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AGROECOLOGICAL YARDS, FOOD SOVEREIGNTY AND PRODUCTION OF ECOSYSTEM SERVICES IN SOUTH BAHIA, BRAZIL

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ABSTRACT

Objective: This study aims to characterize productive backyards, in the identity territory of the Far South of Bahia, highlighting the challenges, potential, characteristics, productive arrangements and ecosystem services perceived by families.

Theoretical Framework: In this article, we will discuss the concepts of ecosystem services, productive backyards and agroecosystems.

Method: The study was carried out in 18 agrarian reform settlement lots in the municipalities of Teixeira de Freitas and Prado/BA. Data were collected through interviews, semi-structured questionnaires, transversal walks, soil collection for chemical analysis and plant collection for identification.

Results and Discussion: Productive backyards stood out for being a biodiverse space, important in generating income, especially non-financial income, promoting food sovereignty, improving soils and promoting quality of life for the families surveyed. The backyards ranged from 0.54 to 3.1 hectares and 94.4% have predominantly agroecological management. 230 special species were found, such as fruit, native, medicinal, horticultural and spiritual, and 15 ecosystem services were evaluated. We conclude that backyards are a powerful tool in promoting food sovereignty, generating income, environmental and biodiversity restoration and promoting of ecosystem services.

Research Implications: Assess whether ecosystem services resulting from productive backyards are important for the construction of public policies and socio-biodiverse productive strategies for the family farming segment.

Originality/Value: It is unprecedented research on settlement projects, presenting a research method, data and important information for evaluating productive backyards.

Keywords: Agroecology, Agroecosystem, Socio-biodiversity, Biocultural Heritage

QUINTAIS AGROECOLÓGICOS, SOBERANIA ALIMENTAR E PRODUÇÃO DE SERVIÇOS ECOSSISTÊMICOS NO SUL DA BAHIA, BRASIL

RESUMO

Objetivo: Este estudo visou a caracterização dos quintais produtivos, no território de identidade do Extremo Sul da Bahia, destacando os desafios, potencialidades, características, arranjos produtivos e serviços ecossistêmicos percebidos pelas famílias.

Referencial Teórico: Abordaremos nesse artigo os conceitos de serviços ecossistêmicos, quintais produtivos e agroecossistemas.

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Método: O estudo foi realizado em 18 lotes de assentamento da reforma agrária nos municípios de Teixeira de Freitas e Prado/BA. Os dados foram coletados através de entrevistas, questionários semiestruturados, caminhadas transversais, coleta de solos para análise química e coleta de plantas para identificação.

Resultados e Discussão: Os quintais produtivos se destacaram por ser um espaço biodiverso, importante na geração de renda, sobretudo na renda não monetária, na promoção da soberania alimentar, na melhoria dos solos e na promoção da qualidade de vida para as famílias pesquisadas. Os quintais variaram de 0,54 a 3,1 hectares e 94,4% possuem o manejo predominantemente agroecológico. Foram encontradas 230 espécies classificadas como frutíferas, nativas, medicinais, hortícolas e espirituais, e neles, foram avaliados 15 serviços ecossistêmicos. Concluímos que os quintais são uma potente ferramenta na promoção da soberania alimentar, geração de renda, recuperação da biodiversidade e na promoção de serviços ecossistêmicos.

Implicações da Pesquisa: Avaliar se os serviços ecossistêmicos decorrentes dos quintais produtivos são importantes para a construção de políticas públicas e estratégias produtivas sóciobiodiversas para o segmento da agricultura familiar.

Originalidade/Valor: É uma pesquisa inédita em projetos de assentamentos, apresentando método de pesquisa, dados e informações importantes para avaliação de quintais produtivos.

Palavras-chave: Agroecologia, Agroecossistema, Sóciobiodiversidade, Patrimônio Biocultural.

PATIOS AGROECOLÓGICOS, SOBERANÍA ALIMENTARIA Y PRODUCCIÓN DE SERVICIOS ECOSISTÉMICOS EN EL SUR DE BAHÍA, BRASIL

RESUMEN

Objetivo: Este estudio tuvo como objetivo caracterizar los patios productivos, en el territorio identitario del Extremo Sur de Bahía, destacando los desafíos, potencialidades, características, arreglos productivos y servicios ecosistémicos percibidos por las familias.

Marco Teórico: En este artículo discutiremos los conceptos de servicios ecosistémicos, patios productivos y agroecosistemas.

