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Article

Urban Agroforestry System in the West Zone of Rio de Janeiro: Floristic and Nutritional Diversity for Food Security

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RESUMO

O presente trabalho descreve a implantação de um Sistema Agroflorestal (SAF) de subsistência em uma comunidade localizada na Zona Oeste do Rio de Janeiro, com destaque para as etapas de planejamento, execução e os benefícios gerados. Os SAFs são sistemas produtivos sustentáveis que integram espécies arbóreas, cultivos agrícolas e, eventualmente, criações animais, baseando-se nos princípios da sucessão ecológica e da estratificação florestal. Esses sistemas favorecem a recuperação e conservação do solo, o aumento da biodiversidade, o sequestro de carbono e o fortalecimento da segurança alimentar local. O objetivo deste relato é compartilhar a experiência da implementação do SAF como forma de inspirar outras iniciativas comunitárias, além disso foi aplicado um questionário semiestruturado para avaliar a participação no SAF. A escolha das espécies vegetais levou em consideração o tipo de produto, o período de frutificação e a adaptação às condições edafoclimáticas da área. A diversidade de cultivos contribuiu significativamente para a segurança alimentar de famílias beneficiadas por programas sociais, com a oferta de hortaliças, frutas e tubérculos. O sistema de irrigação foi adaptado à realidade local, e os desafios climáticos foram enfrentados por meio de planejamento técnico e da valorização dos saberes tradicionais da comunidade.
Keywords: cultivos sustentáveis; horta comunitária; soberania alimentar; agricultura urbana.

ABSTRACT

This paper reports on the implementation of an Agroforestry System (AFS) for subsistence farming in a community located in the West Zone of Rio de Janeiro, with emphasis on the planning and implementation phases and the benefits achieved. AFSs are sustainable production systems that integrate tree species, agricultural crops, and occasionally livestock, following the principles of ecological succession and forest stratification. These systems contribute to soil restoration and conservation, biodiversity enhancement, carbon sequestration, and the strengthening of local food security. The purpose of this study is to share the experience of AFS implementation as a means of inspiring other community-based initiatives. In addition, a semi-structured questionnaire was applied to assess participation in the AFS. Plant species were selected based on product type, fruiting period, and adaptation to local soil and climatic conditions. Crop diversity played a central role in improving food security for families supported by social programs, ensuring the availability of vegetables, fruits, and tubers. The irrigation system was adapted to local conditions, and climatic challenges were addressed through technical planning combined with the community's traditional knowledge.
Keywords: sustainable crops; community vegetable gardens; food sovereignty; urban agriculture.

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Introduction

The term agroforestry or Agroforestry System (AFS) is applied to land management that intentionally and simultaneously integrates trees, agricultural crops, and/or animal husbandry in the same space, promoting ecological and economic interactions between the components. This system seeks to reconcile agricultural production with environmental conservation, imitating the structure and functioning of natural ecosystems (Nair, 1993; Silva & Victório, 2022).

AFS is a sustainable approach that promotes soil fertility recovery, increases biodiversity, and strengthens ecosystem resilience to climate change (Rolo *et al.*, 2023). Itencourages also the efficient use of natural resources, reducing dependence on agrochemical inputs and increasing the socioeconomic sustainability of communities (*ibid.*).

One of the main environmental gains of AFSs is their ability to sequester carbon, both in tree biomass and in the soil, reducing the effects of global warming (Rumondang *et al.*, 2025). Agroforestry practices use ecological strategies to increase primary productivity, such as the cultivation of nutrient-fixing species, or green manure, such as legumes, and intercropping plant species based on ecological succession and forest stratification, aiming at the efficient occupation of the different strata (layers) of plant species (SENAR, 2017). Regular pruning allows light to penetrate the AFS and accelerates succession processes. Permanent soil cover with organic material from pruning improves its physical, chemical, and biological characteristics. Such management results in highly productive systems that simultaneously promote soil conservation, increased biodiversity, atmospheric carbon fixation, and water resource maintenance (Borges *et al.*, 2025).

Maintaining AFSs involves strengthening a culture of sustainability in its broadest sense, bringing together social, cultural, environmental, and economic dimensions. The integration of traditional knowledge and ties to the land is fundamental to the development of systems adapted to local realities (Gonçalves *et al.*, 2021). According to these same authors, traditional knowledge, built from the accumulated experience of populations living in close relationship with nature, guides agricultural practices that respect ecological cycles, promote the rational use of natural resources, and value native and adapted species. The link with the territory, in turn, strengthens communities' sense of belonging and encourages environmental care practices, ensuring that interventions are aligned with the sociocultural and ecological characteristics of the region (Victório & Silva, 2020; Gonçalves *et al.*, 2021; Silva & Victório, 2022). In this context, AFSs can be considered regenerative systems for local biodiversity, as they conserve and restore ecosystem functionality, promote the recovery of native vegetation, increase biological diversity, and improve soil fertility and water retention, resulting in ecological and climatic balance (Altieri, 2012; BRAZIL, 2012; Silva & Victório, 2023).

Among the various implementation approaches, Subsistence AFS stands out, a cultivation model that integrates agricultural and tree species in a planned manner, focusing on food production for family self-consumption, respecting the principles of agroecology. It is a resilient, low-cost system adapted to the reality of vulnerable communities, promoting diversified production throughout the year and aligned with the natural cycles of the environment (Wanger *et al.*, 2024). The diversity of crops, in turn, makes the system robust in the face of extreme weather events and enables more regular harvests throughout the year (FAO, 2017), as well as acting as potential instruments for social cohesion, food security, and ecological regeneration (Ferguson & Lovell, 2014; Silva & Victório, 2022; Wanger *et al.*, 2024).

This article is an experience report on the stages of implementing an urban subsistence AFS, from participatory diagnosis and initial planning to practical actions such as planting, ecological management and maintenance, monitoring over time, and harvesting. A semi-structured questionnaire was used to assess community use of the AFS. The technical, social, and human aspects that contributed to the consolidation of the system were highlighted, so as to serve as a reference for other initiatives that wish to adopt agroecological practices integrated with activitiescommunity .

Methodology

This study is characterized as qualitative research, descriptive in nature and of the experience report type, based on agroforestry principles and the perspective of community participation. The experience was developed in conjunction with the Santa Teresinha do Menino Jesus Parish, located in Urucânia, in the Santa Cruz neighborhood (RJ) (Figure 1), which supports approximately 56 families in socially vulnerable situations. In response to a demand identified by social workers and the Pastoral da Saúde (Health Ministry), the agroforestry project focused on promoting food sovereignty and security.

