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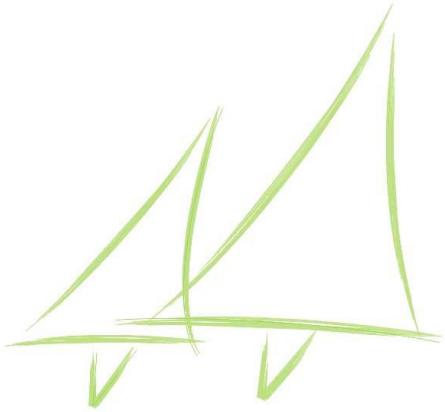
MOVIMENTO COOPERATIVO, TRANSNACIONALIZAÇÃO E IDENTIDADE COOPERATIVA NA AMÉRICA LATINA
MOVIMIENTO COOPERATIVO, TRANSNACIONALIZACIÓN E IDENTIDAD COOPERATIVA EN AMÉRICA LATINA
COMITÊ DE PESQUISA DA ALIANÇA COOPERATIVA INTERNACIONAL



# 186 - THE ROLE OF AGRICULTURAL COOPERATIVES INTERACTION WITH PUBLIC RESEARCH ON TECHNOLOGICAL CHANGE IN BRAZIL[1]

Eficácia e eficiência da empresa, inovação e experiências na integração cooperativa

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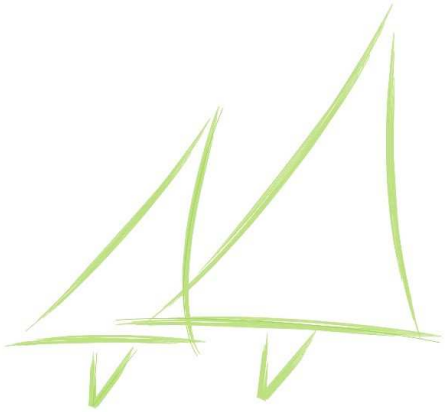
## Abstract

Agricultural cooperatives have played an important role on technological change in Brazilian agribusiness, primarily, on cases in witch these farmer-owned organizations contract with public research and development institutes. The agricultural cooperative sector has operated different ways of coordination with the science and technology sector, some of this are innovate forms of work organization. The theoretical framework of this article relies on social sciences applied to innovation management in the cooperative sector with focus on modes of science and technology coordination. The article identifies, defines the scope, describes and analyses comparatively some cases of interaction between the Brazilian Agricultural Research Corporation - Embrapa and farm cooperatives. Finally, the paper suggests that efforts to improve and expand strategic alliances between public research and agricultural cooperatives may have important effects on agri-food chains and networks, including demand prospecting, knowledge construction and innovation in organization, processes and products.

[1] The opinions expressed in this paper are the authors own responsibility and do not represent the opinion of the institution which they are associated.



**Key-words: Research and Development; Cooperation; Agricultural Cooperatives, Networks**

## Resumo

Cooperativas agrícolas e agroindustriais têm desempenhado um importante papel na mudança tecnológica no agronegócio brasileiro, com destaque para casos em que as cooperativas operam em coordenação com organizações públicas de pesquisa e desenvolvimento. O cooperativismo de produção agropecuária tem operado diferentes modos de coordenação com a atividade de C&T, alguns desses constituindo inovadoras formas de organização do trabalho. Neste trabalho, utilizam-se elementos conceituais das ciências sociais aplicadas à gestão da inovação no setor cooperativista com foco nas formas de coordenação de ciência e tecnologia. O artigo identifica, circunscreve, descreve e analisa casos de interação entre a Empresa Brasileira de Pesquisa Agropecuária - Embrapa e cooperativas. Finaliza sugerindo que esforços de melhoria e expansão em alianças estratégicas entre a pesquisa pública e organizações de agricultores podem ter efeitos importantes no complexo agro-alimentar, incluindo prospecção de demandas, construção do conhecimento e inovações organizacionais, de processos e de produtos.

**Palavras-chave: Pesquisa e Desenvolvimento; Cooperação; Cooperativas agrícolas, Redes**

## 1. Introduction

This paper analyzes agricultural cooperatives' abilities to deal with specific innovation challenges, according to a sort of alliance cases established with Embrapa – Brazilian Agricultural Research Corporation. In the second part of this essay, we bring some findings about the agricultural cooperatives role on innovation process. In the third section, we are concerned on the micro-analytical approach of innovation, focusing on innovation systems' networks and the technological alliances and partnerships. In the fourth section, we briefly discuss the role of public R&D in agriculture. In the fifth section, we exemplify how farm cooperatives have been contracting with Embrapa and what are the archetypes and spillovers from these alliances. Finally, in the last section, we try to discuss potentialities from this coordination form archetypes applied to the research and development activity.

The role of corporations, small business and research institutions on the innovation has been largely studied, but few studies addressed the role of agricultural cooperatives on the innovation process of the agribusiness sector.

Farm cooperatives have contributed considerably to the process of research and development, transference, diffusion and adoption of technology. A new technology or new business organization form only complete its innovation process when applied into the production process or business organization and management. Cooperative and its tied relations with members are one of the great competitive advantages to fill an important role in the agri-food industry innovation system and in the contextual innovation process. Member screening and selection, technical assistance, member organization and contracting are important cooperative abilities which are difficult to imitate, and therefore, imply great advantages to research institutions to consider agricultural cooperatives as potential partners for a research and development program.

