segmentos. Na sua opinião em quais segmentos da cadeia produtiva do leite o Governo deveria estar presente, em quais ele não deveria estar, e em quais ele deveria atuar em parceria com a iniciativa privada? - Indique com o número 1 os segmentos que o Governo deveria estar presente; - Indique com o número 2 os segmentos que o Governo não deveria estar presente; - Indique com o número 3 os segmentos que o Governo deveria atuar em parceria com a iniciativa privada.

___ Comércio exterior (importação e exportação)
___ Pesquisa agropecuária
___ Mercado Interno (doméstico)
___ Produção de leite
___ Insumos básicos (adubos, sementes, rações, reprodutores, sêmen, etc.)
___ Logística (rodovias, transporte, armazenagem, escoamento de produção, etc.)
___ Indústria de máquinas e implementos
___ Recepção e processamento do leite

35 Argumenta-se que o processo de ajuste da agricultura promovido pelo Governo Brasileiro (extinção de empresas públicas e institutos de pesquisa, eliminação dos subsídios, criação de leis de incentivo fiscais, etc.), que teve o seu ponto alto no início da década de 90, precisa ser revisto para atender as demandas atuais criadas pelo mercado interno e internacional. Considerando as opções listadas abaixo, indique quais políticas de Governo deveriam ser implementadas ou fortalecidas para que haja expansão dos mercados interno e externo do leite e derivados no Brasil. (Por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Comércio exterior (exportação e importação)
❑ Isenção e incentivos fiscais
❑ Ciência e tecnologia no setor agropecuário
❑ Produção agrícola
❑ Mercado e consumo interno
❑ Outros (favor especificar) _____

QUESTIONÁRIO SOBRE O AGRONEGÓCIO DO LEITE NO BRASIL Page 8

36 Você tem conhecimento das Leis estaduais e federais, criadas pelo governo para estimular a participação da iniciativa privada em projetos de pesquisa agropecuária desenvolvidos em parceria com o setor público (Universidades, Embrapa, e instituições estaduais de pesquisa, etc.)?

❍ Sim
❍ Não (Se a sua resposta for não, vá para a questão 39)

37 Se a sua resposta à questão 36 foi sim, por favor informe se você já usou ou está usando os incentivos previstos nestas Leis?

❍ Sim (Se a sua resposta for sim, vá para a questão 39)
❍ Não

38 Se a sua resposta à questão 37 foi não, indique abaixo, o que impede a sua empresa, de usar os incentivos previstos nestas Leis. (Por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Ausência de clara definição das vantagens, direitos e obrigações dos envolvidos nestas parcerias
❑ Os valores dos incentivos previstos nestas leis são baixos e não estimulam a participação do setor priv
❑ O processo de divulgação destas leis é precário e insuficiente para atrair a iniciativa privada nestas par
❑ Os formulários utilizados para a apresentação de projetos são complexos e dificultam o acesso aos inc
❑ As agências do governo não estão suficientemente preparadas para atender e orientar os interessados
❑ Para ceder os benefícios previstos, as leis impõem uma série de exigências que dificultam o acesso da
❑ Outros (favor especificar) _____

39 Quais das opções abaixo representa a sua expectativa em relação à situação econômica do agronegócio do leite no Brasil nos próximos 5 a 10 anos, ?

❍ Excelente ❍ Regular ❍ Muito ruim ❍ Não tenho opinião
❍ Boa ❍ Ruim

40 Se você tivesse que opinar sobre a situação estrutural do agronegócio do leite no Brasil nos próximos 5 a 10 anos, quais das opções abaixo expressariam melhor a sua opinião? (Por favor escolha quantas alternativas você entender necessárias para expressar a sua opinião)

❑ Baseada em grandes rebanhos com produção em larga escala
❑ Baseada em cooperativas de pequenos produtores fornecedores de leite para grandes usinas de benef
❑ Grandes indústrias processando leite de seus próprios rebanhos
❑ Todos os segmentos da cadeia produtiva do leite interligados através de um sistema de comunicação v
❑ A cadeia produtiva do leite totalmente integrada em um sistema de produção moderno e altamente proc
❑ O País, historicamente importador, transformado em grande exportador de produtos láteos.
❑ Outros (favor especificar) _____

41 Qual a probabilidade da sua empresa (fazenda, usina, agência de negócios, empresas de insumos, indústria de máquinas e implementos etc.) continuar atuando na cadeia produtiva do leite nos próximos 5 a 10 anos?

❍ Nenhuma probabilidade ❍ Provável ❍ Altamente provável
❍ Pouca probabilidade ❍ Muito provável ❍ Não tenho opinião formada

QUESTIONNAIRE OF BRAZILIAN DAIRY INDUSTRY Page 1

Instructions:
❍ - select ONLY ONE Choice ❑ - select ALL that apply.

1 In the context of dairy industry in Brazil, to which professional group do you belong? (If you are related to more than one option, please indicate the one that represents your greatest involvement)

❍ Farm input supplier
❍ Farmer / primary producer
❍ Manager or Head of cooperatives, producers association or creators association
❍ Manager of logistic companies (transport in general, dairy collect and distribution)
❍ Agricultural Researcher
❍ Technical Consultant
❍ Trader and Retail Manager or technician
❍ Manufacture/Processor Manager or Technician
❍ Government Authority
❍ University Lecture
❍ Leader of Farmers and Primary producer Syndicate (CNA, Federations and Rural Syndicates)
❍ Leader of dairy Manufactures and Processors Syndicates (SINDLEITESs)
❍ Other (specify) _____

2 Who do you work for?

❍ Public institution employer
❍ Private company employer
❍ Cooperative employer
❍ Non Government Organization employer
❍ Autonomous technical consultant
❍ Not applicable

3 What is your highest education level?

❍ Primary school incomplete
❍ Primary school
❍ High school incomplete
❍ High school
❍ University degree
❍ Specialization course
❍ Masters
❍ PhD

4 If you are a farmer please answer, which is the size of your herd destined for the milk production?

❍ Less than 50 animals
❍ From 51 to 100 animals
❍ From 101 to 200 animals
❍ From 201 to 300 animals
❍ From 301 to 400 animals
❍ From 401 to 500 animals
❍ From 501 to 1000 animals
❍ More than 1000 animals
❍ Not applicable

5 Which is the capacity of milk daily production of your herd? (take into consideration the last year average production)

❍ Less than 200 liters
❍ From 201 to 500 liters
❍ From 501 to 1000 liters
❍ From 1001 to 2000 liters
❍ From 2001 to 5000 liters
❍ More than 5000 liters
❍ Not applicable

6 If you are an owner of a company in the dairy chain (e.g. farms, mills, farm input supplier, retail and trade companies, etc.), please consider the following issues and indicate how many employees you have in your property.

❍ Less than 10
❍ From 11 to 20
❍ From 21 to 40
❍ From 41 to 100
❍ More than 100
❍ Not applicable

QUESTIONNAIRE OF BRAZILIAN DAIRY INDUSTRY Page 2

7 If you are a manager or head of cooperatives, producers association or creators association please inform how many producers/institutions do you represent? (In the cooperatives case, please consider only the active members)

❍ Less than 20 producers/institutions
❍ From 21 to 40 producers/institutions
❍ From 41 to 50 producers/institutions
❍ From 51 to 100 producers/institutions
❍ De 101 to 200 producers/institutions
❍ More than 200 producers/institutions
❍ Not applicable

8 In your opinion, how important are the agricultural research activities to ensure an efficient and competitive Brazilian dairy industry?

❍ Not important ❍ Important ❍ Extremely important
❍ Moderately important ❍ Very important ❍ Do not know

9 In your opinion, how important are the technologies developed by the agricultural research institutions to improve the domestic and international market in the dairy industry?

❍ Not important ❍ Important ❍ Extremely important
❍ Moderately important ❍ Very important ❍ Do not know

10 Consider the following issues and indicate in your opinion how the agricultural technology support has been important to improve the international dairy market? (please choose as many alternatives as you like from the list below)

❑ Development of new silage varieties (E.g. pest and disease resistance and high nutritional value);
❑ Improvement the animal genetics (E.g. increased pest and disease resistance and high produtivity);
❑ Development of farm management software;
❑ lowerd cost of production (smaller production cost, high profit/gain);
❑ Introduction of new techniques of animal pest and disease control, and herd sanitary management;
❑ Development of new methods of animal management including new milk techniques and and milk qualit
❑ Rural constructions models;
❑ Nutrition and animal feeding;
❑ Animal reproduction;
❑ Innovations development in the machines and equipment of the production and processing areas;
❑ Improvement in the product quality;
❑ Adaptability of the product based in the market requirement;
❑ Expanding the domestic consumption;
❑ Enlargement of the external market
❑ Other (specify) _____

11 Have you adopted the technologies created and made available by the dairy research institutions?

❍ Yes ❍ No ❍ Not applicable

12 Do you have or have you had a partnership agreement with any agricultural research institution with the objective to develop and/or to finance research and development projects?

❍ Yes (if Yes, go to question 14)
❍ No
❍ Not applicable

QUESTIONNAIRE OF BRAZILIAN DAIRY INDUSTRY Page 3

13 If not, please consider the following issues and indicate in your opinion what does hinder your partnership agreement with some agricultural research and development institutions? (Please choose as many alternatives as you like from the list below)

❑ The majority of the dairy technologies available in the market present free access;
❑ The information about how to make this partnership is not available or, if it is, it is not adequate;
❑ The research and development instituitions' involvement in the potential partners' orientation process, sl
❑ The laws, rules, and procedures created to define the research and development institutions activities a
❑ It is difficult to obtain financing to improve this kind of partnership agreement;
❑ Others (specify) _____

14 What do you think about the private research and development intitutions' performance working with dairy segments in Brazil? (E.g. Cooperatives, Foundations, etc.)

❍ Very bad ❍ Fairly good ❍ Very good ❍ Excellent ❍ Do not know
❍ Bad ❍ Good

15 Consider the following issues and indicate in your opinion what the private research and development institutions need to do to improve their performance? (Please choose as many alternatives as you like from the list below)

❑ To increase the investment in research projects;
❑ To increase the investment in training the research staff;
❑ Make it easy to access information;
❑ To create new projects expanding to involvie all the dairy industry segments;
❑ To create a systema of research and extension capable to interact and to meet the dairy industry demar
❑ Other (specify) _____

16 What do you think about the government research and development intitutions' performance working with dairy segments in Brazil? (E.g. Embrapa Cattle Dairy; ESALQ, EPAMIG, UFV, etc.)

❍ Very bad ❍ Fairly good ❍ Very good ❍ Excellent ❍ Do not know
❍ Bad ❍ Good

17 Consider the following issues and indicate in your opinion what the government research and development institutions need to do to improve their performance? (Please choose as many alternatives as you like from the list below)

❑ To increase the investment in research projects;
❑ To increase the investment in training the research staff;
❑ Make it easy to access information;
❑ To create new projects expanding to involvie all the dairy industry segments;
❑ To create a systema of research and extension capable to interact with the dairy industry identify/meet it
❑ To create instruments, and give ample divulgation, regulating the partnership with the private sector pro
❑ To enable technicians to work in the Brazilian agribusiness looking to attract and develope partnerships
❑ Other (specify) _____

18 Do you agree or disagree with the statement that there are many dairy technologies created and made available by the research and development institutes, that the dairy industry segments do not have knowledge of and, as a consequence, they lose the opportunity to apply and make a good use of these technologies.

❍ Agree ❍ Disagree ❍ Do not know

QUESTIONNAIRE OF BRAZILIAN DAIRY INDUSTRY Page 4

19 Do you agree or disagree with the statement that if the existent and available dairy technologies resulting from the research and development projects were known and applied by the dairy industry segments, the Brazilian milk and derivate products export would be better than now.

❍ Agree ❍ Disagree ❍ Do not know

20 Please consider the issues listed below and indicate, in your opinion what hinders the technologies to be applied and help to improve the Brazilian milk and its derivate products participation in the international market? (Please choose as many alternatives as you like from the list below)

❑ The research and development institutions are not totally prepared to divulge and to orientate about hov
❑ The dairy segments' difficulty to access the financial resources necessary to apply and to implement the
❑ The producers are not organized in terms of structure to receive and to apply the new technologies;
❑ The research and development institutes are prepared to develop new technologies but not to introduce
❑ Others (specify) _____

21 Please consider the issues listed below and indicate, in your opinion which part of the segments of the dairy chain needs more attention from technology support to modify the Brazilian dairy position in the international market? (Please choose as many alternatives as you like from the list below)

❑ Farm production
❑ Input suppliers
❑ Machinery and equipament
❑ Processors/Manufacturers
❑ Logistics (transport, collection and distribution, etc.)
❑ Information access
❑ Other (specify) _____

22 In your opinion in which area should the research and development institutions put more effort in order to improve dairy production? (Please choose as many alternatives as you like from the list below)

❑ Handling of pasture
❑ Development of new varieties of feed plants;
❑ Improve aspects of animal and plant genetics;
❑ Pest and disease control;
❑ Developement of new specimens of animals suitable to the specific conditions of each producing milk re
❑ Improvement and development of machines and equipaments;
❑ Farming management techniques
❑ Technologies of milk handling and cooling milk;
❑ Technologies of milk and derivatives products processing;
❑ Milk quality;
❑ Characterization and evaluation of milk production systems of the main Brazilian regions;
❑ Elaboration of referential models of milk production for the distinct regions of the Country;
❑ Others (specify) _____

23 In your opinion who should provide the financial support to maintain the Research and Development institutions in the dairy industry?

❍ Private Sector financial funds only (go to Question 25)
❍ Government Sector financial funds only (go to Question 26)
❍ Combined private and government sectors financial funds (go to Question 24)

QUESTIONNAIRE OF BRAZILIAN DAIRY INDUSTRY Page 5

24 If your answer was (combined private and government sectors financial funds), which percentage do you consider ideal to be supported by the private sector?

❍ From 05% to 20% by private sector and from 80% to 95% by government sector
❍ From 21% to 40% by private sector and from 79% to 60% by government sector
❍ From 41% to 60% by private sector and from 59% to 40% by government sector
❍ From 61% to 80% by private sector and from 39% to 20% by government sector
❍ From 81% to 95% by private sector and from 05% to 19% by government sector
❍ Not applicable

25 Would you agree to support financially a fund to improve the investments in R&D corporations which are working with dairy?

❍ Agree ❍ Disagree ❍ Do not know

26 Considering the actual situation of the dairy segments in Brazil, how do you see the international market for the dairy production?

❍ Opportunity ❍ A menace ❍ Indifferent ❍ Do not know

27 In your opinion, how important do you consider the other countries' success experiences to help the Brazilian dairy industry development?