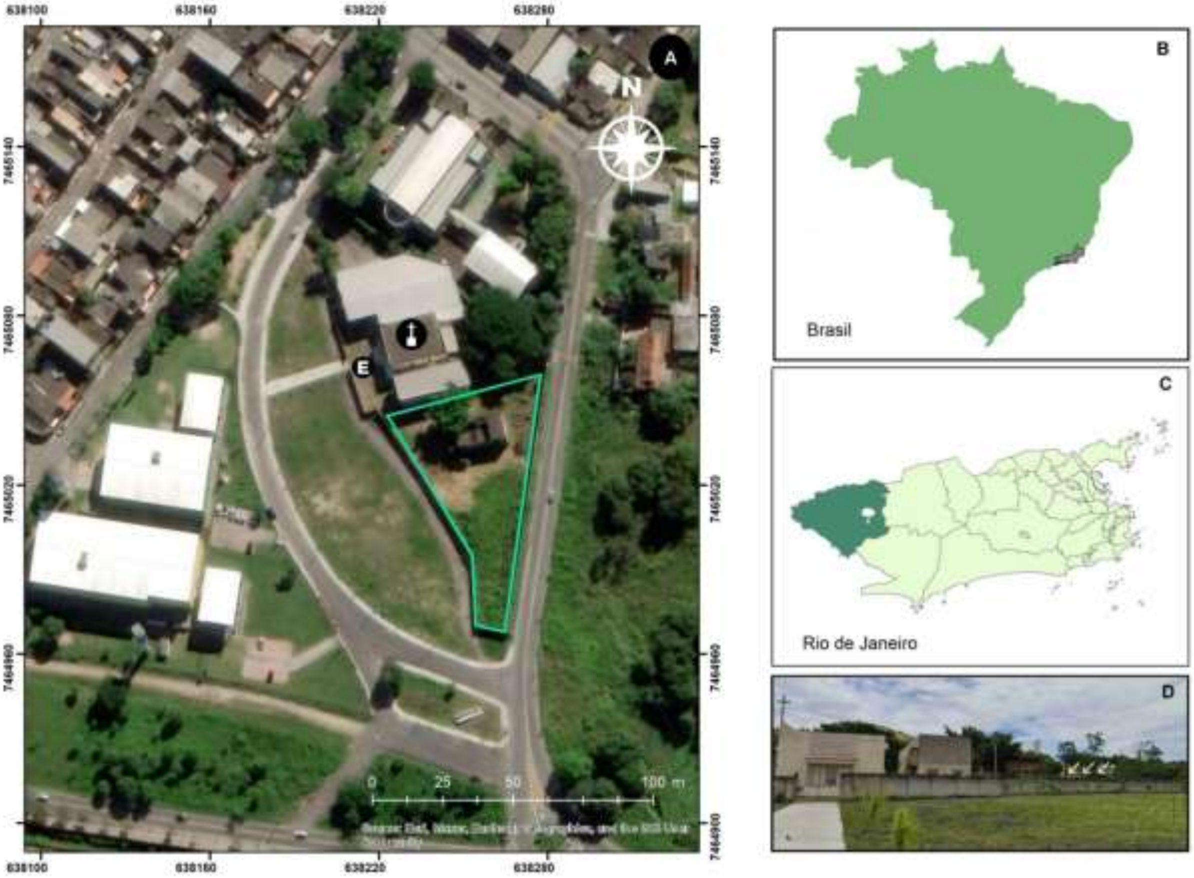

Figure 1. Santa Teresinha do Menino Jesus Parish in Urucânia (E – parking lot and † – church) (RJ). A. Location of the AFS implementation (delimited by the green line)study area ,AFS within the church area. B. Map of Brazil showing the state of Rio de Janeiro in gray. C. Map of the city of Rio de Janeiro, highlighting the Santa Cruz neighborhood in dark green and the tree in white, which indicates the Urucânia community. D. Photo of the front of the church with arrows indicating the area where the AFS is located. Source: Prepared by the authors.

In the AFS area, activities are promoted that encourage knowledge about sustainable practices, the pursuit of quality of life, and the strengthening of family autonomy. The AFS provides moments of AFSe leisure, socialization among residents, a sense of belonging, well-being, joy, and satisfaction. The project has also established itself as an instrument of inclusion, environmental education, collective care, and the promotion of human dignity.

The participatory agroecological implementation was carried out in a previously unproductive space, aiming at environmental recovery and the promotion of food and social security for the community served by the parish.

The implementation of the AFS was conducted in sequential stages, covering the participatory diagnosis of the area and community demands, the planning of the productive arrangement, the preparation of the soil, and the planting of the selected species, followed by agroecological management practices, monitoring of development, and participatory evaluation of the results.

Stage 1 – Participatory recognition and community mobilization

The first stage involved the initial reconnaissance of the land, which was still densely covered with grass and spontaneous vegetation. After partial clearing of the land, it was possible to measure approximately 730 $m^2$of usable area for the implementation of the AFS. During this period, meetings were held with local actors: the social worker, the parish priest (parish administrator), and representatives of the community and th , who were knowledgeable about the dynamics of the community. The actions had the active support of the actors. These conversations were essential for actively listening to the needs of the community, recognizing the potential of the space, and integrating technical and community knowledge, which was the basis for the agroecological design of the system. A list of fruit trees to be planted was also drawn up collectively, prioritizing species that are popular and native to the Atlantic Forest, respecting the eating habits of the local population and the ecological vocation of the territory. This choice took into account the proximity to the Environmental Protection Area (APA) of the Serras de Inhoaíba, Cantagalo, and Santa Eugênia and the Serra de Paciência, reinforcing the commitment to environmental conservation and ecosystem regeneration.

During the meetings, we presented our proposal, clarifying that it was not just about creating vegetable gardens or spaces for occasional food cultivation, but rather the implementation of an AFS capable of producing food year-round while respecting nature's cycles and integrating agricultural, fruit, and medicinal species. We also emphasized the need for institutional commitment to the project, explaining that once the implementation process had begun, it would not be possible to remove species that had already been established, especially trees and perennial crops, as they are living beings that are fundamental to the ecological structure of the system. We emphasized that the AFS would be a permanent collective asset of the community, oriented toward caring for the territory and promoting food and health. Finally, it was agreed that the technical team would be available for questions and guidance, and that biweekly collective efforts would be carried out, bringing together community volunteers to advance the cleaning, planting, and maintenance of the space, promoting social engagement and co-responsibility for the care of the agroforestry system.