## 2. The Role of Cooperatives on Innovation

This section discusses different academic approaches on the role of cooperatives in the innovation systems, from the neoclassical economics competition models to the institutional and sociological analysis.

Generally speaking, the challenges of concentration and specialization of agricultural production circumscribe cooperatives in an environment in which members have higher heterogeneity: few producers of large scale focused on commodities, and a great majority of farmers producing specialties. As a consequence, cooperatives consolidate to play on commodity markets, or start to attend a great number of heterogeneous producers, looking for markets of differentiated products. Cooperatives can capture advantages playing on origination of commodities or at preservation, identification and guarantee of origin and quality of products. However, there are still great challenges in this environment for cooperatives in both approaches due to many factors: the "industrialization of agriculture[2]" implied on higher complexity in the relation between agents and higher complexity of the technology content of products. Concentration implies higher scale of operations and cost reduction. Cooperatives that differentiated their products had to coordinate distribution channels. Theses strategies were dependent of higher knowledge content on organizational and technological innovations (Chaddad *et al,* 1999).

As traditionally organized cooperatives embark on differentiation strategies, they must face both governance problems and capital problems, an issue largely discussed in the academic literature. The consequence of differentiation strategy is the need for capital, in production and sales[3], because the processing of members produce must be far-reaching and much R&D is required. The majority of cooperatives are organized in the traditional vaguely defined property rights archetype that creates low incentives to investment and internal interest conflicts. Therefore, cost leadership strategies are more common among the surviving traditionally organized cooperatives, due to their ability to exploit economies of scale with open membership model, regarding

[2] Industrialization of agriculture mentions the economic phenomenon of more interdependent relations between the supply industry, the agricultural production and the processing of products, in which the dynamics changed from price risks to uncertainty of relations between agents, given the increased complexity of transactions' and products' attributes.

[3] Market research, communication and promotion activities call for capital.

the producer ability to produce at lower cost and the price sensitivity of these undifferentiated products markets. This way, process innovation is more suited to this type of strategic positioning (Nilsson and Ohlsson, 2007). A firm that makes a process innovation gains an advantage over its rivals and enables it to set price above marginal cost, therefore farmers maximize profits demanding inputs from these firms.

On this neoclassical economics perspective, Giannakas and Fulton (2005) discuss that innovation based on pure oligopoly competition model has neglected the presence of cooperatives at the primary production sector: agricultural products origination and processing. When considering the presence of cooperatives, besides their effect of promoting competition, due to the strategic interaction between cooperatives and Investor Oriented Firms - IOFs, in oligopolistic industries, the research has not yet considered the impact of cooperatives on innovation activity in these mixed markets and the resulting impact of this activity on he firms' cost structure and price decisions. Giannakas and Fulton (2005) employed a mixed duopoly model, in which an open membership, welfare-maximizing co-op and an IOF compete in supplying an input to agricultural producers. They examine the impact of cooperative involvement in process innovation on the amount of innovation in an industry, the pricing behavior of the competitors before and after the innovation is undertaking and the social welfare resulting from this competition. Although cooperatives are constrained in their ability to raise investment capital, their focus on member welfare maximization enables them to compete effectively with its IOF counterparts, charging lower prices. Open-membership farm co-ops also has incentives to undertake higher innovation effort than its profit maximizing rival, because co-ops internalize the effect of reduced costs and prices on the welfare of its members. The explanation is that internalization occurs because co-ops maximize member welfare rather than profits. Additionally, due to the reduced price-cost margin of the IOF in the mixed oligopoly, the increase in the producer welfare exceeds the reduction in suppliers' profits, indicating that the presence of the co-op increases total economic welfare in those markets. Their conclusion therefore, is that: "*since the investment in innovation activity affects prices charged by both cooperatives and IOF, and consequently, the profits of IOF and the welfare of all agricultural producers, the factors affecting co-ops innovation activity are of interest to all players in agricultural industry*".

Nevertheless, the agricultural cooperatives' innovation activity has to be understood by a process analysis, and has to take into account the role of government intervention, transaction costs and science and technology organizations, due to its complex interaction by the means of public policy and social construction.

Other important academic school has an exhaustive literature regarding the preoccupation about the research and extension systems' ability to bring technology improvement to farmers. This school describes several R&D and extension organizational models including the role of federations of farmers

associations, cooperatives, pre-cooperatives[4] and other collective action organizational structures on agricultural modernization processes. In this perspective, cooperatives play an important role on technology access for individual farmers, enabling the achievement for credit access conditions, access to technological products, contracting for genetic material reproduction, extension service internalization and/or participation on the resource allocation decisions processes at the national innovation systems.

The interaction of farmers' organizations and the national innovation systems has played an important role on the institutional change of the rural extension services and the agricultural research and development organizations. As Zoundi *et al.* (2001) described for Latin American nations, the governance has changed with the increased participation of farmers' organizations in the governmental innovation agencies, from the local level to the national confederations and commodity associations. It has created a new interaction of the public research with the private demands. In these organizational designs, research and extension corporations were more private supported, upon a tax policy, the management of funds for research induction and the resource allocation become organized with the equitable participation of the farmers associations. Zoundi *et al.* (2001) enumerate many cases of farmers' organizations in Latin America that participate, fund and use research and extension public services bringing more social and market oriented demands to these public organizations. Therefore, cooperatives and its federations have strengthened its competences for negotiating and handling alliances in R&D and extension programs.

