SUSTAINABLE
DEVELOPMENT
GOAL
6

CLEAN WATER AND SANITATION

CONTRIBUTIONS OF EMBRAPA

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Technical Editors

Embrapa

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

Sustainable Development Goal 6

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Chapter 3

Water quality and pollution reduction

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Introduction

This chapter addresses Embrapa's contribution to target 6.3, which relates to water quality and pollution reduction. Decreasing the availability of good quality water is a growing and global concern. Monitoring water quality, coupled with the adoption of good soil and water management practices and the use of technologies to reduce the production of contaminants, can contribute significantly to minimizing this problem and ensuring good quality water for all. The present chapter sought to list search results that point out paths that can be followed. More information is available on the portal Technological Solutions at Embrapa (Embrapa, 2017b).

The water situation of most rivers in Latin America has been critical since the 1990s. Organic and pathogen pollution increased by more than 50% between 1990 and 2010, while pollution by total dissolved solids (salinization) worsened by almost one-third in the rivers of Latin America, Asia and Africa. The concentration of fecal coliforms increased by almost two thirds in the rivers of Latin America, Africa and Asia between 1990 and 2010 (A snapshot..., 2016). The release of dangerous chemicals, including those that can cause hormonal disorders, has increased during this time. The contribution of nutrients, such as phosphorus and nitrogen, promotes the eutrophication of rivers and lakes, harming natural processes. This increase in pollution was attributed to population growth, increased economic activity, the intensification and expansion of agricultural activities and the increase of wastewater discharge with little or no treatment in water courses. The negative consequences have an impact on health, fisheries, ecosystems, water use for irrigation and industry, and the cost of water treatment, among other uses (A snapshot..., 2016).

Actions for the maintenance and recovery of water quality

Among the actions required for the maintenance and recovery of water quality, the most important are those related to the monitoring and evaluation of water quality and to those associated with technical and management measures for pollution prevention, reduction of the pollutant load, integrated use of water in complementary activities and restoration and protection of ecosystems. Most of the solutions presented here were developed in partnership with research and extension institutions, governmental and civil society.

Monitoring and evaluation of water quality

Quality is not a static condition of an environment or system, nor can it be defined by the measurement or estimation of a single quantity. When it comes to water, quality is perceived as the variation of a set of intrinsic parameters that limits its use, being extremely variable in time and space. When reliable data are available on water quality, its safe use becomes possible. This data can be used as support for implementation of public policy. However, reliable data will only be available when monitoring and diagnostic programs are well designed and conducted (Matthiensen, 2014). The definition of quality benchmarks is an important aspect of water monitoring (Oliveira-Filho et al., 2014). Some of the contributions of Embrapa in this area are listed as follows. Detailed information and reference materials on contributions from Embrapa can be found on the portal Technological Solutions, such as:

- Estimation of pesticide concentration in soil and water (Embrapa Environment).
- Monitoring of water quality in tambaqui fattening in fish ponds without water renewal (Embrapa Coastal Tablelands).
- Method for assessing the aquatic toxicity of mining solid waste (Embrapa Cerrados).
- Methodology for environmental risk assessment in water resources (Embrapa Territorial).
- Numerical simulation of the presence of organic contaminants in soil and water (Embrapa Environment).

- Evaluation of the degree of restriction to the use of groundwater in crop irrigation considering soil sodification in the Vaza-Barris River Basin (Embrapa Coastal Tablelands).
- Araquá 2014 – environmental risk assessment of pesticides (Embrapa Territorial and partners).
- Analysis of the impact of cattle breeding on water quality (Embrapa Cerrados).
- Comparative analysis of the quality of water resources in urban and rural areas (Embrapa Cerrados).
- Analysis of the impact of burnt ash on the quality of water resources (Embrapa Cerrados).
- Watershed quality index – a methodology to support strategies for water resources management (Embrapa Pantanal).
- Agroscre – support for the evaluation of transport trends of active pesticides (Embrapa Environment).
- Estimation of pesticide concentration in soil and water (Embrapa Environment).

Technical and management measures

Pollution prevention

Pollution sources can be classified as point or diffuse. Point source pollution occurs when the source of pollution is easily identifiable and usually comes from a single location. Industrial effluents and domestic sewage are examples of point sources. Nonpoint source pollution does not present a definite source, and it is difficult to identify its origin. Unlike point source pollution, nonpoint source pollution is always associated with a specific use of soil (Matthiensen, 2017). Agriculture is a major contributor to nonpoint source pollution in rural areas. In areas of planting and animal production, sources of nonpoint pollution include pesticides, chemical fertilizers, fertilizers and animal waste that, when in excess in the soil, are infiltrated or carried along with the sediments by rainwater into the water bodies (A snapshot..., 2016). Excess sediment in water bodies results in high turbidity, silting and eutrophication, compromising areas of species reproduction and leading to the loss of aquatic habitats. Agrochemicals are transported by surface waters, which can compromise the health of domestic and wild animals, as well as of the people who make use of this water. The degradation of water resources by agricultural activities can be mitigated by conservationist practices in the property, such as the dimensioning of production, proper waste management and maintenance of ciliary forest (Matthiensen, 2017).

