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

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Chapter 8

Water management and sanitation in rural communities

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Introduction

In recent years, in Brazil, local and community water and sanitation management has been strengthened as a viable alternative, which has contributed to the improvement of quality of life and sustainable rural development. However, there are still some major challenges to be overcome with regard to regular and permanent access to any source of water and sanitation in rural areas.

Over more than 40 years, Embrapa has been developing technological solutions that make possible to use water for human, animal and agricultural supplies, as well as access to adequate basic sanitation services for rural property, providing local communities with conditions for agricultural planning of the use of soil and water resources.

This chapter describes agricultural practices, products, processes, methodologies and services (trainings and consulting) that may contribute to target 6.b of Sustainable Development Goal 6 (SDG 6), aiming at supporting and strengthening water management and sanitation in the rural communities.

Use and management of water for crop and animal production

Food production is a priority in many countries, and agriculture, the main user of water resources, must not only provide food for a growing population but also save water for other uses. The challenge is to develop and apply rational methods of use, reuse and water management in agricultural production in rural communities, in order to obtain higher productivity with less water waste.

Suitability of small-scale farms

The characterization of the small-scale rural property consists of compartmentalizing and georeferencing the different environments existing in the property from the studies of geology, soil, climate, relief, water resources and vegetation. For each delimited unit, it is made the recommendation of its main skills of use of the soil. The information from a cartographic map and from a technical report includes the knowledge of the geoenvironmental conditions that constitute the different landscapes of the agroecosystem, which allows to organize and plan, in a rational way, agroforestry activities and environmental services, aiming at the best use and management of the soil and water by the local community.

Embrapa, through its training and consulting, carries out a participatory manner with farmers, technicians and development agents, the horizontal and collective construction of how to compartmentalize and optimize the different environments existing in family-based agroecosystems. The main trainings and consulting offered, within the theme of better use of water in the rural community, are intended for farmers, local development agents and Assistência Técnica e Extensão Rural (Technical Assistance and Rural Extension – Ater) technicians, and consist of:

- Course on Agroecological Zoning of Small-Scale Rural Property.
- Course on use of the Global Positioning System (GPS) in the small-scale rural property, aiming at obtaining sketches, measurements of the property, location of areas, natural resources and improvements in the area.
- Consulting on pedoclimatic zoning, with the objective of guiding technicians and producers on the most suitable areas for agricultural and forestry crops, considering soil and climate aspects, according to the

species' requirements, aiming at reducing environmental and economic risks in agriculture and forestry.

Other courses and consulting related to community participation in water management involve the following technological solutions: soil management and conservation and recovery of degraded areas; equipment and sensors for evaluation of soil water; underground dam; new technological approach for dealing with the semiarid region reality; water in the dairy farm; agroforestry systems (SAFs): composition and management; and characterization of communities and water resources for the implementation of the Programa Água Doce (Fresh Water Program – PAD).

Irrigation techniques accessible to family farming

Despite the availability of water to family farmers in the Northeastern rivers, such as São Francisco and Parnaíba, the water crisis and the competitiveness of the agricultural market have encouraged the change of the irrigation system and the way of applying it to improve the efficiency of water use. In this sense, Embrapa Cassava and Fruits, Embrapa Semiarid Agriculture and Embrapa Mid-North worked in several rural communities in the semiarid region of the Brazilian Northeast to adapt irrigation techniques accessible to the conditions of the family farmers. These techniques, in accordance with targets 6.4, 6.5, 6.6, consisted of procedures to construct low-cost irrigation systems as well as water management in order to use it effectively. Among them, there are:

- Bubbler irrigation system (Coelho et al., 2017) for family farming, without the use of cuttings to control water at the exit of each microtube (Figure 1).
- Surface irrigation system with water delivery in basins around the plants (banana, papaya, melon trees, etc.) using coated channels (Coelho et al., 2017) (Figure 2).
- The use of plastic tarpaulins on beds (Coelho et al., 2017) used in the production of vegetables to save irrigation water (Figure 3).
- Tables used for irrigation water management with irrigation dates, based on day and month of planting, and irrigation time for systems of micro sprinkler, microdiffuser, conventional sprinkler and perforated hose (Coelho et al., 2017).

