SUSTAINABLE DEVELOPMENT GOAL 8

DECENT WORK AND ECONOMIC GROWTH

CONTRIBUTIONS OF EMBRAPA

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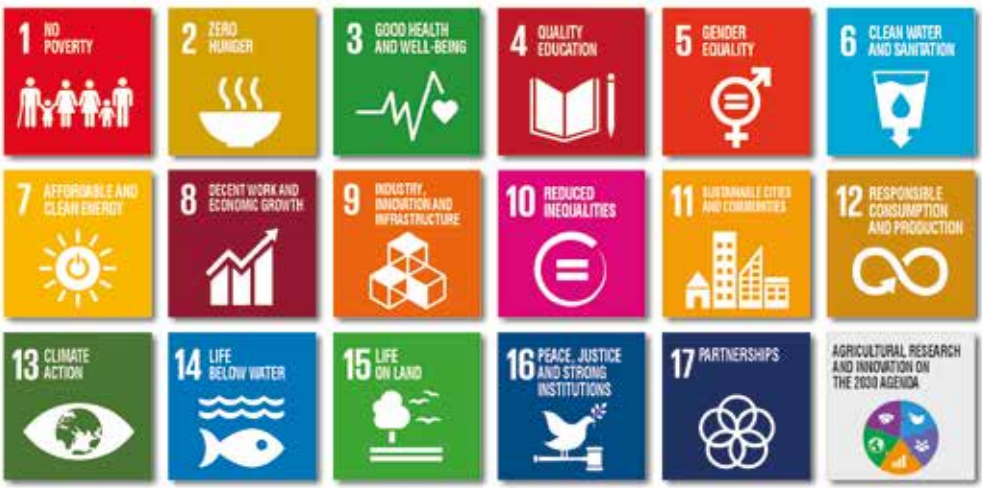
Technical Editors



Embrapa

Brazilian Agricultural Research Corporation
Ministry of Agriculture, Livestock and Food Supply

Sustainable Development Goal 8

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To our long-standing partners – governments, private, education, research, development and innovation institutions, non-governmental organizations and civil society – for the joint trajectory in favor of Brazilian agricultural development, which also reaches in several aspects the international sphere.

To the farmers who place their trust in our Embrapa and, together, work to offer, increasingly, decent jobs, which ennoble the sector and stimulate the new, more productive, efficient and inclusive New Rural.

To those who work for sustainable rural development in Brazil, thank you very much!

Foreword

Launched by the United Nations in 2015, 2030 Agenda for Sustainable Development is powerful and mobilizing. Its 17 goals and 169 targets seek to identify problems and overcome challenges that affect every country in the world. The Sustainable Development Goals (SDG), for their interdependent and indivisible character, clearly reflect the steps towards sustainability.

Reflecting and acting on this agenda is an obligation and an opportunity for the Brazilian Agricultural Research Corporation (Embrapa). The incessant search for sustainable agriculture is at the core of this institution dedicated to agricultural research and innovation. Moreover, sustainable agriculture is one of the most cross-cutting themes for the 17 goals. This collection of books, one for each SDG, helps society realize the importance of agriculture and food for five priority dimensions – people, planet, prosperity, peace and partnerships –, the so-called 5 Ps of 2030 Agenda.

This collection is part of the effort to disseminate 2030 Agenda at Embrapa while presenting to the global society some contributions of Embrapa and partners with potential to affect the realities expressed in the SDG. Knowledge, practices, technologies, models, processes and services that are already available can be used and replicated in other contexts to support the achievement of goals and the advancement of 2030 Agenda indicators.

This content presented is a sample of solutions generated by agricultural research at Embrapa, although nothing that has been compiled in these books is the result of the work of a single institution. Many other partners joined in – universities, research institutes, state agricultural research organizations, rural technical and extension agencies, the Legislative Power, the agricultural and industrial productive sector, research promotion agencies, in the federal, state and municipal ranges.

This collection of books is the result of a collaborative work within SDG Embrapa Network, which comprised, for 6 months, around 400 people, among editors, authors, reviewers and support group. The objective of this initial work was to demonstrate, according to Embrapa, how agriculture research could contribute to achieve SDGs.

It is an example of collective production and a manner of acting that should become increasingly present in the life of organizations, in the relationship

between public, private and civil society. As such, this collection brings diverse views on the potential contributions to different objectives and their interfaces. The vision is not homogeneous; sometimes it can be conflicting, as in society's vision about its problems and respective solutions, a wealth captured and reflected in the construction of 2030 Agenda.

These are only the first steps in the resolute trajectory that Embrapa and partner institutions draw towards the future we want.

Maurício Antônio Lopes
President of Embrapa

Preface

This work focuses on the Sustainable Development Goal (SDG) 8[1]: "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all."

This SDG has as core the working world – the worker – and economic development. It is composed of 12 targets, for three of them, in the context of Embrapa, provides technological solutions with the purpose of mitigating the highlighted problems, as well as a potential portfolio to contribute to sustainable development. This book is divided into six chapters, which discuss solutions developed by Embrapa, highlighting some more relevant examples, as well as indicating future challenges.

Chapter 1 highlights the importance of the Sustainable Development Goals (emphasizing SDG 8), briefly describing the historical evolution of nations' engagement and the need for State, society and private sector participation in inequalities reduction and in guaranteeing the economic, social and environmental sustainability of the planet.

Chapter 2 shows the main problems of Brazilian agribusiness linked to SDG 8, as well as the Brazilian challenges both to maintain the pace of economic growth and decent jobs generation, as well as food production increase in face of the world's need.

Chapter 3 presents some research and development solutions for target 8.2:

> Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors.

Chapter 4 refers to examples of EMBRAPA's participation in achieving the objectives of target 8.3:

> Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services.

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[1] Available at: <https://nacoesunidas.org/pos2015/ods8/>.

Chapter 5 provides examples of solutions to target 8.4:

> Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead.

Finally, Chapter 6 brings a brief analysis of the solutions mentioned in previous chapters and discusses the future challenges in which Embrapa's participation in the search for solutions will be extremely relevant.

By generating, transferring and diffusing technologies, Embrapa seeks to contribute directly to the economic growth of the agricultural sector and indirectly to its benefits to other sectors and to society as a whole. To do so, it has been focusing on sustainable job-creating solutions that provide a decent working environment for workers who will use their products (technologies, techniques, production systems, among others). In order to intensify its contribution both in job creation and in encouraging entrepreneurship, Embrapa has been expanding partnerships with institutions supporting micro and small enterprises as well as in sustainable agricultural production.

Technical Editors

Table of contents

Chapter 1

The context of sustainable economic growth

Sávio Barros de Mendonça
Nádia Solange Schmidt

Introduction

The scientific-technological advances experienced by humankind in the last 200 years, which represent more than 10,000 years of prehistory and human history in terms of quantitative and qualitative leap, are indisputable. The Industrial Revolution process, from the first steam engine in the 18th century, improved and, throughout the 19th century, served as a base to move vehicles, such as trains, as well as industrial machines, which would cause the great boom of technological advances in the 20th century. Advances in chemistry, physics and biology fields would represent paradigm breaks, which are crucial to development in various segments of the sciences, industries, as well as agriculture and the quality of life of human beings.

On the one hand, scientific, technological, agricultural and industrial advances brought comfort to everyday life on an increasingly urban planet, on the other hand, they caused a series of environmental impacts, largely with negative effects. Greenhouse gases emissions, the generation of environmentally harmful waste and effluents, the reduction of animal and plant biodiversity, hydrographic basin degradation, soil, water, noise and visual pollution and the contemporary life stress would put the human being in the dilemma between progress and the quest for life quality. In addition, social exclusion, hunger and malnutrition afflict millions of people in all continents.

The United Nations initiative with the *Stockholm Conference on the Human Environment* in 1972 resumed discussions on these issues that had begun in 1962, with the publication of Rachel Carson's *Silent Spring*, in which the author issued a warning on the agricultural use of synthetic chemical pesticides, highlighting the need to respect the ecosystem in which we live to protect human good health and the environment. This conference discussed on studies that indicated catastrophic predictions about the future of mankind, such as that cited in the Club of Rome's report, *Limits to growth* (Meadows et al., 1972). Generating new

technologies, with a high reducing effect on the use of mineral sources as energy resources, the considerable advances in food production due to technological packages linked to the Green Revolution, among other solutions, would put in question the dismal visions of the years 1960–1970, pointed out by Rachel Carson and the Club of Rome. However, *the United Nations Conference on Environment and Development* (*Rio-92*) would discuss the subject again.

The report *Our Common Future* by former Norwegian prime minister Gro Harlen Brundtland, in 1987, proposed a global agenda for change (Brundtland, 1987). This report, which was the *Rio-92* base document in Rio de Janeiro, emphasizes the need both to rethink the current development model deeply and to adopt living standards that promote sustainable economic growth, not only satisfying the current human needs, but also future generations. The concept of sustainable development was consolidated and would be the generator of a series of agreements, protocols and conventions, in an attempt to discipline the use of natural resources, waste management and promote social inclusion and decent work.

Sustainable Development Goals (SDG)

Rio+20, the *United Nations Conference on Sustainable Development*, in 2012, when assessing the progress made in the 20 years since *Rio-92*, concluded that few countries have advanced in some points, which showed a development far below the targets for the millennium and the concrete results for the more than 190 countries of the globe. This conclusion led to an unprecedented agreement on sustainable development priorities among the 193 UN member states. In this agreement, actions are planned in the areas of no poverty, food safety, agriculture, good health, education, gender equality, inequality reduction, energy, water and sanitation, sustainable production and consumption patterns, climate change, sustainable cities, protection and sustainable use of oceans and terrestrial ecosystems, inclusive economic growth, infrastructure, industrialization, and others (Achieving..., 2015).

The agreement is composed of 17 Sustainable Development Goals (SDG) and 169 targets to be achieved by 2030, and has a direct effect on the urgent need to increase food production and productivity, with nutritional quality, which presupposes the demand for more research and innovation, aiming at technological solutions that positively impact hunger and malnutrition reduction.