❍ Not important ❍ Important ❍ Extremally important
❍ Moderately important ❍ Very important ❍ Do not know

28 Please consider the issues listed below and indicate, in your opinion to what extent do you consider important each of the strategies listed below to improve the relationship with other countries and help the Brazilian dairy industry development? 1 = Not important; 2 = Moderately important; 3 = Important; 4 = Very important; 5 = Extremely important; 6 = Do not know Type a number to indicate your choice, you may give the same level of importance to more than one issue.

___ to increase the interchange among countries of similar production characteristics and markets;
___ to participate in integrated research projects involving multidiscipline teams with common objectives;
___ to join efforts in the winning new markets for the dairy industry;
___ to import new technologies and genetic resources adaptable to the Brazilian characteristics.

29 In your opinion, which option defines better the dairy industry situation, in relation to the Brazilian participation expansion, in the dairy international market.

❍ Not, in any way, organized to allow the expansion of the Brazilian dairy industry participation in the inter
❍ Partially organized to allow the expansion of the Brazilian dairy industry participation in the international
❍ Totallly organized to allow the expansion of the Brazilian dairy industry participation in the international r

QUESTIONNAIRE OF BRAZILIAN DAIRY INDUSTRY Page 6

30 Please consider the following issues and indicate, in your opinion which segments of the dairy chain need to be improved so that the Brazilian international dairy market will get better? (Please choose as many alternatives as you like from the list below)

❑ Input suppliers (vet protucts; feed, etc.)
❑ Service Providers (technical support to the producers and processors)
❑ Producers of milk
❑ Traders
❑ Processors
❑ Manufacturers
❑ Research and development institutions
❑ Marketing and milk and derivate products valorization (increasing importance)
❑ Logistics (collection, transport and distribution)
❑ Others (specify) _____

31 Do you agree or disagree that a good information flow between all the different dairy segments is also necessary to ensure that the Brazilian dairy industry remains efficient and competitive?

❍ Agree ❍ Disagree ❍ Do not know

32 It is argued that a good strategy to improve the information flow between R&D dairy institutes and dairy agribusiness companies is very important to the success of the dairy production chain. To what extent do you consider important each of the strategies listed below to improve the information flow between dairy agricultural research institutes and dairy agribusiness companies? 1 = Not important; 2 = Moderately important; 3 = Important; 4 = Very important; 5 = Extremely important; 6 = Do not know Type a number to indicate your choice, you may give the same level of importance to more than one issue.

___ Training promoted by the diverse segments of the dairy industry with;
___ Participation of representatives from all dairy industry segments in seminars, congresses and conferer
___ Involving all the dairy industry in the decisions process to define research projects to be developed by
___ Stimulating the use of information technologies across the whole chain;
___ Creating web portal specific to all the segments of dairy industry developed for Brazil and other countr
___ Opening channels of communication considering the experiences of other countries, like Australia.

33 In your opinion how important are the government procedures to improve the international marketing of dairy production?

❍ Not important ❍ Important ❍ Extremally important
❍ Moderately important ❍ Very important ❍ Do not know

QUESTIONNAIRE OF BRAZILIAN DAIRY INDUSTRY Page 7

34 It is argued that the government performance in some dairy industry segments concurs with the private sector efforts, and some times it hinders that specific segments growth. In your opinion which dairy industry segments should be the government present, in which it should not be, and in which it should be acting in partnership with the private sector? - type the number 1 beside the segments that the government should be the only entity involved; - type the number 2 beside the segments that the government should not be involved in; - type the number 3 beside the segments where the government should be in partnership with private sector;

___ International trade (export and import)
___ Agricultural research and development
___ Domestic market
___ Rural production
___ Input suppliers
___ Logistics (transport, discharge, delivery, roads, storage, etc.)
___ Industries of machinery and equipment
___ Processors and manufacturing industries

35 It is argued that the process of agricultural industries adjustment promoted by the Brazilian Government (established public companies and research institutes extinction, subsidies elimination, fiscal incentive laws created, etc.) started in the beginning of 90s decade, needs to be reviewed to attend to the new domestic and international markets demands created. Please consider the following issues and indicate in your opinion which dairy industry segments need to be reviewed by the government to improve the production and the international market in the dairy industry. (Please choose as many alternatives as you like from the list below)

❑ International trade (export and import)
❑ Tax exemption and tax incentives
❑ Science and Technology in the agricultural sector
❑ Rural production
❑ Domestic market
❑ Others (specify) _____

36 Do you have knowledged of the States and Federal Government laws, created to stimulate the private sector participation in research projects developed in partnership with universities, and state and federal research and development institutes?

❍ Yes ❍ No (go to question 39)

37 If yes, have you ever used the incentives provide in these laws?

❍ Yes (go to question 39) ❍ No ❍ Not applicable

38 If not, please consider the following issues and indicate in your opinion what hinders the use of the incentives provided in these laws on the part of your company? (Please choose as many alternatives as you like from the list below)

❑ It is difficult to understand which are the real advantages, rights and obligations involved in the partnersl
❑ The incentives values provided in the Laws are small and not enough to justify the private sector particip
❑ The communication and encouragement, on the part of the government, to use the existing laws in the p
❑ The application instruments necessary to present projects are complex, making difficult the access to th
❑ The government agencies attendance with the responsibility to guide the interested parties in using the
❑ To access the offered benefits, the laws impose requirements difficult for small and median companies
❑ Others (specify)
❑ Not applicable _____

QUESTIONNAIRE OF BRAZILIAN DAIRY INDUSTRY Page 8

39 If you would describe the future of the economic situation of the Brazilian dairy industry in 5 to 10 years time, which statement from the list below would best express what you think.

❍ Excellent ❍ Fairly good ❍ Bad ❍ Very bad ❍ No opinion
❍ Good

40 If you would describe the future of the structural (scope) situation of Brazilian dairy industry in 5 to 10 years time, which statements from the list below would best express what you think. (Please choose as many alternatives as you like from the list below)

❑ Based on big farms and big herd with large scale producers
❑ Based on small farms working in a cooperative form of production
❑ Big manufacturers producing their own milk in large farms
❑ All the segments of dairy chain linked by internet system
❑ A modern and integrated dairy production system
❑ The country transformed into a great exporter of dairy products
❑ Other (specify) _____

41 What is the probability of your company (farm, mills, business agency, supply companies, of machines and equipment industry, etc.) continuing to be active in the dairy industry in the next 5 or 10 years?

❍ Not probable ❍ Probable ❍ Extremely probable ❍ No opinion
❍ Less probable ❍ Very probable

Appendix 5

Documents for the Focus Group Meetings (Portuguese And English)

(REGISTER OF THE STAKEHOLDERS' PRESENCE IN THE FGM – PORTUGUESE VERSION)

THE UNIVERSITY OF QUEENSLAND

Muito obrigado por aceitar o convite para participar da segunda fase do processo de coleta de dados da minha pesquisa de tese de doutorado.

Na oportunidade devo informá-lo que, de acordo com o estabelecido na metodologia da pesquisa, as discussões desta reunião serão gravadas. Para tanto, preciso da sua compreensão e concordância. Ao assinar a lista de participantes abaixo, você estará consentindo que eu grave a sua participação nesta reunião. Caso você não concorde que a sua participação seja gravada, por favor não assine a lista e converse comigo sobre as alternativas. Esclareço que todas as informações desta reunião serão tratadas de forma confidencial, e que o nome do participante não será informado a qualquer outra pessoa ou instituição.

Muito obrigado pela sua participação

Lucio Brunale

Supervisores: Malcolm Wegener e Kim Bryceson

The University of Queensland -School of Natural and Rural Systems Management

Lista de participantes da Reunião Grupo Focal – Produto _____

Data: ____/____/_____ Local: _____

	NOME	INSTITUIÇÃO	ASSINATURA

A presente pesquisa foi elaborada em estreita observância dos parâmetros definidos no Código de Ética da Universidade de Queensland. Portanto, sinta-se a vontade para discutir a sua participação neste estudo comigo (s4045118@student.uq.edu.au ou +61 07 3365-7407) ou com o meu supervisor Dr. Malcolm Wegener (+61 07 3365-2939 ou malcolm.wegener@uq.edu.au). Caso você queira falar com alguém da Universidade que não esteja envolvido na pesquisa, você pode contatar a Professora Helen Ross (+61 07 5460-1648 ou em 0408-195324, ou hross@uqg.uq.edu.au).

(REGISTER OF THE STAKEHOLDERS' PRESENCE IN THE FGM – ENGLISH VERSION)

THE UNIVERSITY OF QUEENSLAND

Thank you very much for accepting the invitation to participate in the second phase of my data collection for the research needed for my PhD's completion.

Taking this opportunity, I should inform you that in accordance with the methodology established for the research, the discussions on the meeting will be taped. Therefore, I need your informed consent. If you sign the following participants' list, you will be expected at the meeting. In case you don't agree that your participation should be expected, please do not sign the list and contact me about the other alternatives. I want to make it clear that all the information from this meeting will be treated as confidential information; the name of the participant will not be revealed to a third person or institution.

Thank you so much for your participation,

Lucio Brunale

Supervisors: Malcolm Wegener and Kim Bryceson

The University of Queensland - School of Natural and Rural Systems Management

List of participants of Focus Group Meeting – Industry _____

Date: ____/____/_____ Address: _____

	NAME	INSTITUTION	SIGNATURE

The present research was elaborated under the observation of the parameters defined in the Ethics Code of the University of Queensland. Therefore, feel free to discuss your participation in this research with me (s4045118@student.uq.edu.au or +61 07 3365-7407) or with my supervisor Dr. Malcolm Wegener (+61 07 3365-2939 or malcolm.wegener@uq.edu.au). Or in case you want to talk to someone from the University who is not involved in the research, you can contact Professor Helen Ross (+61 07 5460-1648 or on 0408-195324, or hross@uqg.uq.edu.au).

(QUESTIONS DISCUSSED IN THE FGM – VERSION IN PORTUGUESE)

THE UNIVERSITY OF QUEENSLAND

QUESTÕES PARA REUNIÃO FOCO GRUPAL

01- Na sua opinião o sistema brasileiro de pesquisa agropecuária está estruturado adequadamente para atuar em parceria com empresas privadas do agronegócio, particularmente no processo de definição e execução de projetos de pesquisa?
02- Na sua opinião o Sistema Nacional de Pesquisa Agropecuária, coordenada pela EMBRAPA, funciona de forma integrada, participativa e produtiva no contexto do agronegocio brasileiro? Caso a sua resposta seja positiva, por favor, justificar e exemplificar. Caso a sua resposta seja negativa, por favor, indicar os motivos.
03- Você concorda ou discorda da seguinte assertiva: caso a EMBRAPA (ou as empresas de públicas de pesquisa agropecuária) não promova mudanças estruturais adaptadas às novas exigências do mercado visando maior participação da iniciativa privada na definição e execução de projetos de pesquisa, ela corre o risco de perder a sua hegemonia e importância dentro do agronegócio brasileiro.
04- Os dados parciais obtidos na primeira fase deste estudo indicam que 80% dos representantes das cadeias produtivas do leite, algodão e da cana-de-açúcar concordam em apoiar financeiramente as empresas públicas de pesquisa agropecuária. Por outro lado, empresas como a EMBRAPA, por exemplo, nos últimos 10 anos, tem registrado uma média de participação da iniciativa privada em torno de 5% do orçamento geral da empresa.
Diante dessa aparente controvérsia, favor emitir a sua opinião sobre o que de fato vem impedindo ou dificultando o aporte pela iniciativa privada de recursos financeiros para execução e condução em projetos de pesquisa de empresas públicas de pesquisa agropecuária?
05-Outro ponto levantado na primeira fase desta pesquisa, foi que cerca de 75% dos entrevistados, disseram que as tecnologias geradas pelas instituições de pesquisa agropecuária não estão sendo utilizadas na sua totalidade, ou em outras palavras estão sendo subutilizadas. Contudo, caso estas tecnologias fossem totalmente aplicadas, a posição do Brasil no agronegócio mundial seria muito maior e qualificada. Na sua opinião, o que poderia ser feito para facilitar o acesso e aplicação das tecnologias geradas e permitir um melhor aproveitamento destas tecnologias pelos diversos segmentos das cadeias produtivas do agronegócio brasileiro?

(QUESTIONS DISCUSSED IN THE FGM – VERSION IN ENGLISH)

THE UNIVERSITY OF QUEENSLAND

QUESTIONS DISCUSSED IN THE FGMs

01 - In your opinion, is the Brazilian research system structured adequately to permit (or to act on...) a partnership with private agribusiness companies, particularly in the process of definition and execution of research projects?

02 - In your opinion, does the national agricultural research system, coordinated by EMBRAPA, work in an adequate way, participative and productive in the context of the Brazilian agribusiness? In case your answer is positive, please, justify and give examples. In case your answer is negative, please indicate your reasons.

03 - Do you agree or disagree with the following assertion: In case EMBRAPA (or other public companies of agricultural research) does/do not promote structural changes to adapt to the new demands of the market, in view of the major participation needed from private enterprise, in the definition and execution of research projects, it runs the risk of losing its position and importance in the Brazilian agribusiness.

04 - The partial data obtained in the first part of this research indicate that 80% of the representatives of the milk, sugarcane and cotton industries agree in supporting the public companies of agricultural research financially. Although, companies like EMBRAPA, for example, on the last 10 years, has registered, on average, participation by the private companies of about 5% of the total budget of the company. Because this contradictory situation, please give your opinion about what is actually stopping or making it difficult for the private companies to supply financial resources for the execution of projects by/with public agricultural research institutions?

05 - Another point found out in the first research was that around 75% of the people surveyed said that the technologies generated by the agricultural research institution are not being utilized fully. Therefore, if these technologies were being totally applied, Brazil's position in the global agribusiness would be better qualified. In your opinion, what could be done so that the application and the access to the technologies generated could be improved to permit a better use of these technologies by the diverse segments of the productive chain of the Brazilian agribusiness?