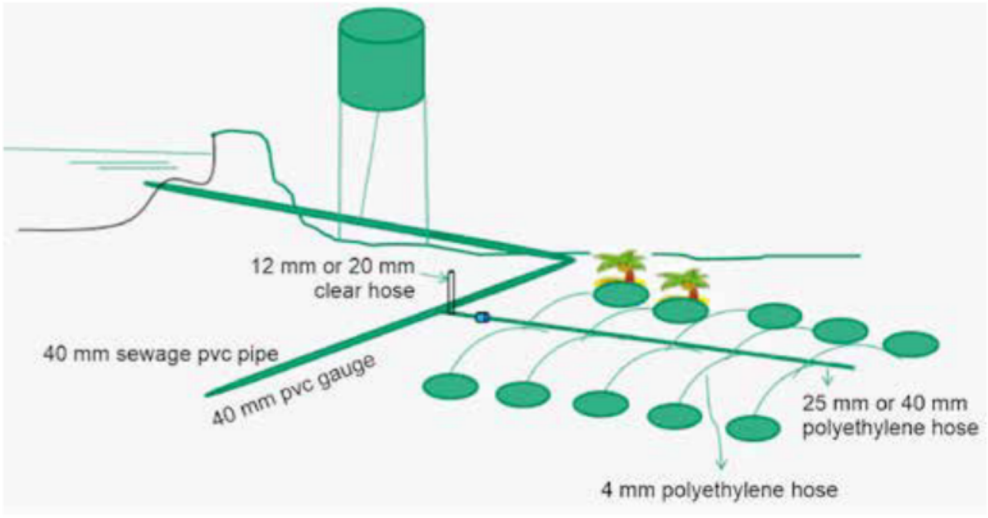

Figure 1. Bubbler irrigation system adapted for use in family farming. Suitable especially for fruit plants.

Illustration: Eugênio Ferreira Coelho

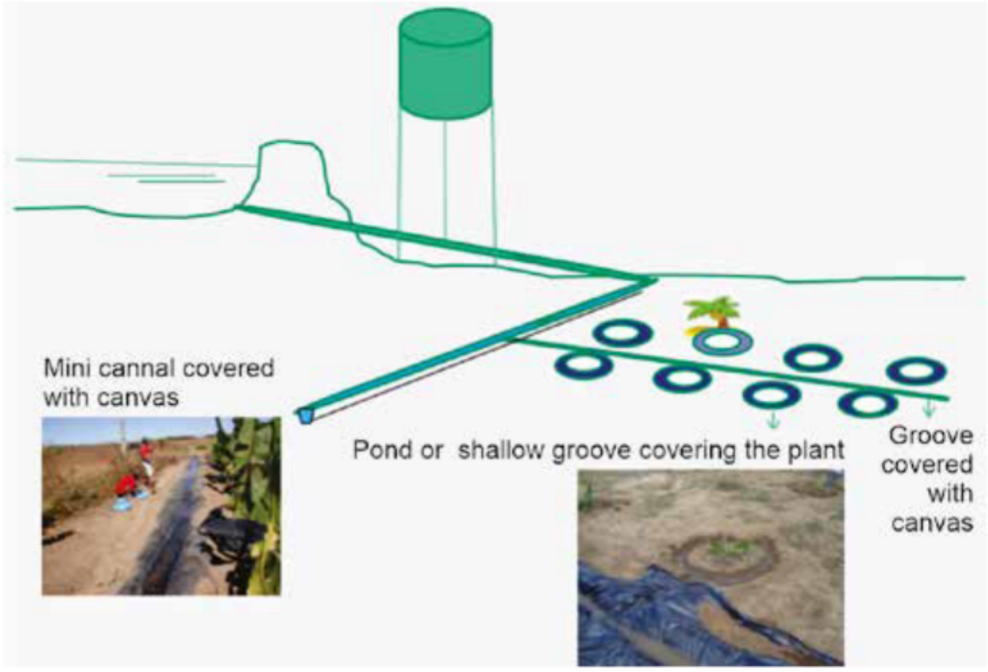

Figure 2. Basin irrigation system with channels and furrows coated with plastic tarpaulins.

Illustration: Eugênio Ferreira Coelho

Photos: Ildos Parizotto

Photos: Tibério Santos Martins da Silva

Figure 3. Use of plastic tarpaulins as background for plant beds.

