ANALYSIS SYSTEMIC TEMPORAL OF TWO COMMUNITIES IN RURAL SETTLEMENT IN THE STATE OF PARÁ, BRAZILIAN AMAZONIA

ANÁLISE SISTÊMICA TEMPORAL DE DUAS COMUNIDADES EM ASSENTAMENTO RURAL NO ESTADO DO PARÁ, AMAZÔNIA BRASILEIRA

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Abstract

The aim this study was to analyse the potential use of forest resources timber and non-timber and the family farming production of rural communities São Mateus and Santo Antônio of the years 2008 and 2018. We evaluated the socioeconomic and environmental aspects through the forest inventories and based on semi-structured interviews and field surveys. In the forest inventory of the of the two rural communities were found 322 species, distributed in 92 botanical families, being the Fabaceae Family the most representative with 125 species. In spite of the results revealed a stock of species with potential timber and not timber and socioeconomic improvements, the majority of family farmers (97%) showed high level of dissatisfaction in relation to the lack of public technical assistance in order to plan their productions through the association of diversified agroforestry systems. This study creates a participatory model able to contribute to the public policies aimed at subsidizing the potential use of the forest resources in rural settlements in the Amazon, as well as to promote the formation of programs to incentive sustainable development, considering the current market and adding value to products.

Keywords: Family Farming Production. Forest Resources. Public Policy. Sustainable Development.

Resumo

O objetivo deste estudo foi analisar o potencial de uso dos recursos florestais madeireiros e não madeireiros e a produção agropecuária familiar das comunidades rurais São Mateus e Santo Antônio

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dos anos de 2008 e 2018. Foram avaliados os aspectos socioeconômicos e ambientais por meio de inventários florestais e com base em entrevistas semiestruturadas e pesquisas de campo. No inventário florestal das duas comunidades rurais foram encontradas 322 espécies, distribuídas em 92 famílias botânicas, sendo a Família Fabaceae a mais representativa com 125 espécies. Apesar dos resultados revelarem um estoque de espécies com potencial madeireiro e não madeireiro e melhorias socioeconômicas, a maioria dos agricultores familiares (97%) apresentou alto grau de insatisfação em relação à falta de assistência técnica pública a fim de planejar suas produções através da associação de sistemas agroflorestais diversificados. Este estudo cria um modelo participativo capaz de contribuir com as políticas públicas voltadas para subsidiar o potencial de uso dos recursos florestais em assentamentos rurais na Amazônia, bem como promover a formação de programas de incentivo ao desenvolvimento sustentável, considerando o mercado atual e agregando valor aos produtos.

Palavras-chave: Produção Agropecuária Familiar. Recursos Florestais. Políticas Públicas. Desenvolvimento Sustentável.

Introduction

The thorough observation of the characteristics described in the settlement projects created by the National Institute for Colonization and Agrarian Reform (INCRA) based on the implementation of the living systems with perspectives for the fulfilment of the function social of land and the sustainable productions promoting to the rural workers and their families possibilities of socioeconomic improvements, utilize of analysis and interdisciplinary studies with several methodologies capable of improving public policies aimed at rural communities.

In this understanding, the rural settlements of agrarian reform constitute as the practice in rural production (MARTINS; PEREIRA, 2012). The social, economic and environmental characteristics of the locality are seen as actions of interdisciplinary and multisectoral nature, in which the participatory diagnostics associated to the rural development indicates interactive dialogues based in the restitution of the decision-making capacity of the family farmers (ANDRADE et al., 2011) and in the transmission of information concerning to combine of the equitable and sustainable development (POKORNY, 2013).

The conjugation of rural development from the standpoint of sustainability, related to family farming and the configuration of labor markets, evidences the organization of family work in pluriactivity and refers to social situations in which the individuals that constitute a rural family begin to dedicate themselves to the exercise of a diverse set of economic and productive activities, such as the practice of agriculture and livestock and their mutual relations (SCHNEIDER, 2003). This agricultural potential represented by family farmers and characterized in the conception of agricultural policies which support the rural development contributes to poverty reduction, the food security and the economic growth (MEDINA et al., 2015).

