E-BOOK – FIDA PROJECT

COVER

It should have an illustration

Introduction

Here it's just text and only one page.

Rural sanitation

(This topic will include a chart)

The water availability in semi-arid regions has been affected, either from qualitative as both from quantitative point of view, mainly due to the high rates of evaporation, irregular distribution of rainfall and the lack of coverage of basic sanitation in urban and rural areas of Brazil (HESPANHOL, 2002; PNSR, 2019).

That is why it is important to advance in the practice of reusing treated sewage, especially for agricultural use in rural areas of the Brazilian semiarid region. However, one cannot think of this advance without first planning to increase the coverage of rural basic sanitation, which already has the component of well-structured water supply, through the diffusion of rainwater harvesting cisterns, but needs to advance in the distribution of piped water.

Contrary to this scenario we have sanitary sewage, which practically did not reach the rural area of Brazil and nevertheless needs to be offered to the populations of these regions, aiming at the promotion of preventive public health, in addition to providing an alternative source of water for the practice of reutilization in agricultural production.

Rural sanitation is a right that has been neglected over the years, endangering the health of people living in the countryside and burdening the single public health system. In 2019 there was a breakthrough in the structuring part, as the federal government launched the National Rural Sanitation Plan – PNSR, establishing guidelines, goals and deadlines for the universalization of rural sanitation in Brazil (PNSR, 2019).

However, the existing infrastructure in rural areas is still very precarious, with millions of people without adequate access to water supply and sanitation. There are several challenges inherent to rural areas, evidencing the need to invest in sustainable technologies, capable of promoting environmental sanitation with the recovery of natural resources, such as water and nutrients.

According to data extracted from the National Plan for Rural Sanitation, more than half of the country's rural population disposes of their waste in rudimentary cesspools, which is an inappropriate practice from a health and environmental point of view, in addition to not promoting the recovery of important resources for the sustainable development of the Brazilian Semiarid (PNSR, 2019).

In this context, the Semiarid National Institute (accordingly to Portuguese acronym, INSA), a research unit of the MCTI (the Portuguese acronym to Innovation, Technology and Science National Department), whose main attributions are the feasibility of interinstitutional solutions for carrying out and research actions, training, dissemination and formulation of policies for the sustainable coexistence of the Brazilian Semiarid, has developed and is disseminating the SARA (the Portuguese acronym to the Environmental Sanitation and Water Reutilization) technology, as an alternative to rural sewage with a focus on the reuse of water used for fodder fertigation.

SARA Technology

In this topic will be included a photo (we will send)

Rural basic sanitation, first of all, is a right established by Federal Law No. 11,445/2007; has as one of its principles the universalization of access to sanitation in urban and rural areas; comprises a set of initiatives or actions that aim to ensure people's health, through public policies and infrastructure works and buildings, which promote water supply, collection and treatment of sanitary sewage, water waste disposal, rain drainage and solid waste management (BRAZIL 2007).

In Brazil, one of the axes of sanitation that has less improved its advance is sanitary sewage, where almost 100 million Brazilians (44.2%) do not have access to sewage collection, as well as wastewater disposal. In the Northeast region, only 30.2% (16.9 million) of the population has access to sewage collection (SNIS, 2021). In rural areas, universalization has been an even greater challenge.

According to the National Rural Sanitation Program, the situation of rural sanitary sewage of the Caatinga biome, which is predominantly inserted in the Brazilian Semiarid, is precarious, since 53.7% of rural establishments have rudimentary cesspools (inappropriate solution), 13.5% do not even have a bathroom and only 7.5% have septic tanks, ratifying the current scenario (FUNASA, 2019).

Linked to this factor is the water vulnerability in the Brazilian Semiarid, which in periods of prolonged drought ends up worsening, negatively impacting the water supply and agricultural production in the region. In addition to these factors, the population living in the region is exposed to low rates of coverage of sewage collection, included wastewater disposal and treatment, which in 2010 had a production of 423 million m^3/year (almost 15 billion cubic feet per year). The volume of sewage collected accounted for, however, only 117 million m^3/year (about 4.1 billion cubic feet per year), approximately 28%, of which it was limited to 89 million m^3/year (about 3.1 billion cubic feet per year) of treated sewage, which is equivalent to 21% of the sewage produced in the Brazilian Semiarid (MEDEIROS et al, 2014).