Stage 2 – Planning the productive arrangement: soil preparation and selected species

Partial cleaning of the land was carried out through community work parties, making 10 m^2 available for each daily action, until 100 m^2 was available for the first year of AFS implementation. As the land had dense vegetation and compacted soil, the clearing was done manually, using hoes and sickles, in order to minimize soil disturbance and generate less impact on its biota. Then, the material that was weeded was shredded and applied as mulch.

The seedlings used were obtained through voluntary donations from parishioners and local farmers. Planting was strategically planned based on SENAR (2017) guidelines, aiming to avoid losses and allow for relocation as new areas were cleared. Pioneer plants were strategically positioned. For example, banana trees, because they grow fast , good produce biomass, and reproduce vegetatively through rhizomes, help improve soil structure, retain moisture, and provide material for composting through their leaves and pseudostems; in addition to their presence contributing to the regeneration of the environment, acting as a facilitating species in the process of ecological succession (Costa *et al.*, 2024).

The selection of species followed the principles of forest stratification and ecological succession (SENAR, 2017), allowing the different strata to be filled (Chart 1). At the end of the cleaning day, pioneer species such as banana and guava trees were planted, along with other long-cycle fruit trees such as avocado, lemon, king-orange, soursop, and coconut trees. At the same time, short-cycle food crops such as sweet potatoes, cassava, corn, cabbage, lettuce, pumpkin, and watermelon were planted, which allowed for harvests in the first year, combining nutritional diversity and quick results t around 30 days for vegetables, 90 days for sweet potatoes, 80 days for watermelons and pumpkins, and 120 days for corn, thereby strengthening food security in the community involved. Cassava and sweet potatoes were planted from cuttings and branches, respectively, donated by parishioners, reinforcing the community nature of the project (Chart 1). During the collective efforts, the team collectively decided that the cassava would be planted lying down in shallow beds to facilitate initial root development. The sweet potatoes were arranged in a raised bed, with the branches distributed over the surface and partially covered to stimulate lateral rooting. The other short-cycle crops, such as corn, cabbage, lettuce, pumpkin, bell pepper, and watermelon, were planted from seeds purchased from specialized nurseries, ensuring greater genetic diversity and complementarity to the system.

Chart 1. Initial plants (first year of planting) of the AFS in the Parish of Santa Teresinha do Menino Jesus, in Urucânia (West Zone - RJ), to occupy diferente vertical stratification of plant species

Common name	Scientific name*	Family*	Origin*	Habit	Quantity	Planting material
Silver banana	*Musa* sp.	Musaceae	cultivated	herbaceous-arborescent	7	seedling
Sweet potato	*Ipomoea batatas* L.	Convolvulaceae	cultivated	Herbaceous	**	branches/twigs
Guava tree	*Psidium guajava* L.	Myrtaceae	naturalized	Shrub	2	seedling
Cabbage	*Brassica oleracea* L.	Brassicaceae	cultivated	Herbaceous	*5*	seed
Soursop	*Annona muricata* L.	Annonaceae	cultivated	Shrub	1	seedling
Lettuce	*Lactuca sativa* L.	Asteraceae	cultivated	Herbaceous	5	seed
King-orange	*Citrus ×aurantium* L.	Rutaceae	cultivated	Shrub	3	seedling
Avocado	*Persea americana* Mill	Lauraceae	naturalized	Arboreal	2	seedling
Tahiti lime	*Citrus × latifolia* Tanaka ex Q. Jiménez	Rutaceae	cultivated	Shrub	3	seedling
Lemongrass	*Pectis brevipedunculata* (Gardner) Sch. Bip.	Asteraceae	**native**	Herbaceous	1	seedling
Papaya	*Carica papaya* L.	Caricaceae	naturalized	Shrub	1	seedling
Cassava	*Manihot esculenta* Crantz	Euphorbiaceae	**native**	Herbaceous	*	cassava
Coconut	*Cocos nucifera* L.	Arecaceae	naturalized	Shrub	1	seedling

Consultation Flora and Funga of Brazil (2025). **Five prepared beds were with cassava and six with sweet potatoes. Source: Prepared by the authors.

Stage 3 – Agroecological management practices

In the second year of implementation, the area used for short-cycle crops and the remaining area (630 m^2) were completely cleared, enabling the visual and functional reorganization of the agroforestry space. Equipment and tools were purchased (machete, chibanca, straight and articulated iron spade, hand cart , pump, water tank, and irrigation system), which expanded the resources for practicesmanagement. This made it possible to systematize the planting of grafted fruit trees, adopting a spacing of 3 to 5 m in some cases between plants and rows, according to the needs and species cultivated, respecting the principles of plant stratification and ensuring the balanced development of the system (Chart 2).

The grafted seedlings were planted in 40 x 40 cm planting holes, previously prepared with soil fertilized with d with cattle manure and cured chicken litter. After planting, each seedling received organic mulch of dry leaves and straw from the trees on the land itself on the soil surface around it, which helps maintain moisture, protect against weeds, and form leaf litter.

To supply water to the AFS, a drip irrigation system was installed with a 1000 L water tank, PVC piping, taps distributed along the planting rows, and drip hoses near the stems of the fruit trees. This system allows for efficient water use, reduces evaporation losses,, when properly sized, andallows for crop-specific water management (FAO, 2006; Trottier & Barbieri, 2015). The system provides water to the fruit trees on demand, is manually operated, and the watering period is defined according to the weather conditions on the day.

A total of 51 individuals were planted, including shrubs and trees (Figure 2). The seedlings were organized according to their need for sunlight and the size of the species. Among these, eight plants are native and most are commonly cultivated in Brazil. Larger plants that require more space and are therefore more tolerant of direct sunlight, such as mango and acai trees, were placed on the sides. Medium and low-growing species, such as lemon and king-orange trees, were distributed along the inner rows of the AFS, ensuring balance in stratification and harmonious coexistence between species (Figure 2).

Among the fruit trees, crops such as corn, beans, cassava, pineapple, and pumpkin were intercropped, favoring the diversity of the system, better use of the area, and increased food production in the short and medium term.

Chart 2. Planting of species in the second year of AFS management at the Santa Teresinha do Menino Jesus Parish in Urucânia (West Zone - RJ).