This conception of rural development becomes even more relevant in the importance of the diagnosis of the forest species found in these settlements and in their diverse uses by the community as regards to socioeconomic aspects, verified in the commercialization of the trees and in the potential non-timber of the seeds and oils, besides relating the phytosociological and ethnobotanical data established in the patterns of use of medicinal, domiciliary and commercial plants influenced by the cultural and environmental factors of the communities (LUCENA et al., 2012; MEDEIROS et al., 2013).

In this sense, the participatory research characterized in the ethnobotanical diagnosis and conditioned to maintenance of local biodiversity enables a greater interaction between the rural communities and the natural resources, increasing equally to the perception and the autonomy of the settled families (ALBUQUERQUE et al., 2012; GILMORE; YOUNG, 2012), besides to promoting a substantial improvement in the quality of life of local communities through the association between the social collaboration and sustainable development (GUIVANT, 2002; LAGUNAS-VÁZQUEZ et al., 2008; VALENCIA-SANDOVAL et al., 2010).

Therefore, the aim of the present study was to analyse the potential use of forest resources and the family farming production of rural communities São Mateus and Santo Antônio comparing the qualitative and quantitative data of the years 2008 and 2018, in order to contribute to the creation of new public policies in relation to the adequate natural resources management and provide the

potential improvement of the living conditions of rural families inherent to the ecological, economic and social sustainability and to the regional development.

Methodology

Study area

The study was conducted in the communities São Mateus and Santo Antônio of the Settlement Project Moju I and II, meso-region of Lower Amazon, Pará State, Brazil, originating from the municipality of Santarém, through of the BR-163 highway (Cuiabá-Santarém) (Figure 1), these being chosen communities due to road access; the participation in sustainable forest management projects; local leaders disposed to the strengthen socioeconomic and environmental development and to the studies realized in 2008 that allowed the systemic comparison between the two years of research analysis.

Figure 1: Localization of the Settlement Project (SP) Moju I and II along the BR-163.
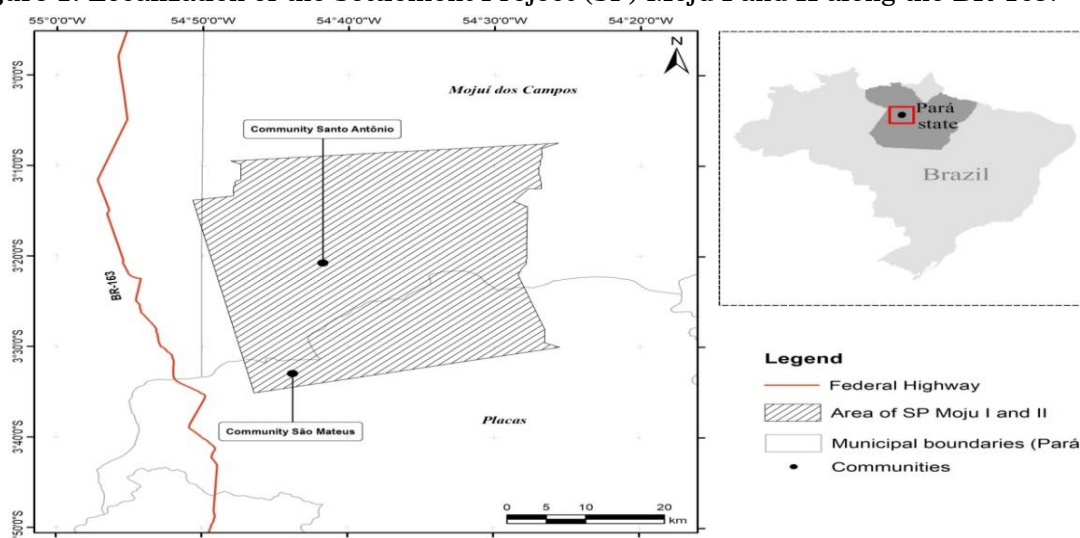
Source: Elaborated by the author (2018).