Método: El estudio se llevó a cabo en 18 lotes de asentamientos de reforma agraria en los municipios de Teixeira de Freitas y Prado/BA. Los datos se recolectaron a través de entrevistas, cuestionarios semiestructurados, caminatas transversales, recolección de suelo para análisis químico y recolección de plantas para identificación.

Resultados y Discusión: Los patios productivos se destacaron por ser un espacio biodiverso, importante para generar ingresos, especialmente no monetarios, promover la soberanía alimentaria, mejorar los suelos y promover la calidad de vida de las familias encuestadas. Los traspatios oscilaron entre 0,54 y 3,1 hectáreas y el 94,4% tiene un manejo predominantemente agroecológico. Se encontraron 230 especies clasificadas en frutales, nativas, medicinales, hortícolas y espirituales, y se evaluaron 15 servicios ecosistémicos. Concluimos que los patios traseros son una herramienta poderosa para promover la soberanía alimentaria, generar ingresos, recuperar la biodiversidad y promover los servicios ecosistémicos.

Implicaciones de la investigación: Evaluar si los servicios ecosistémicos resultantes de los patios productivos son importantes para la construcción de políticas públicas y estrategias productivas sociobiodiversas para el segmento de la agricultura familiar.

Originalidad/Valor: Se trata de una investigación inédita sobre proyectos de asentamiento, que presenta un método de investigación, datos e información importante para la evaluación de patios productivos.

Palabras clave: Agroecología, Agroecosistema, Sociobiversidad, Patrimonio Biocultural.

1 INTRODUCTION

In this article, we will evaluate, based on socio-ecological elements , the productive backyards implemented in the Agroecological Settlement Projects in the Far South of Bahia, by the Popular School of Agroecology and Agroforestry Egídio Brunetto and how these have been important in promoting ecosystem services. Understanding socio-ecological systems as the integration between socioeconomic and biophysical components and processes (Buschbacher , 2014).

A topic of fundamental importance, in these days of serious socio-environmental crisis, where the construction of agrarian systems aimed at generating food sovereignty, the conservation of medicinal and food plants, adaptation to the effects of climate change, integration with native genetic resources , and the valorization of traditional knowledge, are fundamental and emergency actions.

2 THEORETICAL FRAMEWORK

Research on socio-ecological aspects of productive backyards in rural settlements and the resulting ecosystem services involves understanding various social, environmental and economic configurations, which encompass their constitution and consolidation. In this topic we will synthetically address two important concepts that help us understand them, namely: a) productive backyards; and b) ecosystem services.

2.1 PRODUCTIVE YARDS

Productive backyards can be considered as complex systems, which resemble natural forest ecosystems, ecologically more balanced than conventional agricultural production models (Canuto, 2014).

Considered as a reservoir of agrobiodiversity , they promote greater resilience in the socio-ecological system , constituting an important guarantee of a healthy diet, as there is a high circulation of food products throughout the year, it is considered as part of the family's daily domestic tasks, and a place of experimentation for local and non-domesticated varieties (Kageyama , 2008; Caballero-Serrano, 2016).

According to Salazar- Barreientos (2015), the biodiversity that integrates this agroecosystem is what guarantees a fundamental role in the subsistence of families and the biological and socioeconomic cushion in productive units.

Productive backyards differ from "traditional SAF", as they are normally located around the house, with production aimed at providing food for the family and small farms, being true centers of agricultural diversity, the result of social, environmental and cultural variations in ecosystems. where they are located (Caballero-Serrano, 2016). The biodiversity that integrates this agroecosystem is what guarantees a fundamental role in the subsistence of families and the biological and socioeconomic cushioning in productive units (Salazar- Barreientos , 2015).

biocultural heritage , as they are the result of centuries-old knowledge inherited from traditional and acquired systems, based on the relationship between human beings and nature, being a space for experimentation and co-evolutionary processes , based on genetic exchanges of species of plants and animals of the most varied parts of the world (Ninez , 1984)

2.2 ECOSYSTEM SERVICES

Ecosystems are the set of animal, plant and microorganism communities that interact as a functional unit in a given environment. Ecosystem services are the benefits that humans directly and indirectly obtain from ecosystems (MEA, 2005; Constanza , 1997).

For Constanza (1997), ecosystem services are a combination of ecosystem goods (such as food, wood and others) with services (such as waste assimilation), which together represent the direct and indirect benefits of ecosystem functions for human well-being . At the same time, it has a character of interdependence between the different ecosystem functions, and in general, it can assume a characteristic of complementarity.