Common name	Scientific name*	Family*	Origin*	Habit	Quantity.	Planting material
Mulberry	*Morus alba* L.	Moraceae	cultivated	Shrub	2	grafted seedling
Guava	*Psidium guajava* L.	Myrtaceae	naturalized	Shrub	4	grafted seedling
Pitanga	*Eugenia uniflora* L.	Myrtaceae	native	Shrub	1	grafted seedling
Grape	*Vitis vinifera* L.	Vitaceae	cultivated	Shrub/ Climbing	2	grafted seedling
Pomegranate	*Punica granatum* L.	Lythraceae	cultivated	Shrub	3	grafted seedling
Cocoa	*Theobroma cacao* L.	Malvaceae	native	Shrub	3	grafted seedling
King-orange	*Citrus reticulata* Blanco	Rutaceae	cultivated	Shrub	3	grafted seedling
Tahiti lime	*Citrus* × *latifolia* Tanaka ex Q. Jiménez	Rutaceae	cultivated	Shrub	3	grafted seedling
Sicilian lemon	*Citrus limon* (L.) Osbeck	Rutaceae	cultivated	Shrub	4	grafted seedling
Lime orange	*Citrus sinensis* (L.) Osbek	Rutaceae	cultivated	Shrub	3	grafted seedling
Avocado	*Persea americana* L.	Lauraceae	naturalized	Arboreal	2	grafted seedling
Mango	*Mangifera indica* L.	Anacardiaceae	cultivated	Arboreal	2	grafted seedling
Jabuticaba	*Plinia grandifolia* (Mattos) Sobral	Myrtaceae	native	Arboreal	2	grafted seedling
Coconut	*Cocos nucifera* L.	Arecaceae	naturalized	Arboreal	6	seedlings
Açaí	*Euterpe oleracea* Mart.	Arecaceae	native	Arboreal/Stipe	2	seedlings
Acerola	*Malpighia emarginata* DC.	Malpighiaceae	cultivated	Shrub	4	grafted seedling
Laurel	*Plumbago scandens* L.	Plumbaginaceae	native	Shrub	3	grafted seedling

Watermelon	*Citrullus lanatus* (Thunb.) Matsum. & Nakai	Curcubitaceae	cultivated	Climbing vine/creeping liana	6	seed
Pineapple	*Ananas comosus* (L.) Merr.	Bromeliaceae	native		10	Crowns (seedlings)
Purple basil	*(Ocimum basilicum var. purpurascens)*	Lamiaceae	cultivated	subshrub	4	seedlings
Peppermint	*Mentha x piperita* L.	Lamiaceae	cultivated	Low herbaceous (ground cover)	4	seedlings
Chilean boldo	*Peumus boldus* Molina	Monimiaceae	cultivated	Low/medium tree	4	seedlings
Parsley	*Petroselinum crispum* (Mill.) Nym. ex A.W. Hill	Apiaceae	cultivated	Low herbaceous plant	10	seed
Chives	*Allium fistulosum* L.	Alliaceae	cultivated	Low herbaceous	10	seed
Coriander	*Coriandrum sativum* L.	Apiaceae	cultivated	Low herbaceous plant	10	seed
Corn	*Zea mays* L.	Poaceae	cultivated	Emergent/tall stratum	10	seed
Pumpkin	*Cucurbita maxima* Duchesne	Curcubitaceae	cultivated	Creeping (ground cover)	10	seed
Pepper	*Capsicum* spp.	Solanaceae	cultivated	Low shrub	10	seed
Bell pepper	*Capsicum annuum* L.	Solanaceae	cultivated	Low shrub	10	seed
Carrot	*Daucus carota* L.	Apiaceae	cultivated	Low herbaceous	10	seed
Rosemary	*Salvia rosmarinus* Spenn.	Lamiaceae	cultivated	Low shrub	4	seedlings
Beet	*Beta vulgaris* L.	Amaranthaceae	cultivated	Low herbaceous	10	seed
AFSfron	*Curcuma longa* L.	Zingiberaceae	cultivated	Low herbaceous	2	seedlings

Consult Flora and Funga of Brazil (2025). Source: Prepared by the authors

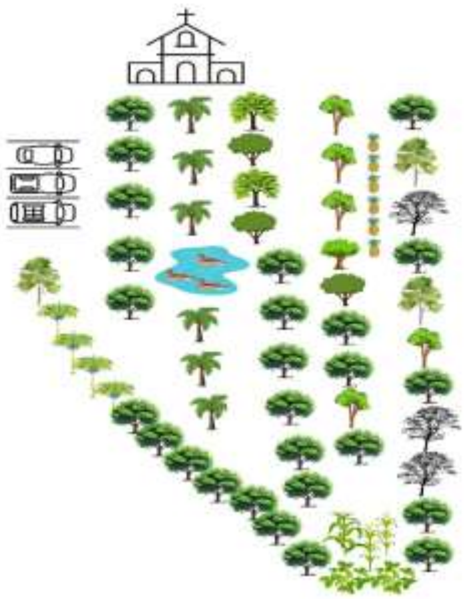

Figure 2. Schematic sketch showing the planting of 51 individuals among shrub and tree species listed in Tables 1 and 2, in the Parish of Santa Teresinha do Menino Jesus, in Urucânia (West Zone - RJ). Source: Prepared by the authors.

At the same time, the creation of raised beds made it possible to expand the cultivation of vegetables, legumes, and herbs, diversifying agricultural species and reinforcing the supply of short-cycle foods. The beds were constructed using the technique of fitting concrete blocks together without the use of mortar, which allows them to beneeded removed and relocated as , facilitating maintenance and future changes in the system design, in addition to reducing implementation costs (Figure 3).

Figure 3. Suspended beds for herbaceous plant cultivation in the AFS area, in the Parish of Santa Teresinha do Menino Jesus, in Urucânia (West Zone - RJ). Source: Prepared by the authors.

The beds were filled with organic compost, characterized by high nutrient content and adequate drainage and aeration capacity. These properties favor root development, reduce soil compaction, and help maintain moisture. The substrate used was produced, in part, on the land itself, from pruning debris, cured manure, and other organic waste from the area.

With this functional structure, it was possible to regularly introduce and harvest easy-to-manage, multi-purpose species such as basil, rosemary, mint, parsley, pepper, and bell pepper. In addition to their nutritional and medicinal value, these plants act as natural repellents, attract pollinators during the flowering period, and help maintain living ground cover, positively influencing the ecological balance of the AFS.

Stage 4 – Monitoring development

In the third year of the AFS, the stage of continuous monitoring, fruiting of tree species, and expansion of sustainable practices is consolidated. Figure 4 shows the expected stratification characteristics for the agroforestry system over the years, considering the dynamics of growth and vertical occupation of species. The organization of the system follows the principles of ecological succession, distributing plants in layers: low (short-cycle herbs and vegetables, such as pineapple), medium (small shrubs and fruit trees, such as Tahiti lime), medium-high (intermediate perennial species, such as acerola and mulberry), and emergent (fast-growing species that exceed the canopy, such as avocado and acai palm). high (large trees with productive and shading functions, such as avocado and acai trees), and emergent (fast-growing species that exceed the canopy, such as papaya trees). This stratification provides efficient use of sunlight, soil protection, and maintenance of biodiversity.