The São Mateus Community accessed by the vicinal of km 145 of BR-163 and belonging to the municipality of Placas, Pará, Brazil, has an area of 2430.964 ha and is inserted in the geographic coordinates 03º32'31.20'' S and 54º42'6.81'' W (RIBEIRO et al., 2013). The community was founded in 2002, in which reside on average 100 families, with about 300 people on 70 agricultural properties (GAMA et al., 2011).

The Santo Antônio Community belonging to the municipality of Mojuí dos Campos, Pará, Brazil, comprises an area of 5012.25 ha and is located in the vicinal of km 124 of the highway Santarém-Cuiabá (VIEIRA et al., 2014). It is inserted in the coordinates 03°20'23.29'' S and 54°42'8.88'' W, having 53 lots, being 36 lots for deforestation and legal reserve and 17 lots destined besides these uses of the land to the area of permanent preservation (ALMEIDA et al., 2013).

The climate of the region is classified as Afi in the system Köppen, that is, tropical humid with mean annual minimum temperature of 16 °C and mean annual maximum of 34 °C and with average relative humidity of 91%. The precipitation is of the type convective of short-lived. Presents annual values oscillating around 2,000 mm and the driest trimester from September to November; the rainiest trimester from February to April (ALVARES et al., 2013; RIBEIRO et al., 2013).

Data collect

In the analysis of family farming production was employed the Participatory Rural Appraisal in semi-structured interviews[4] and field surveys configured in the method of participant observation

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[4] The semi-structured interview has an open characteristic in dialogue, that is, the interviewee answers the questions within his conception, but, it is not a question of letting him speak freely.

and associated with the quantities and destinations of the marketed products; to the place of sale; to the average prices of products and producers incomes; to the harvest period and to the demands of commercialization, establishing, thus, adequate techniques before the constructed dialogues, rescuing and assimilating subjective aspects not always objectively manifests (SCOPINHO; MARTINS, 2003).

In this item were interviewed 58 family producers, being 31 responsible in the São Mateus Community and 27 responsible in the Santo Antônio Community in the years 2008 and 2018, which represented 45% and 71%, respectively, of families resident in the communities, characterizing the participatory methodology in greater effectiveness and social cohesion pertinent to a greater capacitation of the familiar farmers, highlighting planning and management tools of the processes of decision-making and offering a greater potential for sustainable agricultural development organized in practices and structures of traditional governance (ISON; AMPT, 1992; PRETTY, 1995; EVANS et al., 2010; KREMEN et al., 2012).

In the potential use of the timber and non-timber forest products was employed stratified sampling with allocation of 9 sample units in São Mateus and 12 sample units in Santo Antônio, both in managed forests and a systematic way, in addition to totalling, respectively, about 780 ha and 1040 ha. In each sample unit was installed a parcel, including in the forest inventory 2018 all individuals with Diameter at Breast Height (DBH) at 1.30 m of the soil equal to or greater than 10 cm which were measured according to the following levels of inclusion and size of parcels: Inclusion Level 1 (10 cm ≤ DBH < 30 cm) in subparcels of 20 m x 50 m; Inclusion Level 2 (30 cm ≤ DBH < 50 cm) in subparcels of 20 m x 150 m; and Inclusion Level 3 (DBH ≥ 50 cm) in subparcels of 20 m x 250 m (ALMEIDA et al., 2012; RIBEIRO et al., 2013; VIEIRA et al., 2014).

The taxonomic identification of the species occurred initially in the field by the regional name, being the most complex identified posteriorly with the assistance of specialists by means of comparisons in the herbarium of the University Federal of the West of Pará (VIEIRA et al., 2015). These species were classified in groups of use medicinal, timber, animal feed, human food, rustic constructions and charcoal production according to Almeida et al. (2012), observing similarly the therapeutic action of the species of the flora utilized in the two rural communities and the part of the vegetable utilized in the domestic preparation.

Data analyses

The analysis of the data related to the family farming production consisted in the construction of tables and graphs interdisciplinary with the aid of the program Microsoft Excel 2010 in order to compare the data of the agricultural productions of the communities São Mateus and Santo Antônio in the periods of 2008 and 2018 according to the methodology utilized by Herrera (2012), correlating to productive activity and economic performance with the set of factors intrinsic to the family nucleus and to the external factors that interfere in the dynamics of the production.