In recent decades, several wastewater treatment technologies have been developed and disseminated in the Brazilian Semiarid region by universities, research institutes and social organizations, aiming to contribute to improving the disastrous scenario of rural sanitary sewage and, above all, to offer an alternative source of water for agricultural production.

The SARA Technology (Environmental Sanitation and Water Reuse) was one of these technologies, having been developed by INSA as an alternative of sustainable rural basic sanitation, which has as main impacts the promotion of public health, generation of an alternative source of water, continued agricultural production, increase in income and strengthening of family agriculture (MAYER *et al, 2021*).

This technology provides the collection, treatment and reuse of domestic sewage produced in rural homes, strengthening family farming, which corresponds to almost 80% of the rural territory of the Brazilian Semiarid, and meeting five SDGs of the UN 2030 agenda.

The water supply that SARA provides, through treated sewage, strengthens continued agricultural production, as the water and nutrients contained in the reuse water are produced daily in farmers' homes. In this way, the natural resources, previously wasted, are reused in the irrigated cultivation of fruit and forage plants.

The use of this technology promotes the prevention of the health of farmers, children, adolescents, and the elderly of areas, as well as of the animals that are raised in the backyard, reducing waterborne diseases associated with open sewage and the consumption of contaminated water.

SARA is a technology that was considered by the UN (2020), as a technology with the potential to launch sustainable development, in the category of public policy in Latin America (GRAMKOW, 2020). The SARA Technology can be inserted to, within the scope of the Rural Brazil Sanitation Program – PSBR (Portuguese acronym), as one of the viable and eligible options for rural sanitary sewage, focusing on the concept of the "circular economy", from the recovery of water and nutrients for agricultural reuse.

The technology has as a differential the low cost of CAEPX and OPEX, in addition to serving diffuse residences, in locations unassisted by the collective basic sanitation service, as well as small rural agglomerations and schools.

On a single-family scale, the system has a sewage treatment capacity of up to 1,000 liters/day (about 264 gallons per day) and can serve up to 10 people. In the school and community scales, the system has a sewage treatment capacity of up to 10,000 Liters/day (about 2,642 gallons per day), being able to serve 200 people.

The treatment of sewage for reuse is an important tool for the management of water resources, especially in the Brazilian Semiarid, increasing water availability and reducing social conflicts over water use (BARBOSA *et al*, 2021).

Forage palm under conventional irrigation and reuse water

In the semiarid region, mainly due to its edaphic characteristics, climatic rainfall distribution and high luminosity, the cultivation of crops with C_3 and C_4 metabolism becomes limited, however under these conditions the cultivation of forage palm stands out, because it has morphological characteristics of adaptation, which provide greater efficiency in the use of water in conditions of high water deficit (MORAIS, 2016). This combined with the attributes of tolerance to prolonged droughts, high acceptability and animal digestibility, supply of energy and good quality water for the maintenance of herds during periods of drought, being able to participate with 40 to 50% of the dry matter of cattle diets, make this crop not a forage alternative, but the basis for animal feed in the Semiarid (DUBEUX JÚNIOR & SANTOS, 2005; SOUZA et al., 2018; RAMOS et al., 2021).

The forage palm presents a physiological dynamic that allows to have high yields both in rainy and dry periods, and this can be considered due to its photosynthetic pathway that ensures adaptation also to periods of water scarcity (PIMENTEL 2004; SILVA et al., 2015). In addition to high tolerance to abiotic stresses, forage palm provides high efficiency in water use, estimating an efficiency between 5 and 10 times higher than in C_4 and C_3 plants, respectively, and still with a very peculiar characteristic having the ability to become an optional CAM, migrating to the C3 pathway depending on the conditions in which it is found (OJEDA-PÉREZ et al., 2017; YU et al., 2019). This characteristic present in forage palm, besides being favorable for its survival, still becomes conducive to cultivation due to having high yield and higher dry matter in adverse conditions when compared with other species, especially in arid and semi-arid regions.

On the other hand, current research has shown that the additional supply of water to the palm can be a relevant strategy for the establishment of the palm plantation, promoting improvements in the characteristics related to plant growth, number of cladodes, *cladodium calophyllum* area index and productivity (ROCHA et al., 2017). The use of irrigation has contributed significantly to the increase of agricultural productivity and incorporation of areas whose potential for exploitation of agriculture is limited, especially those destined to the cultivation of forage palm in the Semiarid, that are characterized in their great majority by having shallow, stony soils, and low content of organic matter (CUNHA, 2018).