Figure 4. Schematic drawing of stratification over the years of production in urban AFS. Source: Prepared by the authors.

This phase marks an important transition in the system: from the initial implementation stage to productive maturation and ecological and community strengthening. Based on monitoring through direct observation, photographic records, field diaries, and constant interaction with users of the space, it is possible to verify significant improvements in soil structure, vegetation growth, and the organization of collective management practices. The AFS proved to be functional and integrated with the local reality.

Among the highlights of the period is the beginning of fruiting of mulberry and banana trees, which are starting to produce, representing a milestone in the consolidation of the system and confirming the efficiency of staggered planting, proper preparation of beds, and selection of well-adapted species.

Continuous management remains a constant necessity. Regular mowing is carried out to control weeds, maintain organic soil cover, and introduce new short-cycle species, such as vegetables and aromatic plants, ensuring diversified productivity throughout the year. This alternation between short- and long-cycle species reinforces the principles of ecological succession and keeps the soil active and nutrient-rich.

Another important advance at this stage was the start of the installation of a meliponary, with the introduction of native stingless bees (meliponines), recognized for their crucial role in pollinating native and cultivated plants and for contributing to environmental education and the appreciation of local biodiversity. The presence of the meliponary reinforces the project's ecological commitment, enabling ecological interactions in the agroforestry ecosystem (Kingazi *et al.*, 2024). Meliponiculture contributes to food security and stabilization of the AFS, in addition to favoring native plants.

Considering the stages presented, the project, which began in April 2023, had a total average investment of R$ 6,475.00. Despite the progress in implementing the AFS, some structural needs have not yet been met, such as the acquisition of shade cloth, a seedling nursery, and a brush cutter.

This stage symbolizes the maturation of the AFS as a productive, educational, and community space, with the consolidation of agroecological practices, strengthening of biodiversity, and effective production of food and ecosystem services.

Stage 5 - Participatory evaluation of results

The implementation of the AFS was evaluated using a semi-structured questionnaire (Chart 1). Twenty members of the community linked to the AFS were considered. Of these, 10 answered the questions orally during face-to-face meetings, while the others participated through online responses. The participants were women and men, most of whom were adults. The questionnaires were made available between August 5 and 20, 2025, both online and in person through the social worker. The data were organized and evaluated with the aim of verifying the community's perception of the AFS. These questionnaires collected information on access, maintenance, food use, environmental, social, and emotional impacts, as well as the relevance of the space for food and collective well-being.

Chart 1. Semi-structured questionnaire applied to the parish community of Santa Terezinha do Menino Jesus assisted with food harvested at the AFS in Urucânia (West Zone - RJ).

1. How does the community access the AFS?
2. How is the AFS space maintained?
3. What foods have you collected or do you usually collect at the AFS?
4. Do you think the parish space has improved with the presence of the AFS?
5. Have you ever helped with the maintenance of the AFS (planting, cleaning, harvesting, etc.)?
6. In your opinion, is the AFS important for the local environment? What has changed for you in this location?
7. Do you think the AFS is a space that helps with emotional well-being, such as in cases of anxiety or depression?
8. Does AFS fulfill its goal of helping to feed the community?
9. Space for comments

Source: Prepared by the authors, 2025

Results and Discussion

The community is satisfied to have a space where children can play AFSely, without tall grass, venomous animals such as snakes, and other risks associated with the abandonment of the site. The initiative goes beyond providing food. The AFS space is an environment for social transformation, learning, and community living.

The parish's Pastoral Health Care outlines the proposal for the use of medicinal plants based on monographs of species of interest to the Unified Health System (SUS), as established by the National List of Medicinal Plants of Interest to the SUS (RENISUS, 2025). This initiative is based on the appreciation of natural and traditional resources, in line with public policies for the promotion of integrative health. Among the species listed in RENISUS, the following stand out: avocado, mulberry, Brazilian boldo, pomegranate, guava, and pitanga. The AFS has provided unique health benefits, with attention to the community and the environment. According to Altieri and Nicholls (2017), the AFS is a dynamic agroecosystem with ecological, social, and cultural functions that expresses the synergy between biodiversity and human action.

The implementation, management, and production in the agroecological system developed in the project area can be seen in Figure 5. The collective action of cleaning and preparing an area by removing waste, manually weeding , and organizing the space according to participatory planning (Figure 5A-B) is a fundamental strategy for establishing a sustainable agroforestry system, especially in the early stages of implementation. This management aims to eliminate competition from unwanted plants for resources such as water and nutrients, allowing the planted seedlings to develop and increasing the potential for nutrient cycling and biomass accumulation, which are crucial elements for the sustainability of the system. According to Guimarães and Mendonça (2019), selective weeding aims to remove plants from the agroecosystem that may compete for water, light, and nutrients with crops of productive interest.