MEA (2005) points out that although the human species is protected from environmental changes by culture and technology, it is essentially dependent on flows of ecosystem services, which, in a didactic way, divides them into four categories: a) provision service; b) regulation services; c) support services and d) cultural services. For this same author, these categories can be described as follows:

a) provision service : are those obtained directly by human beings, which are related to food, medicinal and aromatic plants, fibers, fuels, water, ores, wood, and civil construction materials, and others;
b) regulation service : contribute to cushioning against damage from external events, such as climate regulation, minimization of floods, erosion and drought, treatment of

tributaries, carbon sequestration, air and water purification, biological control, among others, i.e. are those that act as a buffer effect in the relationship between human beings and ecosystems;

c) support : are those that support others, such as soil formation, nutrient cycling, genetic interaction, photosynthetic processes, and others; It is
d) cultural: these are non-material services, such as leisure, recreation, spiritual, psychological, ethical and educational values.

3 METHOD

This research had a qualitative and quantitative methodological approach and bibliographic reference study, which contributed to the theoretical foundation and comparative analysis between the data obtained in the research and in other studies around the world.

3.1 STUDY AREA

The study was carried out in two agroecological settlement projects, 40 km apart, one called Settlement Bela Manhã (17º28'22"S, 39º38'21"W), which has 134 families and is located in the municipality of Teixeira de Freitas, and the second, the Jacy Rocha Settlement (17º11'13"S, 39º35'01"W), with 237 families and located in the municipality of Prado, Bahia. The two settlements are part of the identity territory of the Far South of Bahia, and in both, productive backyards were implemented between 2016 and 2017. The studies were conducted in the productive backyards of 18 lots, nine lots in the first settlement and nine in the second .

These areas were old farms, which for more than four decades were used for extensive livestock farming, many of the family plots (of 10 hectares), were found as pastures composed of *Urochloa decumbens* (Stapf) RDWebster (“ braquiarão ”) or *U. humidicola* (Rendle) Morrone & Zuloaga (“ quicuia ”), with no native trees existing at the time of dividing the lots.

A standard size of 1 hectare was defined for each backyard, each family received 48 native seedlings and 26 fruit trees, based on the idea that it was possible to combine the previous elements, with the proposal of generating income in the short and medium term, up to the economic structure within the lot, that is, the design of the yard around the house was maintained, but the productive actions around it were expanded. A series of training sessions were held to prepare sketches of productive backyards, where dialogue and local knowledge were prioritized for planning actions.

3.2 SAMPLING AND DATA ANALYSIS

The field research was carried out using the qualitative and quantitative method , using interview techniques through the application of a semi-structured questionnaire, followed by a transversal walk, and recording the plants present in the backyards, such as fruit trees, native essences, medicinal plants and vegetable gardens. The backyards and species were photographed and the interviews were recorded with the full knowledge and authorization of the families. The area of each yard was delimited using Garmim GPS etrex 10, based on the definitions of its edges by the families, the data was systematized using the GPS TrackMaker application . The research was registered and approved by the consolidated opinion of the Research Ethics Committee (CEP) of UFSB under nº 5,948,759.

The initial selection of the first productive backyard was recommended by the leaders of each settlement, the others were made using the snowball method *described* by Bernard (2011). In this method, after completing an interview, the interviewer asks the interviewee to indicate other people he/she deems important for the research until there is no further indication. According to Steenbock 's approach et al. , (2013), it is important to consider in the research methodology, the empowerment of families over the object to be diagnosed, its conception and its results, as they contribute to the constitution of actions in order to improve the reality analyzed.

The plant survey was carried out through a transversal walk to collect information on tree and shrub species. To analyze the data, we used the statistical index of Shannon (H') which indicates the degree of species diversity and Pielou (J), with the aim of understanding the distribution pattern of the relative abundance of species in the communities.

The tools used were a secateur, pruning shears, hand press, and each sample was cataloged on a specific card, then the samples were dried in a homemade oven (pine box with five fluorescent lamps) for later sending to the CE|PEC herbarium for botanical analysis. Each plant was photographed and a preliminary identification was carried out using the Flora and Funga do Brasil database https://floradobrasil.jbrj.gov.br/ .