Despite the problems caused by salinization, the irrigated cultivation of forage palm should not be understood only as a practice contrary to semi-arid conditions, but as a method capable of providing, at the appropriate time, the amount of water necessary for the optimal yield of the crop, considering that the interval between irrigation events are much longer than that of traditional crops (PADILLA et al., 2011).

This becomes even more relevant in the cultivation of this cactus, because it achieves high yields with the minimum water supply in the system, reaching the point of needing in a month of irrigation what conventional crops need in a day, as found by Lima et al., (2015) through yields above 250 ton (500,000 pounds) ha^{-1} $year^{-1}$ of green matter with the use of an irrigation depth of 15 mm (about 0,59 inches) $month^{-1}$ in the cultivation density of 50,000 plants $ha^{-1,}$ which in Brazilian Semiarid conditions also allows the use of alternative sources of water as rain catchment, or even other sources often neglected as low-flow wells and reuse water, pointing to a high productive potential.

It is difficult to envision a forage crop with so many attributes of yield, forage quality and adaptation to the semi-arid environment, and the adoption of these technologies can work as an alternative to substantially reduce the dependence of producers on the acquisition of commercial concentrates, given that palm for its high energy content has the potential to replace corn not only in periods of drought, but in the composition of diets throughout the year (LIMA et al., 2015).

A worldwide trend in areas under irrigated cultivation, water reuse is an accomplished practice and several countries around the world, this practice has been growing in an ascending way aiming mainly to make the use of this resource increasingly sustainable, whether on a large or small scale. The practice of drinking water reuse has evolved in an important way, in Israel it covers more than 50% of its agricultural water demand with reclaimed water. (HELMECKE et al., 2020). Beneficial effects in relation to agricultural crops irrigated with domestic sewage effluents have been observed by several researchers, such as pasture cultivation by Cruvinel et al. (2021); quality of papaya fruits by Batista et al. (2017) and in forage palm cultivation (OLIVEIRA, 2021).

In countries such as the United States, Saudi Arabia, Jordan, California, Iran and Israel reuse up to 70% of domestic sewage in irrigation, in Brazil some regions have adopted the practice of reuse in the agro-industrial sector, such as the São Paulo State Basic Sanitation Company (SABESP, accordingly Portuguese acronym), one of the pioneers in the production of reused water for industrial supply. In the state of Paraíba, Law number 10,033/2013, which establishes the State Policy for the collection, storage, and use of rainwater, contemplates another form of reuse use, a sustainable way to reduce water scarcity and the preservation of the environment (BATISTA, 2019; OLIVEIRA, 2021).

Wastewater in most municipalities is abundantly available in the urban environment, in most cities, it returns in the form of sewage and without proper treatment. Studies on the viability of agricultural production associated with water reuse have been widely researched and analyzed in some regions of the Brazilian Northeast (CARVALHO et al., 2020). This region for presenting essentially of livestock aptitude, the cultivation of forages irrigated with effluents of this nature can increase the capacity of animal support, productive efficiency of rural properties, generating a great positive impact on the local economy.

A case of success regarding the reuse of water was the implementation by the Semiarid National Institute of an area of one hectare in 2018, irrigated with water from the Sewage Treatment Station – ETE (accordingly Brazilian acronym) belonging to the municipality of Frei Martinho-PB, which receives the effluents of the urban population. The area was cultivated with three varieties of palm: *Miúda (Nopalea cochenillifera salm-dyck), Baiana (Nopalea cochenillifera* salm-dyck*) and Orelha de Elefante Mexicana (Opuntia stricta haw),* in consortium with five legumes: *mesquite* (*Prosopis juliflora*), *cunhã (*Clitoria ternatea*), gliricidia (*Gliricídia sepium*) and sabiá (*Mimosa caesalpiniifolia), for the purpose of forage and timber and a witness treatment. Drip irrigation was performed via drip, with a water depth of 7.5 l (15.85 pints) /linear meter and a frequency of 07 (seven) days, which corresponds to 1.87 liters (3.95 pints) /plant/week.