Appendix 6

Federal government grants & funding in Australia

Name of grant	Description	Administering agency
Agriculture Advancing Australia (AAA)	AAA is a package of programs designed to help primary producers in agriculture, fishing, forestry and processed food industries.	Department of Agriculture, Fisheries and Forestry
Agriculture, fisheries and forestry grants and assistance	Grants and assistance for Australian businesses in the agricultural, food, fisheries, forestry and natural resources industries.	Department of Agriculture, Fisheries and Forestry
Australia China Agricultural Cooperation Agreement (ACACA)	ACACA provides funding for agricultural oriented exchange projects between Australia and China.	Department of Agriculture, Fisheries and Forestry
Australian Tourism Development Program (ATDP)	The ATDP provides funding to businesses to develop regional tourism.	Australia Industry
Automotive Competitiveness & Investment Scheme (ACIS)	ACIS issues import duty credits to registered participants.	Australia Industry
Business Ready Program for Indigenous Tourism	The Business Ready Program for Indigenous Tourism supports emerging and established indigenous tourism businesses.	Australia Industry
Certain Inputs to Manufacture (CIM)	The CIM program provides import duty concessions on certain imported raw materials and intermediate goods as well as prescribed metal materials and goods.	Australia Industry
Commercial Ready	The Commercial Ready program offers competitive grants for commercialisation activities.	Australia Industry
Commercialising Emerging Technologies (COMET)	COMET is a federal government program focusing on innovation and its commercialisation.	Australia Industry
Enhanced Project By-Law Scheme (EPBS)	EPBS provides tariff duty concessions on eligible capital goods of significant sized projects in the mining, resource processing, food processing, food packaging, manufacturing, agriculture and gas supply industry sectors.	Australia Industry

Ethanol Production Grants (EPG)	The EPG program aims to provide a targeted means of maintaining the use of biofuels in transport in Australia.	Australia Industry
Export Market Development Grants Scheme (EMDG)	EMDG reimburses up to 50% of expenses incurred on eligible export promotional activities, less the first $15,000.	Australia Industry
Food Innovation Grants	The Food Innovation Grants Program provides funding to improve levels of innovation in the food industry.	Department of Agriculture, Fisheries and Forestry
Forest and Wood Products Research and Development Corporation Projects (FWPRDC)	The FWPRDC invests in a range of research and development projects for the benefit of the Australian forest and forest products industry.	Department of Agriculture, Fisheries and Forestry
Fuel Sales Grants Scheme (FSGS)	FSGS provides grants to fuel retailers for the sale of petrol and diesel to consumers in regional and remote areas of Australia.	Australian Tax Office
Grape and Wine Research and Development Corporation Projects	The GWRDC provides funding for research projects for the wine industry.	Grape and Wine Research and Development Corporation
Horticulture Australia's R&D Program	This program provides funding for projects in the fields of science and technology, marketing and economics.	Horticulture Australia Ltd
Indigenous Business Development Programme (IBDP)	IBDP is a combined loans and grants program for indigenous Australians.	Department of Employment and Workplace Relations
Indigenous Capital Assistance Scheme (ICAS)	Provides culturally appropriate commercial finance, and professional and mentoring support.	Department of Employment and Workplace Relations
Indigenous Self Employment Programme (ISEP)	Provides business advice and support, financial literacy training and an interest free loan funding.	Department of Employment and Workplace Relations
Indigenous Small Business Fund (ISBF)	ISBF provides funding for the development and expansion of Indigenous businesses and enterprises.	Department of Employment and Workplace Relations
Industry Cooperative Innovation Program (ICIP)	ICIP is aimed at encouraging business-to-business cooperation on innovation projects that enhance productivity, growth and international competitiveness in Australian industries.	Australia Industry
Information Technology Online (ITOL) Program	ITOL is a grants program designed to accelerate the national adoption of e-business solutions, especially by small to medium enterprises.	Department of Communications, Information Technology and the Arts
Innovation Investment Fund (IIF)	The IIF is a venture capital program that invests in venture capital funds to assist	Australia Industry

	small companies in the early stages of commercialization.	
IT Training and Technical Support Program	This program provides access to basic IT training and technical support.	Department of Communications, Information Technology and the Arts
Land and Water Australia	Land and Water Australia provides funding for research and training into sustainable use and management of Australia's natural resources.	Department of Agriculture, Fisheries and Forestry
Low Emissions Technology Demonstration Fund (LETDF)	LETDF demonstrates the commercial potential of new energy technologies or processes.	Australia Industry
National Australian Technology Showcase (ATS)	ATS is a national and international campaign designed to promote leading-edge Australian technology and the skills of the companies that produce it.	Australia Industry
National Indigenous Cadetship Project (NICP)	Provides funding to employers of Indigenous Australian cadets. Cadets receive an allowance to study full-time and the employer offers a 12 week paid work placement.	Department of Employment and Workplace Relations
New Apprenticeships Scheme	New Apprenticeships offers financial assistance for eligible employers to help reduce the real cost of training.	Department of Education, Science and Training
New Enterprise Incentive Scheme (NEIS)	NEIS assists eligible job seekers to start and run their new, viable small business.	Department of Employment and Workplace Relations
New Industries Development Program (NIDP)	NIDP assists Australian agribusinesses to commercialize new products, services and technologies.	Department of Agriculture, Fisheries and Forestry
Petroleum Products Freight Subsidy Scheme (PPFSS)	PPFSS subsidises the freight cost of delivering eligible petroleum products to remote Australian areas.	Australia Industry
Pharmaceuticals Partnerships Program (P^3)	P^3 provides grants for pharmaceutical R&D in Australia.	Australia Industry
Pooled Development Funds Program (PDF)	PDF is designed to increase the supply of equity capital for growing Australian small and medium-sized enterprises.	Australia Industry
Pre-Seed Fund (PSF)	PSF assists the commercialisation of public sector R&D activities by further developing the management and entrepreneurial skills of public sector researchers.	Australia Industry
R&D Tax Concession	R & D Tax Concession is a broad-based, market driven tax concession which allows companies to deduct up to 125% of qualifying expenditure incurred on R &	Australia Industry

	D activities when lodging their corporate tax return.	
Regulation Reduction Incentive Fund (RRIF)	RRIF provides Local Government Authorities with incentives to press ahead with regulatory and compliance reforms that will benefit small business.	Australia Industry
Renewable Energy Development Initiative (REDI)	REDI is a competitive merit based program supporting renewable energy innovation and its commercialisation.	Australia Industry
Renewable Energy Equity Fund (REEF)	REEF provides venture capital and managerial advice for small, innovative renewable energy companies.	Australia Industry
Rural Industries Research and Development Corporation Research Programs (RIRDC)	RIRDC works closely with Australian rural industries to fund programs for agricultural systems.	Rural Industries Research and Development Corporation
Small Business Entrepreneurship Program (SBEP) - Business Skills Development - Incubators	The Incubators element of the SBEP provides funding to help meet the infrastructure and set-up costs of new small business incubators and to assist established incubators to develop and grow.	Australia Industry
Small Business Entrepreneurship Program (SBEP) - Business Skills Development - Training and Mentoring Projects	The Training and Mentoring Projects element of the SBEP provides competitive grants for initiatives supporting general skills development and mentoring services for small businesses.	Australia Industry
Small Business Entrepreneurship Program (SBEP) - Succession Planning	The Succession Planning element of the SBEP supports initiatives that assist small business owners in developing succession planning strategies.	Australia Industry
Small Business Field Officers Program (SBFO)	SBFO is a competitive grants program providing financial grants to organisations to deliver advisory services to small business owners, particularly in regional areas.	Australia Industry
Space Concession Program (SCP)	SPC provides duty-free entry of goods imported for use in a space project.	Australia Industry
Structured Training and Employment Projects (STEP)	Provides flexible funding for projects that lead to lasting employment for Indigenous job seekers.	Department of Employment and Workplace Relations
Textile, Clothing and Footwear Expanded Overseas Assembly Provisions Scheme (EOAP)	The TCF EOAP provides duty concessions to firms who assemble garments and footwear overseas from predominantly Australian fabric and/or leather and then import them back into Australia for local consumption.	Australia Industry

Textile, Clothing and Footwear Post-2005 Strategic Investment Program Scheme	Aims to foster the development of a sustainable and internationally competitive TCF manufacturing industry and TCF design industry in Australia by providing incentives which will promote investment and innovation.	Australia Industry
Textile, Clothing and Footwear Product Diversification Scheme (PDS)	PDS is designed to assist Australian clothing and finished textile manufacturers to internationalise their sourcing arrangements.	Australia Industry
Textile, Clothing & Footwear Corporatewear Register	The Corporatewear Register allows employers to register non-compulsory occupational clothing, thereby avoiding liability for FBT and allowing employees to claim the cost of such clothing as a tax deduction.	Australia Industry
Textile, Clothing and Footwear Small Business Program	This program will provide grants to improve the business enterprise culture of TCF small businesses.	Australia Industry
Tradex Scheme	Tradex provides an up-front exemption from Customs duty and GST on imported goods intended for re-export or to be used as inputs to exports.	Australia Industry
Venture Capital Limited Partnerships Program (VCLP)	VCLP provides for the registration of limited partnerships as venture capital limited partnerships.	Australia Industry
Wage Assistance	Wage Assistance provides subsidies to Australian employers who give ongoing jobs to eligible indigenous job seekers.	Department of Employment and Workplace Relations

Source: www.business.gov.au

Appendix 7

2005 Science Award RDC Sponsors

Australian Government Research and Development Corporations	
Award Sponsors	Research and Development Corporation
Australian Wool Innovation Limited	<u>Australian Wool Innovation</u> Australian Wool Innovation Limited (AWI) provides funds for research, development and innovation activities, as well as a range of wool industry services aimed at increasing the profitability, productivity and sustainability of Australian woolgrowers. AWI is funded by Australian woolgrower levies and a capped Commonwealth Government research and development contribution. AWI's shareholders are woolgrowers while the Australian community is a major stakeholder through the Federal Government. AWI's research and development activities aim to benefit its woolgrower shareholders through improving wool quality and productivity, increasing the efficiency of wool processing and developing new wool products for consumers.
Australian Government – Fisheries Research and Development Corporation	<u>Fisheries Research and Development Corporation</u> The Fisheries Research and Development Corporation is a statutory authority jointly funded by the Australian Government and the fishing and aquaculture industry. It is responsible to its stakeholders to: • plan, invest in and manage fisheries R&D throughout Australia; and • facilitate the dissemination, adoption and commercialisation of R&D results.
Australian Government – Forest and Wood Products Research and Development Corporation	<u>Forest and Wood Products Research and Development Corporation</u> The Forest and Wood Products Research and Development Corporation (FWPRDC) provides a national, integrated research and development (R&D) focus for the Australian forest and wood products industry. The FWPRDC identifies research priorities, commissions, administers and evaluates research in a broad range of areas covering wood production, extraction, processing, economics and marketing. Key research areas include: • increasing domestic secondary processing and further value-adding of Australia's forest and wood resource; • studying the impacts of disturbance from wood production, silviculture and management of native forests and plantations; • commercial and economic aspects of wood production; and • research relevant to the continued development and progress of the forest and wood products industry. FWPRDC is a statutory authority within the portfolio of the federal Minister for Agriculture, Fisheries and Forestry, jointly funded by the Australian Government and the Australian Forest and Wood Products industry.
Australian Government	<u>Grains Research and Development Corporation</u> The Grains Research and Development Corporation (GRDC) plans and invests in

– Grains Research and Development Corporation	research and development for Australia's $7 billion grains industry. It drives investments worth over $100 million a year that underpin the profitability and environmental sustainability of the industry and its communities. The GRDC has a worldwide research portfolio and is a global leader in linking industry and community needs with science, technology and effective adoption.
Australian Government – Grapes and Wine Research and Development Corporation	<u>Grape and Wine Research and Development Corporation</u> The Grape and Wine Research and Development Corporation (GWRDC) is the body responsible for investing in grape and wine research and development on behalf of the Australian wine industry and the Australian community. The mission of the GWRDC is to enable a sustainable, innovative and profitable future for the Australian wine industry through strategic investment in research and development.
Australian Government – Land & Water Australia	<u>Land & Water Australia</u> Land & Water Australia is an Australian Government rural research and development corporation. We strategically invest in knowledge, partnerships, innovation and adoption to underpin sustainable natural resource management within Australia's agricultural industries.
Meat Livestock Australia	<u>Meat and Livestock Australia</u> Meat & Livestock Australia Limited (MLA) is a producer-owned company that provides services to the entire Australian red meat industry including producers, processors, exporters, live exporters and retailers. MLA has around 30,000 livestock producer 'members'. MLA's core activities are working to improve market access, building demand for Australian red meat and conducting research and development (R&D) to provide competitive advantages for the industry. MLA is primarily funded by transaction levies paid by producers on livestock sales while the Commonwealth Government provides dollar-for-dollar funds for money spent on R&D.
Australian Government – Rural Industries Research and Development Corporation	<u>Rural Industries Research and Development Corporation</u> The Rural Industries Research and Development Corporation manages and funds research and delivers practical results for industry development. RIRDC's major focus is on new products and services, and new and better ways of producing them. We achieve this by: • enhancing innovation in the rural and related sectors; • fostering the development of new industries; and by • addressing strategic issues facing the rural sector.
Australian Government – Sugar Research and Development Corporation	<u>Sugar Research and Development Corporation</u> SRDC's core business is to foster an innovative and sustainable Australian sugar industry through targeted investment in research and development. Specifically, SRDC will work with its stakeholders to deliver the following outcomes: • An increasing and more reliable cane supply, primarily through the implementation of robust farming systems that enhance economic and environmental performance, and are less vulnerable to the impacts of adverse factors such as disease and climate variability. • Facilitation of change which promotes adoption of whole-of-system solutions to enhance revenue and cost efficiency across the value chain at

	mill area and regional levels. • Demonstration of environmental sustainability to the satisfaction of all stakeholders. • Diversification of the income stream from products derived from sugarcane. • Enhancement of human capacity and partnerships between industry, research and regional communities to underpin change, learning and innovation. • An effective R&D capability underpinning industry futures.
Australian Egg Corporation Limited	http://www.aecl.org/ - The Australian Egg Corporation (AECL) is a producer owned company which integrates marketing, research and development and policy services for the benefit of all stakeholders. AECL is mainly funded through statutory levies collected under the Egg Industry Service Provision Act 2002 and Australian government funds for the purposes of research & development. - The Commonwealth Act, an Agreement between the Commonwealth and AECL and the organization's Constitution provide the legal framework for all company operations. AECL is a public non-listed company and was registered with the Australian Securities and Investments Commission (ASIC) on 18 November 2002 and commenced operations on 1 February 2003. AECL represents approximately 400 commercial egg producers who distribute a range of products to the local market including caged eggs, barn-laid eggs, free range eggs and specialist eggs. This highly nutritious food is an Australian grown product and no fresh shell eggs are imported into Australia from any country.
Australia Pork Limited	http://www.apl.au.com/index.cfm The Australian pork industry is focused on continued and profitable growth to ensure its long-term viability. In order to compete with much larger pork-producing countries, Australian producers need access to quality information that will help them to be competitive at both the farm and industry level. APL's research and innovation programs are developed with these needs in mind. APL invests producer levies and matching Australian Government funds to produce tangible benefits for the pork industry and the Australian community. APL does not fund research where the benefits are restricted to a few individual businesses. Rather, APL's mandate is to identify research that benefits specific sectors or the industry as a whole and which might not otherwise be funded if left to market forces. Innovation and adoption of new technology is critical to the industry's success and many APL research projects are designed to assist this process. Other resources are directed towards technical support to help improve the regulatory environment in which the industry operates. Examples are improving market access for Australian pork, defining appropriate animal health and welfare standards, and streamlining environmental regulations and compliance. APL research also provides the scientific backbone for the industry's on-farm quality assurance program - APIQ.
Australia Government Cotton Research and Development Corporation	http://www.crdc.com.au/ The Cotton Research and Development Corporation was established in 1990 under the Primary Industries and Energy Research and Development Act 1989. It is one of 14 rural Research and Development Corporations which cover dairy, forestry, fisheries, grains, grapes and wine, horticulture, pork, sugar and other agricultural industries.