All data were tabulated in an Excel© spreadsheet, where for Shannon (H´) we used the base of natural logarithms, and is represented by the following formula:

$$H' = -\sum_{e=1}^{S} p_i \ln p_i \qquad p_i \frac{n_e}{N} \qquad (1)$$

Where:

p $_i$ = Relative abundance of species

n $_e$ = number of individuals of the species

N= total number of individuals

OH´ does not have a maximum value and its interpretation is comparative, with higher values indicating greater diversity. For the Pielou equability index (J), we also used the Excel© spreadsheet using the following formula:

$$J = \frac{H'}{H_{max}} = \frac{H'}{ln(S)} \qquad (2)$$

Where:

H´=Shannon index

Hmax = all species would have the same relative abundance

H $_{max}$ = natural logarithm (ln) for species richness.

Using a semi-structured questionnaire, we carried out a survey of the production, commercialization and consumption of each family's backyards, the data was systematized in an Excel© spreadsheet, based on data relating to consumption (household and animal consumption), we stipulated non-monetary income (Barbosa, 2013) based on the commercialization values of the production.

Croubach Coefficient analysis method (Almeida, Santos & Costa, 2010), the analysis was made using the following formula:

$$\propto = \frac{k}{k-1}\left[\delta_t^2 - \sum_{i=1}^{k} \delta_i^2 / \delta_t^2\right] \qquad (3)$$

Where:

k = number of questions

δ_t^2 is the variance of the sum of each subject's responses; of each column x

δ_i^2 variance related to each question of x

We carried out soil collection for chemical and physical analysis, three collections were made consisting of twenty simple collections, for each yard. The collection was in a random

zig and zag format , in order to cover the entire area of the yard. We use a bucket, auger and mattock as tools, at a depth of 0-20 cm.

The simple collections were mixed in the bucket, homogenized and a sample was taken for laboratory analysis. The samples were sent and analyzed at Fullim (Laboratory of Agricultural Analysis, Environmental and Consultancy LTDA.), in the municipality of Linhares/ES. The results were interpreted using the Fertilization Recommendation manual for the state of Espírito Santo (2001 to 2007). Excel© spreadsheets were used to tabulate the data, and the Rbio program was used for statistical analyzes (Bhering , 2017) .

Spearmam 's statistical model to correlate the following data: backyard size; number of native species; quantity of native plants; number of fruit species and quantity of fruit species. We tabulated the data in the Excel© program and ran the analysis in TXT format in the Rbio program , version 192 (Bhering , 2017) .

we systematized the 15 main ecosystem services found in productive backyards, which we incorporated into the semi-structured questionnaire with questions relating to each of them, allowing families to carry out a qualitative assessment based on their perceptions. For teaching purposes, we used the four categories of ecosystem services proposed by the Millennium Ecosystem Assessment (MEA, 2005)

4 RESULTS AND DISCUSSIONS

In a didactic way, we will develop this topic in three sub-items, namely: 4.1) Socioeconomic profile of families; 4.2) Characterization of productive backyards; and 4.3) Identified ecosystem services.

4.1 SOCIOECONOMIC PROFILE OF FAMILIES

The socioeconomic profile data of the 18 families interviewed in the Jacy Rocha and Bela Manhã settlements will be described below and at the end we will present the data summarized in table 01. A total of 50 people were found, with an average of 2.77 people per lot, number close to the average for households in Brazil, which is 2.79 (IBGE, 2023); and the percentage of lots in relation to the number of people were: two people (33%); three people (27%); four people (22%); one person (11%) and five people (5%).

In relation to the age group, the public between 30 and 60 years old (56%) and between 61 and 79 years old (22%) stand out, which is well above the figures for Bahia, which are 20.5%

and 11.3%. % (IBGE, 2022) respectively; The young public presented a low number in relation to data from Bahia (above 34%), only 6% of the public interviewed were in this age group.

Regarding the distribution in terms of gender, there are 54% men and 46% women, numbers close to the data found in the state of Bahia (48.3% and 51.7%) and in the municipalities of Teixeira de Freitas (49.2%). % and 50.8%) and Prado (50.5% and 49.5%) (IBGE, 2022).

Regarding the educational level of the families interviewed, 25 people (50%) had incomplete primary education (six of these are at the normal school age), and only three people (6%) have higher education. Five people (10%) declared themselves illiterate, numbers that are similar to data from Bahia, which is 10.2% (Bahia, 2022). The data demonstrate the low level of education in the two settlements, mainly in relation to the predominance of adults, as 64% of residents in adulthood did not have completed secondary education, data that is similar to the rates in the state of Bahia, which is 60% (MPE- BA, 2022).