It is observed in Figure 1 A and B, that both in height and plant width, the *miúda* variety (107.3 and 111.9 cm, or 42.24 inches and 44.06 inches respectively) surpassed the Bahian materials (92.2 and 91.2 cm, or 36.30 inches and 35.91 inches) in 16.3 and 22.7 % and *orelha de elefante mexicana* (mexican elephant ear), OEM, (93.2 and 94.8 cm, or 36.69 inches and 37.32 inches) in 15.1 and 18%, respectively. This is possibly because this material has more erect growth and greater emission of cladodes (Figure 6), this directly influences its growth in height and width.

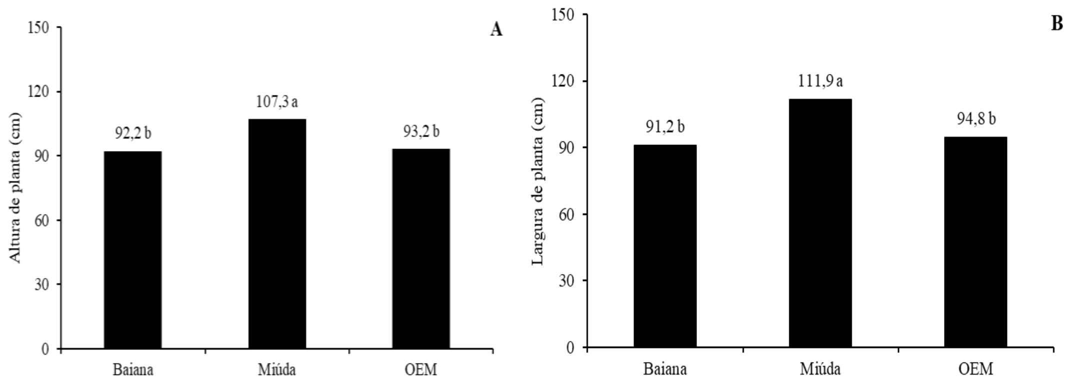


Figure 1. Height (A) and width (B) of forage palm varieties irrigated with reuse water, 24 months after planting, regardless of the consortium used.

Silva et al. (2015) working with these materials in dry conditions 24 months after planting, found that the OEM variety obtained higher plant height, while for plant width there was no difference between genotypes. However, Rocha et al. (2017) in irrigated cultivation of m*iúda*, OEM and IPA 20 materials at 16 months after planting, obtained that m*iúda* obtained greater plant width, being like IPA 20 in tall.

The atmospheric CO_2 (A) uptake rate of forage palm varieties in the same consortium system obtained statistical difference only for OEM when cultivated with *gliricidia* (2.8 μmol m^2 s^{-1}), superiority of 100 and 55.5% in comparison with the materials *baiana* and *miúda*, in this order (Figure 2). In the comparison of the influence of the different consorts with the forage palm materials, it was found that the *baiana* palm captured more CO_2 when grown under the mesquite (2.8 μmol m^2 s^{-1}), an increase of at least 75% in relation to the other consortiums. OEM obtained higher CO_2 capture when consortium with mesquite and *gliricidia* (2.3 and 2.8 μmol m^2 s^{-1}), while the mesquite cultivation, *gliricidia* and *sabia* provided higher 'A' to the m*iúda* genotype (2.4 and 1.8 and 1.7 μmol m^2 s^{-1}).

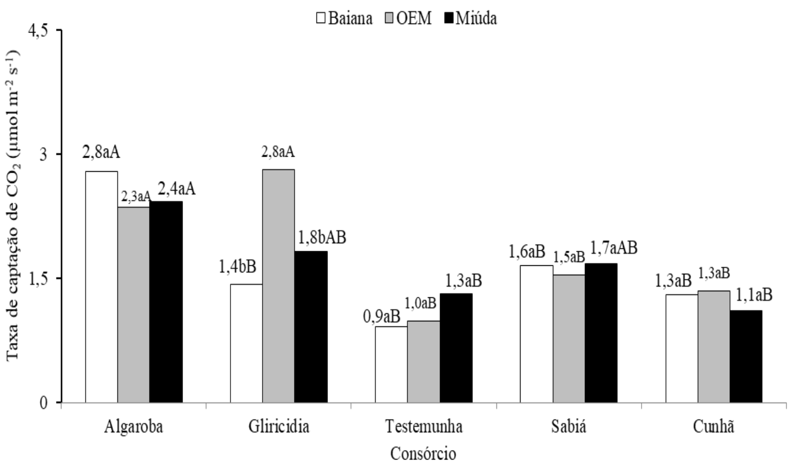


Figure 2. CO2 Capture Rate of forage palm varieties irrigated with reuse water, 24 months after planting, depending on the consortium used.