SDG 8 and its connection with agriculture

When analyzing all the SDG (The millennium..., 2015), there is a direct relation between some of these goals and agricultural activity and, therefore, the necessity to adopt public policies converging with these goals, which, in turn, demand research and innovation. Among them, in this chapter we highlight SDG 8: "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all." (United Nations, 2018).

The concept of "decent work" was formalized by the International Labor Organization (ILO) in 1999 and aims at promoting opportunities for men and women to obtain productive and quality work in freedom, equity, security and human dignity conditions, which are fundamental for overcoming poverty, reduction of social inequalities, guarantee of democratic governance and sustainable development (Agenda..., 2006).

In this context, SDG 8 has a strong relationship with productive chains linked to agriculture, since these chains generate employment and income and, consequently, direct economy impacts. In SDG 8, three targets stand out, which are more directly related to agriculture (United Nations, 2018):

> Targets
>
> 8.2 – Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors.
>
> 8.3 – Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services.
>
> 8.4 – Improve progressively, through 2030, global resource efficiency in consumption and production and endeavor to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead.

Overall, SDG 8 turns to economic investment measures, based on good practices of sustainable development and work. Its execution is of extreme relevance, since

it promotes economic development, based on human rights and sustainability. This practice is indispensable for the growth of a country, considering that decent work generates positive society returns, especially when associated with the maintenance of natural resources and the reduction of environmental impacts.

The enormous challenges for sustainable development are undeniable due mainly to growing inequalities within and between countries. There are huge disparities of opportunities, wealth and power. Unemployment is a major concern, as are natural disasters, natural resources depletion and the negative impacts of environmental degradation (desertification, drought, soil degradation, fresh water scarcity and biodiversity loss), jeopardizing the survival of mankind and biological systems.

In turn, every great challenge brings with it an opportunity. In the case of SDG 8, the opportunity translates into the development of solutions aimed at new options for work associated with economic and environmental sustainability. In conclusion, this points to the need for synergy between the government, society and the private sector, in order to improve workers' rights and institutional environment adequacy to encourage R&D investments that result in technological innovations, more jobs and sustainable development.

Final considerations

Brazil seeks a balance between internal policies and its international commitments, which are the hallmarks of Embrapa's institutional mission. Some of the concrete examples are: the Plano Setorial de Mitigação e de Adaptação às Mudanças Climáticas para a Consolidação de uma Economia de Baixa Emissão de Carbono na Agricultura (Sectoral Plan for the Mitigation and Adaptation to Climate Change for a Low-Carbon Emission Agriculture – ABC Plan) and the national policy of agroecological and organic production, present in several Embrapa actions, aimed at the promotion and generation of sustainable solutions for the agricultural sector (Embrapa, 2015).

Another outstanding example of Embrapa's performance aligned with SDG 8 is the integrated crop-livestock-forestry system (ICLFS), a strategy that combines productivity increase with natural resources conservation in already deforested areas that undergo an intensification of their uses. ICLFS's main goal is to change the land use system based on the integration of the components of the production system, in order to achieve ever-higher levels of product quality, environmental

quality and competitiveness. ICLFS presents itself as a strategy to maximize desirable effects on the environment, combining increased productivity with the conservation of natural resources in the intensifying process of use of areas already deforested.

However, the scarcity scenario of public resources for research, combined with large, global changes in which knowledge, technology and intellectual property rights play a relevant role, results from a growing public-private sector approach through public-private partnerships. Thus, it is increasingly evident that partnership with the private sector in search of solutions to the major challenges will be the key element in achieving competitive advantages for the markets. Therefore, the intensification of relations between the public and private sectors could become a relevant agent for Brazil to fulfill the commitments assumed in this agreement (Lopes, 2017).

Finally, it is important to point out that scientific and technological organizations, such as Embrapa, have a fundamental participation in innovation for sustainable development, considering its role in society as the largest Brazilian institution for agricultural research. In order to achieve this, Embrapa has developed research and innovation projects aimed at complying with the SDG and its various targets, seeking to overcome obstacles to reach the proposed target up to 2030.

References

ACHIEVING zero hunger: the critical role of investments in social protection and agriculture. Rome: FAO, 2015. Available at: <http://www.fao.org/3/a-i4951e.pdf>. Accessed on: Mar. 17, 2018.

AGENDA nacional do trabalho decente. Brasília, DF, 2006. Available at: <http://www.ilo.org/wcmsp5/groups/public/---americas/---ro-lima/---ilo-brasilia/documents/publication/wcms_226229.pdf>. Accessed on: Mar. 17, 2018.

BRUNDTLAND, G. R. **Our common future**. 1987. Report of the World Commission on Environment and Development. Available at: <http://www.un-documents.net/wced-ocf.htm>. Accessed on: Mar. 17, 2018.

EMBRAPA. Secretaria de Gestão e Desenvolvimento Institucional. **VI Plano Diretor da Embrapa**: 2014-2034. Brasília, DF, 2015. 24 p. Available at: <https://www.embrapa.br/documents/10180/1600893/VI+Plano+Diretor+da+Embrapa+2014-2034/7f0c7f31-b517-4621-8083-6450224d2f4e>. Accessed on: Mar. 17, 2018.

LOPES, M. A. O Brasil na agenda global de desenvolvimento sustentável. **Notícias**, 12 set. 2017. Available at: <https://www.embrapa.br/busca-de-noticias/-/noticia/26823665/artigo---o-brasil-na-agenda-global-de-desenvolvimento-sustentavel>. Accessed on: Mar. 17, 2018.

MEADOWS, D. H.; MEADOWS, D. L.; RANDERS, J.; BEHRENS III, W. W. **The limits to growth & a report for The Club of Rome's project on the predicament of mankind**. New York: Universe Books, 1972.

THE MILLENNIUM development goals report. New York: United Nations, 2015. Available at: <http://mdgs.un.org/unsd/mdg/Resources/Static/Products/Progress2015/English2015.pdf>. Accessed on: Mar. 17, 2018.

UNITED NATIONS. **Sustainable development goal 8**: promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. Available at: <https://sustainabledevelopment.un.org/sdg8>. Accessed on: Mar. 17, 2018.

Chapter 2

Demands and opportunities for sustainable growth

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Introduction

The promotion of sustained economic growth and the generation of decent work, central points of SDG 8, are directly related. Economic growth occurs due to an increase in the total volume of goods and services produced in an economy, through a positive variation of productive capacity, in order to meet human needs. In turn, one of the main variables that characterize the economic growth process is the employment level. Sustainable economic growth is associated with caring for social and environmental issues for current and future generations. Thus, for economic growth to occur in a sustainable way, it is necessary to create conditions that allow people to have quality jobs and stimulate the economy, without damaging the environment.

Projections for 2050 show a world population around 10 billion inhabitants (World..., 2017) so food production becomes critical – and strategic – especially for Brazil, which has the potential to become a major producer and food supplier. In this context, there is the challenge of maintaining sustainable per capita economic growth, i.e., in proportion to socioeconomic development, especially labor.

The role of agriculture for sustainable growth

Brazilian agricultural production has the challenge of keeping to develop, in order to meet the demands of food, fiber, energy and other raw materials for both the green chemistry and process industries, and to generate surpluses for export, in order to contribute to global food and energy security. However, it is necessary that meeting current demands does not jeopardize future generations.

Dealing with this challenge requires professional qualification linked to the entrepreneurship culture, in order to take better advantage of the opportunities

that the new business dynamics, both urban and agricultural, have made available (Buainain et al., 2014).

Technological changes have been taking place at an ever-faster pace. This fact signals a huge challenge for rural extension and technical assistance, which need to decode the knowledge generated by the research or by the farmers themselves into technologies that most rural producers can adopt on their different conditions.

Throughout this modernization process of Brazilian agriculture, in some situations, the passive differences between agricultural production and the environmental and social issues persist, leading to efforts to advance sustainability. These liabilities mainly concern the following problems: a) low efficiency in the use of global resources, leading to inefficiency of production processes, reflecting on production costs and final consumer prices, also reducing the supply of these resources, which, if better used, would be input to other productive processes; b) non-conscious consumption, i.e., not identifying items such as the origin of the product, the way it is produced and what inputs were used, focusing (here, the final consumer of the good or service) rather on the "paid price" than in the sustainability of the production process; c) lack of an effective national plan for sustainable economic growth aimed at minimizing environmental damage, coupled with positive socioeconomic impacts.

Another important point now is the exit of process elimination of those producers who have been marginalized by technological revolutions, regardless their scale of production. Alves et al. (2012) illustrate it by indicating the concentration of agricultural product (income) in proportionally few establishments. About 500,000 properties, out of approximately 5.2 million, accounted for 87% gross income of the sector. In addition, in 2030, Brazilian rural population will probably decrease to about 10% of the total population (Indicadores..., 2011). This demographic scenario has direct effects on the production characteristics, which will need to be more automated and mechanized to accommodate population aging and increase labor productivity. This new population profile will require special attention to production models and their impacts on social and environmental dimensions, in addition to economic and nutritional issues (Buainain et al., 2014).

This demographic trend in several regions (aging and steady migration of rural population to cities) points out that the labor availability for work in agriculture tends to become increasingly scarce. In addition, with the intensification of climatic changes, the planting conditions, such as temperature, precipitation,

soil humidity, will require more accuracy in the conduct of various agricultural practices.

Despite the success of Brazilian agriculture, the adoption of modern technologies still affects a limited contingent of producers. A more productive inclusion requires greater investment and innovative strategies in the creation and transfer of knowledge and technology. Above all, this will help the most vulnerable producers to participate in this growth path.

Among other factors, mechanization and automation will play a role in the coming decades in response to population aging (World..., 2013); to the migration from rural areas to cities and the reduced or insufficient contingent of young labor in the field; as well as to education limitations in several countries (as in Brazil). These processes together contribute to the shortage of skilled workers in the field. Increasing both the supply and the adoption of these technologies in rural areas are a decisive factor in increasing the productivity of work in the field (Contini et al., 2010), besides making agriculture more attractive to young people compared to the offered, or expected options in the urban area. Research and innovation systems should be prepared to respond to more multidisciplinary agriculture and to the challenge of young labor force migration to the cities.