This public-private character of these innovation systems is an even stronger trend in the latest years. The prognosis about the future of the Latin American research and extension services were on the furthering of this trend, for nations on hardship condition for governmental investments, and as many other governmental structures, public research and extension systems were dismantled.

The role and governance structure of the public R&D and extension agencies has changed for a more focused and effective action, directing efforts on social demands, opening their decision processes. This process has involved the participation of society on policy formulation and execution. However, the agricultural production has very heterogeneous technological demands, and so are their interest groups, therefore, it is not possible to identify a single socially efficient archetype for the innovation systems in which to fit the role of cooperatives. But, it is very important to address cases for identifying under what conditions an archetype works effectively in accordance to a theoretical framework of cooperatives' organization, management and strategy theory and innovation systems theory.

## 3. The Science of the Innovation Process

[4] Also pre-cooperative organization formation have a role on the innovation process as described by Lundborg (1999) on the consequences of the extension and R&D system strategies for strengthening rural communities' capabilities for technology adoption in Nigeria, Africa concerning small scale farmers.

We apply a multiple theoretical substrate from the science of innovation systems regarding some assumptions from the fusion of the Sociology of Science and the Economics of Science, furthering its development on the New Economics Sociology and the New Institutional Economics. The contribution of this analytical structure is the possibility of identifying governance patterns in the innovation systems and to elaborate propositions on its efficiency respect.
In this section, we are concerned on the individuals' interaction and organizations interaction, in an institutional change process (North, 1992). We describe the social and economic behavior under transaction costs view (Williamson, 1996, 1998) that influence the innovation system coordination, in the general historical context of the science and technology (S&T) institutions of governance. According to Johnson (1992)[5] *apud* Salles-Filho and Bonacelli (2001), it is being more evident that innovations are molded by institutions and by institutional change. In addition to this conception, there is the fact that the innovation phenomena is a social construction affected by the ideological aspects and the social relations among individuals

### 3.1. A Innovation Systems approach: knowledge, institutions, organizations and individuals.

The theoretical discussion on the science production[6], on its sociological, economical and epistemological perspectives, considered the decision decentralization, exposure priority, the critic and the focus at the same knowledge frontier, as efficiency factors. However, science paths are increasingly interdisciplinary (Dahrendorf, 1999), the knowledge economics imply in uncertainties (Arrow, 1973), weakening those prescriptions. The interdependency among scientists and other economic agents brings different forms, in which, the innovation systems organize, finance and evaluate themselves, and relate with society, in a way that a complex arbitrage system determines their surviving.
Nelson e Winter (1982) characterized the dynamic economic environment of the innovation system, and bring other factors other than uncertainty, as irreversibility, lock in and inertia, due to institutions and path dependent technologies. And they contemplate the inheritance of characteristics acquired and the emergence of variations by adversity stimulus, an evolutionary approach. In their approach, learning based on routines and interactive is influenced by institutions. The ability to learn, adapt and change the institutional reference framework defines competitiveness and the organizational surviving ability. For Williamson (1996, 1998), the way in which transactions occur in the science production determines the coordination systems in the innovation economic system.
On this perspective, Salles-Filho and Bonacelli (2001) differentiate mechanisms non-investor oriented, considering the selective process of firms in the market for the case of governmental research organizations, and adding elements of political and public legitimacy that turn the selection more complex by overlapping in a broad range the market dimensions.

[5] Johnson, B. Institutional learning. In: Lundvall, B. A. (ed) **National systems of innovation**: towards a theory of innovation and interactive learning. London: Pinter, 1992.
[6] Polanyi (1962), Popper (1978, 1993), Merton (1957, 1968, 1973), Latour (1995).

The innovation systems are increasingly based on scientific knowledge, therefore, considering dimensions of scientific work transactions, become critical to understanding the role of individuals inside the innovation systems.

The scientists define strategies to satisfy their expectations, guided by rewards generated by the scientific production, as recognition and financial support. The interaction between scientists is governed by norms and the authority of the scientists' network they belong, what imply an evaluation pattern on their scientific output, by the means of critic and acceptance in scientific publication (Franck, 1999). This process turns possible scientists' stratification and generates competition. Although, the meritocratic system' competitive mechanism itself is distorted by power and influence from the positions occupied by scientists inside this systems and by the collective strategies of scientists. As a consequence, the value of scientific production of an individual increase disproportionally in relation to other contribution that is less used (Merton, 1957).

Inside of this institutional archetype which leads to an imperfect market, scientists, according to Stephan (1996), establish diverse strategies: i) they move to outside of the mainstream to be first in other fields or lines of research; b) they diversify the portfolio projects, share risks and rewards, to balance the uncertainty and to reduce the problem of limited rationality (Simon, 1955); c) they establish reputation to get *ex ante* funding for research, corresponding to the inherent difficulties for monitoring R&D projects, in face of the agency problems (Jensen and Meckling, 1976; Fama and Jensen, 1983; Williamson, 1996a).