The higher rates of CO_2 uptake obtained by palm varieties when intercropped with larger legumes (a*lgaroba*, *gliricidia* and *sabiá*), possibly occurs due to the microclimate created by them, which ends up positively benefiting this cactus. Sampaio (2005) points out that in consortium of forage palm with C_3 and C_4 crops both can be benefited, because during the night these plants are breathing, that is, releasing CO_2 into the atmosphere, creating an environment richer in CO_2 in the space between the soil and the upper part of the plant.

Nobel (2009) points out that the plants governed by MAC have a maximum photosynthetic rate of 7.6 μmol CO_2 m^{-2} s^{-1}, but usually the rate is 2.5, these low photosynthetic rates in most cases cause the plant to have a very slow growth. However, it is observed that the use of the consortium with plants governed by other metabolisms, the forage palm obtained more intensity of CO2 uptake, maintaining at adequate levels.

The instantaneous efficiency of water use (USA) behaved similarly to CO2 capture, when in consortium with *gliricidia*, the OEM variety (5.0 μmol m^2 s^{-1}/mmol of H_2O m^2 s^{-1}) surpassed the b*aiana* and m*iúda* varieties by 212.5 and 163.1%, respectively (Figure 3). This EUA was also the highest for this palm variety in comparison with the other consorts, while the *baiana* obtained the highest EUA in cultivation with mesquite (3.7 μmol m^2 s^{-1}/ mmol of H_2O m^2 s^{-1}) and *miúda* was positively influenced through the consortium with mesquite (3.8 μmol m^2 s^{-1}/ mmol of H_2O m^2 s^{-1}) and thrush (2.4 μmol m^2 s^{-1}/ mmol of H_2O m^2 s^{-1}).

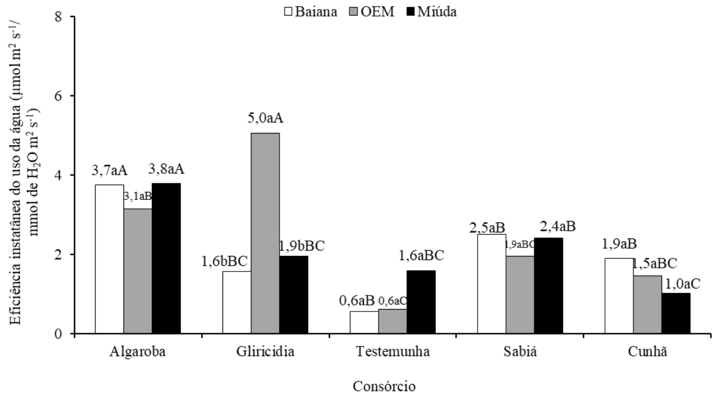


Figure 3. Instantaneous water use efficiency of forage palm varieties irrigated with reuse water, 24 months after planting, depending on the consortium used.

The EUA levels obtained in this study are mostly well above those achieved by Souza et al. (2020) in consortium with annual forages, such as with *buffel* grass and forage watermelon (1.33 and 1.10 µmol m-2 s-1)/(mmol H_2O m^{-2} s^{-1}, respectively). This demonstrates the superiority of CO2 uptake in response to higher transpiration rates, determining an increase in this variable.

Figure 4 shows that the *miúda* variety obtained 54 cladodes of the plant-^{1}, relative increase of 157.1 and 125% compared to the *baiana* and OEM materials, which obtained respectively 21 and 24 cladodes plant^{-1}.

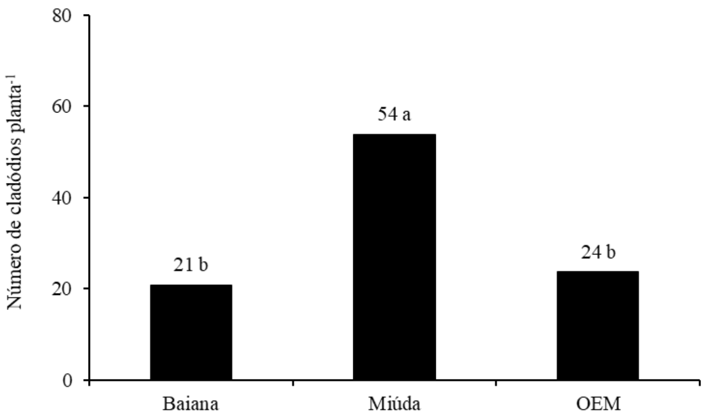


Figure 4. Number of cladodes per plant of forage palm varieties irrigated with reuse water, 24 months after planting, regardless of the consortium used.