Use and management of water for fish production

Integrated system for food production

The integrated system for food production or simply Sisteminha Embrapa (Sistema..., 2013) is a technological alternative for rural communities in regions with water shortages and consists of fish production integrated with raising chickens, quails, preys and other small animals, in addition to earthworms, vegetables, hydroponics, biogas, etc. The main objective of the system is the integrated production of food for families and animals. The system works from small 8,000 L tanks built with cardboard, plastic, mud, masonry, cement slabs, fiberglass, etc., which act as the engine of an integrated system for food production, with low consumption of electricity and water. The Sisteminha (Figure 4) is another efficient alternative that Embrapa has been making available to families in areas with water scarcity in the Brazilian Mid-North and semiarid regions, aiming at

Photos: Luiz Guilherme

Figure 4. Sisteminha Embrapa.

socioeconomic and environmental sustainability by combating hunger, reducing poverty and increasing opportunities in rural communities without harming the environment. One year after its implantation, the system is supposed to produce about 100 kg of fish, 1,000 hens, 1,000 ears of corn, 500 kg of earthworm compost and 300 kg of fruits and vegetables.

Floating cages

Brazil has 5.3 million hectares of freshwater in artificial and natural reservoirs that can have a significant economic use through fish farming, considering the growing demand of the domestic market, currently supplied by fish imports (Sonoda et al., 2016). From the available technologies for captive fish breeding, floating cages or net tanks are appropriate alternatives for these environments and constitute an intensive breeding system, whose implementation cost is comparatively lower than that of other systems used in fish farming (Figure 5). Having water in quantity and quality is a fundamental condition for the viability of this technology, being necessary to adopt adequate management practices to guarantee its economic and environmental sustainability.

Embrapa has been operating in practically all the national territory with researches and transfer actions that aim at the safe adoption of this technology. In this section Embrapa's activities in the North and Northeast regions with the species tambaqui (*Colossoma macropomum*) and Nile tilapia (*Oreochromis niloticus*), respectively, aiming mainly at the environmental management of the activity and stimulating the adoption of good practices of management (BPMs). Technology transfer actions are developed under different Embrapa projects, strengthening their adoption and stimulating the publication of diverse materials (books, folders,

Photo: Roselany de Oliveira Corrêa

Figure 5. Net-tanks installed in a hydroelectric reservoir.

booklets, videos) that are easily accessible to the public (Teixeira et al., 2009; Moro, 2014; Taniguchi et al., 2014; Seleção..., 2015; Ituassú, 2015; Queiroz; Rotta, 2016).

Multi-purpose lake

The multi-purpose lake consists of a tank built with a soft ramp, covered with ordinary plastic tarpaulin, covered by a 25 cm soil layer for its fixation and protection, used for irrigation and fish farming purposes. The system, developed by Embrapa Maize & Sorghum, is an efficient, long-lived and low-cost alternative when compared to lakes constructed with special tarpaulins (Figure 6).

Water reuse in dairy farming

The reuse of wastewater consists of the reuse of certain water that was an input in the development of an activity. The reuse in dairy farming occurs from corral cleaning water, which can be used again for this purpose, after passing through simple treatment systems, as it can be used in fertigation.

Embrapa works to reuse water in dairy farming in rural communities as a technological solution for efficient use of water and reduction of inputs with the

Photo: Luciano Cordoval de Barros

Figure 6. Multi-purpose mini lake used for irrigation of gardens and fish farming.

application of biofertilizer produced in the substitution or complementation of nitrogen fertilization, preserving the water resource, conditioning and fertilizing the soil.

The treatment processes of these waters are for the removal of suspended solids and organic load and the reduction of pathogenic microorganisms present in the waste. The reuse of water from hydraulic cleaning of corrals, for example, should be considered in the planning and sustainable management of water resources as a substitute for the use of waters intended for agricultural and irrigation purposes, among others. In this way, this practice results in good quality water sources for activities of other priority uses, contributing to the conservation of water resources, reducing the demand on water sources because of the substitution of drinking water for water of inferior quality (Otenio, 2015). The reuse of wastewater from the dairy cattle for hydraulic cleaning of floors reduces water consumption by 85% in relation to the processes that do not use the reuse (Torres et al., 2002), besides significant electrical energy and labor savings. In addition to the environmental conservation that the reuse of water resources promotes, there is also a reduction of costs, making production more sustainable. The biofertilizer generated from the final effluent produced has been used for fertigation, and some studies have already proven its application in sugarcane manure and in the cultivation of maize for silage (Otenio et al., 2017).

Water in cattle breeding

In rural properties, the use of water from different sources or without adequate treatment is common. However, water quality is determinant in the search for better results in production, as it contributes to animal welfare and positively impacts milk quality. Contaminated water can carry bacteria that cause mastitis in cows and also bacteria that contaminate milk.

Issues such as good agricultural practices, safe food production and normative instructions No. 51 and No. 62 (Brasil, 2002, 2011) dictate requirements for quality milk production, reflect the demand for a specialization in the production process and indicate the chlorination of water for use from milking to entering the dairy industry.