The output content observability (Akerlof, 1970) from the two different types of researchers (Cassiman, 1998): of basic research and of industrial or applied R&D; require scientists with different research abilities, which measurable product of the researcher performance is different. The perceived benefits of projects of basic research are typically intangible and the value of the project is not contractible upfront. The observable products of more applied projects are: patents of applications, new products and new processes, whose return can be appropriable. Although Stephan (1996) and Latour (1995) suggest that the environment of basic public science is not distinguished from the environment of applied private science and technology, Paez (2000) considers not possible to intend to speed up the production of the knowledge for the standardization of the signaling of incentives between some phases of the innovation system. The preservation of the "science environment" and the "technology environment" particularities allows that each one of them functions efficiently in a complementary form. McKelvey (1997) *apud* Paez (2000) justified the emergency of new firms of biotechnology in U.S.A. in an intermediate environment. Paez (2000) schema suggests that such phenomenon would be leaded by knowledge assets specificity, according to the Williamson's propositions in relation to the system of coordination inside the continuous: markets - hybrid - hierarchy; also, being based on the works of Teece (1986; 1998) on strategic alliances or networks, when complementary assets available for innovation with the objective to internalize quasi-rents generated with private arrangements between parties, instead depending exclusively upon legally

established rights, but comparably with high costs concerned in its accomplishment.

Comparing institutions from a historical point of view (Greif, 1988; North, 1992) disclosed a link of the economic system efficiency in function of its dependence of a historical path. The scientific works are evaluated by the scientists who are in areas of adjacent overlapping to its specialty, making possible the formation of a net of judgments. The structure of governance of the transactions in scientific production, corresponds to the structure, in which is applied the concepts (Williamson, 1994) of the auto-arbitration (forbearance law) and informal organization, therefore: a) the authority of the scientific opinion is established by the cooperation among scientists in their reviews, therefore only the adjacent peers are able to mediate disputes, with concepts brought by philosophical traditions; b) scientists enter in organizations that produce science, balancing the authority they submit themselves and its degree of choice freedom, in function of available resources for scientific production and its perspective of public recognition.

Popper and Polanyi had shared of the same position in the Open Society and the Republic of Science, as well as Dahrendorf (1999) and Schwartzman (2001), that the scientific community acquires public support through the recognition of its efficiency, principles of authority and legitimacy, of public character without external pressures to its scientific community. However, regarding the nuisance of the scientific community on this question as of how to create and to constitutes demand and purpose for the applied research, Latour (1995), Stephan (1996), Paez (2000) and Salles Filho and Bonacelli (2001) affirm that this conception of the demand and its noticed contrast with the basic research, do not have reason to exist anymore, as a consequence of the profound transformation that occurred, becoming impossible to distinguish them. Additionally, discovers of scientists from public organizations would be disclosed due to its doubtless interests in publishing, while scientists, in the private initiative, are not encouraged to publish with disclosure, but to ask for patenting, to increase the reputation in P&D of the firm and to bring more resources of the financial markets.

Different capacities of appropriation and the competition structure, as much for public institutions as private, become necessary to disclosure information selectively. For Salles Filho and Bonacelli (2001), to deal with this question only the theoretical principle of public goods and private goods is insufficient, accurately, for the fact that it does not considers the diverse forms of appropriation and of rivalry in the economy, yet more complex when dealing with production of scientific and technological knowledge: public goods are not isolated goods of the economic mechanisms.

According to Stephan (1996), firms participate in basic research of cooperative form between them and the public sector, as much to monitor scientific advances, how much to absorb researchers assuring the technological development of its products, and to have counterparts in the R&D transactions. It has increasing co-authorship between researchers of the private initiative and public organizations, therefore, it does not have differences between contents.

Farina and Zylbersztajn (1991) argue that the technological developments in the Brazilian agribusiness are driven by the technological demands from the agro-

processors feasibility, the relations of vertical rivalry in the agro-industrial systems in function of the asymmetry of information, uncertainty, opportunism, segmentation of the markets and differentiation.
Silva *et al*. (2006) assume that any knowledge is constructed by culture and in a specific social context, joining groups or individuals with common interests. In this concern, the idea of interaction between cooperatives and R&D organizations brings an alternative mode of knowledge creation (Gibbons *et al*. 1996; Guedes, 2005).

### 3.2 The coordination of innovation system

Applying the economics of organization, and its theories of the firm, concerning the firm as a knowledge appropriation by the means of contractual nexus as an alternative for transaction costs reduction, we aims to argue, in this section, that different forms of coordination emerge in the CT&I production.

#### 3.2.1 Public organizations of research

Governmental research organizations have legal rules and political restrains that inform the inter-organizational partnerships possibilities and limits the R&D programs. Public research organizations possess an organizational rigidity that restricts flexibility to define its limits and develop relationships. This restriction hinders its autonomy, survival and competitiveness, therefore, these organizations started to redefine their mission, legal statutes, sources of financing, management of research, and their understanding of the sector dynamics and strategic positioning in the innovation systems (Bin and Paolino, 2004).