The multifaceted characteristic of Brazilian agriculture (food safety, bioenergy, climate changes, green chemistry, rural development, international trade agreements, among others), with information processed faster and challenges that do not respect national borders (pests, diseases, climate changes, among others), reinforces the dependence on knowledge, technology and innovations. All these facts highlight the urgency of a broad effort to technology transfer and rural extension, so as to allow greater inclusion of technological and productive innovations in the field.

An inexorable fact is that the agricultural sector will be increasingly pressured to broaden efficiency in the use of fertilizers, agrochemicals and other inputs and resources, especially water. It is necessary to produce more, with an optimal level of inputs utilization, or produce the same quantity with a lower level of inputs.

The quest for continuous improvement of productivity and efficiency of economies should consider increasing formalization (and empowerment) of micro and small enterprises, always focusing on decent employment of human capital.

Final considerations

Therefore, research and innovation companies on agriculture have the potential to contribute to job generation and economic growth without harming future generations. Embrapa plays an important role in this process, contributing to the agriculture sector in general, through technological solutions, training and/or support to public policies formulation. The results of these contributions can be materialized through productivity, quality, and value-added gain, or solutions to the sector problems, among other factors.

It is important to remember that agriculture also contributes to the generation of urban jobs, such as suppliers of machinery and inputs in the logistics, agroindustry and marketing sectors. Therefore, by supporting productive activities, agricultural research activates the multiplier effects throughout the economy. In addition, this potential goes beyond the generation of traditional agricultural jobs. The new interactions that take place in innovation systems, marked by the involvement of diverse actors, as well as by innovation in products and processes, entrepreneurship and creativity and, mainly, by intensive use of Information and Communication Technologies, take the results of agricultural research farther away, generating jobs in many sectors.

References

ALVES, E.; SOUZA, G. S.; ROCHA, D. P. Lucratividade da agricultura. **Revista de Política Agrícola**, ano 21, n. 2, p. 45-63, 2012.

BUAINAIN, A. M.; ALVES, E.; SILVEIRA, J. M. da; NAVARRO, Z. (Ed.). **O mundo rural no Brasil do século 21**: a formação de um novo padrão agrário e agrícola. Brasília, DF: Embrapa, 2014. 1182 p.

CONTINI, E.; GASQUES, J. G.; ALVES, E.; BASTOS, E. T. Dinamismo da agricultura brasileira. **Revista de Política Agrícola**, ano 19, p. 42-64, 2010.

INDICADORES sociais municipais: uma análise dos resultados do universo do censo demográfico 2010. Rio de Janeiro: IBGE, 2011. (Estudos e pesquisas informação demográfica e socioeconômica, 28).

WORLD population prospects: the 2012 revision: highlights and tables. New York: United Nations Population Division, 2013.

WORLD population prospects: the 2017 revision. New York: United Nations, 2017. Available at: <https://esa.un.org/unpd/wpp/publications/Files/WPP2017_KeyFindings.pdf>. Accessed on: Dec. 13, 2017.

Chapter 3

Increasing productivity and improving the conditions of the rural worker

Espedito Cezário Martins
José Pedro Pereira Trindade
Leandro Bochi da Silva Volk
Loiva Maria Ribeiro de Mello

Introduction

This chapter addresses the target of SDG 8.2, which advocates,

> Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labor-intensive sectors (United Nations, 2018).

Embrapa generates knowledge and technological assets for the sustainability of Brazilian agriculture, whose main objective is the incessant search of new paradigms of economic development. Thus, increasing productivity with technological solutions that contribute to the economic growth of agricultural sector, coupled with the improvement of rural working conditions, must meet the guiding principles of sustainable development proposed by Sachs (1993). Namely: meet the basic needs of citizens; be supportive of future generations; seek the effective participation of the population involved, which is constituted by the true actors of the development process; have as a target the incessant search for the preservation of natural, renewable and/or non-renewable resources, as well as the environment in general; create a social system that guarantees stable work, with decent remuneration for all, social and personal security, and cultural preservation; and promote educational projects and plans at all levels, for the entire population.

Embrapa is concerned to reach these paradigms, whose main aspect is social well-being, so it develops technologies and technological solutions for the economic growth of the Brazilian agricultural sector, emphasizing the main problems of the rural population. Thus, it is important to search for solutions to the chronic problems of Brazilian agriculture, such as low margins of commercialization

of small-scale farm products, short-term sales concentration, production surplus risk with the consequent price deterioration, difficulty in placing products on the market, among others. Thus, it is necessary to implement technological solutions that add value to the final product with improved income for families, production diversification, opportunities for new market niches for agricultural products that were not commercially exploited, development of more productive new cultivars, geographic indications, use of collective trademarks, access to new markets and improvement of products and processes, among others.

Technological solutions for the economic growth of the agricultural sector

Embrapa annually publishes its social report, in which registers the main actions developed by its various research centers, for the benefit of its internal collaborators, the communities where it operates and the Brazilian society. The social report documents the economic, social and environmental impacts of the technologies developed by Embrapa and adopted by the Brazilian society. Some examples of these technological assets that contribute to the sustainability of Brazilian agriculture, which have been registered for more than 2 decades, are based on: more productive and nutritious plant cultivars that are resistant to pests, diseases and bad weather; more productive and adaptable to different environments animal breeds; new machinery, equipment and production systems; computer programs and applications; new cultivation processes, animal production and pest and disease control; geographic information systems to map regions and monitor land use; among others. Some examples of technological solutions developed by Embrapa that contributed to the economic growth of Brazilian agriculture, such as the integrated crop-livestock-forestry system (ICLFS); Integrated Soybean Pest Management (IPM-Soybean); the efficient water use in irrigated rice production; the Management of Milk Production Systems (Gisleite); the Carbon Neutral Brazilian Beef concept, among others, are available on the technological solutions page on the Embrapa's web portal.

The economic impacts generated by the 117 technologies and around 200 cultivars published in Embrapa's social report sheet in 2017 (base year 2016) showed that the it obtained a social profit of US$ 10.71 billion[1]. Net operating

[1] Values related to December 30, 2016: US$ 1.00 corresponded to R$ 3.2585 (Taxa…, 2016).

revenue resulted in a benefit-cost ratio of 11.37, that is, each dollar invested in Embrapa generated US$ 11.37 for Brazilian society (Embrapa, 2017).

When analyzing the returns of investments made by Embrapa in the generation of technologies monitored and evaluated since 1997, investing in research is a good business, given that, in 2016, the average internal rate of return (IRR) of Embrapa's investments were 38.2%, indicating high profitability compared to the return of most of the investments and financial applications available in the market. This high profitability rate shows that Embrapa is important for the economic growth of Brazilian agriculture, since this indicator significantly influences the composition of the economic growth index.

Another indicator that attests the significant contribution of Embrapa to the economic and social growth of Brazilian agriculture is the new job generation index. In the last decade, 775,238 new jobs were generated due to Embrapa technologies analyzed in the social report sheet. This is a parsimonious value, since it refers only to the number of new jobs created each year only by the analyzed technologies. As Embrapa has traditionally been developing job-creating technologies, the real number of generated jobs is actually much higher.

With regard to productivity, Embrapa has developed throughout its existence a range of technologies that enabled a substantial increase in the productivity of Brazilian agriculture. The 2016 social report lists only a sample of successful cases, which in this chapter will be used as examples. Nevertheless, the number of technologies and technological solutions and/or processes developed by Embrapa, which contribute to the increase of the Brazilian agricultural productivity, is much greater.

In 2016, the technologies that contributed to increase the average productivity of national agriculture and food supply for the Brazilian population generated an economic impact of approximately US$ 4.30 billion (Embrapa, 2017). As an example of success, the new passion fruit cultivars stand out, including hybrids BRS Gigante Amarelo and BRS Sol do Cerrado, which, besides being more palatable, have generated employment and income. The average productivity of Brazilian passion fruit trees is 14 t/ha, and these new cultivars reach the level of 40 t/ha. Another example is the implementation of acai handling technology, which allowed doubling its production and requiring very little resource input, thus benefiting the population of riverine and extractive people in Amazon. In both examples, Embrapa contributed decisively to increasing the export of these products.

Still related to productivity increase, the BRS Amélia sweet potato cultivar stands out; besides being tasty, it promotes food safety and increases producers' incomes. Its average productivity is 32 t/ha, that is, 2.36 times higher than the average production in Brazil. BRS Estribo Johnson grass, which, in addition to being more productive, has a high tilling capacity, presence of a thinner stem, flexible handling for continuous or rotational grazing conditions, and a longer cycle of use.

Technological solutions for improving working conditions in agricultural production

Sustainable agricultural production implies the increasing use of technologies dedicated to improving working conditions, a constant Embrapa concern.

Concerned with the reduction of exhaustive work and the elimination of unhealthy and inadequate activities in agricultural production, Embrapa has been continually developing technologies aimed at improving working conditions in Brazilian farming production, especially with regard to activities that require intensive labor use and increase worker productivity.

An example is the upright compact classifier (Figure 1), which was developed for fruit improvement and classification for small and medium producers. This equipment reduces the painfulness of the work in the classification process and does not require water use. These aspects make it possible to increase work efficiency and improve conditions in the conduction of productive activity (Classificadora..., 2015).

The table for vegetable selection (Figure 2) is another technology that enables the improvement of the productive process of vegetables, with reduction of labor pain and labor costs (Lana, 2014). The following examples are also worthy seeing: threshing machines for rice and bean crops (Silva et al., 2002); Sembra 2000 (Sembra..., 1999), a specific sowing system for direct planting system in small and medium-scale farms, aiming at the sowing of crops such as maize, bean and soybean, which provides increases in the productive process, soil protection and work quality; and the stationary cotton mini power plant, technology developed to ginning cotton (Silva et al., 2000).