Rocha et al. (2017) observed that the *miúda* variety presented at 16 months 44.2 cladodes plant$^{-1,}$ while OEM and IPA 20 in the same period presented 19.7 and 11.05 cladodes plant^{-1}, respectively. Lira et al. (2021) verified in a forage palm consortium system with annual crops that the OEM and *miúda* varieties produced 224.8% and 176.1% more rackets per plant compared to the *baiana* variety.

Studies of this nature support the use of this type of water promoting in addition to greater plant growth, sustainable water use and improvements in public health, this type of policy also in rural areas, where there is practically no basic sanitation should be further considered by the great potential for expansion of new productive areas.

Important aspects in irrigation with treated wastewater

Hello farmers! Did you know that the use of treated water in your plantations can bring many benefits? This water contains nutrients important for the healthy growth of crops, such as nitrogen and phosphorus, as well as improving soil quality and increasing crop productivity.

However, it is very important to ensure that the water has undergone an effective treatment process to remove harmful substances, such as bacteria and chemicals, to protect human health and the environment. The use of treated water should follow specific rules and guidelines to minimize risks and maximize benefits (MAYER et al., 2021).

In this way, the use of treated water in their plantations can be a sustainable practice that helps preserve our water resources and increase agricultural production more efficiently.

The drip system is very efficient, as the water is applied directly to the roots of the plants, reducing losses by evaporation and surface runoff. This is important when it comes to treated wastewater as it avoids wasting resources and contaminating the environment.

In addition, the use of the drip system reduces the risk of contamination of crops and workers in the field, as the water is applied in a controlled and localized way. This is key to ensuring the safety of the food produced and the health of agricultural workers.

Another advantage is that the drip system helps prevent the accumulation of salts near the roots of plants, which could harm the development of crops. In addition, the controlled application of water helps prevent the leaching of nutrients and pollutants into water bodies.

Therefore, using drip irrigation systems is a smart choice for the reuse of treated wastewater in agriculture, contributing to food production in a more sustainable way and to the protection of the environment.

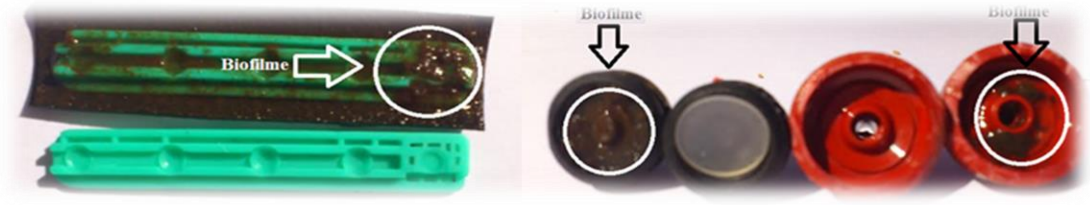
Some important factors for irrigation system management

Types of drippers and their clogging

There are many types of drippers available on the market, each with a different maze that helps reduce the sedimentation of particles inside.

Clogging can be caused by biological, physical and/or chemical factors, especially when using water with high levels of iron, manganese, bacteria and organic material.

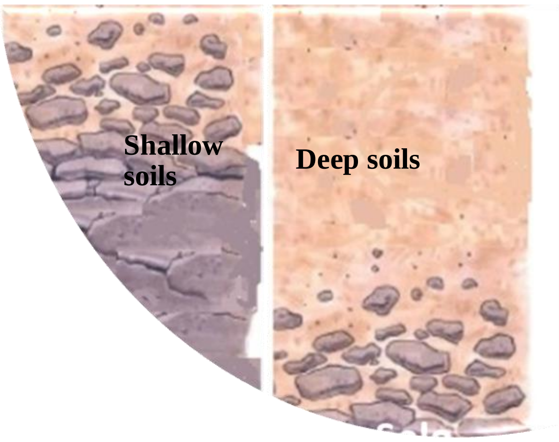
It is important to remember that the use of wastewater in irrigation can lead to biofilm formation, a result of the interaction between physical, chemical and biological factors. This biofilm formation can contribute to the partial clogging of the drippers and, consequently, reduce the flow of irrigation systems. Therefore, it is essential to carry out a proper treatment of wastewater before using it in irrigation to minimize these risks and ensure the efficiency of the irrigation system.