#### 3.2.2 Corporations of research

The research corporations are trusts of companies who form one pool of resources for research projects by which they generate their competitive position. Such phenomenon is recent in U.S.A., according to Cassiman (1998), and is an alternative cooperation form, distinguished from the internal development of R&D, agreements of licensing of technology, acquisitions e *joint ventures* of research. In meanwhile, research corporations have less focus than *joint ventures* of research. Frequently, the corporations of research in U.S.A. have relationship with the universities. However, differently from university-company cooperation, initiated for the university and fomented by the government, the research corporations are private initiatives of firms member that determine the type of research to be lead, and the research corporations contract the universities. Thus, it consist an institutional arrangement for scale economy, for lessening the individual risk of industrial R&D, the competition for human resources and the effort of research for determined industry.
For Cassiman (1998), in the research corporations, the formal authority on the choice of the projects is exerted by the boards of directors of the member firms. A private organization with lucrative ends could not leave from intervene in the choice of the researchers' projects. However, as higher the number of firms, lesser is the member effort for monitoring and inducing the projects of the researchers, therefore the exercise of a formal authority on the choice of the projects for scientists is a collective good that suffers from the problem of the

free riding in the investment, directing, monitoring and use effort (Olson, 1965). Such fact makes corporations of research with many proprietors to give greater autonomy to the scientist, when compared with the isolated firm that develops internally in a R&D department. Therefore, scientists are more attracted by research corporations, than by internal departments of R&D of firms, as well as more attracted by universities that guarantee the freedom of choice of the research program. Comparatively, the research corporations offer more resources for science production, but a better control on the result and dissemination. In their turn, universities demand other obligations as to give classes, to manage resources, but they offer projects and publication of results' freedom of choice (Cassiman, 1998).

Researchers, generally, are sufficiently worried about their projects of research and its continuity, due to their specific investment that they compromise in the project, to takes researchers to try to influence the executives' decision on continuation, for the continuity of the project, despite the value of the project for the firm (Cassiman, 1998a),. These activities of influence (Milgrom and Roberts, 1988) have been registered as resource spending activities in the organization. The time that the researchers spend trying to influence the executives, is a time that could devote the productive activities. The importance and effect of the activities of influence in organizations, lead to the search of the excellent drawing of the organizations, to reduce the incentives of the scientists to be engaged in activities of influence that affect the expected profitability of the projects, what it is difficult to prescribe.

### 3.2.3 Networks in the Innovation System

Britto (2002) highlights the increasing convergence of different schools of thought, analyzing factors that lead to a superior competitive performance, and emphasizes the relations among companies and other non-profit oriented organizations. Thus, an analytical reference in the network concept propitiates the study of: i) strategic alliances between organization, in which, agents with different abilities interact to make possible a specific innovation; ii) national and regional systems of innovation based in the specialization and interaction of the involved agents with the accomplishment of the innovation (individuals, public and private companies, universities, research organizations).

Freitas Filho *et al.* (1996) have advocated that the nature of an efficient partnership for science and technology is that both parts in a partnership are equal, that both have no power above the other, and that size, financial condition, technical competencies do not interfere in the relationship among them, because the institutional commitment to the common interest. For Castells (2000) the network participants keep their autonomy and at the same time establish a dependence relation. Therefore, the effectiveness of a network will depend on connectivity and coherence between the network objective and of its members.

Nevertheless, in reality, all these characteristics of each part is been now considered as components of a game, in which, players have to convince their counterparts to joint into alliances, exchanging gains of trade, where different competencies and resources are put in charge and contracts are set to put transactions to work, and many conflicts rise and are solve along the time lime.

In this direction, the network idea lines up with the composition of strategic alliance between farming cooperatives and a public institution of R&D. For Castells (2000), strategic corporative alliances distinguish from traditional forms of cartels and oligopolies, therefore specific times, markets, products and processes are mentioned to it, not excluding the competition in areas not covered for agreements. This organizational model is particularly excellent, according to the author, in high-tech sectors, due to the high R&D costs sectors, in which innovation represents the main competitive weapon.

Networks are a coordinated set of actors, for example, public laboratories, centers of applied research, companies, financial organizations, users and government - that they participate collectively in the conception, development, production and distribution or diffusion of procedures for production of goods and services (Callon, 1992 *apud* Salles Filho and Bonacelli, 2001).

Coordinated networks assume the definition of output internalization limits and of a degree of control verticalization, on present actors - private firms, government agencies, not-for-profit organizations or public research organizations. To operate in a network, a party has to define its essential capabilities, to define its focus of action, to draw the governance structures that reduce transaction costs. This means that different mechanisms of governance can be mobilized according to objective and its restrains. Thus, a specific project can be lead totally inside the firm, another one can be carried through contracts or be searched in the market. This type of analysis can lead to strategic decisions that detach one organization's performance in determined specter of the innovation process, in example, in the diffusion of techniques and the assistance to users (Salles Filho and Bonacelli, 2001).

Salles Filho and Bonacelli (2001), on Teece (1986) network interaction conception, explain activities Inter-firms (joint ventures, agreements of co-production, cooperation, crossed distribution and licensing of technology) also for the study of the public research organizations and its relations in the market. They proposed three factors as: i) the reason that the appropriation of the innovation is carried on by another agent and not by the innovator; ii) regimen of appropriation (nature of the technology and mechanisms of protection); dominant drawing (pre-paradigmatic/paradigmatic, innovator/follower); and complementary assets (additional assets or boosters). Intangible assets of the firm whose product is the knowledge, possess two categories: legally protected (as trademarks, patents, copyrights, contracts/commercial licensing, industrial secrets and database), and not legally protected (as information of public domain, reputation of the product of the firm, personal and organizational networks).