The advances in the use of Information Technology (IT) and in the development of new technologies and tools represent an important tool for improving working

Photo: Letícia Longo

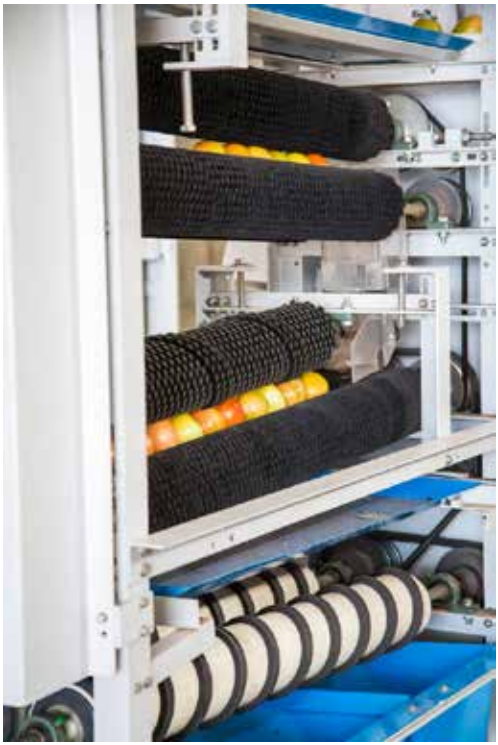

Figure 1. Upright compact classifier.

Photo: Lana Milza Moreira

Figure 2. Table for vegetable selection.

conditions in rural areas, since they ease access to new technologies that improve rural workers and their families' conditions. Besides the developed applications (programs), such as Códex and Agritempo GIS, both developed by Embrapa (Embrapa Informática Agropecuária, 2017).

The technologies associated with precision agriculture can be aid tools in the planning and execution of productive activities of rural producers of different scales, reducing risks and providing the well-being of their families. An example that applies to all farmers, regardless of the productive scale, is the Automatic Field Weighing System with remote data transmission (Figure 3), developed in partnership with the Federal University of Mato Grosso do Sul and with Comércio e Indústria de Madeiras e Metalúrgica São Cristóvão Ltda. (Coimma). Such technology allows the replacement of collection of animals for weighing, as well as labor reduction for the weighing of animals and, consequently, of the risks inherent to the activity (Embrapa Gado de Corte, 2017).

Some rural activities involve risk, such as green coconut water extraction and peeling Brazil plum process. With the intention of reducing risk in these activities, Embrapa developed the mechanical extractor of green coconut water (Abreu, 1999) and the Brazil plum fruit peeler (Anjos; Cavalcanti, 2001). The latter is

Photo: Coimma Collection – unidentified photographer

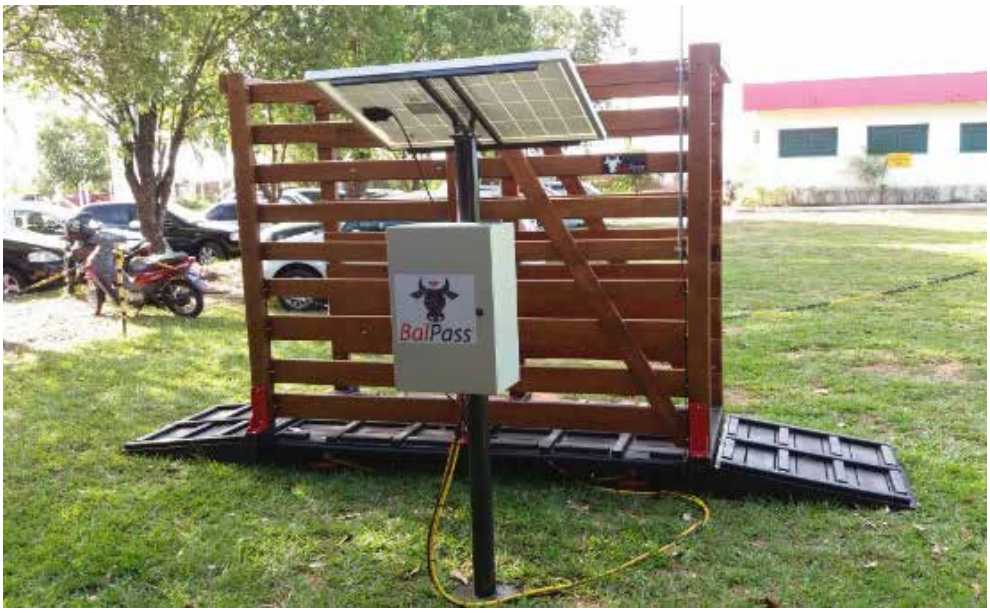

Figure 3. Automatic Field Weighing System.

equipment that aims to take advantage of the bark with the minimum hand contact of the handler with the raw material.

Embrapa also participates actively in regional development programs that contribute in an effective way to the socioeconomic and environmental development of the Brazilian agricultural sector. Examples are the delimitation of the geo-economic region of Matopiba (acronym of the initials of the states of Maranhão, Tocantins, Piauí and Bahia); geographical indications, which organize production, promote development and add value to products; the Rota do Cordeiro Program and the Estradas das Araucárias Project, developed in the states of Paraná and Santa Catarina. In the latter, the producer receives US$ 307.13 per year until Brazilian pine begins the production of pine nuts, as a way of increasing the income of smallholders, as well as stimulating rural tourism and preserving the environment.

Final considerations

Embrapa contributes significantly to sustainable development by increasing the productivity of Brazilian agriculture, providing technological innovations that reduce labor pain and promote better working conditions for the rural population.

The same technology addresses, directly or indirectly, several dimensions of sustainable development, in the economic, social or environmental spheres. Thus, the same technology can contribute to the achievement of several targets of several sustainable development goals. This chapter considered the impacts of technologies on economic growth and rural work issues, clearly showing some Embrapa contributions.

References

ABREU, F. A. P. de. **Extrator de água-de-coco verde**. Fortaleza: EMBRAPA-CNPAT, 1999. (EMBRAPA-CNPAT. Comunicado técnico, 34). Available at: <http://ainfo.cnptia.embrapa.br/digital/bitstream/item/33806/1/Ct-034.pdf>. Accessed on: Feb. 2, 2018.

ALVES, B. J.; ROMANI, L. A. S.; OTAVIAN, A. F. AgritempoGIS: um aplicativo para auxiliar agricultores em processos de tomada de decisão. In: MOSTRA DE ESTAGIÁRIOS E BOLSISTAS DA EMBRAPA INFORMÁTICA AGROPECUÁRIA, 12., 2016, Campinas. **Resumos expandidos**... Brasília, DF: Embrapa, 2016. p. 35-41. Available at: <http://ainfo.cnptia.embrapa.br/digital/bitstream/item/156332/1/PL-Mostra-AgritempoGIS.pdf>. Accessed on: Feb. 2, 2018.

ANJOS, J. B. dos; CAVALCANTI, N. de B. **Descascador de frutos de umbu**. Petrolina: Embrapa Semi-Árido, 2001. 2 p. (Embrapa Semi-Árido. Comunicado técnico, 115).

CLASSIFICADORA vertical compacta. São Carlos, SP: Embrapa Instrumentação, 2015. Flyer.

EMBRAPA GADO DE CORTE. **Soluções tecnológicas**: balança de passagem – BalPass. Campo Grande, MS, 2017. Available at: <https://www.embrapa.br/busca-de-solucoes-tecnologicas/-/produto-servico/4214/balanca-de-passagem---balpass>. Accessed on: Dec. 12, 2017.

EMBRAPA INFORMÁTICA AGROPECUÁRIA. **Soluções técnológicas**: software. Available at: <https://www.embrapa.br/informatica-agropecuaria/busca-de-solucoes-tecnologicas>. Accessed on: Feb. 2, 2018.

EMBRAPA. Secretaria de Comunicação. Secretaria de Gestão e Desenvolvimento Institucional. **Balanço social 2016**. Brasília, DF, 2017. Available at: <http://bs.sede.embrapa.br/2016/arquivo.html>. Accessed on: Dec. 12, 2017.

LANA, M. M. **Hora da colheita**: hora de cuidar do seu produto e de você: mesas para seleção de hortaliças. Brasília, DF: Embrapa Hortaliças, 2014. (Embrapa Hortaliças. Comunicado técnico, 99).

SACHS, I. Estratégias de transição para o século XXI. In: BURSZTYN, M. **Para pensar o desenvolvimento sustentável**. São Paulo: Brasiliense, 1993. p. 29-56.

SEMBRA 2000: plantio direto para a pequena propriedade. Ibirubá: SFIL; Passo Fundo: Embrapa Trigo, 1999. 1 folder, 4 p.

SILVA, J. G. da; SOARES, D. M.; SILVEIRA, P. M. da. **Trilhadoras de arroz para pequenas lavouras**. Santo Antônio de Goiás: Embrapa Arroz e Feijão, 2002. 2 p. (Embrapa Arroz e Feijão. Circular Técnica, 53). Available at: <http://ainfo.cnptia.embrapa.br/digital/bitstream/CNPAF/20447/1/circ_53.pdf>. Accessed on: Dec. 12, 2017.

SILVA, O. R. R. F. da; CARTAXO, W. V.; CARVALHO, O. S.; ARAÚJO, J. M. de. **Mini-usina de beneficiamento de algodão de 50 serras e prensa hidráulica, uma alternativa para associação de pequenos produtores**. Campina Grande: Embrapa Algodão, 2000. 5 p. (Embrapa Algodão. Comunicado técnico, 128).

TAXA de câmbio comercial para compra: real (R$) / dólar americano (US$) - média. Available at: <http://www.ipeadata.gov.br/ExibeSerie.aspx?serid=38590&module=M>. Accessed on: Dec. 30, 2016.

UNITED NATIONS. **Sustainable development goal 8**: promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. Available at: <https://sustainabledevelopment.un.org/sdg8>. Accessed on: Mar. 17, 2018.

Chapter 4

Policies for sustainable agricultural development

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Introduction

This chapter addresses target 8.3:

> Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services (United Nations, 2018).

This is one of the targets of SDG 8 that is considered relevant within the scope of Embrapa's performance as a research and innovation corporation for the agricultural sector.

One of Embrapa's basic functions is to generate public value and, in accordance with the principles and values declared in its mission and vision, to act in research, development and innovation, regarding the sustainability search (Embrapa, 2015). Public or private policies formulated, proposed, adopted and/or encouraged by Embrapa have some direct or indirect relationship with target 8.3, through the generation and maintenance of decent jobs and sustainable economic growth in the agricultural sector.