To avoid clogging in drip systems, it is necessary to adopt some preventive measures. One of them is to keep the drippers facing up, as this helps prevent the entry of solid particles into the inside of the drippers. In addition, it is important to perform regular maintenance on irrigation systems, such as cleaning filters and drippers, to prevent the accumulation of sediment and other materials that can obstruct the flow of water.

It is always recommended to give preference to irrigate in deep soils, as they have greater storage capacity of water and nutrients, ensuring a more efficient and sustainable irrigation.

In addition, deep soils allow plant roots to develop better, which contributes to a healthier and more productive production. Therefore, it is important to know the soil of your growing area well and choose the best irrigation strategy to ensure a good development of the plants.



Types of soils ideal for wastewater irrigation

It is important to choose growing areas that are not subject to flooding, as excess water can cause damage to plants and the irrigation system. In addition, it is recommended to choose areas with a small slope of about 5 cm (two inches) per meter, as this helps to ensure good soil drainage and prevents the accumulation of salts on the surface.

It is important to consider soil characteristics when defining the irrigation strategy. In sandy soils, irrigation should be short-lived, to prevent water from infiltrating beyond the root zone. In clay soils, irrigation should be even shorter, to prevent effluent from dripping on the soil surface.

In silty soils, which are intermediate between sandy and clayey soils, it is possible to perform irrigations with a longer time, because these soils can retain water without letting it infiltrate too quickly. However, it is important to monitor the soil regularly to prevent excessive accumulation of water on the soil surface, which can impair plant development. In general, it is recommended to adjust the time and frequency of irrigation according to the specific soil characteristics of the growing area.

Declivity direction

Sandy soil

Clay soil

Sandy soil

Management in the irrigation system to avoid problems with the use of treated wastewater

It is essential to adopt appropriate management measures to avoid problems in the use of treated wastewater in irrigation. One of the most important measures is to clean the filter before turning on the motor pump, because the small diameter of the emitters can present clogging problems caused by sand particles, algae, bacteria, iron oxide and organic matter present in the water. In addition, it is important to perform periodic maintenance.

Before starting irrigation, it is recommended to clean the disc filter and wash it thoroughly. It is also important to open the end of the line at least once a week to clean the tapes. If there are no self-cleaning valves at the end of the drip tape, it is necessary to open weekly the end of the line and the registers at the end of the main network to dispose of the first waters, which will be concentrated with dirt.

These measures help prevent the accumulation of sediment and other materials that can obstruct the flow of water and cause problems in the irrigation system.

Forage palm and agricultural reuse: looking at the gestation of economic and social impacts

The SARA, a technology developed by INSA, is configured as a sustainable model that adapts to the reality of rural sanitation to solve the problem in an integrated way, promoting sanitary sewage, associated with the recovery of water and nutrients for continued agricultural production, contributing to the public health of the entire community, generating income, and giving dignity to rural families. This technology can treat gray water from the kitchen sink, laundry, washbasin and shower of the residence, as well as dark water (total sewage), which includes the dumps from the sanitary basin.

Considering the importance and need to expand the production of forage palm and agricultural reuse, the National Institute of the Semiarid – INSA, is coordinating and executing the Project **"Production of forage palm and agricultural reuse: alternative for coexistence with the Semiarid",** TED Nº 00001420220052-000449/2022 - MDA/INSA that aims to disseminate, within the scope of the Dom Helder Câmara Project (PDHC, accordingly Portuguese acronym), the culture of forage palm, resistant to *Cochonilha-do-Carmim*, in the Brazilian Semiarid, using water for localized irrigation, from the SARA Technology (Environmental Sanitation and Water Reuse) and production cisterns associated with photovoltaic energy systems, aiming to reduce the water vulnerability of family agriculture in the Semiarid and provide appropriate sanitary sewage to rural areas, with continuity of agricultural production and improvement of family income Farmers.

This project is being implemented by an INSA team, with the guidance of the PDHC and MDA team, has financial resources from IFAD and has the support of the State Technical Assistance Companies in the states, as they have fulfilled the role of indicating the possible beneficiaries.