	The CRDC is a partnership between the Federal Government and the Australian Cotton industry. It is funded through a levy on production with a matching contribution from the Commonwealth. The Corporation also receives income from royalties on seed sales of CSIRO-bred cotton varieties. The Corporation is accountable to the industry through the Australian Cotton Growers' Research Association (ACGRA) and to the Federal Parliament through the Parliamentary Secretary to the Minister for Agriculture, Fisheries and Forestry, the Hon. Sussan Ley MP. The Corporation is a member of the cotton industry's peak body the Australian Cotton Industry Council, however the Industry Council is not a stakeholder in the Corporation. The Corporation is based in Narrabri, NSW and is unique among the Rural R&D Corporations for having its headquarters away from a capital city. Narrabri is in the heart of one of Australia's major cotton production areas and is close to the industry's key research facility, the Australian Cotton Research Institute. The Cotton Research Institute is the headquarters for the Cotton CRC and the CRDC is a core investor in the Cotton CRC. The Corporation's corporate outcome is a more sustainable, profitable and competitive cotton industry, providing increased environmental, economic and social benefits to regional communities and the nation. The CRDC has a nine-member board with directors being drawn from the industry, community and government. The Chair is Ms Bridget Jackson, an agricultural consultant who was involved with the development of irrigation and the cotton industry in the Macquarie Valley in New South Wales. In the financial year 2005/06 the Corporation invested about $10.7 million directly into research and extension activities and a further $11.7 million will be invested in 2006/07.
Dairy Australian Limited	http://www.dairyaustralia.com.au The recent changes in the Australian dairy industry make it timely for all dairy farmers and the wider industry to understand the composition and application of compulsory, statutory milk levies. On 1 July 2003, Dairy Australia Limited, a public company limited by guarantee, was formed from the merger of the Australian Dairy Corporation (ADC) and the At that time, the three existing levies (corporation, promotion and research) funding the ADC and the DRDC were combined into one levy to fund Dairy Australia. The combined levy rate is equal to the total of the former levy rates. The levy funding Animal Health Australia (AHA) which existed before 1 July 2003 also continues. Dairy Australia is the industry-owned service company, limited by guarantee, whose members are dairy farmers and industry bodies. Dairy Australia invests approximately $35 million a year of dairy farmer levy payments and $15 million a year of Australian Government funds in projects for the benefit of the Australian dairy industry. These projects span the industry value chain from farm through to consumer. They include research and development, information services, international trade development and national marketing programs. The levies are paid monthly to the Australian Government by dairy companies, based on the milk they have received from farmers during the previous month. **National Industry Levies (from 1 July 2003)**

	<table><tr><th>Organization</th><th>Milk fat(cents/kg)</th><th>Protein (cents/kg)</th><th>Milk (cents / liter)</th></tr><tr><td>Dairy Australia</td><td>2.6075</td><td>6.35580</td><td>0.31500</td></tr><tr><td>Animal Health Australia</td><td>0.0370</td><td>0.08800</td><td>0.00400</td></tr><tr><td>Total</td><td>2.6420</td><td>6.43800</td><td>0.32100</td></tr><tr><td colspan="4">Based on an average Australian milk fat and protein composition</td></tr><tr><td colspan="4">Source: Primary Industries (Excise) Levies Amendment Regulations 2003 (No. 7)</td></tr></table> Understanding the dairy industry levies.pdf Download
Horticulture Australia Limited	http://www.horticulture.com.au/# Horticulture Australia Limited (HAL) is a national research, development and marketing organization that work in partnership with the horticulture sector to invest in programs that provide benefit to Australian horticulture industries. HAL invests almost $80 million annually in projects in partnership with the horticulture sector. During the year HAL was running more than 900 research, development and marketing projects covering a diversity of topics including consumer marketing, market research, supply chain management, export marketing, market access, quality assurance, food safety, skills development, industry communication, biosecurity, biotechnology, breeding, plant health, pesticide regulation, agronomy, crop regulation, physiology, irrigation and sustainable practices. HAL does not conduct research and development itself. It contracts organizations such as state departments of agriculture, universities and the CSIRO to undertake the work. HAL conducts some activities within the marketing program but also engages external suppliers to undertake marketing activities. As part of the Australian Government's commitment to rural research and development, horticulture industries can access matching Commonwealth funding through HAL for research and development activities.

Source: Australian Government – Department of Agriculture, Fisheries and Forestry (DAFF 2006)

Appendix 8

Commonwealth Agreement 30 June 2005

AGREEMENT
between the
COMMONWEALTH OF AUSTRALIA
and

_____

in relation to
The
Cooperative Research Centre
for

_____

to be supported under
THE COOPERATIVE RESEARCH CENTRES PROGRAMME

Commonwealth Agreement 30 June 2005 1

TABLE OF CLAUSES

Execution Clauses

TABLE OF SCHEDULES

THIS AGREEMENT is made on the _____ day of _____ 2005

between the

COMMONWEALTH OF AUSTRALIA, represented by the Department of Education, Science and Training, (**"the Commonwealth"**)

and

_____

("**the Company**")

and

_____

and

_____

(**"the Participants"**)

RECITALS:

A. The Commonwealth provides funding under a programme known as the Cooperative Research Centres Programme (the CRC Programme).

B. The Objective of the CRC Programme is:

to enhance Australia's industrial, commercial and economic growth through the development of sustained, user-driven, cooperative public-

private research centres that achieve high levels of outcomes in adoption and commercialisation.

C. The Participants and Supporting Participants applied to the Commonwealth for funding under the CRC Programme to carry out the Activities of the
" Cooperative Research Centre for ……"
("the CRC") described in Schedule 1 to this Contract.

D. The Minister approved funding by the Commonwealth under the CRC Programme for the CRC on the conditions set out in this Contract.

E. The Company and Participants have entered into a Participants Agreement to establish, and for the Company to manage and govern, the CRC. A copy of the agreement has been initialled by the Company and provided to the Commonwealth prior to the date of this Contract.

F. The arrangement between the Participants and the Company in the agreement referred to in Recital E is designated as a CRC under the CRC Programme.

G. The Commonwealth is required by law to ensure accountability for public money, and the Company and Participants are required to be accountable for all Commonwealth Funding.

H. The Company accepts the funding on the terms and conditions set out in this Contract.

OPERATIVE PART:

1. INTERPRETATION

1.1 In this Contract, unless a contrary intention appears:

"**Account**" means the account referred to in clause 8 [Accounting for Commonwealth Funding and Contributions];
"**Activities**" means the activities described in Schedule 1;
"Appraisal Panel" means the Panel appointed by the CRC Committee;

"**Asset**" means an item of real or personal property, including a Capital Item, but not including Intellectual Property;
"**Budget**" means the budget specified in Schedule 3;
"**Capital Item**" means an Asset of a durable nature, the value of which exceeds $20,000;
"**Cash Contribution**" means money, which is not a loan, that is immediately available for use for the Activities;
"**Chief Executive Officer**" means the person appointed as the Chief Executive Officer of the CRC (whether known as Chief Executive Officer or another title such as director or manager);
"**Commercialise**" or "**Commercialisation**", in relation to Intellectual Property, means to manufacture, sell, hire or otherwise exploit a product or process, or to provide a service, incorporating that Intellectual Property, or to license any third party to do any of those things, or to otherwise license or assign the Intellectual Property;
"**Committee**" means the Cooperative Research Centres Committee appointed by the Commonwealth for purposes of the CRC Programme;
"**Commonwealth Confidential Information**" means information that:

(a) is described in Schedule 6 [Commonwealth Confidential Information];

(b) the Commonwealth identifies, by notice in writing to the Company after the date of this Contract, as confidential information for the purposes of this Contract; or

(c) the Company and Participants know or ought to know is confidential;

"**Commonwealth Funding**" means the financial assistance to be provided by the Commonwealth as specified in Schedule 2 for expenditure on the Activities;
"**Company**" means the Company referred to in Recital E established to govern the CRC and manage the Activities of the CRC, and participate in the CRC, in accordance with the Participants Agreement and this Contract;
"**Company Confidential Information**" means information that:

(a) is described in Schedule 7 [Company Confidential Information];

(b) the Company identifies, by notice to the Commonwealth after the date of this Contract, as confidential information for the purposes of this Contract and which the Commonwealth accepts as confidential information by notice to the Company;

"**Conflict**" means a conflict of interest, or an apparent or potential conflict of

interest, arising through the Company or Participants or Supporting Participants engaging in any activity that is likely to interfere with or restrict them in meeting their obligations under this Contract fairly and independently;
"**Contact Officer**" means the person nominated by the Company for the purposes of clause 9, as set out in Schedule 4;
"**Contract**" means this agreement including the Schedules and any attachments to them;
"**Contract Material**" means all material brought or required to be brought into existence as part of, or for the purpose of performing the Contract including, but not limited to, documents, equipment, information and data stored by any means;
"**Contract Period**" means the term of the contract specified in clause 2.1;
"**Contributions**" means the Participant Contributions and the Supporting Participant Contributions;
"**Constitution**" means the Constitution of the Company;
"**Cooperative Research Centre (CRC)**" means the Cooperative Research Centre referred to in Recital C and managed and governed in accordance with clause 4 [Management, Governance and Activities of CRC];
"**CRC Indicia**" means "CRC", "Cooperative Research Centre" and the logo as specified by the Commonwealth from time to time;
"**CRC Title**" means the name of the CRC specified in Recital C;
"**Delegate**" means the person for the time being exercising the authority to sign the Commonwealth Agreement or variations thereto on behalf of the Commonwealth;
"**Department**" means the Commonwealth department or agency, and its successors, that administers the CRC Programme;
"**Financial Year**" means a period of 12 months ending on 30 June each year, or where the context necessitates a part of such period;
"**Funding Period**" means the period specified in Schedule 2;
"**Governing Board**" means the board of directors of the Company;
"**Guideline**" means a CRC Programme Guideline published by the Commonwealth from time to time;
"**Head of Expenditure**" means a category of expenditure provided for in Schedule 3;
"**In-Kind Contributions**" means Contributions other than cash;

"**Intellectual Property**" includes all copyright and neighbouring rights, and all rights in relation to inventions (including patents), plant varieties, registered and unregistered trade marks, registered designs, confidential information (including trade secrets and know-how) and circuit layouts and all other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields;
"**Minister**" means the Commonwealth Minister having for the time being responsibility for the administration for the Commonwealth of the CRC Programme;
"**Objective of the CRC Programme**" means the objective stated in Recital B;
"**Other Firm Cash**" means money that is not part of the Cash Contribution, is immediately available for use for the Activities and may include donations and grants from other programmes, but does not include anticipated future earnings;
"**Participant Confidential Information**" means information that:

(a) is described in Schedule 5 [Participant Confidential Information];

(b) a Participant identifies, by notice to the Commonwealth after the date of this Contract, as confidential information for the purposes of this Contract and which the Commonwealth accepts as confidential information by notice to the Company;

"**Participant Contributions**" means the money, Assets, personnel, facilities and services to be provided by a Participant to the CRC for the Activities from its own resources and in accordance with the Budget;
"**Participants**" are those parties, other than the Company and the Commonwealth, who have signed this Contract;
"**Participants Agreement**" means the Agreement referred to in Recital E;
"**Performance measures**" means the Outcomes, Outputs, Milestones and Key Performance Indicators specified in Schedule 1;
"**Personal Information**" means information or an opinion (including information or an opinion forming part of a database), whether true or not, and whether recorded in a material form or not, about a natural person whose identity is apparent, or may reasonably be ascertained, from the information or opinion;

"**Privacy Commissioner**" means the Privacy Commissioner appointed under the *Privacy Act 1988* (Cth);

"**Qualified Accountant**" means:
(a) a person registered as a company auditor or a public accountant under a law in force in a State or Territory; or

(b) a member of the Institute of Chartered Accountants in Australia or a CPA member of the Australian Society of Certified Practising Accountants;

"**Quarter**" means a period of 3 months or part of that period ending on 31 March, 30 June, 30 September or 31 December;
"**Quarterly Report**" means a report as specified in clause 14.1 of this Contract;
"**Research Provider**" means a person or organisation whose principal activity is undertaking and providing research in or to the CRC, or any employee or agent of an organisation whose principal activity is undertaking and providing research in or to the CRC;
"**Secretary**" means a person for the time being performing the duties of the office of the Secretary to the Department and includes a person designated in writing by the Secretary to exercise any of the Secretary's powers under this Contract;
"**Shortfall**" means any difference between the Participant Contributions or Supporting Participant Contributions received by the Company during a Financial Year and the Participant Contributions or Supporting Participant Contributions which should have been received by the Company during that Financial Year as specified in Schedule 3;
"**Specified Personnel**" means the personnel specified in Schedule 1;
"**Supporting Participants**" are not parties to this Agreement but provide the Contributions to the CRC shown in Schedule 3;
"**Supporting Participant Contributions**" means the money, Assets, personnel, facilities and services to be provided by a Supporting Participant to the CRC for the Activities from its own resources in accordance with Schedule 3;
"**Tax Invoice**" has the meaning as given by the *A New Tax System (Goods and Services Tax) Act 1999* (Cth);
"**Term of the Contract**" means the period described in clause 2; and
"**Working Day**" means in relation to the doing of an act in a place, any day other than a Saturday, Sunday or public holiday in that place.

1.2 In this Contract, unless a contrary intention appears:
(a) words in the singular include the plural and vice versa;

(b) words importing a gender include the other gender;

(c) a reference in this Contract:

(i) to the Company includes the Company's legal representatives and legal assigns; and

(ii) to a Participant includes each member of the Participant and the Participant's legal representatives and legal assigns;

(d) clause headings and words in bold format are inserted for convenience only, and have no effect in limiting or extending the language of provisions;

(e) all references to dollars are Australian dollars;

(f) unless otherwise stated, a reference to legislation is to legislation of the Commonwealth, as amended from time to time;

(g) an uncertainty or ambiguity in the meaning of this Contract will not be interpreted against a party just because the party prepared the provision; and

(h) where a word or phrase is given a defined meaning, any other part of speech or other grammatical form of that word or phrase has a corresponding meaning.

1.3 The Company and Participants agree that the Commonwealth's right to take action under or pursuant to this Contract, including without limitation withholding Commonwealth Funds or terminating this Contract, for a failure by the Company or a Participant to comply with an obligation or undertaking under the Contract, is not in any way dependent on whether or not the relevant obligation or undertaking of the Company or Participant is expressed to be in favour of the Commonwealth.