Information and reference materials related to pollution prevention are available on the Embrapa Technological Solutions portal. Some of the contributions of Embrapa to reduce the use of pesticides and chemical fertilizers are:

- Biological insecticide INOVA-Bti (Embrapa Genetic Resources & Biotechnology).
- Clean technology for post-harvest treatment of fruits (Embrapa Environment).
- Sustainable management of the main pests in the sugarcane crop (Embrapa Western Agriculture).
- Control of weeds in pasture (Embrapa Beef Cattle).
- Evaluation of environmental behavior (leaching, dissipation, surface runoff, etc.) of agrochemicals in different production systems and soil management (Embrapa Cerrados, Embrapa Western Agriculture and Embrapa Environment).
- Determination of the percentage of water exchange in fish farms (Embrapa Environment).
- Method for determining the quantity of sewage sludge for agricultural use as a source of nitrogen (Embrapa Environment).
- Safety analysis of microbiological agents for pest control (Embrapa Cerrados).
- Anonáceas – instructions for the use of pesticides (Embrapa Cerrados).
- Mango – instructions for the use of pesticides (Embrapa Cerrados).
- Integrated citrus production in Rio Grande do Sul (Embrapa Temperate Agriculture).
- Integrated strawberry production – PIMo (Embrapa Environment).
- Integrated management of soybean pests – MIP-Soybean (Embrapa Soybean).

- Organic coffee production system (Embrapa Agrobiology).
- Integrated production of mangoes, fine table grapes and melon (Embrapa Semiarid Agriculture and Embrapa Grape & Wine).

Regarding the reduction of the release of contaminants, the following contributions may be mentioned:

- Tambaqui production in excavated tanks with aeration (Embrapa Western Amazon).
- Training for waste management in the dairy farm (Embrapa Dairy Cattle).
- Biobed Brazil – final disposal of effluents contaminated with pesticides originating in agriculture (Embrapa Grape & Wine).

As for the reduction of sediment transport, the main technological solutions are:

- Agronomic practices of soil and water management and conservation and recovery of degraded areas (Embrapa Soils).
- Revegetation of gullies with inoculated and mycorrhized tree legumes (Embrapa Agrobiology).
- Good agricultural practices for the areas of springs: erosion control and optimized application of pesticides (Embrapa Environment).
- Multiple use pond (Embrapa Maize & Sorghum).

Reduction of the pollutant load that reaches the water bodies

Brazil has approximately 31 million inhabitants living in the rural area. Out of this population, 22% have access to basic sanitation services, and almost 5 million people do not have toilets. The use of rudimentary pits (septic tank, well, hole, etc.) is common and they contaminate groundwater. Sewage contains pathogens (viruses, bacteria, parasites), organic matter and chemical residues such as drugs. When organic pollution is severe, it can reduce the levels of dissolved oxygen in the water and raise the concentrations of ammonia and hydrogen sulfide, which are associated with the sediments and the bottom waters of rivers, compromising aquatic life (A snapshot..., 2016). Embrapa has simple and feasible solutions for rural basic sanitation, sewage and effluent treatment, and fundamental to change this reality, available in the rural basic sanitation (Embrapa, 2017a) and Technology Solutions portal, such as:

- Treatment of waste water from the acaricide bath (Embrapa Southeast Livestock).
- Cellulose nanocrystals for sorption of metals (Embrapa Genetic Resources & Biotechnology).
- Biodigester septic tank (Embrapa Instrumentation).
- Filtering garden (Embrapa Instrumentation).
- Biobed System (Embrapa Grape & Wine).

Integrated water use in complementary activities

The integration and optimization of multiple uses is among the alternatives pointed to increase water efficiency. In this management model, the water supply usually comes from a common system – the river basin – and the surplus of use and the effluents are once again integrated into the system. Thus, water resources are used more efficiently, maximizing the benefits. In several countries, this integration of uses is consolidated. In Brazil, Embrapa's studies with these integrated production systems are recent, requiring research to define the best form of exploitation (Santos, 2009). Two of Embrapa's technological solutions available on the portal are:

- Oyster bioremediation in aquaculture (Embrapa Mid-North).
- Recommendation of multiple use of water in the cultivation of cowpea with effluent from fish farming (Embrapa Mid-North).

Ecosystem restoration

Ecological restoration can be defined as the process and practice of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed. The role of natural or restored ecosystems in protecting the quality of surface water is well understood, especially in riparian zones. Restoration interventions should prioritize the recovery of soil and vegetation in the most fragile sites, in the uncovered areas and in the sections of the basin subject to greater surface runoff and, therefore, exposed to greater risks of erosion and silting. Springs and sloping lands should therefore be primarily protected (Honda; Durigan, 2017). There are several ways to do the restoration, and choosing the right model is partly responsible for success. Among the contributions of Embrapa for the restoration of ecosystems available in the Technological Solutions portal are:

- Diagnosis and planning of actions for the recovery of degraded ecosystems – RED (Embrapa Forestry).
- Direct tree seeding for ecological restoration of the Brazilian *Cerrado* (Embrapa Genetic Resources & Biotechnology).
- Topsoil for restoration of *Cerrado* vegetation in degraded areas (Embrapa Genetic Resources & Biotechnology).
- Implantation and management of forests in small-scale farms (Embrapa Forestry).
- Agroforestry systems – SAFs (Embrapa Agrobiology e Embrapa Western Agriculture).
- Management of molasses grass (*Melinis minutiflora*) in areas with *Cerrado* native vegetation (Embrapa Genetic Resources & Biotechnology).
- Production of seedlings of forest species (Embrapa Forestry).

Final considerations

When a water source is exposed to human activity, there are risk situations that increase its vulnerability. Conservation measures of this resource need to be studied and adopted to mitigate impacts that alter its quality and quantity, but without affecting its availability to meet its demand.

There are available technologies of different degrees of complexity capable of minimizing, or even avoiding, problems related to water contamination. It is important that this information reaches society, and especially the technicians and promoters of public policies capable of causing greater impact and facilitating the effective adoption of these technologies. The availability of the material in the Embrapa portal is an important step in facilitating this disclosure, allowing also the research centers involved in the process to collaborate more closely, if necessary, both to deepen their studies and seek solutions to specific problems, such as the elucidation of technical aspects for the implementation of these technologies.

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