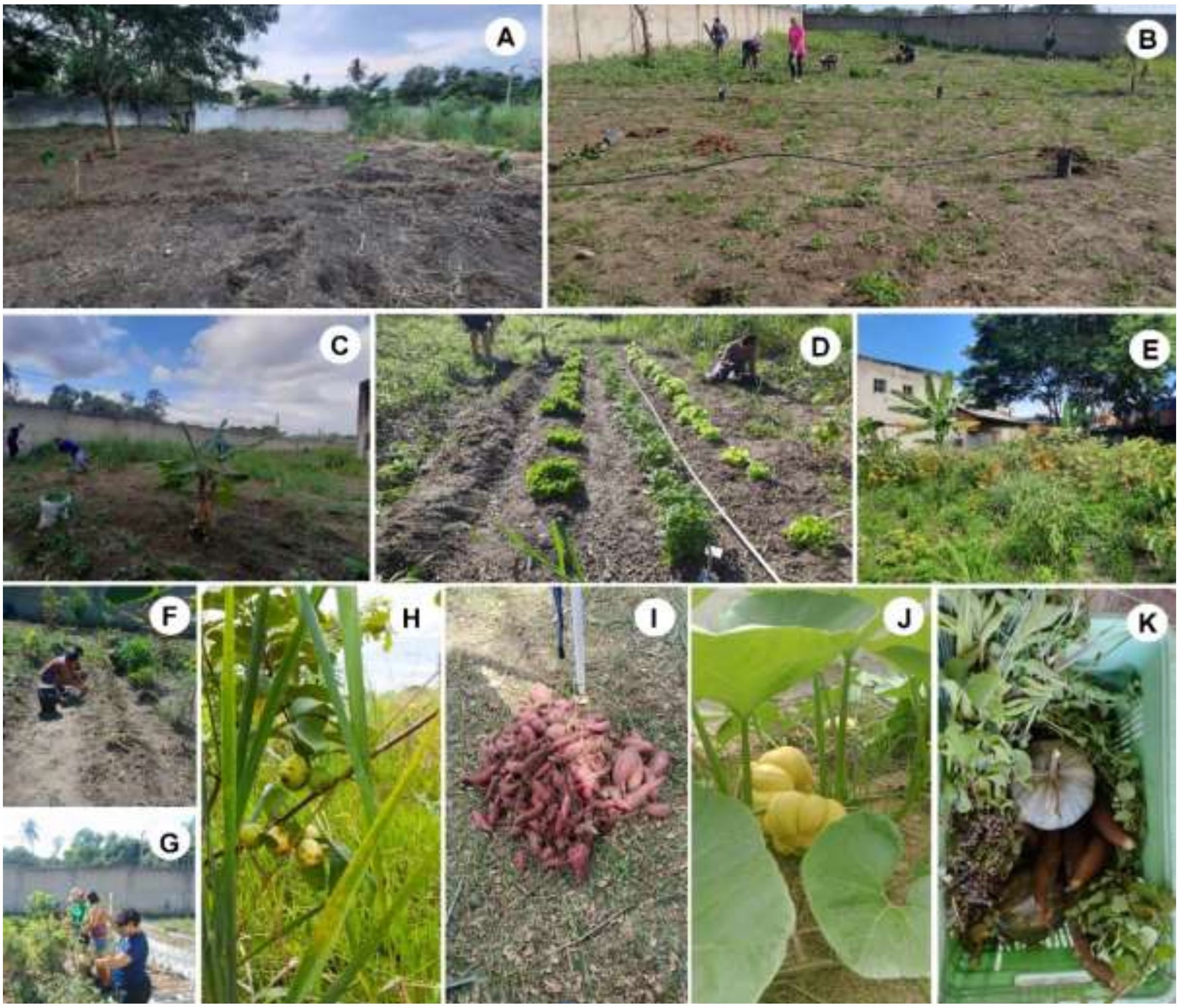

Figure 5. Implementation of urban AFS in the Parish of Santa Terezinha do Menino Jesus, in Urucânia (West Zone - RJ). A – Beginning of cleaning and planting in the first year: record of initial land preparation, with removal of debris, leveling of the soil, and organization of the first beds; B – Planting of grafted seedlings in the second year: insertion of selected fruit species, with grafted seedlings for greater vigor and productivity; C – Maintenance of the initial area: weeding, fertilization, and monitoring the development of plants introduced into the AFS ; D – Harvesting of lettuce and arugula in the initial area: beginning of short-cycle vegetable harvests, marking the system's rapid food return; E – Cassava planting: extraction of the first tubers, resulting from intercropping with medium-term food crops; F – Sweet potato planting: introduction of new species adapted to the area, resulting in greater food diversity and more efficient use of the soil; G – Vegetable beds: removal of basil flowers; H – Guava tree bearing fruit; I – Result of the sweet potato harvest, reinforcing the permanence of energy foods in the system; J – Pumpkin plantation: pumpkin production; K – Foodafter basket harvest: diversity and abundance, representing the success of the model implemented in terms of food security and sustainability. Source: Prepared by the authors

The planting of the first seedlings donated concretely expresses community engagement and constitutes an action rooted in agroecological values and the appreciation of traditional knowledge, since the species chosen were selected according to the priority food and medicinal uses identified in the initial consultation. This alignment with community demands at the time of implementation leads to the strengthening of agroforestry systems as culturally appropriate, economically viable, and ecologically diversified practices. This echoes the argument of Lacerda et al. (2020), who highlight the role of traditional agroecological practices, particularly those conducted by local farmers, as fundamental to fostering multifunctional landscapes that increase biodiversity, strengthen ecosystem services, and allow producers to generate solutions adapted to the socio-environmental reality of Brazil (Figure 5C-G).

Among the most significant results of the AFS, the harvests of about 80 kg of food, such as sweet potatoes (Figure 5 I), cassava, lettuce, kale, and parsley (Figure 5D), represent not only the productive efficiency of collective management but also the consolidation of a space for food security built in a participatory manner when the estimated productivity is achieved (Table 3). Obtaining this diversity of food from donated seeds and branches demonstrates how community cooperation and agroecological management can generate concrete returns in the short term, strengthening local autonomy and reducing dependence on external inputs. The plants mentioned are distributed across 19 botanical families. There are more representatives of Rutaceae (four species), citrus , and Myrtaceae (three species), both of which are fruit-bearing. Banana trees are represented by three varieties. As Oliveira Junior and Rodrigues (2024) point out, the adoption of agroecological practices associated with the use of traditional varieties enhances productivity, stimulates food diversity, and contributes to socio-environmental sustainability.

Table 3. Estimated productivity per year in the AFS.

Species	Estimated Productivity	Observations
Acerola	20 to 50 kg	Produces up to twice a year
Açaí	3 to 6 bunches/plant (~20 kg)	The açaí palm will produce well when grown in humid locations or with good irrigation.
Guava	30 to 60 kg	Seasonal production
Blackberry	10 to 25 kg	Continuous harvests
Avocado	150 to 300 fruits (~300-500 kg)	High peak production
Lemon	100 to 250 fruits (~80-200 kg)	Varies by variety
Silver/Purple banana	25 to 40 kg/bunch, 1-2 bunches/year	Fast yield
Coconut	50 to 100 fruits (~50-150 L of water)	Can have multiple harvests
Pomegranate	20 to 40 fruits (~20-40 kg)	Dry climate favors
Mango	100 to 300 fruits (~200-500 kg)	Very productive
Pitanga	10 to 25 kg	Medium-yield shrub
Jabuticaba	20 to 40 kg	Slow growth
King-orange	100 to 300 fruits (~80-180 kg)	The first harvest is the largest, and then tends to decrease.
Grape	15 to 40 kg	Depends on pruning
Soursop	25 to 50 fruits (~150-300 kg)	Requires spacing
Papaya	30 to 80 fruits (~100-200 kg)	Fast growing, non-perennial, with a lifespan of 2 years.
Lime	150 to 300 fruits (~100-200 kg)	Sweet varieties

Source: Prepared by the authors.