It began in the last month of 2022 with the process of indicating families, potential beneficiaries, considering some criteria such as: Family farmer according to article 3rd of Law No. 11,326, dated July 24, 2006; Holder of Declaration of Aptitude to Pronaf (DAP); Have an area around the house (200 m^2) for the installation of the SARA and 0.5 hectare for planting forage palm, soil that can be excavated; Reside at least 5 people in the household; Raise cattle, goats or sheep. In the case of families to receive units with production tanks, the criteria were the same, differing only the need to already have a 52,000-liter (about 13,737 gallons) cistern.

The composition of the Project units

Forage palm production unit with SARA	
Item	**Description**
1 Palm field	Palm variety resistant to Cochineal-do-Carmim for planting up to 0.5 hectares.
1 Solar power kit	The off-grid **system or** the autonomous system, has as its main characteristic the operation without connection to the electrical networks.
1 SARA System kit	Composed of 1 Fat Box; Equalization tank; UASB reactor; Polishing ponds; Reuse water reservoir; Pumping; Measurement; and Irrigation system
Technical Advisory	The beneficiary family will receive technical advice in the initial period
Forage palm production unit with Production Cistern	
1 Palm field	Palm variety resistant to Cochineal-do-Carmim for planting up to 0.5 hectares.
1 Solar power kit	The off-grid **system or** the autonomous system, has as its main characteristic the operation without connection to the electrical networks.
1 kit for subirrigation	Irrigation system sufficient for the field of up to 0.5 hectare of palm.
Technical Advisory	The beneficiary family will receive technical advice in the initial period
School Unit	
1 field of palm consortium	Palm variety resistant to Carmine Cochineal for planting up to 0.5 hectare
1 Solar power kit	The off-grid **system or** the autonomous system, has as its main characteristic the operation without connection to the electrical networks.
1 kit for subirrigation	Irrigation system sufficient for the field of up to 0.5 hectare of palm in intercropping with native and stealthy species.
1 SARA System kit	Composed of 1 Fat Box; Equalization tank; UASB reactor; Polishing ponds; Reuse water reservoir; Pumping; Measurement; and Irrigation system

Materials and methods

Here you will have 2 photos

This project is still in the process of implementation.

The benefited families are social subjects inserted in community and municipal dynamics. Considering the local context of these subjects, the activities to be carried out will have a reflective and practical character, individual and collective, starting from the analysis of their daily lives in the perspective of leading them to think about SARA technology, treatment of domestic effluents, management of water resources, collective health, environment, cultivation and management of forage palm (from planting to harvesting), irrigation with treated wastewater or with water from the production cisterns. Families will be guided to follow and be involved in the activities of installing SARA in their homes and growing areas, becoming an active component in the process.

To collect data from families and social organizations in the municipalities where this project operates, visits will be made to the homes of the benefited families for the application of a questionnaire and/or interviews, as well as to the Municipal Councils of Sustainable Rural Development (CMDRS, accordingly Portuguese acronym) of the municipalities contemplated. This information should be organized graphically for analysis and evaluation of the project.

In order to describe the experiences of the families with the management of wastewater, interviews and photographic records of before and after the installation of the unit will be carried out with a sample of 25% of the families benefited.

To contribute to the training process for coexistence with the Semiarid, lectures and/or thematic workshops on health, rural sanitation and forage security will be held with the CMDRS's, associations, schools or groups of benefited families.

Results (experience report) – Here you will have 2 graphs and 2 photographs

UF	Municipalities with family units	Communities	Families	People
Alagoas	Água Branca, Mata Grande, Canapi, Delmiro Gouveia and Piranhas	9	12	60
Bahia	Arcado and Backwater Pestle	10	12	49
Ceara	Alto Santo, Iracema and Jaguaribe	11	12	63
Minas Gerais	Francisco Sá, Captain Enéas and Janaúba	7	13	75
Paraiba	Silver, Old Gold and Amparo	13	13	63
Pernambuco	Tuparetama, Brejinho and São José do Egito	12	12	53
Piaui	São Lourenço do Piauí	10	12	71
Rio Grande do Norte	Lajes, Pedra Preta and Jardim de Angicos	11	12	68
Sergipe	Round Well	4	12	38
Total		**87**	**110**	**554**

This project is reaching 110 families, of which 7 are in settlement areas of the National Agrarian Reform Program, 6 are from traditional pasture fund communities, another 8 are from remaining *quilombola* areas and 88 families are from traditional family farming communities.

Conclusions

Here only text and a maximum of 400 characters without space

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