Embrapa has been working on policies that include not only participation in public hearings aimed at discussing objectives, definitions, targets and parliamentary advice, but also the realization of projects to provide good practice standards, maps and bulletins related to zoning and climate, in order to guide agricultural production and offer technologies for productive arrangements. In addition, Embrapa seeks to engage in issues related to current topics, such as climate change and renewable energy (Araujo; Gazoola, 2017).

Embrapa's participation in these policies relies on extensive networking, ranging from surveying the demands of the sectors and concerned communities (forums, committees, technical chambers, participatory workshops) to networking with universities, public and private companies, non-governmental organizations (NGOs), as well as project implementation, monitoring and evaluation.

To demonstrate Embrapa's performance in policies and in accordance with target 8.3, some examples are presented next.

Policies for family farming

Policies related to family farming are essential, as it is estimated that about 60% of the food consumed in Brazil and in the world comes from small and medium-scale farmers. In addition, small and medium-scale agriculture is an important employment source because it is intensive labor and because 74.4% of people employed in Brazilian agriculture come from family establishments (Embrapa, 2014). By virtue of these aspects, family farming is fundamental for the balance of populations and for development between rural and urban environments.

Policies related to family farming are also necessary for being a fragile sector due to several factors, such as lack of economic resources, lack of access to training and information, lack of technical assistance and adequate technologies, difficulty in organizing, among others. Despite the difficulties, family farming must be seen for what it represents for sustainable development. In addition to its importance in sustainable food production and food sovereignty of family farming, it relates to the diversification of the productive matrix in the different biomes and ecosystems, having a strategic role in maintaining biodiversity and in the search for technological formats less dependent on external inputs (Embrapa, 2014). With adequate policies for training access, for information and technologies, small and medium-scale producers can become entrepreneurs, not only by producing food in sufficient quantity and quality for the growing demand, but also by adding value to the products and by participating in the development process.

United Nations Food and Agriculture Organization (FAO) declared 2014 as the International Year of Family Farming (IYFF), which was important for the worldwide consolidation, dissemination and recognition of the importance of this segment. Embrapa has held more than 400 events related to the subject and continues to develop important projects as well as participating in public policies on the subject.

Embrapa participated in several policies, laws and regulations related to family farming, such as:

a) Política Nacional de Assistência Técnica e Extensão Rural na Agricultura Familiar e na Reforma Agrária (National Policy of Technical Assistance and Rural Extension on Family Farming and Land Reform – Pnater) – Law 12.188/2010 (Brasil, 2010). Pnater's objective is to provide educational technical assistance, develop rural extension for young farmers, in order to expand family farming opportunities. Embrapa participated in the elaboration of this law and in the actions to reach the objectives.

b) Programa Estadual de Desenvolvimento da Pecuária de Corte Familiar (State Program of Family Development of Beef Cattle – Pecfam) – Law 13,515/2010 (Rio Grande do Sul, 2010). Pecfam was developed through a partnership between the Department of Rural Development, Fisheries and Cooperativism of the State of Rio Grande do Sul (SRD/RS), the Association of Technical Assistance and Rural Extension Enterprises of Rio Grande do Sul (Emater-RS) and Embrapa Southern Livestock. This program aims to increase the productivity and income of family cattle ranchers and rural territorial development. Embrapa participated in the demand collection, law formulation, training of family technicians and cattle ranchers and implementation of Participatory Experimental Units (Uepas).

c) Plano de Ações Mais IDH do Estado do Maranhão (Action Plan More HDI of the State of Maranhão) – The government of Maranhão selected the Sistema Integrado de Produção de Alimentos na Agricultura Familiar (Integrated System for Food Production in Family Farming – Sisteminha Embrapa), developed by Embrapa Mid-North, as one of the technologies to be implemented in the state. Ninety technicians were trained and Family Learning Units (Uefas), contemplating the *Sisteminha* in the 30 municipalities with the worst HDI indicators. This action plans to contribute to the food sovereignty of families by generating family farmer products.

d) Plano Brazil Sem Miséria (Brazil without Misery Plan – PBSM) – Established by Decree 7,492/2011 (Brasil, 2011), it aims to overcome extreme poverty, acting on three axes: income guarantee, public services access and productive inclusion. Embrapa integrated the institutional arrangement in the axis of rural productive inclusion in 14 Territories of the Citizenship of the semiarid region. It involved 11 Embrapa Decentralized Units in 12 territorial projects and 5 transversal projects.

Policies to encourage entrepreneurship: startups' challenges

Embrapa, in accordance with policies to promote Brazilian entrepreneurship, creativity and innovation in agriculture (important elements mentioned in the scope of target 8.3), coordinated, in partnership with several private and public entities, the startups challenges, such as *Vacathon*, *Ideas for Milk* and *Hackathon*.

Vacathon and *Ideas for Milk* were some of the first startups challenges aimed at Brazilian agribusiness. *Hackathon* was the first challenge organized by Embrapa nationwide. It was held in 2017 (Embrapa, 2017) in five municipalities of different states simultaneously and involved five Embrapa Units. Each Unit proposed its challenge topic, which was conducted together with universities for students to develop proposals for web software, mobile applications and/or hardware solutions, such as Internet of Things (IoT) devices, related to the topics.

As a result, these challenges brought together ideas, investors and market demands, integrated agribusiness and Information and Communication Technologies (ICT) stakeholders, as well as stimulating agribusiness innovation and entrepreneurship and promoting the applied use of agricultural research results. In addition, identifying innovative solutions with the potential to generate profitable business benefited competing teams (e.g., *Hackathon* had 260 participants in 69 teams), through business proposals and solutions improvement. From the interactions that started at the events, several competitors improved their ideas and were able to present them to important ICT companies or to potential users in the chain. In turn, the production chain was benefited, as the created interactions established strong bases for the development of the innovation ecosystem around agribusiness.

Policies on Agricultural Zoning on Climate Risk

Developed by Embrapa and partner institutions, the Zoneamento Agrícola de Risco Climático (Zoning Agricultural Risk Assessment – Zarc) method is the main technical-scientific instrument to support the formulation and implementation of public policy of risk management in Brazilian agriculture, whose legal framework was established by Law 8,171/1991 (Brasil, 1991), and its operationalization has been officially conducted since 1996 by the Ministry of Agriculture, Livestock and Food Supply (Mapa). Through Zarc, obtaining indications of the best regions, cultivars, varieties and sowing periods is possible with lower risk of losses in each municipality, according to the historical analysis of climate behavior.

When operationalized in an integrated manner with the official rural credit and agricultural insurance policies, such as the Programa de Garantia da Atividade Agropecuária (Agricultural Guarantee Program – Proagro) and the Programa de Subvenção ao Prêmio do Seguro Rural (Rural Insurance Grant Program – PSR), it is possible to rationalize the use of public resources and stimulate the adequate application of available technologies, promoting a significant risk reduction of loss and productivity and income increase of the producers. Zarc is submitted annually to reviews with the Embrapa participation, and its updates are published as ordinances, in the Official Gazette of the Union and on Mapa website. Currently, the studies include 40 crops, of which 15 are of annual cycle and 24 are permanent, in addition to zoning for maize intercropping with brachiaria, reaching 24 states.

Environmental and territorial development policy

The Plano Setorial de Mitigação e de Adaptação às Mudanças Climáticas para a Consolidação de uma Economia de Baixa Emissão de Carbono na Agricultura (Sector Plan for Climate Change Mitigation and Adaptation for the Consolidation of a Low Carbon Economy in Agriculture – ABC Plan) is a public policy that presents the details of mitigation and adaptation actions to climate change to the agricultural sector, as well as to show how Brazil intends to comply with the commitments of reduction emission of greenhouse gases (Plano..., 2012). Its period of validity is from 2010 to 2020, and revisions and updates are scheduled in regular periods, not exceeding 2 years, to re-adapt it to society demands, to new technologies and to incorporate new actions and targets, if necessary.

ABC Plan consists of seven programs, six of which relate to mitigation technologies and one climate change adaptation actions: 1) Recovery of Degraded Pastures; 2) Integrated Crop-Livestock-Forestry System (ICLFS) and Agroforestry Systems (AFS); 3) No-Tillage System (NTS); 4) Biological Nitrogen Fixation (BNF); 5) Planted Forests; 6) Treatment of Animal Waste; 7) Climate Change Adaptation. Therefore, it is a wide-ranging program closely related to population resilience and maintenance of work and productive capacity in the face of climate change.

The steering committee of the ABC Platform is composed of representatives of Mapa, Ministry of the Environment (MMA) Ministry of Science, Technology, Innovation and Communications (MCTIC) and Embrapa, as well as members of civil society and the private sector, Banco do Brasil and the Brazilian Development Bank (BNDES). The committee coordinates and evaluates the progress of the platform's implementation and maintenance policies.

Industrial policy

In 2004, the Marco Regulatório do Biodiesel (Biodiesel Regulatory Framework) was created, after the development of the Programa Nacional de Produção de Biodiesel (National Biodiesel Production Program – PNPB). Law 11,097/2005 (Brasil, 2005), which gave the initial step for the Brazilian biodiesel production, by defining a minimum percentage of biodiesel blend in diesel. Thus, the adjustment to the program became mandatory for producers, distributors and assemblers. Currently, B8 is in effect (8% blend biodiesel in diesel). In March 2018, the mix became 10%. Since 2007, Embrapa Agroenergy has been contributing to this public policy through articulations with the following institutions: União Brasileira do Biodiesel e Bioquerosene (Brazilian Union of Biodiesel and Biokerosene – Ubrabio), Associação dos Produtores de Biodiesel (Association of Biodiesel Producers – Aprobio), Frente Parlamentar do Biodiesel do Congresso Nacional (Parliamentary Biodiesel Front in the National Congress), Comitê Interministerial de Biodiesel da Casa Civil (Interministerial Committee on Biodiesel of the Civil House), Associação Brasileira de Óleos Vegetais (Brazilian Association of Vegetable Oils – Abiove), Ministry of Industry, Foreign Trade and Services (MDIC), Mapa, Ministry of Foreign Affairs (MRE), MMA and MCTIC. Embrapa also contributes strongly to research, studies and analyzes, helping and reinforcing the production chain importance and the biodiesel blend increase.