The construction of agroecological beds prioritized sustainable soil management techniques, such as the incorporation of organic matter, mulch, and crop organization according to principles of intercropping and ecological succession. The planning respected the AFS design and the specific needs of the planted species, favoring moisture retention, weed control, and functional diversity. This integration of technical knowledge and traditional knowledge ensures that agroforestry systems function as productive and resilient mosaics, capable of sustaining productivity and diversity in the medium and long term.

These actions strengthened the project's productive base, enabling advances in the cultivation of vegetables, herbs, and medicinal plants, while promoting regenerative practices aimed at restoring and maintaining soil and environmental health. The incorporation of organic matter, mulching, and crop diversification in intercropping and ecological succession not only increase soil fertility and water retention capacity but also stimulate ecological processes that restore biodiversity and system resilience, central characteristics of regenerative agroecology. As highlighted by Carvalho *et al.* (2020), integrated management of agricultural systems with a regenerative approach contributes to nutrient cycling, improved soil structure, and increased sustainable productivity. In addition, the practices described by Silva *et al.* (2018) show that diversified and participatively managed systems are fundamental to the ecological and social sustainability of cultivated areas.

With the maturation of the AFS and constant monitoring, the beginning of production of some fruit plants was observed after one year. The forecast for other plants to bear fruit is from six to eight years (Table 4), considering a well-structured canopy to achieve maximum productivity. Fruiting may occur before this period, but with low fruit production.

Table 4. Beginning of the fruit production period in the urban in the Parish of Santa Terezinha do Menino Jesus, in Urucânia (West Zone - RJ)AFS .

Common name	Habit/Stratum	Start of production
Acerola	Shrub/Low	1.5 to 2 years
Açaí	Medium/Undergrowth	3 to 4 years
Guava	Shrub/Medium/Understory	2 to 3 years
Blackberry	Shrub/Low	1 to 2 years
Avocado	Tree/Tall/Emergent	4 to 6 years
Sicilian Lemon	Medium	2.5 to 3 years
Tahiti Lemon	Medium	3 to 5 years
Silver/Purple Banana	Herbaceous/Low	1 to 1.5 years
Coconut	Tall/Emerging	5 to 7 years
Pomegranate	Shrub/Low	2 to 3 years
Mango	Tall/Emerging	3 to 6 years
Pitanga	Shrub/Undergrowth	2 to 3 years
Jabuticaba	Shrub/Undergrowth	6 to 8 years (or more)
King-orange	Shrub/Medium	3 to 4 years
Grape	Climber/Low	2 to 3 years
Soursop	Shrub/Medium	3 to 4 years
Papaya	Shrub/Low	6 to 12 months
Lime orange	Shrub/Medium	3 to 4 years

Source: Prepared by the authors.

Agroecological plots continued to expand, with the introduction of new food and medicinal species, strengthening local food diversity and security. Practices such as soil cover, pruning, productive consortia, and organic fertilization were intensified, contributing to soil quality and system productivity.

The set of fruit trees planted comes from actively listening to the community around the AFS. Among the main fruits mentioned, citrus fruits such as oranges, king-oranges, and types of lemons stood out, not only for their nutritional value but also for their symbolic and religious importance. Pomegranates were widely mentioned for their sacred nature. The pomegranate tree is an important symbol in Christian spirituality, representing wisdom and virtue, mentioned in the Old Testament: "...the pomegranate tree, the palm tree, the apple tree, and all the trees wither; joy is gone, and has fled from men" (Joel 1:12).

The diversity of species cultivated in AFSs, such as avocado, mango, guava, acerola, blackberry, coconut, jabuticaba, laurel, melon, watermelon, and pineapple, reflects the communities' search for food rich in nutrients and flavors that evoke positive emotions. In addition to these, there was significant demand for medicinal plants, spices, and herbs, highlighting the interest in reviving agroecological practices and health care through ancestral knowledge and popular herbal medicine. The presence of medicinal plants is common in AFSs given the appeal of traditional medicine that persists in some urban areas (Dugaya & Chaudhry, 2025). The participatory cultivation of these species strengthens food security, health, and local autonomy, valuing traditional knowledge associated with agroecological production (Peneireiro, 2011).

The climate was a major challenge in the implementation and maintenance of the AFS, especially in January and February 2025, when high temperatures and long periods without rain were recorded. Despite the adverse conditions, losses were minimal (five plants) as a direct result of the soil cover, shading, and organic fertilization techniques implemented from the outset.

In the third year of AFS implementation, the monitoring stage was marked by the transition from a system in formation to a consolidated productive system. Continuous monitoring allowed for the evaluation of the development of the planted species, the identification of points for adjustment in management, and the strengthening of the community's autonomy in agroecological practices. As a result, several fruit species began their fruiting cycle, especially those with shorter cycles, such as acerola, mulberry, and banana, demonstrating the effectiveness of the ecological management adopted since the initial phases.

The monitoring process involved systematic observations, photographic records, and knowledge exchanges among participants, resulting in continuous learning and the valorization of local knowledge. This stage was marked by the expansion of links with partners and supporters, enabling new structural and formative advances for the project.

To evaluate the implementation of the AFS, a questionnaire was administered between July and August 2025, involving volunteers and beneficiaries from the community. The responses were organized in Chart 2, allowing for the identification of patterns of use, environmental perception, and social impact of the AFS.

Among the most collected foods were short-cycle herbaceous plants and tubers, such as sweet potatoes, cassava, lettuce, chicory, arugula, pepper, cilantro, parsley, and pumpkin. Participants also reported the use of medicinal herbs and spices, such as cilantro and Chilean boldo, highlighting the value of plants with food and medicinal functions. These data reflect the role of AFSs in diversifying the family diet and strengthening local food security, as pointed out by Lacerda *et al.* (2020), who highlight the importance of cultivating food and medicinal species in AFSs to ensure community autonomy and resilience.

Regarding the emotional impact, most respondents pointed out that AFSs contribute to well-being, functioning as a therapeutic space and a place for contemplating nature. Reports such as “the smells of herbs and medicin e me calm” and “yes, occupational therapy” show that AFSs also act as mental health tools, reinforcing recent discussions about the psychosocial benefits of green spaces and community gardens (Silva *et al.*, 2018; Carvalho *et al.*, 2020).

During the pandemic, studies have shown that home and community gardens reduced symptoms of anxiety and depression, providing relaxation and a sense of belonging (Silva *et al.*, 2018; Carvalho *et al.*, 2020). Community reports highlighted that the aromas of medicinal herbs, contact with nature, and the quiet environment of the AFS function as a therapeutic resource, especially in times of social isolation. These results reinforce the literature on horticultural therapy, which points out that involvement in gardening and plant cultivation activities improves mood, reduces stress, and strengthens social bonds, being particularly beneficial for the elderly and emotionally vulnerable people.

