

Chapter 2

Contributions of Embrapa overview

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Introduction

Everyone on the planet must have access to clean water and sanitation. This is the focus established by the SDG 6, inserted in a sustainability agenda to be adopted by the member countries of the United Nations (UN) and to be fulfilled until 2030. In this goal, targets are defined as the access to clean water and sanitation; improving water quality, reducing pollution, safe treatment and re-use; increasing the efficiency of use in all sectors; the integrated management of water resources; and the protection and restoration of water-related ecosystems, making use of both international cooperation and the participation of local stakeholders.

The issue of water and sanitation is transversal, with water being considered as a key resource for sustainable development, for the promotion of the well-being of people and communities, and for the growth of the countries' economies. In this sense, in Brazil, the theme has been worked by different sectors of government at different federative levels; and fostering the best tune between them is an institutional challenge.

Embrapa is among these sectors, developing research and disseminating its results related to several thematic lines aligned with the SDG 6. This chapter aims to present its main researches, as well as related strategic actions of Embrapa and its partners that have much to contribute in order to meet the SDG targets.

Strategic goals

The strategic programming of the Brazilian Agricultural Research Corporation (Embrapa), established in the [VI Plano Diretor da Embrapa](#) (Sixth Embrapa Master Plan – PDE) (Embrapa, 2015), presents the interfaces and synergies, directly or indirectly, by generating knowledge and technological assets for the sustainability of Brazilian agriculture, with the 17 SDGs and their targets (Brasil, 2016).

The impact axes and the strategic goals and guidelines of the PDE represent the directions for achieving the desired transformations (Embrapa, 2017b). Of Embrapa's five impact axes (IA), three have adherence to SDG 6, namely:

- IA 1 – Advances in the search for agricultural sustainability.
- IA 2 – Strategic and competitive insertion in the bioeconomy.
- IA 3 – Contribution to public policies.

Of the 12 strategic goals (OE) of the PDE, four are strongly aligned with SDG 6, which are:

- OE 1 – Develop knowledge and technologies for the adequate management and sustainable use of Brazilian biomes.
- OE 6 – Develop innovative production systems capable of increasing agricultural, forestry and aquaculture productivity with sustainability.
- OE 11 – Generate knowledge and technologies that promote managerial innovations to address the increasing complexity and multifunctionality of agriculture with efficiency, efficacy and effectiveness.
- OE12–Developanddisseminateinformationproductsandcommunication strategies that contribute to the valorization of agricultural research and to the expansion of society's support to Brazilian agriculture.

Research, development and innovation projects

Embrapa's research, development and innovation projects are organized into strategic themes of the Brazilian agriculture whose management has corporate information systems and management support tools called portfolios (23), covering topics of national relevance, and arrangements (84), organized to address priority challenges in a given theme (Embrapa, 2017b). Within Embrapa's research program, the portfolios and arrangements with the greatest affinity to the water theme in agriculture are: Irrigated Agriculture, Coping with Drought, Climate Change, and Environmental Services in Rural Landscapes – Arranjo SA and Coping with Droughts – Agrichuva (arrangements). Several others have affinities with the water theme, either by the technologies used in the different agricultural and forestry production systems, such as integrated crop-livestock-forest system, social innovation in agriculture, Aquaculture, Rational Management of Agrochemicals, Ecological Basis Production System, Food: safety, nutrition and health, Amazon; either through the vision of the ecosystems they work with,

such as the portfolios Intelligence, Territorial Management and Monitoring, and Brazilian Soils.

Technological solutions

The knowledge generated is largely translated into products, processes and services for the agricultural sector, composing a wide range of technological solutions. There are also included in this set of technological solutions to the methodologies, agricultural practices and production systems. In addition, this information also contributes to the formulation and improvement of public policies in areas related to Embrapa's mission.

In accordance with SDG 6, Embrapa has several [Technological Solutions](#) developed or adapted for the different Brazilian biomes, which show how to use water in agriculture with rationality and without waste, for plant and animal production (Embrapa, 2017d). In addition to agricultural production, technological solutions are available for the recovery/maintenance of ecosystems, improvement of water quality and the quantity of water available.

Within the thematic of [water use in agriculture](#), Embrapa highlights the following technologies: irrigation management; monitoring of water availability; technologies of adequacy of properties for abstraction of rainwater; recharge of groundwater and revitalization of springs and streams; in addition to others such as underground dam, reuse of agricultural water and use of inferior quality water (brackish and saline); rural cisterns, soil and water conservation practices in production systems; use of cultivars adapted to the water conditions of the region (Embrapa, 2017a).