1.4 In the event of any conflict between the terms and conditions contained in the clauses of this Contract and any part of the Schedules and attachments (if any) then the terms and conditions of the clauses shall take precedence.

2. TERM OF CONTRACT

2.1 This Contract commences on the latter of the date on which the last party signs the Contract or 1 July 2005. This Contract ends when the Company has completed all of its reporting obligations to the Commonwealth after the end of the Funding Period, unless earlier terminated in accordance with this Contract.

3. PAYMENT OF COMMONWEALTH FUNDING

3.1 Subject to this Contract, the Commonwealth will, during the Funding Period, pay the Commonwealth Funding to the Company, and the Company will receive the Commonwealth Funding in its own right, in the instalments, on the date, in the manner and subject to the conditions (if any) specified in Schedule 2.

3.2 The first instalment of Commonwealth Funding is payable within 28 days of all parties executing this Contract, but not before 1 July 2005, and following receipt by the Commonwealth of a valid Tax Invoice from the Company.

3.3 Each subsequent instalment of Commonwealth Funding is payable within 28 days following receipt by the Commonwealth of the Quarterly Report for the preceding Quarter in accordance with clause 14 [Reporting and Monitoring], and following receipt by the Commonwealth of a valid Tax Invoice from the Company.

3.4 In addition to the power of the Commonwealth to defer, vary or cancel payment of an instalment of Commonwealth Funding under clause 16, payment by the Commonwealth of any instalment shall be conditional upon:

(a) the making of all necessary Appropriations by Parliament;

(b) receipt of any relevant report or other document required to be provided under clause 14;

(c) compliance by the Company and Participants with this Contract; and

(d) the performance by the Company to the satisfaction of the Commonwealth of anything required to be done as a result of a periodic review or evaluation of the Activities under clause 14.

3.5 The Commonwealth may, at its discretion, pay an instalment of Commonwealth Funding notwithstanding that a condition of clauses 3.2, 3.3 or 3.4 (other than the condition in clause 3.4 (a) and the requirement for the receipt by the Commonwealth of valid Tax Invoices in clauses 3.2 and 3.3) is not met. An exercise of the Commonwealth's discretion under this clause does not constitute a waiver of any other right it may have under this Contract or at general law.

3.6 The liability of the Commonwealth to make payments to the Company or to otherwise support the Activities is limited to the amount of the Commonwealth Funding.

3.7 The total amount of Commonwealth Funding specified in Schedule 2 as identified in this Contract is inclusive of Goods and Services Tax. Goods and Services Tax is included

as part of any instalment only where the Company provides a Tax Invoice to the Commonwealth in accordance with this Contract which specifies the amount of Goods and Services Tax payable by the Company in relation to the relevant instalment.

4. MANAGEMENT, GOVERNANCE AND ACTIVITIES OF THE CRC

4.1 The Company must manage and govern the CRC under the CRC Title.

4.2 Clause 4.1 is not intended to limit the ways in which the Company may participate in the CRC.

4.3 The Company must, during the Funding Period, ensure that the Activities are carried out in accordance with the Contract.

4.4 The Company and Participants must not agree to any changes in the Participants to the Participants Agreement without the prior written approval of the Commonwealth.

4.5 The Chairperson of the Governing Board of the Company must be independent of the Participants and Supporting Participants and the management of the CRC and free of any business or other relationship that could materially interfere, or could reasonably be perceived to materially interfere with, the exercise of their unfettered and independent judgement.

4.6 The Governing Board of the Company must be comprised of a majority of members independent of the Research Providers.

4.7 The Chairperson of the Company and the Chief Executive Officer of the Company must not be the same individual.

4.8 The Company must notify the Commonwealth, within 10 Working Days, of any change in the membership of the Governing Board or to its Chief Executive Officer.

4.9 The Company must notify the Commonwealth, immediately of becoming aware, of any circumstances that are likely to affect adversely the Company's ability to comply with the terms of the Contract, in particular its solvency or ability to ensure that the Activities are carried out in accordance with the Contract.

4.10 The Company must provide the Commonwealth with a copy of any amendment or variation to the Participants Agreement within 10 Working Days of the changes. Nothing in this clause affects the Company's obligations under clause 4.4.

5. CONTRIBUTIONS

5.1 Each Financial Year, a Participant must provide to the Company from its own resources its Participant Contributions specified in Schedule 3 for that Financial Year, at such times and in such a manner as required by the Company or otherwise specified in the Participants Agreement.

5.2 Each Financial Year, the Company must procure from each Supporting Participant its Supporting Participant Contributions and Other Firm Cash specified in Schedule 3 for that Financial Year.

5.3 Where by the end of a Financial Year, a Participant has not provided to the Company its Participant Contributions or the Company has not procured from a Supporting Participant its Supporting Participant Contributions specified in Schedule 3 for that Financial Year, the Commonwealth may, subject to clause 5.4, by notice:

(a) require the Company to make up the Shortfall within the period specified in the notice; or

(b) if the Company does not make up the Shortfall within the period specified in the notice in clause 5.3(a), require the Participants to make up the Shortfall to the Company within the period specified in the notice.

The Participants' obligation under clause 5.3(b) is a joint liability. Nothing in this clause affects the Company's or Participants' obligations under clauses 5.1 and 5.2 or the Commonwealth's rights under clause 16.

5.4 The Commonwealth may not issue a notice under clause 5.3 unless the Shortfall exceeds:

(a) $200,000 or 10% of the annual Cash Contributions specified in Schedule 3 for that Financial Year, whichever is the greater, or

(b) $200,000 or 10% of the non-staff In-Kind Contributions specified in Schedule 3 for that Financial Year, whichever is the greater, or

(c) 10% of the staff in-kind full time equivalents specified in Schedule 3 for that Financial Year.

Nothing in this clause affects the Commonwealth's rights under clause 16 in the event of breach of clause 5.1 and 5.2.

5.5 Where any of the Participant Contributions are to be made by a party to this Contract which is an Agency as defined by the *Financial Management and Accountability Act 1997* (Cth), that Agency warrants that it has obtained any relevant expenditure approval for its Cash Contributions made under this Contract, including any relevant approval in writing from the Finance Minister or his delegate as required under Regulation 10 of the Financial Management and Accountability Regulations (Cth). In the event this clause is not complied with, the Company and Participants acknowledge they have no rights against the Commonwealth under this Contract or otherwise.

6. APPLICATION OF COMMONWEALTH FUNDING AND CONTRIBUTIONS

6.1 The Company must use the Commonwealth Funding and the Contributions only for the Activities and in accordance with the Budget in Schedule 3.

6.2 Without limiting clause 6.1, the Company must not use the Commonwealth Funding:

(a) for any expenditure for which the CRC is otherwise being funded by the Australian Government;

(b) to reimburse Participants or Supporting Participants for In-Kind Contributions;

(c) to pay post-graduate student stipends so as to exceed the maximum stipend range normally offered by the Australian Research Council or the National Health and Medical Research Council for students covered by the National Health and Medical Research Council research fields;

(d) for Capital Item expenditure not listed in Schedule 3; and

(e) for research conducted overseas.

6.3 If, at any time, the Commonwealth is of the view that the Company has expended an amount of Commonwealth Funding other than in accordance with clauses 6.1 and 6.2 of this Contract (the "Improperly Expended Amount"), the

Commonwealth may by notice in writing to the Company, at its sole and unfettered discretion:

(a) withhold any further payment of Commonwealth Funding; or

(b) reduce the amount of Commonwealth Funding by the Improperly Expended Amount;

(c) require repayment by the Company of the Improperly Expended Amount specified in the notice to the Commonwealth within the period specified in the notice (such amount being a debt due to the Commonwealth without further proof of the debt by the Commonwealth); or

(d) exercise any other right it may have under this Contract including termination of the Contract under clause 16.

6.4 The Company must comply with any notice issued by the Commonwealth under clause 6.3(c) within the period specified in the notice (provided such period allows the Company at least 5 Working Days to comply).

6.5 A Capital Item acquired in breach of clauses 6.1 or 6.2 shall become the property of the Commonwealth on acquisition.

7. OTHER FINANCIAL ASSISTANCE

7.1 During the Funding Period, the Company may accept financial or other assistance otherwise than as provided in this Contract, provided such assistance does not affect adversely the extent to which the CRC can achieve the Activities specified in Schedule 1.

8. ACCOUNTING FOR COMMONWEALTH FUNDING AND CONTRIBUTIONS

8.1 The Company must ensure that:

(a) proper accounting standards and controls are exercised in respect of the Commonwealth Funding and the Contributions; and

(b) income and expenditure in relation to the Activities are recorded separately from other transactions of the Company.

8.2 The Company must establish an account (the Account) in the name of the CRC for purposes of the Activities.

8.3 The Company must ensure that:

(a) any money forming part of the Commonwealth Funding is deposited in the Account;

(b) any money forming part of the Contributions is deposited in the Account;

(c) all drawings on the Account are used for the Activities and not for any other purpose; and

(d) any interest on the balance of the Account is credited to the Account.

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9. LIAISON

9.1 The Company shall liaise with and report to the Commonwealth as reasonably required by the Commonwealth during the period of this Contract.

9.2 The Company agrees that the Contact Officer specified in Schedule 4 has the authority to receive and sign notices and written communications for the Company under this Contract.

10. INTELLECTUAL PROPERTY

10.1 Subject to clause 10.2, Intellectual Property in the Contract Material does not vest in the Commonwealth.

10.2 The Company grants to the Commonwealth a permanent, irrevocable, royalty-free, non-exclusive licence to use and reproduce any reports provided by the Company to the Commonwealth under this Contract, including but not limited to, the reports provided under clause 14 of this Contract.

10.3 The Company shall at all times during the Funding Period have in place documented procedures to ensure that, before any Contract Material is published or disclosed to any person other than the Commonwealth, a Participant or the Company, consideration is given to the potential prejudice to the subsistence or Commercialisation of any Intellectual Property in that material, including the possibility that publication or disclosure might preclude the grant of a patent or cause the loss of Intellectual Property.

10.4 The Company must use its best endeavours to ensure that any Intellectual Property in Contract Material is commercialised or otherwise utilised. Any Commercialisation or utilisation of the Intellectual Property in Contract Material must maximise the national benefits accruing to Australia, including Australian industry, the Australian environment and the Australian economy generally. The use and exploitation of such Intellectual Property must be consistent with the Objective of the CRC Programme. The maximum national benefits accruing to Australia will be deemed to have been delivered where the Intellectual Property in Contract Material is commercialised or otherwise made available in a way that results in industry expansion or activity within Australia. Where there are no opportunities for Commercialisation within Australia and the Commercialisation of the Intellectual Property occurs in a country other than Australia, the Intellectual Property must be Commercialised in such a way that substantial national benefits will accrue to Australia.

10.5 The Company must ensure that any Commercialisation or utilisation of Intellectual Property, including by any third party, is undertaken in accordance with the Activities and the Commercialisation and Utilisation Plan described in Schedule 1.

10.6 If at any time, the Commonwealth is of the reasonable view that the Company, including by any third party, is not Commercialising or utilising the Intellectual Property as contemplated by clause 10.4 and in accordance with the Activities and

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Commercialisation and Utilisation Plan in Schedule 1, the Commonwealth may, by notice at its sole and unfettered discretion:

(a) withhold any further payment of Commonwealth Funding;

(b) reduce the amount of Commonwealth Funding;

(c) require the Company to repay some or all of the Commonwealth Funding (such amount being determined by the Commonwealth at its sole and unfettered

discretion and being a debt due to the Commonwealth without further proof of the debt); or

(d) exercise any other right it may have under this contract including termination of this Contract under clause 16.

11. PUBLICATIONS, PUBLICITY AND USE OF CRC INDICIA

11.1 The Company and Participants acknowledge that the Commonwealth owns all rights to the CRC Indicia.

11.2 The Commonwealth grants the Company a non-exclusive licence to use the CRC Indicia (including a right to sublicense to the Participants), during the Funding Period, subject to any reasonable conditions required by the Commonwealth.

11.3 Unless otherwise agreed in writing with the Commonwealth, during the Funding Period the Company must ensure that all publications and publicity by the CRC use the CRC Indicia prominently, and in a manner consistent with the Objective of the CRC Programme.

11.4 On the expiration or termination of this Contract, the Company and Participants must cease using the CRC Indicia, unless otherwise agreed in writing with the Commonwealth.

11.5 Both during and after the Funding Period the Company must ensure that all publications (including, without limitation, reprints) and publicity relating to the Activities of the CRC, whether published by the Company or other persons:

(a) contain an acknowledgment as is required by the Commonwealth, from time to time, of the funding of the Activities of the CRC by the Australian Government; and

(b) refer to the CRC Programme.

11.6 The Company shall be liable for the performance of its own, and the Participant's, obligations under clause 11.4.

11.7 The Participants shall be severally liable for the performance of their obligations under clause 11.4.

12. CONFLICT OF INTEREST

12.1 The Company and Participants warrant that to the best of their knowledge after making diligent enquiries, at the date of signing this Contract, no Conflict exists or is likely to arise in the performance of their obligations under this Contract.

12.2 If, during the Funding Period, a Conflict or apparent or potential Conflict arises or is likely to arise in relation to a Participant, that Participant must:

(a) notify the Company in writing of that Conflict and of the steps the Participant proposes to take to resolve or otherwise deal with the Conflict;

(b) make full disclosure to the Company of all relevant information relating to the Conflict; and

(c) take such steps as the Company or Commonwealth, if the Commonwealth chooses to, reasonably requires to resolve or otherwise deal with that Conflict.

12.3 If, during the Funding Period, a Conflict or apparent or potential Conflict arises, or is likely to arise in relation to the Company, or a Participant has notified the Company in accordance with clause 12.2, the Company must:

(a) notify the Commonwealth in writing of that Conflict and of the steps the Company proposes to take to resolve or otherwise deal with the Conflict;

(b) make full disclosure to the Commonwealth of all relevant information relating to the Conflict; and

(c) take such steps as the Commonwealth, if the Commonwealth chooses to, reasonably requires to resolve or otherwise deal with that Conflict.

12.4 If the Company fails to notify the Commonwealth under this clause 12, or the Company or Participants are unable or unwilling to resolve or deal with the Conflict as required, the Commonwealth may terminate this contract under clause 16.

13. CONFIDENTIAL INFORMATION

13.1 Subject to clause 13.5:

(a) the Company and Participants must not, without the prior written approval of the Commonwealth, disclose any Commonwealth Confidential Information to a third party;

(b) the Commonwealth must not, without the prior written approval of a Participant, disclose any Participant Confidential Information to a third party; and

(c) the Commonwealth must not, without the prior written approval of the Company disclose any Company Confidential Information to a third party.

13.2 In giving written approval to disclosure, a party may impose conditions as it thinks fit, and the other party agrees to comply with the conditions.