The uncertainties tend to be comparatively more present in situations of "technical cooperation" than in "economic action" ones, according to the level of the codification of scientific knowledge involved in these types of R&D transaction. In the contract case, these particular conditions of the R&D, more than ever, demand incremental adjustments and renegotiations between parties, during the execution of the activities, same as if in the case of public agencies, in which the restrictions imposed for the governmental regulations are numerous. In contraposition, the creation of trust and commitment by the previous experience acquired and accumulated in the relations with its partners

and customers can, besides diminishing these contractual problems, offers subsidies to delineate future clauses that better safeguard the interests of the parts, without raising the costs of monitoring of contracts, especially when there are their essential capabilities and specific assets in charge. A good project management congregates legal-contractual information, an integrated vision of technical problems and the legal/institutional ones, to subsidize incremental governance improvement saving transaction costs.

## 4. The role of public R&D in agriculture

The innovation system and its organization have an important implication of the public research policy. The problem is to identify the role of the public R&D investment and the institutional design for its interaction in the innovation system. One trade-off is into what extent the contributions of public R&D are to countervail the public good problem of science and technology and in what targets should the government allocate research effort.

Underinvestment in R&D by the business firms are in part due to: the public good nature of the R&D product, when the social benefits from R&D exceed the private benefits, or the free riding problem; also the duplication of research efforts, when only one firm can grant a patent and appropriate the direct benefit of the innovation; the lack of an institutional framework for appropriating the benefits of innovation; and the public investment in R&D that subsidizes the firms investment on innovation activities.

Onofri and Giannakas (2001) develop a game among government, firms and farmers to analyze the role of public research in agricultural R&D in a mixed oligopoly framework with strategic interaction among innovation firms and the government. They argue that "*the existence of public applied research can enhance the arrival of innovations while mitigating the socially undesired consequences of market power in applied R&D production. Under certain conditions, direct government involvement in applied R&D is equivalent to the provision of targeted subsides to less efficient firms*."

Kon (1999) discussed regional implications of technological innovation, highlighting that each region has a potential demand that drives the increase of the resultant production, industry capacity. Other factor as availability of internal and external savings, capability to finance new investments, implies that the combination of public and private capital is condition for the creation of technological changes in a region, fostering the process of regional economic development.

The problem of allocation has being addressed by the means of decentralization of the agricultural R&D and extension systems, approximating them to the local farmer organizations as stated by Zoundi *et al*. (2001), and therefore, the development policy has to be taken into account in the scientists' evaluation and promotion systems, and in the participation methods of technological demand prospecting.

## 5. Agricultural Cooperatives Alliances with Embrapa

Agricultural supply and marketing cooperatives have a relevant market share worldwide and have benefited an important rural population fraction. The

Brazilian agricultural cooperatives have an increasingly share of agricultural markets in the last decade after a market oriented restructuring process.

Data from the Brazilian Cooperatives Organization – OCB, indicates that in 2008 there are 1,544 active agricultural cooperatives, accounting to 879.649 farmer members, employing 139,608 employees directly. The economic status of these organization is perceived by it share of 38.4% in the Brazilian agricultural Gross Internal Product – GIP, and 47.5% in the total Brazilian cooperative sector GIP. Direct exports from agricultural cooperatives generated revenue of USD 3.3 billion in 2007.

Cooperatives have been increasing their role on technology access and diffusion for farmers, by supplying credit, inputs, technical assistance and marketing agricultural products.

In the last decade, the governmental rural extension service, in municipal, state or federal levels have been dismantled, and cooperatives in competition with private input distributors, have occupied an increased role of technical assistance and input supply for rural communities. Among agricultural cooperatives, there are several initiatives of partnerships with the largest biotechnology, chemical, and machines global corporations. These partnerships range from offering a pack of inputs with a set of price, payment and credit conditions, to the advertisement, promotion, field demonstrations and technical assistance. Agricultural cooperatives also had intensively experienced investing in processing facilities and brand marks, for value added products. All these strategies are concerned to improve member competitiveness with lower operational costs and higher quality.

Although, some existing farmers organizations were inducted, created, promoted and controlled by the state, for many years in many countries, as stated by Zoundi *et al.* (2001), it lacks legitimacy for a sound partnership policy, due to its low credibility for its members and potential partners. It is important to remark that, cooperatives and its federations has to be strengthened reputational and technically for negotiating and handling alliances in R&D and extension programs, primarily when third part funding resources are at stake.

By the other hand, the survivor of the science and technology organizations relies on its ability to establish partnerships to respond complex demands (Freitas Filho, *et al.* 1996). In this concern, the way that research themes are defined in the research grant system, the public R&D organizations' autonomy and the participation of interest groups in these decision processes are very important elements to direct what partnerships should be established for an effective development policy. Therefore, if only a scientific commission is deciding research priorities, without any intervention from a management committee that represent users' demands, the selection would rarely meet the socially best concerted allocation. Nonetheless, the management committee can eventually be misrepresented in content or in power on the decision processes (Zoundi *et al*., 2001).