Regarding the families' declared income, the highest occurrence was between R$ 1,001.00 and R$ 2,000.00 (11 families), then three families declared an income of R$ 2,001 and R$ 3,000.00, four families above R$ R$3,001.00 and a family up to R$1,000.00. This data is related to the sale of products, retirement or payment for external services, not including non-monetary income as we will see later.

The origin of the people involved in the research is largely from the territory of the Extreme South of Bahia (76%), the others are from the north of Minas Gerais and Espírito Santo and the South of Bahia. When self-declaring their profession, 70% of people called themselves farmers, farmhands, rural workers and cowboys, the rest declared themselves as students and only two people presented another profession (mechanics and general services).

Table 1

Jacy Rocha and Bela Manhã Agroecological Settlements Project , southern Bahia, Brazil.

Social aspect		PA Jacy Rocha	PA Bela Manhã	Total	%
Gender	Masculine	14	13	27	54%
	Feminine	13	10	23	46%
	Total	27	23	50	100%
Age range	0-05	0	1	01	two%
	06-12	two	two	04	8%
	13-17	two	1	03	6%
	18-29	two	1	03	6%
	30-60	17	11	28	56%
	>60	4	7	11	22%
Naturalness	Far south	19	18	37	74%
	BA Regions	04	02	06	12%
	Other states	04	03	07	14%
	Illiterate	4	01	05	10%

Schooling	EJA	0	02	02	4%
	Fundamental teaching. Incomplete	11	14	25	50%
	Fundamental teaching. Complete	03	0	03	06%
	Incomplete high school	02	01	03	06%
	Complete high school	04	05	09	18%
	Graduation	two	0	02	04%
	Postgraduate	1	0	01	02%

In relation to agricultural practices in productive backyards, these basically follow agroecological management, where 16 families use organic fertilization, one uses chemicals and one does not fertilize the backyard. The origin of the fertilizers are leaves and chicken manure from their own backyard, cattle manure from the lot or from collective corrals in the settlements, only one family declared that they buy reactive phosphate in the city.

In controlling the weeds, the 18 families indicated that they use manual weeding, eight use some type of machinery (one uses a tractor, six use a backpack brushcutter and one a tractor) and only one family uses herbicides. In pest and disease control, seven families declared that they do not carry out any control, 11 use ecological mixtures and two use pesticides. Land preparation is mostly done using a hoe (10 families), six families use a tractor, five families do not prepare the land and two families prepare it using a tractor .

Families have a very close relationship between their agricultural practices and the phases of the moon, 17 families consider it for planting, nine for pruning and one for preparing the land. Regarding the use of green manure in the backyard, 12 families said they carry out this practice, the origin being pruning trees and planting green manure.

Of the 18 families, 11 (61%) knew the name of quintas, the others knew them by other names (orchard, farm and farm). When asked what the main differences were between old backyards and those implemented in agroecological settlements, only one family said they were the same, the other answers can be systematized into three axes: a) they were more productive, as the soils were better (“ours today were made in pasture areas”); b) they were only with fruit trees (“the native ones, if you had them, would cut them down”); lack of technical assistance (there was no notion of high, medium and low extract, distance between plants and methods of pruning and fertilizing backyards (limestone, reactive phosphate, and legumes).

The presence of a technical team is effective, contributing to the construction of knowledge on the management of pruning of shrub and tree plants, enabling the expansion of

plant diversity in the same production system, and the materiality of the ecological potential that native plants exert on subsystems.

4.2 CHARACTERIZATION OF PRODUCTIVE YARDS

Of the backyards analyzed, nine (50%) had a current area larger than the size implemented in 2016, which was one (1) hectare, ranging from 1.6 to 3.1 ha, the other half ranged from 0.54 to 0. 94 hectares. The median of the Jacy Rocha settlement was 1.1 hectares and that of Bela Manhã was 0.95 hectares, the averages respectively were 1.2 and 1.0 hectares, a number well above the productive quintas analyzed by Gazel Filho (2008) which varied from 0.35 to 0.86 hectares, Canuto (2014) between 0.2 to 0.8 hectares and Moraes (2022) who found an average of 0.6 hectares per backyard.