Among the technological solutions related to the quantity and the water supply, the following stand out: the lakes of multiple use, that in addition to the storage avoid the contamination of the water table; the different methods for collecting rain in situ (furrow, plowing), cistern, *barraginha* (mini-dams), underground dam, floating cages, among others. For irrigation, they involve both the improvement of irrigation systems for different crops, such as equipment technologies, sensors, irrigation parameters (evapotranspiration, crop coefficient, soil water retention curve) and modeling for greater efficiency in water use, as hydrological models that simulate the availability of water; besides the possibility of fertigation and use of secondary waters, as effluent of fishery.

In relation to the soil and water conservation practices, there are those that reduce soil erosion and help the storage of soil water, such as building *barraginhas* (mini-dams); no-tillage; management of green cover crops and dead cover crops; underground dam; use of crop consortia and integrated production systems such as integrated crop-livestock-forest (ILPF), agroforestry systems and afforestation of pasture; design and construction of terraces; besides the good agricultural practices for different cultures, that aim at the rational use of inputs and pesticides and compliance with the legislation for rural property. The technologies of concentration evaluation and leaching of pesticides in the soil are also presented; treatment of wastewater as wash water for animal facilities, post-harvest treatment of fruit and mining waste; composting of animal and vegetable waste; mini-dam building.

Among the technological solutions related to farms, it is important to highlight: technologies for the recovery of degraded areas, such as revegetation of gullies with legume species; implementation and management of both natural and planted forests. In the rural sanitation, Embrapa stands out with technologies widely used and applied by it and partners, namely: Embrapa chlorinator, used to chlorinate water for domestic supply; the biodigester septic tank, which enables the treatment of domestic sewage (black waters) with the production of liquid fertilizer; and the filtering garden, with the purpose of purifying the gray water, complementing the treatment of sewage in the rural areas through the biodigester septic tank.

Many of these technological solutions aimed at meeting SDG 6 will be described in subsequent chapters, pointing out their current application, future potential and limitations.

Governmental partnerships and programs

Embrapa operates in the federal sphere with implementation or expansion of government programs/policies, especially the Water Producer program of the National Water Agency (ANA); the payment program of the Serviço Florestal Brasileiro (Brazilian Forest Service), of the Ministry of the Environment (MMA); and the Programa de Capacitação para Gestão Integrada e Sustentável da Água no Meio Rural (Training Program for Integrated and Sustainable Water Management in the Rural Environment). In this sense, Embrapa presents other technological solutions that also include methodologies such as those for mapping and evaluating environmental service indicators, as well as manuals

for implementing programs of Environmental Payments for Services – PSA) and environmental valuation; consulting services; mapping products and agro-climatic and agro-ecological zoning; software to support irrigation management, such as IrrigaFácil; and several courses of training and qualification of agent multipliers of knowledge. All these technological solutions have a positive impact on society and the country. In 2016, the economic impacts and social gains of 117 technologies and around 200 Embrapa cultivars were determined, indicating that each US\$ 1.00 invested in the Company returned US\$ 11.34 for the Brazilian society (Embrapa, 2017c).

Embrapa has shared many experiences with families and government and civil society partners in order to promote knowledge exchange, which has greatly contributed to advances in the proper use of natural resources, especially soil, aiming to capture and store rainwater, in order to collaborate with the socioecological strategies for family farmers of regions with water shortages to face climate change. This fact has helped overcome the social and environmental limitations of the Brazilian semiarid region, using the technologies of coping with the semiarid region as the source to improve and balance the productive process, promoting greater stability of the family agro-ecosystem, consequently improving the family's quality of life.

Embrapa has also had significant collaboration with federal government water access programs, such as the Plano Brasil sem Miséria (Brazil Without Misery Plan – PBSM) and the Programa Nacional de Universalização do Acesso e Uso da Água (National Program for Universal Access to and Use of Water for All – Água para Todos). Both programs were conceived by the federal government based on the need to universalize access to and use of water for poor populations living in rural communities, not served by this essential public service, served by poor water supply systems, or by diffuse supply. Through its innumerable technological solutions, Embrapa has participated in several actions aimed at the uses of water for food production, which has contributed to food and nutritional sovereignty and security, consequently to the valorization of citizenship and the quality of life of the families of agricultural production systems in regions with water shortages. Another significant performance of Embrapa concerns technical cooperation aimed at supporting capacity building for developing countries, especially in rainwater harvesting and storage activities.

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