In this sense, this method proposes a study of the interpretation of the reality of the family agricultural producers related to the social formation and the economic structure as determinants of the connection between all spheres of social life, indicating trusting relationships, ethics, values, and politics, beyond the perception of the objective and subjective needs of the two rural communities surveyed and their modes of expression (SCOPINHO; MARTINS, 2003; JORGENSEN, 2015).

In the analysis of the timber and non-timber forest products of the communities São Mateus and Santo Antônio of the year 2018 intrinsic to the potential of use of the tree species in the sample units surveyed were utilized the calculation of the diversity of the species through Shannon-Weaver Index (H') (MAGURRAN, 1988) and the calculation phytosociological parameters through the Importance Value Index (IVI) according to Mueller-Dombois and Ellenberg (1974).

$$H' = - \sum_{i=1}^{s} pi.\ln pi$$
$$Pi = ni / N$$

ni = number of individuals of species i
N = total number of individuals sampled
S = total number of species in the community

$$IVI = \frac{DRi + DoRi + FRi}{3}$$

IVI = importance value of the i-th species
DRi = relative density of the i-th species
$DoRi$ = relative dominance of the i-th species
FRi = relative frequency of the i-th species

Also, according to Magurran (1988) was utilized the Sorensen Similarity Index to verify the relation between the species of the two communities studied. The results were organized in tables and figures for the analysis of information. The tabulation and the data processing were realized through Microsoft Excel 2010.

$$SO_{ij} = \frac{2c}{a + b}$$

a = number of species occurring in the community 1
b = number of species occurring in the community 2
c = number of species common to both communities

Results and discussion

Family farming production

The agricultural production of the year 2008 of São Mateus Community presented in average six types of crops: *Manihot esculenta* (cassava), *Oryza sativa* (rice), *Phaseolus vulgaris* (bean), *Zea mays* (maize), *Piper nigrum* (black pepper) and *Bixa orellana* (annatto). In this period the family farmers harvested in average 112 sacks of 50 kg of cassava flour, totalizing an annual production of 5,600 kg (Table 1). The second largest production corresponded to the rice with 1,400 kg and the third largest was to the black pepper with 1,342 kg (Table 1). The maize cultivation obtained an average yield of 700 kg and the bean and annatto crops obtained similar productivities of 500 kg (Table 1) (GAMA et al., 2011).

Table 1: Family farming production of the 2008 harvest in the São Mateus Community.

Products	Number of producers (%)	Unit	Qty. year-1 Average	Destination (%) Sale	Destination (%) Consumption	Place of sale	Average price (R$)	Income (R$)	Harvest	DC[1]	For whom?[2]
Oryza sativa	70	sack	28	60	40	Community, Santarém and Rurópolis	29.29	492.00	May - Jul	1	1 - 2 - 3 - 4
Manihot esculenta	90	sack	112	92	8	Community, Santarém and km 164	48.00	4.945,92	Whole year	3	1 - 2 - 4
Phaseolus vulgaris	65	sack	10	40	60	Community, Santarém and Rurópolis	94.00	376.00	May - Dec	2	2 - 4
Zea mays	55	sack	14	30	70	Community and Santarém	28.33	119.00	May - Dec	2	2 - 4
Piper nigrum	35	kg	1,342	99	1	Community, Santarém and Rurópolis	3.43	4.568,04	Jul - Dec	3	1 - 2 - 3 - 4
Bixa orellana	10	kg	500	95	10	Santarém	2.00	950.00	Whole year	3	1 - 2 - 4

Source: Technical Report of the Study of Environment Impact and Sustainable Development Proposal for the Settlement Moju I and II (2011). [1]Demand of Commercialization (DC): 0 - Does not market; 1 - Low; 2 - Average e 3 - High. [2]For whom?: 1 - Local market; 2 - Middleman; 3 - Wholesaler; 4 - Subsistence and 5 - Cooperative.