Final considerations

The examples in this chapter are only a small sample of the policy spectrum in which Embrapa operates. It has been increasingly recognizing the importance of active participation in the elaboration and implementation of policies in the sector, based on the assumption that agricultural research has an ethical commitment to society and sustainable development.

In addition, Embrapa has been increasingly demanded by the government and the legislative to contribute to the discussion and formulation of policies of society interest. In this context, the Embrapa needs to commit itself to propositional positions. As presented in this chapter, several policies related to decent work and sustainable agricultural development were implemented based on systemic studies, such as Zarc and ABC Plan.

References

ARAUJO, M. de; GAZOOLA, R. Políticas públicas: prestação de contas dos atores. **Revista de Política Agrícola**, ano. 26, n. 1, p. 25-37, 2017.

BRASIL. Decreto nº 7.492, de 2 de junho de 2011. Institui o Plano Brasil Sem Miséria. **Diário Oficial da União**, 3 jun. 2011. Available at: <http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2011/decreto/d7492.htm>. Accessed on: Mar. 19, 2018.

BRASIL. Lei no 11.097, de 13 de janeiro de 2005. Dispõe sobre a introdução do biodiesel na matriz energética brasileira; altera as Leis nos 9.478, de 6 de agosto de 1997, 9.847, de 26 de outubro de 1999 e 10.636, de 30 de dezembro de 2002; e dá outras providências. **Diário Oficial da União**, 14 jan. 2005. Available at: <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2005/lei/l11097.htm>. Accessed on: Mar. 19, 2018.

BRASIL. Lei nº 12.188, de 11 de janeiro de 2010. Institui a Política Nacional de Assistência Técnica e Extensão Rural para a Agricultura Familiar e Reforma Agrária – PNATER e o Programa Nacional de Assistência Técnica e Extensão Rural na Agricultura Familiar e na Reforma Agrária – PRONATER, altera a Lei no 8.666, de 21 de junho de 1993, e dá outras providências. **Diário Oficial da União**, 12 jan. 2010. Available at: <http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12188.htm>. Accessed on: Mar. 19, 2018.

BRASIL. Lei nº 8.171, de 17 de janeiro de 1991. Dispõe sobre a política agrícola. **Diário Oficial da União**, 12 mar. 1991. Available at: <http://www.planalto.gov.br/ccivil_03/Leis/L8171.htm>. Accessed on: Mar. 19, 2018.

EMBRAPA. **Divulgados os vencedores do Hackathon Acadêmico 2017**. 2017. Available at: <https://www.embrapa.br/busca-de-noticias/-/noticia/29221543/divulgados-os-vencedores-do-hackathon-academico-2017>. Accessed on: Dec. 17, 2017.

EMBRAPA. Secretaria de Gestão e Desenvolvimento Institucional. **VI Plano Diretor da Embrapa**: 2014-2034. Brasília, DF, 2015. 24 p. Available at: <https://www.embrapa.br/documents/10180/1600893/VI+Plano+Diretor+da+Embrapa+2014-2034/7f0c7f31-b517-4621-8083-6450224d2f4e>. Accessed on: Dec. 17, 2017.

EMBRAPA. **Soluções tecnológicas e inovação**: a Embrapa no ano internacional da agricultura familiar. Brasília, DF, 2014.

PLANO setorial de mitigação e de adaptação às mudanças climáticas para a consolidação de uma economia de baixa emissão de carbono na agricultura. Brasília, DF: Ministério da Agricultura, Pecuária e Abastecimento, 2012. Available at: <http://www.agricultura.gov.br/assuntos/sustentabilidade/plano-abc/arquivo-publicacoes-plano-abc/download.pdf>. Accessed on: Dec. 17, 2017.

RIO GRANDE DO SUL. Lei nº 13.515, de 13 de setembro de 2010. Institui o Programa Estadual de Desenvolvimento da Pecuária de Corte Familiar e dá outras providências. **Diário Oficial [do] Estado**, 14 set. 2010. Available at: <http://www.al.rs.gov.br/filerepository/repLegis/arquivos/13.515.pdf>. Accessed on: Mar. 19, 2018.

UNITED NATIONS. **Sustainable development goal 8**: promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. Available at: <https://sustainabledevelopment.un.org/sdg8>. Accessed on: Mar. 17, 2018.

Chapter 5

Production and sustainable consumption: welfare, social equity and environmental balance

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Introduction

This chapter focuses on target 8.4, which aims to improve progressively through 2030 global resources efficiency in consumption and production and endeavor to decouple economic growth from environmental degradation. This target has been created because the unbridled search for growth often results in the unconventional exploitation of natural resources with negative effects on biodiversity and environment. This requires the development of new technologies to mitigate these effects. Thus, the inclusion of this target in the 2030 Agenda is a necessary but complex condition, requiring a joint effort of governments and society.

Embrapa has made efforts so that Brazil can achieve this target. Among the initiatives carried out, the sustainable production systems stand out based on agroecological practices, such as integrated production systems, which seek the production sustainability; the contribution in the elaboration of public policies for sustainable production; and the development of technological solutions for the achievement of production residues.

The following are some examples of these systems as well as technologies developed and made available to society to improve the efficiency of natural resources in the food production and consumption process.

Sustainable production system

The intensification of agricultural production processes in conventional models has resulted in negative environmental impacts on natural ecosystems and their ability to

provide essential ecosystem services. The prospects for intensifying these processes will increase these impacts (Tilman, 2013), indicating, in the near future, biodiversity reduction and changes in the composition and functioning of the world's natural ecosystems. The emergence of invasive species for agriculture and other natural environments, changes in food chain structure and the fishing undermining are some of the expected impacts. However, these negative environmental impacts can be reduced with the adoption of sustainable production systems.

Although grain production has increased at a rate higher than the human population in recent years, FAO (El estado..., 2011) states that in order to serve a population of 9 billion by 2050, this production should increase by at least 60%. In addition, meat demand must increase from 270 million to 470 million tonnes (Muteia, 2014). In this context, countries urgently need to adapt their production systems to become sustainable and biodiverse.

Embrapa, as a public research institution, has made efforts in the search for technological solutions not only in order to comply with SDG, but also to maintain competitiveness in Brazil, in an increasingly demanding market in relation to production sustainability. To do so, it has developed and made available several technological solutions that seek to incorporate, throughout the life cycle of goods and services, the best possible alternatives to minimize environmental and social impacts.

Sustainable production considers the limits in the supply of natural resources and the capacity of the environment to absorb human action impacts, being less intensive in emissions of greenhouse gases, energy and other resources. These systems consist on the application of good agricultural practices for the preservation of ecosystems and the principles associated with integrated production methods and their importance for agriculture sustainability. This protects biodiversity, landscape, natural resources and production of goods of differentiated quality, with appreciation market. The solutions presented by Embrapa are mostly practices, and the agricultural processes focus on the following aspects: soil handling, development of cultivars in organic and agroecological systems, training, zoning and no-tilling system. Some of these solutions are described as follows.

Integrated Production System – IP Brazil

The Programa de Sistema de Produção Integrada (Integrated Production System Program – IP-Brazil) is coordinated by the Ministry of Agriculture, Livestock and Food Supply (MAPA), and the technological base that supports it comes from Embrapa and partners of the National System of Agricultural Research. The central focus is on the production process management, with a high monitoring level of all production stages, with traceability to supermarkets, generating a certification called Brazil Certificate. Companies accredited by Inmetro perform the certification, following a specific protocol with technical standards appropriate to each product including Good Agricultural Practices, in relation to environmental, sanitary and labor legislation. It adopts Integrated Pest Management (IPM) and reduces the use of fertilizers and pesticide.

Embrapa has developed integrated production systems for several crops, such as coconut, grape, mango, cashew, beans, strawberries, citrus, and apple, among others. It also researches integrated food production technologies that consist of a production rotation involving the integrated production of fruits, vegetables, poultry, small animals and fish, seeking to generate safe food for the consumer (Zambolin et al., 2009).

Full Bucket

Balde Cheio (Full Bucket) is a project coordinated by Embrapa aiming at promoting the sustainable development of milk agriculture through technology transfer. Its dynamics consist in the training of technicians hired by partner entities to assist producers as a way of encouraging growth and productivity of the sector, seeking to modulate the factors of production according to the reality of each producer (Novo et al., 2017). The practice encourages the introduction of new technologies and investment in productivity as well as the genetic improvement of herds, management tools and property organization.

Waste utilization from agricultural production

The challenge of continuously increasing the efficiency of use and the yield from environmental, social and economic resources worldwide, for production, processing and consumption, is becoming increasingly complex and essential. Approximately one-third of all food produced for human consumption is wasted

or spoiled before being consumed (Global..., 2011). Thus, expanding production is not the only alternative to remedy this challenge. It is necessary to reduce food waste.

In middle and high-income countries, waste occurs at the end of the supply chain, with the consumer, due to poor consumption habits, such as the purchase of food that exceeds its validity before being consumed. In developing countries, the largest losses occur in the early supply chain stages, especially in the production and processing links. Among other factors, this occurs due to the lack of access to technologies, problems with cultural practices and management, harvesting and post-harvesting, use of inefficient machines and equipment, as well as transport and storage logistics infrastructure.

Agricultural production systems generate several wastes that are discarded during the process. However, various technologies offer opportunities for their reuse, reincorporating them to the productive system. Embrapa has developed and made available several technological solutions for this purpose (Pires; Mattiazo, 2008), such as manufacture of organic compounds; manufacture of anaerobic compounds; biofertilizers; composting of agricultural residues on static furrows; composting waste for the production of organic fertilizers, for small and large-scale properties; composting from carcasses and livestock residues; mulching with legume residues. In addition, it developed manipulation techniques and processing of part of agricultural products to be reinserted in the productive process, such as the use of cassava wastewater, organic residues and cassava hay for ruminants, as well as biodegradation techniques of agricultural products.