According to the families' views, a total of 184 species were listed, 86 of which were native species (five were also considered medicinal), 37 were fruit species (09 were considered medicinal), 45 were medicinal, 16 were part of the vegetable gardens and nine (9) plants considered spiritual. It is noteworthy that the classification followed the answers given by the families, and is closely related to their habit of using plants, the jaboticaba for example was considered as fruitful, but it is also a native species of the Atlantic Forest.

Hemiepiphyte plants are distributed in 44 botanical families, the seven most common and the respective number of individuals were: Musaceae (2,511), Malvaceae (1,291), Arecaceae (883), Rutaceae (745), Myrtaceae (472) , Lauraceae (309) and Fabaceae/ Leguminosae (229).

Productive backyards have as centers for maintaining and radiating biodiversity (Kageyama , 2008). We highlight that 100% of families reported that the backyards were implemented in areas where there was only pasture, and that only nine (9) trees existed considering all 18 backyards investigated.

The trees identified that already existed prior to the implementation of the backyards were: one of Itapicuru (*Goniorrhachis marginata* Taub .), one of boleira (*Joannesia princeps Vell* .), two of curindiba (*Trema micranthum (L.) Blume*); two from Ibicurú (*Pseudobombax grandiflorum* (Cav.) A. Robyns .), one of babassu (*Attalea speciosa* Mart. ex Spreng .) and two rosewood (*Dalbergia nigra (Vell .) German ex Benth* .). The evolution of land use in the areas where the backyards were located can be seen in Figure 01.

Figure 1

Evolution of a productive backyard in the Jacy Rocha settlement, Southern Bahia, Brazil: a) in 2014; b) in 2019 and c) in 2022.

Source: Adapted from Google Earth Pro.

Effectively we see in the figure above, a reversal of a pattern of land use, where pastures are giving way to a continuous process of enrichment of biodiversity. In the 18 productive backyards, 10,372 tree, shrub and hemiepiphyte plants were found , with an average of 576 per backyard.

The fruit plants with the highest quantity in backyards and occurrence on lots were: Silver Banana (*Musa paradisiaca* L. *)* (2,250, 15); cocoa (*Theobroma cocoa* L.) (1,114, 16); dwarf coconut (*Cocos nucifera* L.) (875, 17); dragon fruit (*Hylocereus sp .)* (584, 11); papaya (*Carica papaya* L.) (394, 18); orange (*Citrus* sp.) (296, 17) and avocado (*Persea americana* Mill.) (303, 18).

Backyards are then presented as a strategy for strengthening local biodiversity, as the data showed us that of the 100 native and fruit seedlings made available in 2016 by the PAA, today we find in productive backyards a number almost six times greater than initially proposed. . Thus, it shows effectiveness in the interaction between different extracts and plant functionality.

We analyzed the heterogeneity indices using the Shannon index (H´) nats /individuals and the Pielou equability index (Table 02). To preserve the identity of the interviewees, the backyards are identified in the table with the initial of one of the family names, followed by the initials of the names of the settlements BM for Bela Manhã and JR for Jacy Rocha.

Table 2

Data per productive yard: number of individuals, number of species and Shannon (H´) and Pielou (J) indices.

Family/settlement	Total individuals	No. species	Shannon (H´)	Pielou (J)
IBM	241	32	2.8632	0.8261
OBM	274	49	3.1500	0.8093

TBM	607	45	2.5775	0.6771
BBM	229	59	3.5060	0.8598
ORBM	970	56	3.1150	0.7738
PBM	366	40	2.8109	0.7617
CBM	203	24	2.3435	0.7374
RBM	239	52	3.4245	0.8666
DBM	240	61	3.5742	0.8694
VJR	1,997	56	2.6677	0.6627
CJR	55	22	2.7538	0.8908
VVJR	631	41	1.7103	0.4605
MJR	254	39	2.7593	0.7531
NJR	956	49	2.5697	0.6602
NEJR	291	26	2.3772	0.7296
RJR	411	57	3.1159	0.7706
DJR	422	57	3.1951	0.7902
RJR	2.380	53	2.1891	0.5513

Jacy Rocha settlement had an average of 822 shrubs, trees and hemi-epiphytes per yard, while the Bela Manhã settlement had 374 plants. The average number of species per backyard was close (46.4 and 44.4 respectively), the Shannon index (H´) averaged 2.59 and 3.04 and the Pielou index (J) averaged 0.69 and 0.79 , respectively. Thus, the Bela Manhã settlement presented the greatest diversity and the greatest distribution of the relative abundance of species.

