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.

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