In these perspectives, in Brazil, we can list several initiatives managed by the Brazilian Agricultural Research Corporation - Embrapa that have being taken theses prescriptions into account. In example, PRODETAB and the Brazilian Consortium for R&D for Coffee, and other initiatives, are Embrapa's answers to social demand, revealed on the widespread network of alliances with private

firms, local governments, non-profit organizations and producers. This orientation is under the perspective of trust, pro-activity, quality and mutual gains (Souza and Silva, 1993). Contextual innovation applied to farmers sustainable agro-biodiversity management (Machado, 2007; Guedes and Tavares, 2001; Silva *et al*. 2001) is one emerging path of technology co-development at Embrapa.

The Embrapa's technology transference activity has kept and important network with producers, municipalities, extension services, state agriculture secretaries, and agricultural cooperatives, although no explicit trend and/nor strategy implementation is shown from 2000 to 2007, related to these partnerships in the period. Chart 1.

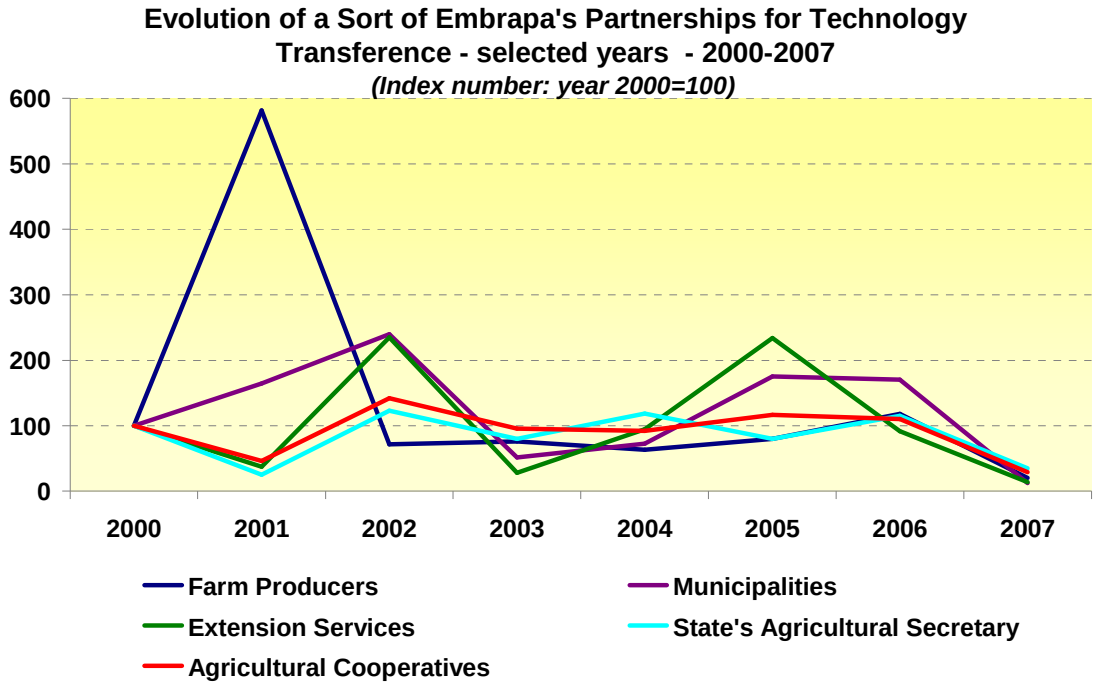



**Chart 1**

Among these Embrapa's partnerships with cooperatives, several interaction archetypes have taken place. The Embrapa's project management and its results' impact evaluation can bring a rich secondary data as a research material for elucidating how these interactions proceeded. Many publications were produced from the conduction of theses partnerships of Embrapa and agricultural co-operatives, yet not counted although, is a great base for a sort of cases furthering this research path.

Upon a very selective search among the Embrapa's experiences of interaction with cooperatives, and upon conversations with key Embrapa's personnel, we identified an emblematic case for studying and describing in this paper. For this selection, we elected some criteria, besides the data availability parameter: to have technology content, to be a complete innovation process, to have a notable impact, and to have a replicable organization interaction design.

## 5.1 Case Study of AURORA Technological Partnership with EMBRAPA

This exploratory effort is pervasive to different theoretical frameworks applied to the innovation process, searching to identify unities of analysis for the study of the role of agricultural cooperatives interaction with public research on the innovation process. Therefore, the descriptive nature of this case study has the fundamental objective to identify the application of the existing literature to this object of research, characterizing archetypes of interaction, regarding its context and some of its implication (Bruyne *et al.*, 1991; Yin, 1994; Gil, 1994; Godoy, 1995; Stake, 1994; Vergara, 1998).