In relation to the products cultivated by São Mateus farmers, four were directed to the local market (rice, flour, black pepper and annatto); being that the flour (93%), the black pepper (99%) and the annatto (95%) were the products that presented the greatest demands. Maize and bean were predominantly for the subsistence, however, surpluses were marketed. Castro et al. (2009) and

Guedes et al. (2012) analysing family farmers in rural communities in the Amazon, also showed the presence of these agricultural products as sources of subsistence and income generation and being responsible for the socioeconomic sustainability of these areas.

The farmers of the São Mateus Community in the year 2008 destined the largest parcel of the sale of its products to the municipalities of Rurópolis and Santarém, reflecting the market situation of most rural communities belonging to the municipality of Placas whose relations of assistance to public policies are solved in general in Rurópolis and Santarém for logistical reasons (MENTON et al., 2009).

In terms of average sales prices the black pepper appeared as the most profitable (R$3.43/kg), followed by bean (R$1.88/kg) and by cassava flour (R$1.00/kg). The cassava flour also presented high demand for commercialization due to the consumption satisfaction of rural families and the guarantee of food security, as well as the rice and the black pepper were demanded by buyers inside and outside the community (ADAMS et al., 2009).

In the Santo Antônio Community the agricultural production of the year 2008 evidenced on average 25 types of products, of which only 11 presented some commercial relevance (Table 2). The species with the highest commercialization indices were: chilli pepper (*Capsicum* spp.) (95%); gherkin (*Cucumis anguria* L.) (95%); black pepper (*Piper nigrum*) (93%); banana (*Musa* spp.) (90%); cassava (*Manihot esculenta*) (85%); annatto (*Bixa orellana*) (75%) and rice (*Oryza sativa*) (70%). The productions of beans (*Phaseolus vulgaris*), maize (*Zea mays*) and coffee (*Coffea arabica* L.) were marketed in the surpluses, being the remaining 14 species directed exclusively to subsistence (Table 2), indicating in this period a relative situation of financial stability of these rural families (GAMA et al., 2011).

Table 2: Family farming production of the 2008 harvest in the Santo Antônio Community.