The agroindustrial processing stage also generates several residues. For this production stage, technologies aimed at the different stages of processing were developed, aiming to transform them into new products with greater value-added and reduction of environmental impact. As an example, the following stand out: the utilization of peels and fruit cores to produce jellies and oil extraction; the utilization of meat waste to prepare new products, such as *pâtés*; the development of beverages and natural colorants; the processing of cores and shells to obtain a platform for new products, such as green coconut shell and mango core; films and edible toppings for food use. Chemical processes were also developed for the production of lipases and nanocomposites and for obtaining active substances from the agroindustrial wastes, which would be discarded.

Due to these challenges, Embrapa has sought technological solutions to make better use of production residues. These technologies aim to reduce food waste,

generate new opportunities and uses of agricultural raw materials, and develop byproducts resulting from agroindustry processing and implement technological routes for agricultural and agroindustrial waste. Next, some of these technological solutions will be described for production waste utilization.

Biocomposite from mango core

The biocomposite is developed from the mango kernel (*Mangifera indica* L.) discarded from the juice processing industry in mixture with poly (hydroxybutyrate-co-hydroxyvalerate) (PHBV) and triacetin. It is obtained with nanotechnology to develop high-value-added biomaterials, using industrial wastes of low commercial value. This biocomposite (Figure 1) is resistant, semi transparent and biodegradable and may become a substitute for petroleum composites used in the manufacture of greasy food packaging. The manufacture of biocomposites from mango core to the food packaging area may be a potential strategy for the reuse of this residue from the mango juice agroindustry.

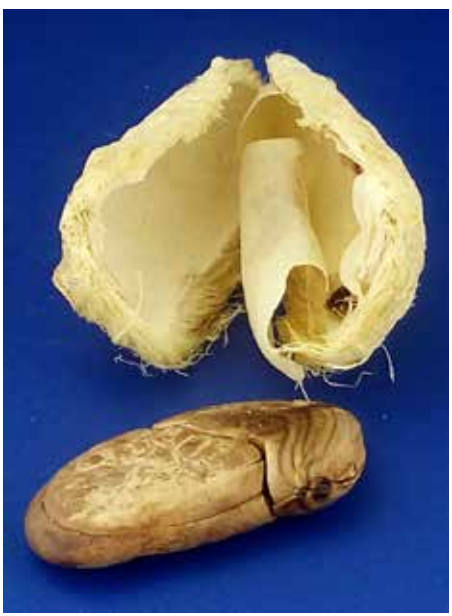

Photo: Edla Lima

Figure 1. Biocomposite from mango core.

Dyes based on bark of java plum, malabar plum or Brazilian grape tree

Natural dyes from Brazilian grape shells (*Plinia cauliflora*), malabar plum (*Syzygium jambos*) and java plum (*Syzygium cumini*) promote good health benefits (Figure 2). With potential for food, pharmaceutical and cosmetic industries, dyes are rich in anthocyanins, water-soluble pigments. The products stand out for having high stability of the anthocyanins, for being free of microbiological contamination and for having characteristic coloration of the pigments of interest. It is a simple and inexpensive process for agroindustry, constituting a differential, considering the growing interest in natural dyes, mainly due to the toxicity of synthetic dyes and the prohibition of using some of them.

Photo: Sidney Pacheco

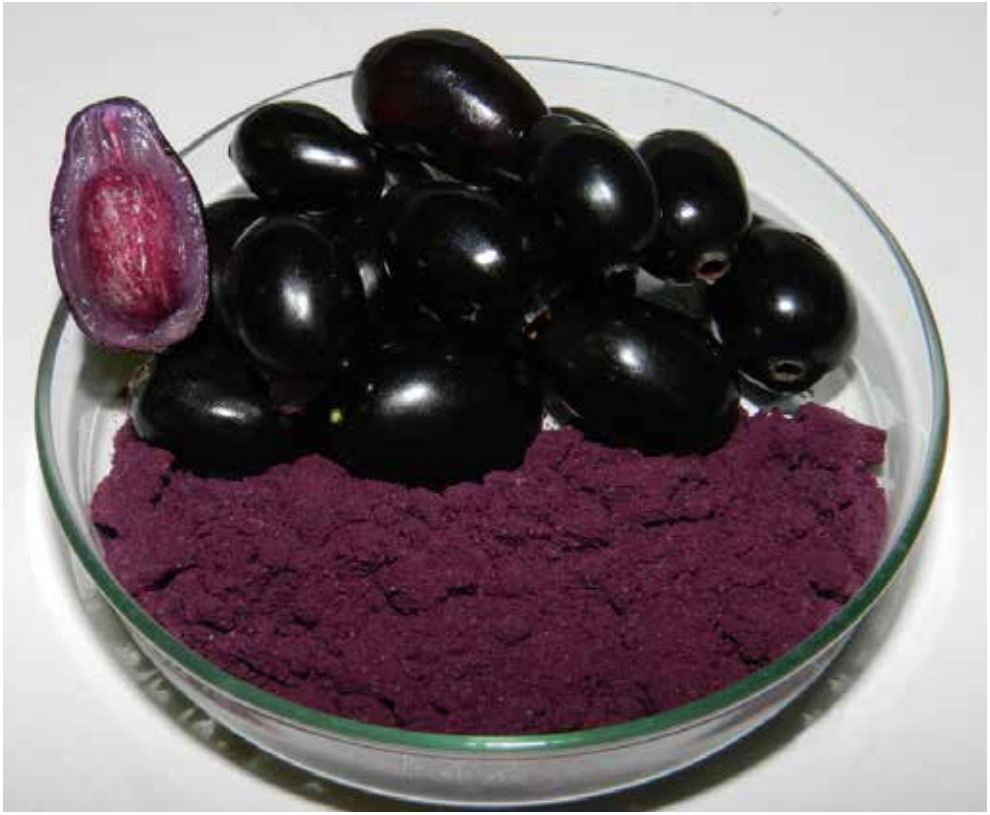

Figure 2. Dye based on java plum bark (*Syzygium cumini*).

Processing of green coconut shell for fiber and powder production

Coconut powder is a biodegradable, renewable, and very light material, which provides high porosity, high moisture retention potential and favors the physiological root activity. It can be used as an ingredient for the formulation of agricultural substrates and organic compounds. The fiber can be used as a raw material for handicrafts, for making pots and plates for planting, as a substitute for *xaxim*, as well as for upholstery of vehicles and manufacture of biomantle, which can be used to contain slopes or degraded areas (Embrapa, 2004). The use of the coconut shell allows reducing inadequate disposal of solid residues and provides a new yield option for the production sites (Figure 3).

Waste utilization is already a reality within Embrapa, which has advanced in the search for new opportunities for agricultural production chains.

Photo: Claudio Noroes

Figure 3. Processing of green coconut shell.

Final considerations

The technologies presented in this chapter highlight Embrapa's effort and participation so that Brazil achieves the targets established in the global sustainable development agenda, specifically those related to target 8.4 of the Sustainable Development Goals.

The intensification of sustainable production is one of the best alternatives to decouple economic growth from environmental degradation. Therefore, the expansion of public and private investments in agricultural research for new technologies generation is essential. Despite the strong presence of Embrapa in agricultural activities, Brazil needs to prepare itself to deal with new and increasingly complex challenges.

In this context, in which technological risks are high, the task of confronting them is not an isolated institution; it requires the participation of other stakeholders who act in a collaborative way. The heterogeneity of Brazilian agriculture also requires more effective technology mechanisms transfer and innovation promotion.

References

EL ESTADO mundial de la agricultura y la alimentación. Rome: FAO, 2011. Parte I. Available at: <http://www.fao.org/publications/sofa/el-estado-mundial-de-la-agricultura-y-la-alimentacion/es>. Accessed on: Jan. 31, 2018.

EMBRAPA. **Soluções tecnológicas**: beneficiamento da casca de coco verde para produção de fibra e pó. Fortaleza: Embrapa Agroindústria Tropical, 2004. Available at: <https://www.embrapa.br/busca-de-solucoes-tecnologicas/-/produto-servico/33/beneficiamento-da-casca-de-coco-verde-para-a-producao-de-fibra-e-po.> Accessed on: Jan. 31, 2018.

GLOBAL food losses and food waste: extent, causes and prevention. Rome: FAO, 2011. Available at: <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>. Accessed on: Jan. 31, 2018.

MUTEIA, H. O crescimento populacional e a questão alimentar. **O País**, 25 jul. 2014. Opinião. Available at: <http://www.fao.org/fileadmin/user_upload/faoweb/lisbon/docs/O_Pa%C3%ADs_25_7_2014.pdf>. Accessed on: Dec. 10, 2017.

NOVO, A. L. M.; CAMARGO, A. C. de; MORI, C. de; PALHARES, J. C. P.; VINHOLIS, M. de M. B.; BARIONI JUNIOR, W. **Relatório 2016**: dados zootécnicos, econômicos e de uso de tecnologia: Projeto Balde Cheio – Minas Gerais. São Carlos, SP: Embrapa Pecuária Sudeste, 2017. 63 p.

PIRES, A. M. M.; MATTIAZZO, M. E. **Avaliação da viabilidade do uso de resíduos na agricultura**. Jaguariúna: Embrapa Meio Ambiente, 2008. 9 p. (Embrapa Meio Ambiente. Circular técnica, 19).

TILMAN, D. Global environmental impacts of agricultural expansion: the need for sustainable and efficient practices. **Proceedings of the National Academy of Sciences of the United States of America**, v. 96, n. 11, p. 5995-6000, 2013. DOI: 10.1073/pnas.96.11.5995.

ZAMBOLIM, L.; NASSER, L. C. B.; ANDRIGUETO, J. R.; TEIXEIRA, J. M. A.; KOSOSKI, A. R.; FACHINELLO, J. C. (Org.). **Produção integrada no Brasil**: agropecuária sustentável alimentos seguros. Brasília, DF: Mapa, 2009. 1008 p.