The indices presented here showed higher values than the studies presented by Lopes (2014), in five (5) agroforestry systems of agrarian reform settlements in Pontal do Paranapanema/SP, where H´ values ranged from 1.404 to 0.7338 and those of J ranged from 0.4089 to 0.2492. The variation found here was for H´: 3.5742 – 1.7103 and J: 0.8908 – 0.4605.

When analyzing the relationships between the following variables: size of backyards; number of native species; quantity of native plants; number of fruit species and quantity of fruit species, we used the Spearman statistical model (Table 03).

Table 3

*Spearman correlation for data on native and fruit species from productive backyards in PA Jacy Rocha and Bela Manhã. The * indicates the significant difference at 5% (non-zero correlation); ns – not significant (correlation = zero).*

	Yard size	Species Native	Quantities Native	Species Fruit trees	Amount Fruit trees
Yard size	1.00	0.15ns	0.37 ^{ns}	0.33 ^{ns}	0.7*
Esp. Native		1.00	0.7*	0.39 ^{ns}	0.3 ^{ns}
Qty. Native			1.00	0.14 ^{ns}	0.33 ^{ns}
Fruit species				1.00	0.24 ^{ns}
Qty. Fruit trees					1.00

The results showed that there was a correlation between the size of the yard and the number of fruit species, as well as the number of native species with the number of native species planted, with significant differences at 5% (p-value<5%) for both correlations. . The data helped us understand the importance that fruit trees have for families, suggesting that the expansion of the area of backyards is linked to the need to increase their production.

Data referring to agricultural production in the year 2022 in productive backyards (Table 04) also showed the potential that exists in this subsystem, both in terms of food production and income generation.

Table 4

Data on production, commercialization, consumption and income from productive backyards in PA Jacy Rocha and Bela Manhã, southern Bahia, Brazil

Segment	Family No.	Production (kg)	Marketing (Kg)	Consumption (Kg)	Income Monetary (R$)	Non-monetary income (R$)
Fruit trees	11	**63,600**	25,000	38,400	60,286.00	86,747.00
Crops (b)	14	45,000	27,900	17,100	**98,275.75**	58,515.80

Small Animals (c)	Item	Qty.	Items	Commercialization	Consumption	Income Monetary (R$)	Non-monetary income (R$)
14 lots	Eggs	30,480	Items.	5,181	25,299	11,350.00	52,810.00
14 lots	Birds	1,547	cab.	523	1,024	14,175.00	27,724.00
07 lots	Pig	2,650	kg	684	1965	7,470.00	21,430.00
02 lots	Piglet	212	Items.	212	0	31,800.00	0.00
02 lots	Fish	130	kg	57	73	750.00	950.00
					Sub Total (c)	65,545.00	**102,914.00**
				Total (a+b+c)		224,106.75	**248,176.80**

Source: Prepared by the authors (2023).

The total income values showed the potential of productive backyards in promoting family food sovereignty, as when non-monetary income (consumption) is computed, the value of family income goes from R$ 1,037.53 to R$ 2,186.49 on average monthly for each of the 18 families. The data corroborates those found by Barbosa (2013), pointing out that the combination of the two incomes is an important parameter to identify the decrease in farmers' vulnerability to the seasonality of the market.

Around 68% of the production volume of backyards is destined for consumption, similar data were found by Buchelli (2017) in studies carried out in productive backyards in the Amazon region, which was 60% and well above the 21% found by Moraes (2022).

Fruit trees stood out for the volume of production within the two settlements (63,600 kg), although only 11 of the 18 families managed to specify production, consumption and commercialization volumes. The raising of small animals stood out for non-monetary income (R$102,914.00), representing a little more than 61% of the income in this segment, while crops stood out for generating monetary income (R$98,275.75).

It was considered by the families that of the food consumed in the 18 lots, 47% are products from backyards, 11% from other parts of the lots and 42% are purchased. We also carried out a survey of the main products from backyards consumed by families (Table 05), where families valued the degree of importance for family consumption.

Croubach Coefficient analysis method (Table 05), the result showed a degree of consistency in responses Croubach 's alpha = 0.84, remaining within the values (0.7 – 0.9) observed by Almeida et al. (2012) as satisfactory.