The Cooperativa Central Oeste Catarinense – Coopercentral Aurora (***Aurora Alimentos***) is a regional federated co-operative on the food business, founded in 1969, by 8 local co-ops from the west of Santa Catarina State aiming to improve live conditions of the former hog producers members, selling handcrafted products. After 36 years, with its headquarter set in Chapecó, SC, it produces a range of 700 product mix, including input supply (feed), pork and chicken, dairy products, juice and pizza. ***Aurora Alimentos*** is one of the largest federated cooperative in Brazil and a world-recognized expert in meat processing technology, with 17 member co-operatives, with 77.5 thousands farmer members, and employs more than 9,000 employees. As the largest hog slaughter of Santa Catarina State and an industry leader in Brazil, with annual revenue ranging from R$1.9 billion in 2006 and R$2.2 billion in 2007, the company's business goals are to expand product mix with smaller packaging and semi-finished products and to offer consumers food products that are easy to prepare. Its distinction in the market is its modernity, market orientation, commitment with member producers, consumers and the communities in which it is placed in. ***Aurora Alimentos*** account to 3 central poultry slaughtering facilities, 8 hog slaughtering facilities, 1 dairy facility, 4 feed mills, 3 incubating facilities, 3 grain elevators, 3 broiler breeding facility, 3 hog breeding facility, 32 distributors for reaching 45.000 clients (AURORA ALIMENTOS, 2008).

The ***Embrapa Swine and Poultry*** research center is one of the 39 Embrapa's research unities with national action, towards hog and poultry supply chain industry. In its trajectory it has created competency in swine genetic improvement, based on quantitative genetics. Its institutional expertise and regional insertion had conquest a diversity of costumers. Among them we detach the academic, rural production specialist professionals, farm technicians, farmers and their organizations, and state research and extension services.

The ***Embrapa Swine and Poultry*** operates in the scientific knowledge market applied for offering technological solutions selling products and services as: technical and scientific publications, courses and training, supply for swine and poultry raising, laboratorial diagnosis, software, consulting, machines, equipments and installations, farming practices and processes, among others. We highlight, the swine lines MS58 and MS60 (EMBRAPA/CNPSA, 2006b).

**The swine MS58 and MS60** are lines designed to intensive enclosed hog raising farms in the hog food industry. Both are derived from the scientifically planned and oriented crossing of pure races in the R&D process aiming to increase meat quantity and quality enhancement, what include: more special cuts and less fat fraction, feed conversion efficiency. In the genetic enhancement effort the line MS58 was the first to be achieved, being substituted by the MS60 in the process. The process includes data and

information analysis and interpretation inside Embrapa's experimental fields and results measured from the performance of animals in the production system of farmers that incorporates the new hog lines in their breeding systems.
The ***Embrapa Swine and Poultry*** effort on dissemination of the MS60 hog line, known as "Ligth Pork" given its low fat character, has been done through production organizations, aiming multiplication and reproducers spreading for hog farmers. In this process, the Embrapa's unity sold 476 genetic hogs in 2005. (EMBRAPA/CNPSA, 2006a).
In 1996, ***Embrapa Swine and Poultry*** contracted with ***Aurora Alimentos,*** selling its MS58 sows and boars for commercial breeding and distribution of piglets. In this contract, Embrapa's offers technical assistance and have access to data, for analysis of piglet breeding performance. ***Aurora Alimentos*** had to breed and sell the piglets for its farmer members and affiliated local cooperatives. In this technology transference process, the contract specifies royalties to be paid by the Cooperative to the Research organization, upon products sales. The contract is under the Federal Act 8.666/1993, which imposes legal restrains.
In 1997, the amount of hogs sold from ***Embrapa Swine and Poultry*** to ***Aurora Alimentos*** was increased, by a contract add-on. In the following years, the contract was continued as both parties were in accordance to cooperate due to results produced until that time (EMBRAPA and COOPERCENTRAL, 1996).
In 2003 from ***Embrapa Swine and Poultry*** to ***Aurora Alimentos*** set a new contract agreement, with the purpose of effort conjunction for the maintenance and enhancement of MS60 hog line, with a contract add-on. In the following years, the contract was continued again as both parties were in accordance to cooperate due to results produced until all that time (EMBRAPA and COOPECENTRAL, 2003).
Beyond the multiplication in the commercial hog breeders, MS60 boars have been served artificial insemination centers. Thus, this is a technology that was adopted by the private agents in the hog industry.
The ***Embrapa Swine and Poultry***'s researchers analyzed that the development of MS60, by which MS58 was substituted for, was turned possible due to the interaction with ***Aurora Alimentos***. In the contracting successively continuation between both parties, a post selling system was developed and improved, what was important for information flow in the R&D process in a research organization as well as for the innovation process at the cooperative and farmer levels. Due to this network spreading, in many different hog production regions, which have their own characteristics in the South of Brazil, specially, in the Santa Catarina State, MS58 and MS60 substituted pure races or other lines.

## 6. Final considerations

Most agricultural cooperatives concentrated on gross products stage of the value chain and entering into the higher value-added stages of processing is very knowledge demanding. Nevertheless, origination of agricultural products is a very complex and high technology content operation. Therefore, innovation is a crucial matter for farm cooperatives to keep their member producers competitive and to survive. Two critical success factors are highlighted for agricultural cooperatives to interact in an innovation process. Its ability to: i)

screen members, suppliers and clients; ii) search synergies of knowledge and capabilities externally; iii) interact, lobby, articulate, aggregate and contract, aiming the internalization the benefits from public goods, partnerships and strategic alliances. These partnerships and it relational contractual character seems to have a long term effect when dealing to R&D programs, and continuity is a great challenge in the coordination effort.

This essay brought many possibilities to be explored, from theory to cases, in which derives the notion that agricultural cooperative interaction with public research organization, in technology R&D programs, deserves a contextual innovation approach.

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