Embrapa offers several technologies to meet the current legislation for milk production, from small to large-scale dairies. When the consumption of water for animal production and use in the milking process area is less than 1,000 L per day, Chlorator Embrapa is indicated. For consumptions above 1,000 L per day, Embrapa indicates chlorination by diffusion (Otenio et al., 2017). Other Embrapa technologies relevant to this subject are the consulting on water in the dairy rural property and the analysis of the impact of the cattle breeding on the quality of the water.

Reuse of water in rural sanitation

Basic sanitation and elimination of contaminants

Brazil has greatly advanced in the area of basic public sanitation, but the numbers are still worrying. It is estimated that a daily volume of 4.8 billion liters of sewage is released in the countryside, considering direct release and inadequate treatment systems. Embrapa has developed technologies aimed at rural basic sanitation, whose premises involve the simplicity and efficiency of the systems, low implementation/maintenance costs and easy appropriation and use by farmers. Social technologies were proposed for the treatment of rural sewage (black and gray waters) and disinfection of water used for consumption:

- Septic tank biodigestor (Silva, 2014) – an easy-to-install, low-cost technological solution, efficiently treating sewage from the toilet (Figure 7).

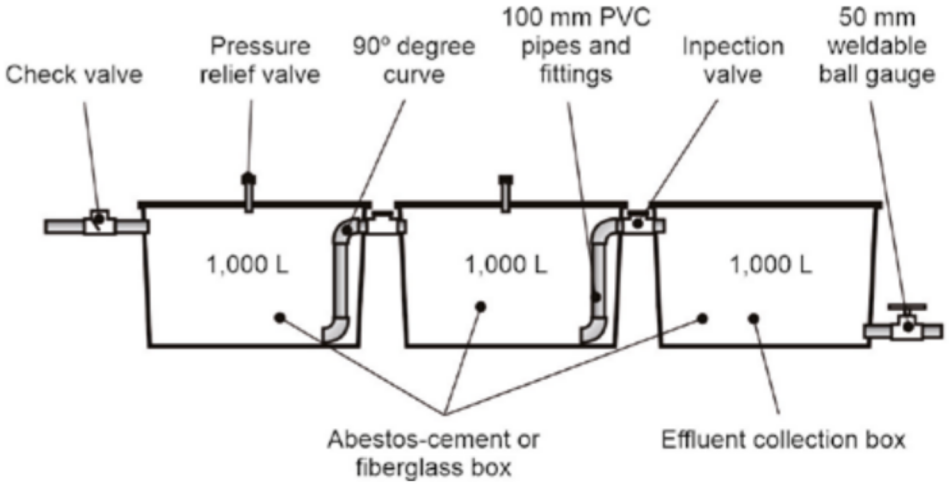

Figure 7. Septic tank biodigestor: technological solution for treatment of sanitary sewage from rural residences.

Ilustration: Valentim Monzane

- Filter garden (Silva, 2014) – alternative to treat the sewage coming from sinks, tanks and showers (gray water). It is a small lake with rocks, sand and aquatic plants where the sewage is treated through the interaction of plant species and microorganisms in this ecosystem (Figure 8). It is a technology adapted to complement the use of the septic tank biodigestor.

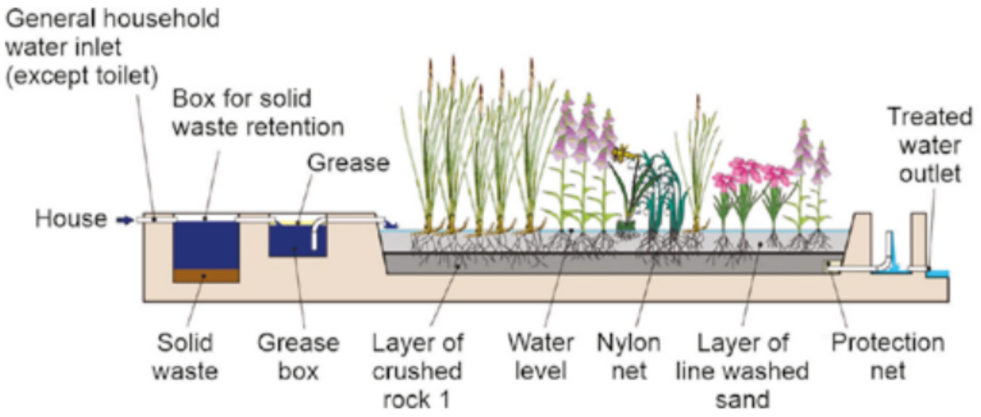

Figura 8. Filter garden: alternative technology for treatment of sewage from sinks, tanks and showers from rural residences.