Regarding the contribution to community food security, the responses indicated that, although still in its infancy, the AFS supports needy families, preventing food insecurity. Comments such as "it helps many needy families not to go hungry" show that, even on a small scale, AFSs can complement the local diet and generate positive social impacts (Chart 2). These findings are in line with the literature that highlights the relevance of AFSs in urban and peri-urban communities for strengthening food sovereignty and the sustainable use of resources (Guimarães & Mendonça, 2019).

Finally, the open space of the AFS was highlighted as a AFSe, accessible, and educational environment, especially for the elderly, encouraging visitation, contemplation, and community participation. Participants emphasized the importance of collective organization and shared care, indicating that such spaces contribute to social integration and local environmental appreciation.

The graph (Figure 6A) shows that the community still has doubts about the functioning of the AFS, especially regarding forms of access. The space is mostly open and freely accessible, allowing any parishioner to pass through the site at any time, without physical barriers. Only the activities of the collective efforts are scheduled in advance, ensuring that these specific visits are monitored and organized by those responsible for coordinating activities at the AFS web.

Most respondents (90%) recognize that the AFS is beneficial to the parish, as it promotes the improvement of the space and the appreciation of the community. About 60% of participants said they collaborate in the maintenance of the AFS, performing activities such as cleaning, planting new seedlings, and harvesting. Among these, 80% act as regular volunteers, demonstrating engagement and a sense of community responsibility (Figure 6B). These data indicate that, although access is widespread, active community involvement occurs mainly through voluntary actions, reinforcing the importance of environmental education and collective organization for the sustainable use of the AFS.

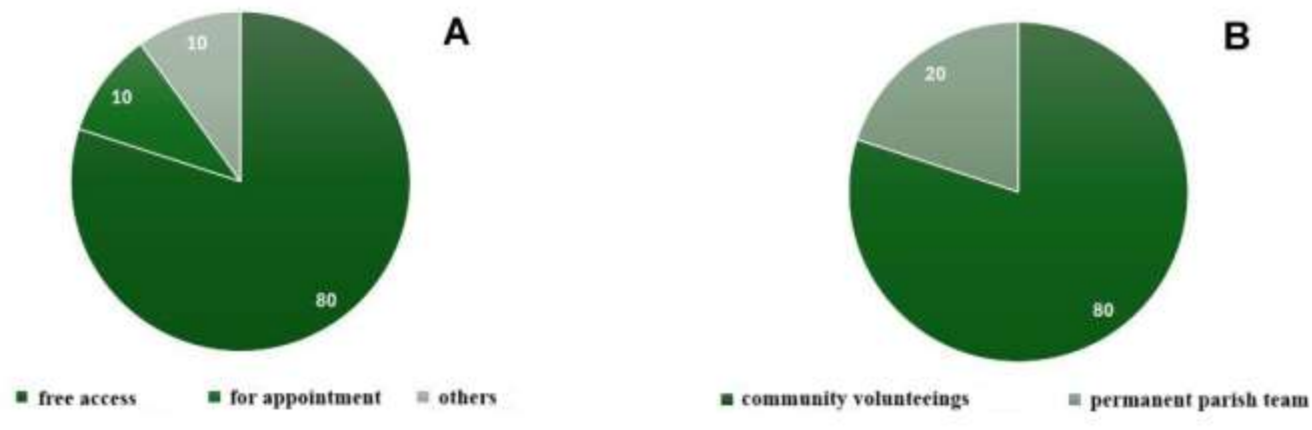

Figure 6. Responses (%) to questions. A. "How does the community access the AFS?" B. "How is the AFS space maintained?" Both questions were asked to 20 people.

Chart 2. Analysis of the content of the questionnaire applied between July and August 2025 to volunteers and beneficiaries of the community linked to the AFS, located in the Parish of Santa Terezinha do Menino Jesus, in Urucânia (West Zone-RJ).

Question	Answers	
What foods have you collected or do you usually collect at the AFS?	"Sweet potatoes, cassava, lettuce, chicory, arugula, peppers, cilantro, parsley, and pumpkin." "Vegetables and tubers."	*"Green cake."* *"Cilantro and Chilean boldo."*
Do you think AFS is a space that helps with emotional well-being, such as in cases of anxiety or depression?	"Yes, definitely. The smells of medicinal herbs have a calming effect. It's a quiet and beautiful place to see nature manifesting itself beautifully."	*"Yes, occupational therapy."*
Does AFS fulfill its goal of helping to feed the community?	"We are starting slowly. It helps some people. It is not yet possible to feed the entire community."	*"It helps many needy families not to go hungry."*
In your opinion, is AFS important for the local environment? What has changed for you in this place?	"Very important, including in encouraging the use of idle spaces in the community. An example of community use and participation." "Very important, we have an area that we can cultivate for our community and parish."	*"Yes. The cleanliness of the place, the calm, the aroma, the moment to contemplate watching nature grow."* *"Many things from the garden can help certain people in need."*
Free space	"We need to strengthen and promote this space even more, making it a reference point for outdoor activities... especially for the elderly."	*"The space is free to visit and contemplate whenever you want. However, harvesting is only allowed with the group and those responsible for AFS. Nothing can be taken without authorization."*

Source: Prepared by the authors, 2025.

Conclusion

Each stage of the project was a fundamental element in the consolidation of a dynamic, biodiverse AFS based on the principles of collectivity. From the initial stage of listening and participatory diagnosis to the harvesting of the first fruits, the process showed that the implementation of an AFS transcends the simple act of planting seedlings, constituting a socio-territorial process that integrates the gradual construction of social bonds, the re-signification and reoccupation of territories, as well as the cultivation of affective relationships.

AFS fulfills its objective of providing organic food, with a diverse range of vegetables, tubers, and fruits, ensuring food security for a portion of the community surrounding the parish.

The challenges of community implementation of the AFS can be overcome through organization, active listening, and continuity of actions. It was found that the successive realization of collective efforts and the introduction of new plant species into the system contributed to the consolidation of a collective sense of belonging and to the expansion of expectations for the project's continuity among participants.

This project was designed with the purpose of meeting basic food needs, but throughout its development, the care, zeal, and meaning attributed to practices related to the garden became evident. Interaction with the green space began to influence and reconfigure the socio-environmental relationships of AFS participants. In this context, the project's trajectory highlights a process of both physical and symbolic rooting: roots firmly planted in the soil sustain collective and resilient practices, while the orientation toward the future expresses the search for more equitable, healthy, and socially inclusive food systems.

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