13.3 The Commonwealth may at any time require the Company to arrange for any person engaged in, or in relation to, the performance or management of this Contract to give written undertakings, in a form required by the Commonwealth, relating to the non-disclosure of Commonwealth Confidential Information.

13.4 If the Company receives a request under clause 13.3, it must promptly arrange for all undertakings to be given.

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13.5 The obligations on the parties under this clause will not be taken to have been breached if information:

(a) is disclosed by the Commonwealth to the responsible Minister;

(b) is disclosed by the Commonwealth, in response to a request by a House or a Committee of the Parliament of the Commonwealth of Australia;

(c) is authorised or required by law to be disclosed; and

(d) is in the public domain otherwise than due to a breach of this clause.

13.6 Nothing in this clause limits the Company's and Participants obligations under clause 31 [Privacy] or clause 22 [Access to Premises and Records].

14. REPORTING AND MONITORING

Quarterly Report

14.1 During the Funding Period, the Company must, within one month after the end of each Quarter, complete and forward to the Commonwealth a report (Quarterly Report) incorporating:

(a) a report in respect of that Quarter indicating the sources of all cash funding of the Activities of the CRC, and the application of that cash funding to each Head of Expenditure; and

(b) a declaration by the Company certifying the correctness of the particulars provided under paragraph (a) and including a statement that the Commonwealth Funding has been expended only for the Activities and in accordance with Schedule 3 and otherwise in accordance with this Contract.

Annual Report, Termination and Wind-up Reports

14.2 The Company must prepare and forward to the Commonwealth a comprehensive and detailed report in accordance with clause 14.3, within 3 months of:

(a) the end of each Financial Year during the Contract Period; and

(b) if the contract is terminated under clause 16 [Deferral of Instalments and Termination], the date of termination; and

(c) if the CRC is wound up, on the winding-up of the CRC.

14.3 Reports prepared in accordance with clause 14.2 must:

Report on the Activities

(i) identify progress in the Activities including how the Company has met, or progressed toward meeting, the outcomes and outputs specified in

Schedule 1 in relation to the milestones and other performance measures specified; and

(ii) include information about the Commercialisation and utilisation of any of the Intellectual Property in Contract Material (including any prospective use or Commercialisation of Intellectual Property) identifying how such use and Commercialisation is consistent with the Commercialisation and Utilisation Plan in Schedule 1 and identifying progress in the delivery of national benefits as specified in Schedule 1.

Financial Report on the Account:

(iii) include an accrual accounting report on revenues, expenses, assets, liabilities and cash flows of the Account.

Report on Cash Contributions:

(iv) include a report on the amount of cash contributions from each Participant and Supporting Participant.

Report on In-kind contributions

(v) include a report on staff and non-staff in-kind contributions provided by each Participant and Supporting Participant.

Financial report on the Company

(vi) include an audited statement of the Financial Position of the Company.

Audit

(vii) include a statement by a Qualified Accountant, that the reports specified under this clause 14.3 (iii), (iv), (v) present fairly that the Commonwealth Funding and the Contributions have been expended solely for the Activities and in accordance with Schedule 3 of this Contract and Australian accounting concepts and applicable Australian Standards; and that all CRC transactions have been conducted through the Account.

The Qualified Accountant must be independent of the Company, Participants and Supporting Participants and the management of the CRC and free of any business or other relationship that could materially interfere with the exercise of their judgment.

CONTENT AND FORMAT OF REPORTS

14.4 The Commonwealth may issue a direction in writing to the Company in respect of a report or reports the Company is required to provide under clause 14 specifying:

(i) a format for the report (or for part of the report); and

(ii) information the Company is to include in the report (or part of the report); and

(iii) the person or persons who is to certify that information contained in a report (or part of a report) is accurate.

14.5 For the purposes of clause 14.4 the Commonwealth will be taken to have issued a direction in writing concerning a matter referred to in 14.4 if it includes that information in the Guidelines or any similar document and that document is available to the Company.

14.6 Subject to clause 14.7, the Company must comply with any direction issued by the Commonwealth under clause 14.4 or which the Commonwealth is taken to have issued under clause 14.5.

14.7 The Company need not comply with a direction issued by the Commonwealth under clause 14.4 (or taken to have been issued under clause 14.5) in respect of a report, where the Commonwealth issues the direction (or in the case of clause 14.5 makes the relevant information available to the Company) less than 20 Working Days before the relevant report is due to the Commonwealth.

14.8 The Company must provide to the Commonwealth such other information about the operation of the CRC, its performance and the expenditure and management of the Commonwealth Funding and Contributions by the Company at such times and in such form as is reasonably required by written notice from the Commonwealth to the Company from time to time.

14.9 If any of the reports provided to the Commonwealth under this clause 14 are not provided within the time required by this clause or within the time required by notice under clause 14.8 or do not meet to the satisfaction of the Commonwealth the requirements of clause 14 or the Guidelines, the Commonwealth may exercise its rights under clause 16.

Reviews, Evaluations and Surveys

14.10 The Company must, at its own cost, assist the Commonwealth with and participate in:

(a) reviews of the performance of the CRC;

(b) reviews related to performance of the CRC Programme; and

(c) surveys, questionnaires and other evaluation procedures related to the performance, outputs and outcomes of the CRC or the CRC Programme;

within the timeframes and in the manner as required by the Commonwealth by written notice issued by the Commonwealth from time to time.

14.11 The Company must, at its own cost, in performing its obligations under clause 14.10, adhere to any directions of the Commonwealth concerning how reviews, surveys and questionnaires or other evaluation procedures are to be conducted and any other relevant matters.

Cooperation and Provision of Information

14.12 For the purposes of clause 14, each Participant must cooperate with and provide to the Company any information about the Participants Contributions and Activities reasonably required by the Company to comply with the Company's obligations under these clauses.

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15. SPECIFIED PERSONNEL

15.1 The Company is responsible for ensuring that the Specified Personnel as nominated in Schedule 1 perform the functions in respect of the Activities as described in Schedule 1. The Company may replace the Specified Personnel nominated in Schedule 1 during the term of the Contract without notification to or the approval of the Commonwealth providing the Company ensures that any such replacement personnel have the time commitment, qualifications and competency to undertake the Activities to the standard required by the Contract and are similar to those of the Specified Personnel nominated in Schedule 1 they are replacing.

16. DEFERRAL OR VARIATION OF INSTALMENTS AND TERMINATION

16.1 The Commonwealth may immediately exercise its rights under clause 16.2 by giving notice to the Company if:

(a) the Commonwealth is satisfied that any statement in the application for Commonwealth Funding by the Participants and Supporting Participants is incorrect, incomplete, false or misleading in a way which may have affected:

(i) the original decision to approve the Commonwealth Funding;

(ii) the terms and conditions of this Contract; or

(iii) action taken by the Commonwealth under this Contract;

(b) the Company or a Participant fails to fulfil, or is in breach of any of its obligations under this Contract, and where the Company or the Participant does not rectify the omission or breach within 10 Working Days of receiving a notice in writing from the Commonwealth to do so;

(c) the Commonwealth is of the reasonable opinion that the Company is unable or unlikely to meet its obligations under this Contract;

(d) the Company or Participants, as the case may be, are in breach of clauses 5.1 or 5.2;

(e) the Commonwealth has issued a notice under clause 5.3 and the notice has not been complied with;

(f) the Company fails to comply with a statutory demand within the meaning of section 459F of the *Corporations Act 2001*;

(g) proceedings are initiated to obtain an order for the Company to be wound-up or any shareholder, member or director convenes a meeting to consider a resolution for the Company to be wound-up;

(h) the Company comes under one of the forms of external administration referred to in Chapter 5 of the *Corporations Act 2001* or equivalent provisions in other legislation, or an order has been made to place the Company in external administration; or

(i) notice is served on the Company or proceedings are taken to cancel the Company's registration or to dissolve the Company as a legal entity.

16.2 The Commonwealth may, by notice given under clause 16.1, at its sole and unfettered discretion and without prejudice to any other right the Commonwealth may have with this Contract or otherwise at law, either:

(a) defer, vary or cancel any further payment of Commonwealth Funding; or

(b) terminate this Contract.

16.3 Where the CRC is granted funding under the CRC Programme for the establishment of a new from existing CRC as referred to in the Guidelines, the Commonwealth may terminate this Contract from the day before the commencement of the last Financial Year specified in Schedule 2.

16.4 Without in any way limiting the Commonwealth's rights to otherwise recover monies or obtain damages upon termination of the Contract, where the Contract is terminated pursuant to clauses 16.2 or 16.3 the Company:

(a) may, unless otherwise notified by the Commonwealth in writing, draw from the Account moneys necessary to meet commitments properly made prior to the termination of this Contract;

(b) must not incur any new commitments of expenditure from the Account unless they will be satisfied entirely from the funds that will remain in the Account after the Company has complied with paragraph (c); and

(c) must within 3 months of termination of the Contract pay to the Commonwealth a proportion of the funds remaining in the Account after all commitments properly made prior to the termination of this Contract have been met, such amount being a debt due to the Commonwealth without further proof of the debt by the Commonwealth.

16.5 The proportion referred to in clause 16.4(c) shall be the proportion that the Commonwealth Funding paid by the Commonwealth during the Funding Period bears to the total of the deposits made into the Account during the Funding Period.

16.6 A commitment referred to in clause 16.4 shall be deemed not to have been properly made if:

(a) it was made in breach of clause 6 [Application of Commonwealth Funding and Contributions]; or

(b) the resultant expenditure is likely to occur more than 3 months after the termination of this Contract.

16.7 Notwithstanding any of the provisions of clause 16, upon the written request of the Company the Commonwealth may, at its absolute discretion, permit the funds that would otherwise be required to be paid to the Commonwealth in accordance with clause 16.4(c) to be retained by the Company to be used in accordance with a purpose agreed by the Commonwealth and permitted under the terms of this Contract.

16.8 If the Commonwealth agrees to a request by the Company under clause 16.7 and funds so retained by the Company under clause 16.4 are not fully used for the purpose agreed to by the Commonwealth within any timeframe for such use specified by the

Commonwealth, or are used for a purpose not permitted by the Commonwealth, the Company must pay immediately to the Commonwealth the portion of those funds that are not used in accordance with the agreed purpose, such amount being a debt to the Commonwealth without further proof of the debt by the Commonwealth.

17. EFFECT OF EXPIRATION OR TERMINATION OF CONTRACT

17.1 On the expiration or termination of this Contract, the Company and the Participants must do all things reasonably required by the Commonwealth (including the execution of documents) to ensure an orderly winding up of the Activities, or in the case of termination under clause 16.3, ensure orderly transition to the New from Existing CRC.

17.2 The Company must, at least 12 months prior to the expiration of this Contract, submit a detailed and comprehensive wind-up plan for the CRC (Wind-up Plan) to the Commonwealth for its approval. The Wind-up Plan must be consistent with this Contract and any written directions or guidelines notified to the Company by the Commonwealth.

17.3 The Company must ensure the implementation of the Wind-up Plan and the submission of the wind-up report specified in clause 14.2.

17.4 The Company must take any actions required under the *Corporations Act 2001* in relation to the wind-up of the CRC.

17.5 The Company must amend the Wind-up Plan in accordance with any notice given by the Commonwealth requiring amendment and within the time period specified in the notice.

18. ASSIGNMENT AND SUB-CONTRACTING

18.1 The Company or Participants must not assign any of their rights under this Contract without the prior written consent of the Commonwealth.

18.2 The Company must not, without the prior written approval of the Commonwealth, sub-contract the performance of any part of its obligations under this Contract.

18.3 A Participant must not, without the prior written approval of the Commonwealth, sub-contract any part of its obligations under this contract, including the Activities specified in Schedule 1.

19. RELATIONSHIP WITH COMMONWEALTH

19.1 The Company and Participants must not, by virtue of this Contract, be or for any purpose be deemed to be an employee, partner or agent of the Commonwealth.

19.2 The Company and Participants must not represent themselves, and must ensure that their employees, partners, agents or sub-contractors do not represent themselves, as being the Commonwealth's employees, partners or agents.

20. INSURANCE

20.1 The Company and each Participant must for as long as any obligations remain in connection with this Contract have the following insurance:

(a) workers' compensation insurance as required by law; and

(b) adequate insurance to cover loss or damage the Company or the Participant may suffer or cause in connection with its participation in the CRC.

20.2 When requested, the Company and each Participant must provide the Commonwealth, within 10 Working Days of the request, with evidence satisfactory to the Commonwealth that they have complied with their obligation to insure.

21 INDEMNITY

21.1 In this clause 21 an "Indemnifying Party" means any party to this Contract other than the Commonwealth.

21.2 Except as provided in clause 21.3, each Indemnifying Party separately (and not jointly, nor jointly and separately with any other Indemnifying Party) agrees to indemnify the Commonwealth, its offices, employees and agents (including members of the Committee and its Appraisal Panel) against any:

(a) loss or liability incurred by the Commonwealth:

(b) loss or damage to Commonwealth property; or

(c) loss or expense incurred by the Commonwealth in dealing with any claim against the Commonwealth, including legal costs and expenses on a solicitor/own client

basis and the cost of time spent, resources used, or disbursements paid by the Commonwealth;

arising from:

(i) any act or omission by the Indemnifying Party or any of its employees, agents or subcontractors in connection with this contract, where there was a fault on the part of the person whose conduct gave rise to that liability, loss, damage, or expense;

(ii) any breach by the Indemnifying Party or any of its employees, agents, or subcontractors of obligations or warranties under this Contract;

(iii) any use or disclosure by the Indemnifying Party, its employees, agents or subcontractors of Personal Information held or controlled in connection with this Contract; or

(iv) the use by the Commonwealth of Contract Material, for which it has a licence (including any claims by third parties about the ownership or right to use Intellectual Property rights, including moral rights in that Contract Material).

21.3 Only the Company is liable to indemnify the Commonwealth under clause 21.2 (iv).

21.4 The liability of any Indemnifying Party under this clause 21 will be reduced proportionally to the extent that any fault on the part of the Commonwealth or any other Indemnifying Party contributed to the relevant loss, damage, expense, or liability.

21.5 The right of the Commonwealth to be indemnified under this clause 21 is in addition to, and not exclusive of, any other right, power, or remedy provided by

law, but the Commonwealth is not entitled to be compensated in excess of the amount of the relevant loss, damage, expense or liability.

21.6 In this clause 21, “fault” means any negligent or unlawful act or omission or wilful misconduct.

21.7 Each Indemnifying Party warrants and acknowledges that in entering into any arrangement or contract associated with the CRC they have relied upon their own independent legal advice and in particular (but without limitation) releases the Commonwealth from all liability which might arise from the use of any template agreements made available by the Commonwealth or by third parties.