Table 5

Degree of valuation according to families by consumer segment PA Jacy Rocha and Bela Manhã, southern Bahia, Brazil. Where A= Fruits; B=Vegetable garden; C=Corn; D= String beans; E=Medicinal; F=Seasoning; G=Eggs; H=Poultry Meat; I=Pork and J=Firewood:

	CONSUMPTION VALUATION BY SEGMENT										
Families	A	B	W	D	AND	F	G	H	I	J	TOTAL
1	100	95	50	100	100	100	100	70	80	100	895
2	100	0	0	0	100	0	0	100	0	0	300
3	100	0	0	0	100	0	40	40	0	20	300
4	90	0	0	0	100	0	0	0	0	100	290
5	100	100	100	50	100	100	50	100	0	100	800
6	100	100	20	60	100	100	100	100	100	100	880
7	90	100	30	90	100	100	0	100	100	100	810
8	100	0	100	100	100	100	10	100	0	100	710
9	100	0	0	0	100	100	10	20	0	100	430
10	100	100	100	100	100	100	100	50	95	100	945
11	100	20	20	100	100	100	100	50	0	100	690
12	100	100	95	100	100	100	50	70	0	0	715
13	100	100	100	100	100	100	50	50	50	100	850
14	100	0	0	0	100	100	50	10	0	50	410
15	100	100	40	100	100	100	50	95	100	100	885
16	100	100	30	100	100	100	95	100	30	20	775
17	50	0	0	0	100	50	0	0	0	0	200
18	80	0	100	100	100	0	0	0	0	50	430
Total	1710	915	785	1100	1800	1350	805	1055	555	1240	

The data highlighted the importance that productive backyards assume for family consumption, especially medicinal use, with 100% of families giving maximum marks to the consumption of fruits, seasonings and the energy use of firewood with 77%, 72% and 61%,

respectively. Here, the centuries-old knowledge of peasants about the use of medicinal plants, the knowledge and flavors of cooking, the generous nutritional supply of fruit trees and the economy with the replacement of external energy inputs are incorporated.

4.3 IDENTIFIED ECOSYSTEM SERVICES

15 ecosystem services were indicated based on the interviews carried out, which were grouped into the four categories proposed by MEA (2005) and can be seen in table 10.

Table 6

Ecosystem services identified by families in PA Jacy Rocha and Bela Manhã, southern Bahia, Brazil

Category		Number of responses		
	Ecosystem services	**Yes**	**No**	**Do not know**
Provision	Improvement in nutrition;	17	1	0
	Fertilizer supply;	16	two	0
	Firewood supply;	14	4	0
	Supply of medicinal plants	15	two	0
	Improvement in income.	17	1	0
Regulation	Decrease in temperature;	17	1	0
	Maintaining water in the soil;	18	0	0
	Reduction of pests and diseases;	11	6	1
	Wind protection.	17	1	0
Support	Soil improvement;	18	0	0
	Increase in the number of birds.	18	0	0
Cultural	Place for leisure;	17	1	0
	Beautification;	18	0	0
	Place for children to learn;	9	3	6
	Place for spiritual activities.	9	7	two

Source: Prepared by the authors (2023).

The ecosystem services (ES) that stood out as positive for all families were: beautification (cultural), soil improvement, increase in the number of birds (support) and maintenance of water in the soil (regulation), while the provision category had 17 answers yes to improving food and improving income, the same valuation for reducing temperature and protection against the wind (regulation) and the productive backyard as a place of leisure (cultural).

These results demonstrate that there was an effective perspective from families on ES that are normally more difficult to visualize, such as regulation and support, contrasting with studies carried out by Caballero-Serrano (2016), Ciftcioglu (2017), and Calvet - Mir (2012).

We observed that backyards were perceived by families, even indirectly, as a space that contributes to adapting to climate change, when 94% of those interviewed pointed out backyards as important for reducing temperature, maintaining water in the soil and protecting against the wind.

5 FINAL CONSIDERATIONS

The productive backyards stood out for being an important space for promoting biodiversity, proving to be a place for tree and shrub species from different extracts to coexist, whether fruit-bearing or not, vegetable production, small animal husbandry, medicinal and spiritual plants.

It is a space that brings, in its activities, the transmission of knowledge, cultures, beliefs and new experiments, enhancing the income generation of the lot and above all the food sovereignty of families. Therefore, it is a powerful tool for generating ecosystem services for the segments of agrarian reform settlements.

A perceived limiting factor was the lack of practice among families in recording the quantities of inputs used and consumption (mainly from gardens). Therefore, developing new technologies that help in the systematization process of these practices carried out by families is an important point for future research.

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