Chapter 6

Research and innovation: solutions and challenges for economic and decent work growth

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Introduction

In the last years, Brazilian agricultural industry underwent important transformations conquering relevant space in the internal and external markets. Currently, Brazil is the main exporter of orange juice, sugar, coffee, beef, pork and poultry, and the second largest exporter of soy and maize (Usda, 2017). Technology development and constant technological innovations was the watershed for Brazil to leave the past as a food importer in the 1960s to become an agricultural power, competing in the largest global markets. Within this successful effort, the creation of the Brazilian Agricultural Research Corporation (Embrapa) in December 1972, was decisive. Since its inception, the institution has produced hundreds of innovations that have dramatically increased agricultural efficiency.

From the mid-1990s, while world production stagnated, the growth rates of Brazilian agriculture expanded significantly (Vieira Filho, 2014). Labor productivity increased more than five times between 1975 and 2015, land productivity increased more than fourfold and capital increased more than threefold (Gasques et al., 2017).

Technology explains most of the production growth. According to Alves and Silva (2013), work corresponded to 22.3%; technology, 68.1%; and land, 9.6%. The combination of technology trilogy, knowledge and adoption capacity was essential for both production growth and food price reduction (Vieira Filho, 2014).

Advances obtained with the input of the Embrapa's results

Most technological solutions and public policies aim at economic development. However, in order to achieve the targets of SDG 8, it is necessary to promote

sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Embrapa has contributed to Brazilian economic growth through the development of technological solutions for the sector (Lopes, 2013). The continuous review of its programming adapting it to new challenges has been implemented since its foundation, as well as the alignment of research projects in order to meet the demands of the various productive chains in which it operates (Penteado et al., 2014).

Each year, some technologies developed by Embrapa have been evaluated for economic, social and environmental impacts, and the results contribute to the importance of agricultural research in the economic development.

There were new cultivars with higher productivity, high nutritional values or resistant to pests, diseases and bad weather; races of animals more prolific or adaptable to different environments; new machinery, equipment and production systems; new processes of cultivation, animal production and pest and disease control, geographic information systems to map regions and monitor land use, among others. In addition, they mentioned technologies aimed at improving working conditions in Brazilian agricultural production, especially those aimed at improving the conditions of workers engaged in labor-intensive activities, as well as increasing worker productivity.

Assuming that development-oriented research has an ethical commitment to society, its relationship with public policies at different levels of government can be considered inseparable. Embrapa has actively participated in both the formulation and implementation of those policies that have as their focus the promotion of agricultural and human development.

Important examples are the policies related to agricultural family, such as the Programa Estadual de Desenvolvimento da Pecuária de Corte Familiar (State Program of Family Development of Beef Cattle) and the Plano Brasil Sem Miséria (Brazil without Misery Plan), which have contributed substantially to the improvement of the productivity and income of small-farm products.

Embrapa has also worked on policies to encourage entrepreneurship, farming zoning, territorial and industrial development, financing and rural involvement, among others, thus fulfilling its role as an active institution in all segments that involve agricultural production.

The solutions referring to sustainable production systems consist, in most cases, of agricultural practices and processes, which seek to solve problems related to soil handling, development of cultivars in organic and agroecological systems, integrated crop-livestock-forestry, qualification, agroecological zoning and direct planting system. Also noteworthy are technological solutions that use agricultural production residues to manufacture anaerobic organic compounds and biofertilizers; the use of composting residues in static furrows; the production of organic fertilizers; composting from carcasses and livestock residues; and mulching with legume residues for reuse in the same crops. It is also worth mentioning the transformation of waste from agroindustries into new value-added products such as jellies, oils and *pâtés*; drinks; natural colorants; films and edible coverings, besides the processing of the green coconut shell.

Main research challenges at Embrapa

Despite the success over Embrapa's 40-plus years, some challenges remain, especially those associated with establishments that are unable to appropriate existing technologies because of market imperfections, among other factors. For example, the producer often pays more for inputs and sells production at prices below production cost, which refers to the need to seek solutions that reduce inputs value, respecting quality and environment preservation (Alves, 2016).

According to Barros (2017), Brazil must be attentive to the threats and opportunities that may emerge from new configuration of world trade patterns. Because it is a middle-income country with a high concentration degree of income and poverty, efficient agribusiness – which produces increasing volumes at stable or decreasing prices –, is an essential tool for making distributive policies of income transfer effective. The poverty rate in rural areas is practically double compared to Brasil as a whole, which is a priority in the public policy agenda.

In Brazil, agribusiness is responsible for 21% GDP and accounts for 21% employed labor force, which still has significant potential for the country's economy. The sector is also a supplier of indispensable international reserves. More than legitimate opportunities to generate profits and dividends for entrepreneurs, agribusiness has a social role of the highest relevance in Brazil (Barros, 2017).

Embrapa continually reviews its research programming, adapting it to new challenges, in order to meet demands of the various production chains in which it operates.

Aware of the changes, Embrapa identified seven megatrends with a strong impact potential for Brazilian agriculture until 2030: spatial changes in agriculture; intensification and sustainability of production systems; climate change; risks in agriculture; value added in agricultural production chains; consumerism; and technological convergence for research and innovation (Embrapa, 2017). From this perspective, the challenges associated with economic growth and decent work highlighted:

- Promote the sustainability of Brazilian agricultural and agroindustrial production, especially food production systems that meet the demands of the national and international markets.
- Promote the social and economic inclusion of the poorest farmers, especially those in the North and Northeast regions, through public policies and innovative technological solutions, as well as those that rescue old adapted ways, as long as they are effective.
- Promote the generation of income for agricultural family focusing on value-added strategies.
- Qualify rural labor force in response to the growing demand for more specialized jobs.
- Develop machinery that improves the field worker's conditions and promotes a better life quality.
- Increase productivity and profitability by expanding the use of integrated and sustainable agricultural production systems.
- Take economic advantage of waste from agricultural and agroindustrial processes for the development of value-added products.
- Promote the sustainable use of Brazilian biodiversity and explore positive factors such as authenticity, valuing native and regional products originating from differentiated agricultural systems.
- Promote research to strengthen production in integrated crop-livestock-forestry systems.
- Develop new production forms that consider the rural area, integrating the production of food, fiber and energy to non-agricultural economic activities, such as geographical indications and rural tourism.

- Motivate young persons to continue agricultural activities through innovation and public policies.
- Supporting the decision making of producers, public and private institutions through integrated analyzes of data on natural, agricultural, agrarian, socioeconomic, infrastructure and logistics aspects.
- Develop strategies of automation and precision agriculture for adding value to agricultural products, including the development and adaptation of sensors and actuators for automated systems, both in the production and processing of agricultural products.
- Adopt innovative forms and strategies of communication, articulation and involvement among all members and sectors of the agricultural chain with research, transfer and implementation of technological solutions.
- Evaluate and monitor the results and impacts of research, improving mechanisms to feed demands and feedback.

Final considerations

Despite the acknowledged progress recorded in recent years, there is a need to expand investments in technology to ensure Brazilian growth and to serve both internal and external markets. In agriculture, new technologies will stimulate value added and manufacturing with great possibility of increasing the agroindustrial sector (Levien, 2016). According to the author, this is a path with no return, because technological knowledge will provide the maintenance and increase of competitiveness in the long term. Increasingly, the producer will need to learn how to use new technologies, whether for the mitigation of adverse conditions or in the field of sophisticated equipment or pest control. This also occurs due to the growing shortage of labor in the field, which leads producer to acquire machines that aid during the activities. In addition, with climate changes, it is necessary to increase the adaptability of cultures and populations. Therefore, developing, improving and transferring technologies will enable greater productive security and agility to the producer on a daily basis, thus contributing to sustainable, inclusive and sustained economic growth, as well as promoting full and productive employment and decent work for all.

References

ALVES, E. Desafios da pesquisa. **Revista de Política Agrícola**, ano 25, n. 4, p. 163-168, 2016.

ALVES, E. R. de A.; SILVA R. C. Qual é o problema de transferência de tecnologia do Brasil e da Embrapa? In: ALVES, E. R. de A.; SOUZA, G. da S.; GOMES, E. G. (Org.). **Contribuição da Embrapa para o desenvolvimento da agricultura no Brasil**. Brasília, DF: Embrapa, 2013. p. 182-191.

BARROS, G. **O agronegócio e as crises interna e externa**: desafios e oportunidades. Piracicaba: Centro de Estudos Avançados em Economia Aplicada, 2017. Available at: <https://www.cepea.esalq.usp.br/br/o-agronegocio-e-as-crises-interna-e-externa-desafios-e-oportunidades.aspx>. Accessed on: Dec. 11, 2017.

EMBRAPA. **Documento base para elaboração do documento visão**: o futuro da agricultura brasileira. Brasília, DF: Embrapa, 2017.

GASQUES, J. G.; BACCHI, M. R. P.; BASTOS, E. T. **Impactos do crédito rural sobre variáveis do agronegócio**. Brasília, DF: Instituto de Pesquisa Econômica Aplicada, 2017.

LEVIEN, R. **Os novos desafios da tecnologia no agronegócio**. 2016. Available at: <http://www.semagro.ms.gov.br/os-novos-desafios-da-tecnologia-no-agronegocio>. Accessed on: Dec. 10, 2017.

LOPES, M. Apresentação. In: ALVES, E. R. de A.; SOUZA, G. da S. e; GOMES, E. G. (Ed.). **Contribuição da Embrapa para o desenvolvimento da agricultura no Brasil**. Brasília, DF: Embrapa, 2013. p. 10-12.

PENTEADO, M. I. de O.; FONTES, R. R.; CAMPOS, F. A. de A.; EUCLIDES FILHO, K. A trajetória do planejamento da pesquisa na Embrapa. **Cadernos de Ciência & Tecnologia**, v. 31, n. 1, p. 35-60, 2014.

USDA. **USDA agricultural projections to 2026**. Washington, DC: Office of the Chief Economist, World Agricultural Outlook Board, U.S. Department of Agriculture, 2017. Long-term projections report OCE-2017-1.

VIEIRA FILHO, J. E. R. Transformação histórica e padrões tecnológicos da agricultura brasileira. In: BUAINAIN, A. M.; ALVES, E.; SILVEIRA, J. M. da; NAVARRO, Z. (Ed.). **O mundo rural no Brasil do século 21**: a formação de um novo padrão agrário e agrícola. Brasília, DF: Embrapa, 2014. p. 395-422.

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