22. ACCESS TO PREMISES AND RECORDS

22.1 The Company and Participants must at all reasonable times give the Auditor-General, the Privacy Commissioner, the Delegate, a member of the National Investigations Unit in the Department on production of photo identification, or any person authorised in writing by the Secretary:

(a) reasonable access to:

(i) employees of the Company or a Participant;

(ii) premises occupied by the Company or a Participant;

(iii) Contract Material; and

(b) reasonable assistance to:

(i) inspect the performance of the CRC;

(ii) to locate and inspect Contract Material;

(iii) to make copies of Contract Material and remove those copies,

relevant to the operations of the CRC.

22.2 The rights referred to in clause 22.1 are subject to:

(a) the provision of reasonable prior notice to the Company or Participant; and

(b) reasonable security procedures of the Company or a Participant.

22.3 If a matter is being investigated which, in the opinion of a member of the National Investigations Unit in the Department, or any person authorised in writing by the Secretary, may involve an actual or apprehended breach of the law, clause 22.2(a) will not apply.

22.4 The requirement for access specified in clause 22.1 does not in any way reduce the responsibility of the Company and Participants to perform their obligations under this Contract.

22.5 The Company must ensure that any sub-contract entered into by it for the purpose of this Contract contains an equivalent clause granting the rights specified in this clause.

23. COMPLIANCE WITH LAW

23.1 The Company and each Participant shall in carrying out this Contract comply with the provisions of any relevant statutes, regulations, by-laws, and requirements of any Commonwealth, State, Territory or local authority.

23.2 The Company and each Participant acknowledges that:

(a) Chapter 7 of the Criminal Code provides for offences which attract substantial penalties, including theft of Commonwealth property and other property offences, obtaining property or financial advantage by deception, offences involving fraudulent conduct, bribery, forgery and falsification of documents;

(b) they are aware that giving false or misleading information is a serious offence under the Criminal Code;

(c) the publication or communication of any fact or document by a person which has come to their knowledge or into their possession or custody by virtue of the performance of this Contract (other than a person to whom the Company or Participants is authorised to publish or disclose that fact or document) may be an offence under section 70 of the *Crimes Act 1914*, punishment for which may be a maximum of two years imprisonment;

(d) in respect of data, including personal information, held in connection with this Contract, any unauthorised and intentional access, destruction, alteration, addition or impediment to access or usefulness of the data stored in any computer in the course of performing this Contract is an offence under Part 10.7 of the Criminal Code which may attract a substantial penalty, including imprisonment;

(e) they are aware of the provisions of section 79 of the *Crimes Act 1914* relating to official secrets and;

(f) they are aware of its obligations under the *Charter of The United Nations Act 1945* (Cth) and the Charter of United Nations (Anti-Terrorism Measures) Regulations 2002.

Note: more information about the Charter of the United Nations Act 1945 (Cth) and the Charter of United Nations (Anti-Terrorism Measures) Regulations 2002 is available at www.dfat.gov.au.

23.3 The Company and Participants undertake with respect to any officer, employee, agent or subcontractor who will have access to documents, materials or information within the meaning of section 79 of the *Crimes Act 1914* that prior to having access the officer, employee, agent and subcontractor will first be required by the Company to provide the Company with an acknowledgment that the officer, employee, agent or subcontractor is aware of the provisions of the section.

23.4 The Company and Participants must comply with its obligations, if any, under the *Equal Opportunity for Women in the Workplace Act 1999*.

Note: Information about the Act can be obtained from the Equal Opportunity for Women in the Workplace Agency.

23.5 The Company and each Participant respectively shall, in its dealings with its employees, have due regard to Commonwealth policies on employment, including the *Workplace Relations Act 1996*, and obligations under relevant occupational health and safety laws.

24. BIOLOGICAL AND RADIATION SAFEGUARDS

24.1 When research in Australia is conducted pursuant to the Activities on or involving humans or animals, the Company and Participants must ensure that such research complies with all relevant ethics codes and guidelines adopted by the National Health and Medical Research Council, the Office of the Gene Technology Regulator and all other relevant regulatory agencies operating in Australia and any place in which the research is being conducted, being codes and guidelines in force from time to time during the Term of the Contract, including requirements to obtain prior approval in writing (including from any relevant ethics committee) that the research to be undertaken is so compliant, are observed.

24.2 The Company must nominate to the Commonwealth one or several higher education institution(s) or Commonwealth or State research organisation(s) with a relevant ethics committee constituted in accordance with the codes and guidelines referred to in

clause 24.1, to oversee all ethical clearances which may be required under those codes and guidelines. The Company must notify the Commonwealth of the nomination(s) within 20 Working Days of signing this contract and within 20 Working Days of any changes to the nomination.

24.3 When conducting research in Australia pursuant to the Activities which involves the use of ionising radiation, the Company must ensure that persons performing procedures involving ionising radiation are appropriately trained and hold a relevant current licence from the appropriate State authority.

24.4 Whenever reasonably required by the Commonwealth, the Company must furnish to the Commonwealth written evidence of compliance with the requirements of this clause.

25. WAIVER

25.1 A waiver by any party in respect of any breach of a condition or provision of this Contract shall not be deemed to be a waiver in respect of any continuing or subsequent breach of that provision, or breach of any other provision. The failure of any party to enforce at any time any of the provisions of this Contract shall in no way be interpreted as a waiver of such provision.

26. ENTIRE AGREEMENT AND VARIATION

26.1 This Contract records the entire agreement between the parties in relation to its subject matter.

26.2 Subject to clause 15.1, except for action the Commonwealth is expressly authorised to take elsewhere in this Contract, no variation of this Contract is binding unless it is agreed in writing and signed by the parties.

26.3 If a court or tribunal says any provision of this Contract has no effect or interprets a provision to reduce an obligation or right, this does not invalidate, or restrict the operation of, any other provision.

27. APPLICABLE LAW

27.1 The laws in the Australian Capital Territory apply to the interpretation of this Contract.

27.2 The Parties agree to submit to the non-exclusive jurisdiction of the courts of the Australian Capital Territory in respect to any dispute under the Contract.

28. NOTICES

28.1 Any party giving notice under this Contract must do so in writing or by electronic communication:

(a) if given by the Company, marked for the attention of:

The Delegate
Cooperative Research Centres Programme
Location 320
Department of Education, Science and Training
16 Mort Street
CANBERRA ACT 2601
Postal Address
Location 320
GPO Box 9880
CANBERRA ACT 2601
Facsimile: 02 62409096
Email: crc.program@dest.gov.au

or at any other address specified in writing by the Commonwealth from time to time.

(b) if given by the Commonwealth marked to the attention of the Contact Officer specified in Schedule 4; and

hand delivered or sent by pre-paid post or electronic communication to the address specified in Schedule 4.

28.2 A notice given under clause 28.1 is taken to be received:

(a) if hand delivered, on delivery;

(b) if sent by pre-paid post, 5 Working Days after the date of posting; or

(c) if sent by electronic communication, at the time that would be the time of receipt under the *Electronic Transactions Act 1999* if a notice was being given under a law of the Commonwealth.

28.3 The Company must advise any Participants named in a notice or affected by it of the receipt of a notice.

28.4 The Participants acknowledge any notice received by the Contact Officer is received by the Participant named in the notice at the time it is received by the Contact Officer whether or not it is actually received by the Participant.

29. DISPUTE RESOLUTION

29.1 Subject to clause 29.3, the parties agree not to commence any legal proceedings in respect of any dispute arising under this Contract, which cannot be resolved by informal discussion, until the procedure provided by this clause 29 has been used.

29.2 The parties agree that any dispute arising during the Funding Period is dealt with as follows:

(a) the party claiming that there is a dispute will send the other party a written notice setting out the nature of the dispute;

(b) the parties will try to resolve the dispute through direct negotiation by persons who they have given the authority to resolve the dispute;

(c) the parties have 10 Working Days from the receipt of the notice to reach a resolution or to agree that the dispute is to be submitted to mediation or some alternative dispute resolution procedure; and

if:

(i) there is no resolution of the dispute;

(ii) there is no agreement on submission of the dispute to mediation or some alternative dispute resolution procedure; or

(iii) there is a submission to mediation or some alternative dispute resolution procedure, but there is no resolution within 15 Working Days of the submission, or extended time as the parties may agree in writing before the expiration of the 15 Working Days;

then, either party may commence legal proceedings.

29.3 This clause 29 does not apply if:

(a) either party commences legal proceedings for urgent interlocutory relief;

(b) action is taken by the Commonwealth under clauses 5, 6, 10, 16 or 22;

(c) an authority of the Commonwealth, a State or Territory is investigating a breach or suspected breach of the law by the Company or Participants.

29.4 Despite the existence of a dispute, all parties must (unless requested in writing by the Commonwealth not to do so) continue to perform obligations under this Contract.

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30. COUNTERPARTS

30.1 This Contract may be signed by the Company and Participants in several counterparts. When signed by the Commonwealth, each signed counterpart is taken to be an original of this Contract.

31. PRIVACY

31.1 The Company and Participants agree:

(a) to comply with the Information Privacy Principles when doing any act or engaging in any practice in relation to Personal Information for the purposes of this Contract, as if it were an agency as defined in the *Privacy Act 1988* (Cth);

(b) to use Personal Information received, created or held by it for the purposes of this Deed only for the purposes of fulfilling its obligations under this Deed;

(c) not to disclose Personal Information received, created or held by it for the purposes of this Contract without the prior written approval of the Commonwealth;

(d) not to use or disclose Personal Information received, created or held by it for the purposes of this Contract to engage in a practice that would breach section 16F of the *Privacy Act*, unless the use or disclosure is necessary to meet (directly or indirectly) an obligation under this Contract;

(e) not to transfer Personal Information received, created or held by it for the purposes of this Contract outside Australia, or to allow parties outside Australia to have access to it, without the prior written approval of the Commonwealth;

(f) to co-operate with reasonable demands or inquiries made by the Federal Privacy Commissioner or the Commonwealth in relation to the management of Personal Information by it in connection with this Contract;

(g) to ensure that any person whom it allows to access Personal Information which is received, created or held by Company for the purposes of this Contract is made aware of, and undertakes in writing, to observe the Information Privacy Principles;

(h) to comply with policy guidelines laid down by the Commonwealth or issued by the Federal Privacy Commissioner from time to time relating to the handling of Personal Information;

(i) to ensure that records (as defined in the *Privacy Act*) containing Personal Information received, created or held by it for the purposes of this Contract are, at the expiration or earlier termination of the Contract, either returned to the Commonwealth or deleted or destroyed (unless otherwise required by law) in the presence of a person duly authorised by the Commonwealth to oversee such deletion or destruction;

(j) to the naming or other identification of it in reports by the Federal Privacy Commissioner;

(k) to ensure that any subcontract made by it in connection with this Contract contains enforceable obligations requiring the subcontractor to comply with the obligations in this clause, as if the subcontractor were the Company or Participant;

(l) to enforce the obligations referred to in paragraph (k) in any subcontract entered into with it, in accordance with such reasonable directions as the Commonwealth may give.

32. AGENCY FOR SIGNING CONTRACT VARIATIONS

32.1 Subject to Clause 32.2, the Participants agree that the Company is the Variation Agent for the Participants for the purpose of negotiating and executing variations to the Contract.

32.2 The Participants, except those listed in Schedule 8, agree that the Variation Agent has complete authorisation to execute a variation to this Contract so as to render the Contract as varied binding upon the Participants.

33. SURVIVAL OF CLAUSES

33.1 Termination or expiry of this Contract for any reason must not extinguish or otherwise affect:

(a) any rights of a Party against the other which:

(i) accrued prior to the time of termination or expiry; or

(ii) otherwise relate to or may arise at any future time from any breach or non-observance of obligations under this Contract which arose prior to the time of termination or expiry; and

(b) the provisions of this Contract which by their nature survive expiry or termination, including without limitation clauses 6, 10, 11, 13, 14, 16, 21, 22, 24, 25, 26 and 28.

IN WITNESS WHEREOF the parties have executed this Contract on the dates respectively set out below.

SIGNED for and on behalf of the)
)
COMMONWEALTH OF AUSTRALIA)

by its duly authorised officer)

_____ [Name of Officer])

_____ [Signature]

in the presence of)

_____ [Witness])

_____ [Date])

SIGNED FOR AND ON BEHALF OF)

_____ [Party])

by its duly authorised officer)

_____ [Name of Officer])

in the presence of)

_____ [Witness])

_____ [Date])

[or other mode of attestation prescribed in the Articles of Association]

[NB: Provide a signature block for each party. “Under Common Seal” is only necessary if the party is required to do so under its own legislation etc]

Appendix 9

Evolution of globalization

Date/Epoch	Event/comments	Authors/source
50,000 ago	The process by which our ancestors migrated and populated all the continents except Antarctica was a kind of proto-globalization	(Chanda 2002)
5,000 years ago	Globalization is described as a process that has been going for the past 5000 years (but it has significantly accelerated since the demise of the Soviet Union in 1991)	(Riggs 1998)
1379-1362 BCE[1]	The most globalizing concept in the history of religion has turned out to be monotheism, or belief in one God. It is widely agreed among secular historians that the first thoroughgoing monotheist in recorded history was an African – Pharaoh Akhenaton of Egypt of the 18th Dynasty.	(Mazrui 2000)
325 BCE	Chandragupta Maurya (from India) became a Buddhist and combined the expansive powers of a world religion, trade economy, and imperial armies for the first time, starting the process of globalization.	(Frank and Gills 2004)
1st centuries CE[2]	The expansion of Buddhism in Asia – when it made its first major appearance in China under the Han dynasty, and consolidation of cultural links across the Eurasian Steppe into India. Foundation of the Silk Road.	(Frank and Gills 2004)
313 AD[3]	The globalization of Christianity started with the conversion of Emperor Constantine I of Rome.	(Mazrui 2000)

1 BCE Indicating dates Before the Christian Era or Before the Common Era (i.e., Before the traditional birth date of Christ)

2 CE Indicating dates After the Christian Era or the Common Era (i.e., after the birth date of Christ)

3 AD – Anno Domini, Used to indicate that a date comes a specific number of years after the traditional date of Christ's birth.