Ilustration: Valentim Monzane

- Embrapa´s Chlorinator (Silva, 2014) – technology to chlorinate reservoir water from rural residences (Figure 9). Its main benefit is the disinfection of the water used at home, fostering good health of the residents.

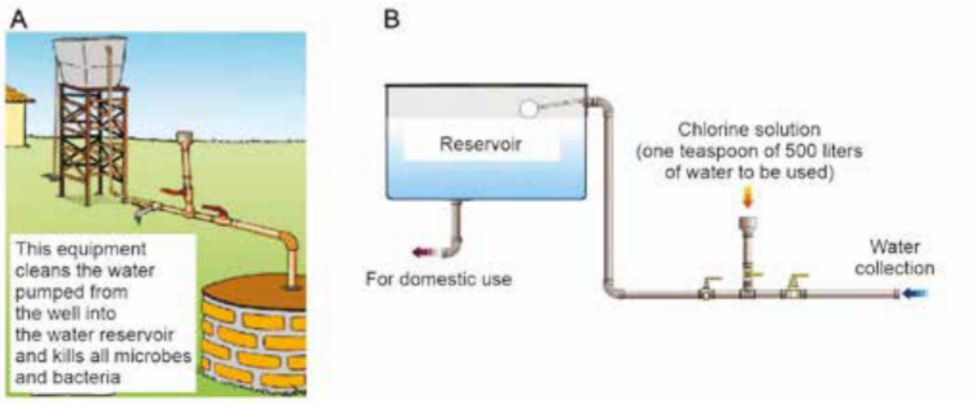

Figura 9. Embrapa's Chlorinator System: technological solution for the chlorination of water from residential reservoirs.

Illustrations: Renato Moura (A); Valentim Monzane (B)

The technologies of the septic tank biodigestor and filter garden are viable options for the reuse of water and fertigation in agricultural properties, mainly for family farming, bringing economic benefits by the application of the effluent in the fertilization of the soil. Within the scope of public policies, the septic tank biodigestor was defined as a reference in the Programa Nacional de Habitação Rural (National Rural Housing Program), within the scope of the program Minha Casa Minha Vida (My House, My Life – PMCMV). Public institutions may request funds for projects for the construction or renovation of bathrooms and sanitary facilities, provided that sewage treatment occurs according to one of the models defined in Ordinance 268/2017. The social technologies of rural basic sanitation of Embrapa have already been implemented in approximately 12 thousand rural residences in Brazil by the network of institutional partnerships formalized by Embrapa, benefiting almost 60 thousand people. Entities such as the Coodenadoria de Assistência Técnica Integral (Coordination of Integral Technical Assistance – Cati/SP), the Banco do Brasil Foundation and the Rio Rural Program (Seapec/RJ) have together installed more than 10 thousand units of the septic tank biodigestor.

Sanitary management in fish farming

Regardless of the type of cropping system, the fish farmer may be faced with diseases, whether due to inappropriate management (Figure 10) or external causes. In this sense, Embrapa Amapá recommends some basic measures of biosafety in order to subsidize farmers and technicians with regard to good management practices, ensuring the quality of the fish produced and the improvement of sanitary conditions of fish farms (Kubitza, 2004; Noga, 2010; Tavares-Dias et al., 2013, Tavares-Dias; Fujimoto, 2014).The effectiveness of sanitary measures depends on the farmer's awareness that important aspects should be taken into consideration when talking about sanitary management, as well as the presence of professionals trained to guide the fish farmer and correctly diagnose the disease, and sanitary inspection by government agencies, in fish farms and fish transportation between properties. Only by taking these precautions into account, can fish farming be more successful in implementing a sanitary control program in the farming system, becoming more competitive and profitable.

Photo: Marcos Tavares-Dias

Figure 10. Fish farming nursery with high presence of red algae due to eutrophication.

Final considerations

Considering the importance of water as a fundamental resource to develop any agricultural activity, it is essential that its rational use be discussed and, more than that, its management be constantly improved through technologies and good conservation practices, so that this resource is preserved in quality and quantity in rural properties. The technological solutions presented in this chapter constitute a "showcase" of the significant work that Embrapa has developed for the benefit of society and which, undoubtedly, has much to contribute to the achievement of target 6.b of SDG 6.

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