650-850	The expansion of Islam to the western Mediterranean and as far as India	(Frank and Gills 2004)
960-1279	The Song Dynasty in China – and contemporary regimes in India – which produced the economic output, instruments (financial), technologies, and impetus for the medieval world economy that linked Europe and China by land and sea across Eurasia and the Indian Ocean.	(Frank and Gills 2004)
1100	The rise of Genghis Khan and the integration of overland routes across Eurasia – producing also a military revolution in technologies of war on horseback.	(Frank and Gills 2004)
1300	The creation of the Ottoman Empire spanning part of eastern Europe, North Africa, and the Middle East, and connected politically overland with Safavids and dynasties in Central Asia and India.	(Frank and Gills 2004)
1350-1500	Networks of trade which involved frequent movements of people, animals, goods, money and micro-organisms that ran from the British Isles to China, running down through France and Italy across the Mediterranean to the Levant of Egypt.	(Frank and Gills 2004)
1450	Start of the cycle of the capitalist world economy,	(Wallerstein 2000)
1492	Christopher Columbus' serendipitous landing on a Caribbean island. It was celebrated as a landmark in the history of globalization. Globalization started when Columbus travelled to the West Indies, sparking the European "Age of Exploration"	(Chanda 2002) (Johnson 2004)
1492 and 1497-8	In this author's view the origins of globalization can be traced to the events following the voyages of Christopher Columbus and Vasco da Gama, when Europeans began to exert an influence on the rest of the world Columbus and da Gama travelled west and east respectively to the Americas and the Indies, inaugurating an age of European seaborne exploration and establishment of empires.	(Spybey 1996) (Frank and Gills 2004)
1500-1600	Militarization of the sea	(Frank and Gills 2004)
1600-1800	The **Age of Mercantilism**. By the 1600s long distance trade was deeply entrenched in the production process. An expansion of commercial production and commodity trading was supported by the arrival in Asia of precious metals from the New World, which came both	(Frank and Gills 2004)

1600-1800	from the East and West. By 1700, also, competing European powers also controlled the Atlantic Economy; and products like cotton from Asia, and sugar and tobacco from the Americas, arrived in Europe as commodities traded within circuits of world capital accumulation. By 1800, the Atlantic and Indian Ocean systems were connected to one another via the flow of currencies and commodities and by the operations of the British, French, and Dutch overseas companies – all being controlled, owned, or chartered by their respective states.	
1650	Expansion of the slave trade which gave birth to integrated economic and industrial systems in the "New World" The expansion of the slave trade had a dramatic effect during the seventeenth century and it sustained the expansion of the Atlantic Economy, giving birth to integrated economic/industrial systems across the Atlantic Ocean	(Johnson 2004) (Frank and Gills 2004)
1733	Industrial Revolution began in England with the first cotton mill	(Johnson 2004)
1750-1950	The world empires of industrial capitalism are established: the formation of national economies; and the emergence of worldwide circuits of industrial and financial trade occurred.	(Frank and Gills 2004)
1776/1789	American and French Revolutions occur and the economic interests of the people are promoted and national empires expanded. The US and French Revolutions marked the creation of the modern form of the state, based on alliances between military and business interests and on popular representation in aggressively nationalist governments. The French aptly called this period "les trente glorieuses". This time coincided with the high point of US hegemony in the world system.	(Johnson 2004) (Frank and Gills 2004) (Wallerstein 2000)
1885	The Berlin Conference – "Scramble for Africa" - was held as European nations expand colonization of the African continent. Treaties of Berlin mark a diplomatic watershed in the age of modern imperial expansion by European and American overseas empires, beginning the age of "high imperialism" with the legalization of the Partition of Africa, which also marks a foundation-point for the creation of **international law**.	(Johnson 2004) (Frank and Gills 2004)

1914-1918	World War I – "The War to End All Wars" involves countries from all continents except Antarctica	(Johnson 2004)
1929	The Great Depression affects all parts of the world simultaneously, signifying growing interdependence of nation economies. The Great Depression was preceded by World War I and followed by the first really global war across the Atlantic and Pacific.	(Johnson 2004) (Frank and Gills 2004)
1939-1945	World War II, a global military conflict that, in terms of lives lost and material destruction, was the most devastating in world history	(Johnson 2004)
1945	Establishment of the United Nations, founded to promote international peace and prevent another world war	(Johnson 2004)
1945-1955	A set of interstate institutions, notably the United Nations (UN), International Monetary Fund (IMF) and the World Bank was created to rebuild the countries' economies and help in social projects. - In this period, the International Bank for Reconstruction and Development (IBRD) and the General Agreement on tariffs and Trade (GATT) werecreated; the Universal Declaration of Human Rights was approved; a Global University (The United Nations University in Tokyo, Japan) was built; and The World Health Organization (WHO) was formed.	(Wallerstein 2000) (Mazrui 2000)
1949	The North Atlantic Treaty Organization formed. Its fundamental role was to safeguard the freedom and security of its member countries	(Johnson 2004)
1950	Decolonization of European empires in Asia and Africa produces a world of national states for the first time and a world of legal-representative-economic institutions in the UN at Bretton Woods, where important decisions on trading and monetary relations between countries were established.	(Frank and Gills 2004)
1951	Formation of European Economic Community – Germany, Italy, Netherlands, Belgium, and Luxemburg were the original members. The Community's goal was to establish a community of interest and cooperation among all nations of Europe	(Johnson 2004)
1957	USSR (Union of Socialist Soviet Republics) launched first live animal into space (liaka) sparking a "space race" between the USSR and the USA	(Johnson 2004)

1960	The Western European countries and Japan recovered control over their national markets and began to compete effectively with US products in the markets of third world countries.	(Wallerstein 2000)
1963	Organization of African Unity (OAU) established. Its charter was signed by 32 countries. It was formed to promote unity and solidarity between African states and to eradicate all forms of colonialism	(Johnson 2004)
1967	Formations of the Association of Southeast Asian Nations (ASEAN), the five original members were Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Their goal was to accelerate economic growth, social progress, and cultural development in the region.	(Johnson 2004)
1968	Revolutions around the world in 1968 were triggered by the discontent of all those who had been left out of the well-organized world order by US hegemony. Cultural, social, political and economic events in China, Mexico, Senegal, Tunisia, Brazil, Cuba, Czechoslovakia and many other countries in the Third World occurred in protest against this situation.	(Wallerstein 2000)
1973	First oil crisis caused rapid inflation and high heating and gas prices around the world	(Johnson 2004)
1989	The Berlin Wall torn down which brought a symbolic end to the Cold War. The globalization of post-industrial capitalism, which appeared to be eroding the power of the nation states in a similar way as in the 1950s, became a concern.	(Johnson 2004) (Frank and Gills 2004)
1990	Western Europe took the essential step forward in its unification with the creation of the Euro and thus achieved the financial underpinning necessary to pull away from its close political links to the USA	(Wallerstein 2000)
1991	The Internet had grown to include some 5,000 networks in nearly 40 countries; it was used by over 4,000,000 people who could then write to others in foreign countries via email	(Johnson 2004)
1993	North Atlantic Free Trade Agreement (NAFTA) signed into law which established free trade between Mexico, US, and Canada and calls were made for complete removal of all trade barriers within 15 years	(Johnson 2004)

1995	Word Trade Organization (WTO) formed. This was the first global organization created to regulate trade and tariffs worldwide, superseding the General Agreement on Tariffs and Trade (GATT)	(Johnson 2004)

Source: Adapted from various authors including (Johnson 2004; Wallerstein 2000; Frank and Gills 2004; Mazrui 2000; Spybey 1996; Chanda 2002; Riggs 1998).

Appendix 10

The evolution of the current economic, commercial and roduction blocs in the world

Year	Institution/Bloc	Member countries
1942	AL – Arab League	Beginning with 7 members: Iraq, Egypt, Jordan, Yemen, Saudi Arabia, Lebanon, Syria; entered after: Arab Emirates, Bahrain, Djibouti, Oman, Comoros, Kuwait, Mauritania, Tunisia, Algeria, Sudan, Somalia, State of Palestine, State of Qatar, Libya and Morocco
1944	BENELUX	Belgium, Holland, Luxemburg
1945	Conference of Yalta: a)Pact of Warsaw b) NATO – North Atlantic Treaty Organization	a) socialist and communist countries; b) capitalist countries
1947	ECE - Economic Commission of Europe GATT – General Agreement on Tariffs and Trade ESCAP - Economic and Social Commission for Asia and Pacific	Generic reach Generic reach Generic reach
1948	OAS –Organization of American States ECLA - Economic Commission for Latin America	Generic reach Generic reach
1949	CEMA – Council of Economic Mutual Assistance	Generic reach
1951	ECCS – European Community of Coal and Steel producers	Belgium, West Germany, Luxembourg, France, Italy and Netherlands
1957	EEC – European Economic Community	Belgium, West Germany, Luxembourg, France, Italy and Netherlands
1958	CACM – Central-American Common Market	Beginning with: Costa Rica, Guatemala, El Salvador, Honduras, and Nicaragua. Panama entered in 1993.

1959	ECA – Economic Commission for Africa	Algeria, Angola, Botswana, Burkina Faso, Burundi, Cameroon, Congo, Côte d'Ivoire, Djibouti, Egypt, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea-Bissau, Equatorial Guinea, Kenya, Lesotho, Liberia, Libyan Arab Jamahiriya, Madagascar, Malawi, Mali, Morocco, Mauritius, Swaziland, Mozambique, Namibia, Nigeria, Togo Rwanda, Sao Tome-et-Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, Tunisia, Uganda, Zambia, Zimbabwe
1960	EFTA - European Free Trade Association LAAFC - Latin American Association of Free Commerce	EFTA: Iceland, Liechtenstein, Norway and Switzerland . LAAFC: beginning with Argentina, Brazil, Uruguay, Paraguay, Peru, Chile, Mexico; entered after: Colombia and Equator (1961), Venezuela (1966) and Bolivia (1967)
1964	CMA - Common Market for Arab countries	Iraq, Egypt, Jordan, Yemen, Saudi Arabia, Lebanon, Syria, Arab Emirates, Bahrain, Djibouti, Oman, Comoros, Kuwait, Mauritania, Tunisia, Algeria, Sudan, Somalia, State of Palestine, State of Qatar, Libya and Morocco
1967	ASEAN – Association of South-East Asian Nations	Beginning with: Indonesia, Malaysia, the Philippines, Singapore and Thailand; entered after: Brunei, Laos, Cambodia, Vietnam and Myanmar
1969	ACM - Andean Common Market	Bolivia, Chile, Colombia, Equador, Peru and Venezuela.
1973 1973	ECWA – Economic Commission for Western Asia ECWA - Economic Community of West Africa CARICOM - Caribbean Community	Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, United Arab Emirates and Yemen Benin, Burkina Faso, Cameroon, Cabo Verde, Chad, Côte D'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Serra Leone and Togo. Antigua, Barbuda, Bahamas, Barbados, Belize, Dominica, Granada, Guyana, Jamaica, Montserrat, Are Cristovao, Nevis, Saint Lucia, San Vicente, Grenadines, Suriname and Trinidad and Tobago. The British Virgin Islands and the Islands Turks and Caicos are associate members.
1980	LAAI – Latin American Association of Integration	Beginning with Argentina, Brazil, Uruguay, Paraguay, Peru, Chile, Mexico, Colombia, Ecuador, Venezuela and Bolivia, and in 1998 Cuba entered
1989	FTA – Free Trade Agreement APEC – Asian and Pacific Economic Cooperation	FTA – Generic reach APEC – beginning with Australia, Brunei Darussalam, Canada, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore, Thailand, and the United States.

		Entered in 1991: China, Hong Kong and Taipei; in 1993, Mexico and Papua New Guinea; in 1994, Chile; and in 1998, Peru, Russia and Viet Nam
1990	Group of Three (Colombia, Venezuela and Mexico); Chile and Argentina Agreement; Chile and Venezuela agreement; Mexico and Venezuela Agreement	Colombia, Venezuela, Mexico, Chile, Argentina
1991	MERCOSUL – Common Market of the South	Brazil, Argentina, Uruguay and Paraguay
1992	EU – European Union NAFTA – North American Free Trade Agreement	EU: Beginning with Belgium, Germany, France, Italy, Luxembourg, Netherlands; later entrants included: Denmark, Ireland and United Kingdom in 1973; Greece in 1981; Portugal and Spain in 1986; Austria, Finland and Sweden in 1995; Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia in 2004. NAFTA: Canada, Mexico and United States of America
1993	SAFCA - South American Free Commerce Area	All the countries of South America

Source: Information taken from (Dunning 1992; Previdelli 1998; WTO 2004a; UNO 2001; OMC 1997; OECD 1997).

Appendix 11

Members of the International Union for the Protection of New Varieties of Plants on April 3, 2006

State/ Organization	Date on which State/ Organization became member of UPOV	Number of contribution units*
Albania	October 15, 2005	0.2
Argentina	December 25, 1994	0.5
Australia	March 1, 1989	1.0
Austria	July 14, 1994	1.5
Azerbaijan	December 9, 2004	0.2
Belarus	January 5, 2003	0.2
Belgium	December 5, 1976	1.5
Bolivia	May 21, 1999	0.2
Brazil	May 23, 1999	0.25
Bulgaria	April 24, 1998	0.2
Canada	March 4, 1991	1.0
Chile	January 5, 1996	0.2
China	April 23, 1999	0.5
Colombia	September 13, 1996	0.2
Croatia	September 1, 2001	0.2
Czech Republic	January 1, 1993	0.5
Denmark	October 6, 1968	1.5
Ecuador	August 8, 1997	0.2

Estonia	September 24, 2000	0.2
European Community	July 29, 2005	5.0
Finland	April 16, 1993	1.0
France	October 3, 1971	5.0
Germany	August 10, 1968	5.0
Hungary	April 16, 1983	0.5
Iceland	May 3, 2006	0.2
Ireland.	November 8, 1981	1.0
Israel	December 12, 1979	0.5
Italy	July 1, 1977	2.0
Japan	September 3, 1982	5.0
Jordan	October 24, 2004	0.2
Kenya	May 13, 1999	0.2
Kyrgyzstan	June 26, 2000	0.2
Latvia	August 30, 2002	0.2
Lithuania	December 10, 2003	0.2
Mexico	August 9, 1997	0.75
Netherlands	August 10, 1968	3.0
New Zealand	November 8, 1981	1.0
Nicaragua	September 6, 2001	0.2
Norway	September 13, 1993	1.0
Panama	May 23, 1999	0.2
Paraguay	February 8, 1997	0.2
Poland	November 11, 1989	0.5
Portugal	October 14, 1995	0.5

Republic of Korea	January 7, 2002	0.75
Republic of Moldova	October 28, 1998	0.2
Romania	March 16, 2001	0.2
Russian Federation	April 24, 1998	0.5
Singapore	July 30, 2004	0.2
Slovakia	January 1, 1993	0.5
Slovenia	July 29, 1999	0.2
South Africa	November 6, 1977	1.0
Spain	May 18, 1980	2.0
Sweden	December 17, 1971	1.5
Switzerland	July 10, 1977	1.5
Trinidad and Tobago	January 30, 1998	0.2
Tunisia	August 31, 2003	0.2
Ukraine	November 3, 1995	0.2
United Kingdom	August 10, 1968	2.0
United States of America	November 8, 1981	5.0
Uruguay	November 13, 1994	0.2
Uzbekistan	November 14, 2004	0.2
(Total: 61 Members)		

(*) The amount of the annual contribution of each Member State is calculated on the basis of the number of “contribution units” applied to it. The contribution unit value is fixed at 8,333 Swiss francs multiplied by the number of contribution units applicable to the member.

Source: (UPOV 2006)