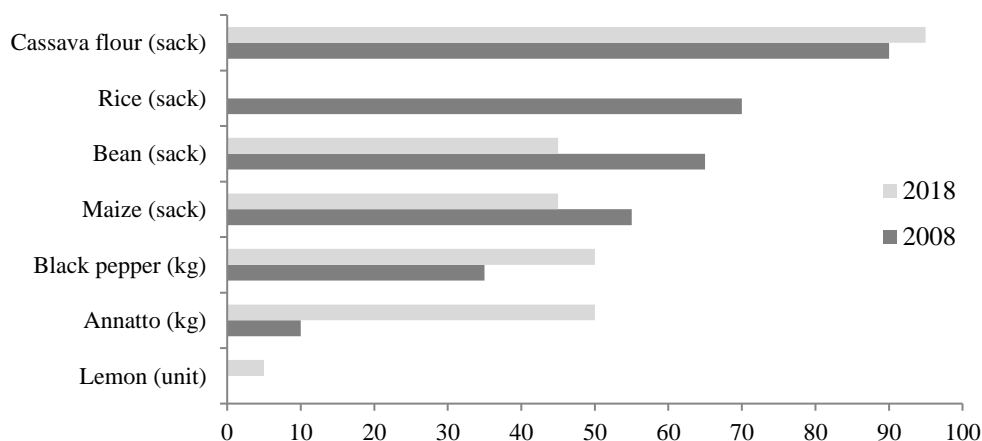| Products	Unit	Number of Producers (%)	Qty. year-1 Average	Destination (%) Sale	Destination (%) Consumption	Place of sale	Average Price (R$)	Income (R$)	Harvest	DC1	For whom?2
Musa spp.	bunch	25.7	300.33	90	10	Santarém	15.00	4.054,50	Aug - Nov	3	4
Piper nigrum	kg	71.4	1,111	93	7	Santarém	3.73	3.855,58	Jul - Dec	3	1 - 2 - 3 - 4
Bixa orellana	kg	8.6	1,200	75	25	Santarém	2.33	2.100,00	Jul - Dec	3	2
Capsicum spp.	kg	2.9	400	95	5	Santarém	2.50	950.00	-	3	1 - 2
Oryza sativa	sack	77.1	23.47	70	30	Santarém	35.00	574.93	May - Dec	2	2 - 3 - 4
Manihot esculenta	sack	71.4	12.87	85	15	Santarém	45.13	493.52	Whole year	3	1 - 2 - 3 - 4
Coffea arabica L.	sack	5.7	25	20	80	Santarém	80.00	400.00	Whole year	1	4
Ananas comosus	unit	14.3	637.50	50	50	Santarém	0.50	159.38	Dec	1	3
Cucumis anguria L.	hundred	2.9	10	95	5	Santarém	7.50	71.25	Whole year	3	3 - 4
Phaseolus vulgaris	sack	42.9	4.38	10	90	Santarém	86.67	37.92	Jul - Dec	2	2 - 3
Zea mays	sack	77.1	7	10	90	Santarém	34.50	24.15	Apr - Dec	2	2 - 3 - 4
Persea americana	hundred	8.6	-	-	100	-	-	-	-	0	4
Annona squamosa L.	unit	2.9	-	-	100	-	-	-	Jul - Dec	0	4
Oenocarpus bacaba	bunch	2.9	-	-	100	-	-	-	-	0	4
Theobroma cacao	hundred	2.9	-	-	100	-	-	-	-	0	4
Anacardium occidentale	unit	14.3	-	-	100	-	-	-	Jul - Dec	0	4
Cocos nucifera L.	unit	5.7	-	-	100	-	-	-	Whole year	0	4
Theobroma grandiflorum	kg	17.1	-	-	100	-	-	-	Jul - Dec	0	4
Psidium guajava L.	hundred	2.9	-	-	100	-	-	-	-	0	4
Annona muricata L.	unit	8.6	-	-	100	-	-	-	-	0	4
Cucurbita spp.	unit	2.9	-	-	100	-	-	-	Whole year	0	4
Citrus sinensis (L.)	hundred	5.7	-	-	100	-	-	-	-	0	4
Citrus limon L.	sack	2.9	-	-	100	-	-	-	Whole year	0	4
Mangifera indica L.	hundred	5.7	-	-	100	-	-	-	-	0	4
Talisia esculenta	kg	5.7	-	-	100	-	-	-	-	0	4

Source: Technical Report of the Study of Environment Impact and Sustainable Development Proposal for the Settlement Moju I and II (2011). [1]Demand of Commercialization (DC): 0 - Does not market; 1 - Low; 2 - Average e 3 - High. [2]For whom?: 1 - Local market; 2 - Middleman; 3 - Wholesaler; 4 - Subsistence and 5 - Cooperative.

The average sales prices in the year 2008 in the Santo Antônio Community presented the black pepper product with the best market price (R$3.73/kg). The cassava flour demonstrated high demand for commercialization; however, its sale price was below of R$1.00/kg. The coffee and the bean showed interesting prices, R$80.00/sack e R$ 86.67/sack, respectively, however, they did not highlight in quantities produced and marketed (Table 2). The occupation of the majority of the rural producers of the Santo Antônio Community consisted in the tradition of the production of cassava flour, besides the production of fruits and vegetables associated to the subsistence and to the market supply in the city of Santarém, identifying, thereby, the low investment in products such as coffee and bean in this period (WINKLERPRINS, 2002; DAL'ASTA et al., 2014).

In the evaluation of the farming production of the São Mateus Community of the year 2018 was observed, practically, the same types of agricultural crops of the year 2008, highlighted: *Manihot esculenta* (cassava), *Piper nigrum* (black pepper), *Bixa orellana* (annatto), *Phaseolus vulgaris* (bean), *Zea mays* (maize) e *Citrus limon* (lemon). In the comparison of the productions of 2008 and 2018 were observed an increase in the percentage of the number of producers and in the average quantity of the products marketed (Figure 2), totalizing an annual production of 3,000 kg of black pepper, 800 kg of annatto and 336 sacks of cassava flour (Table 3). The destination of the largest parcel of sale of the products remained the municipalities of Rurópolis and Santarém, with the exception of the bean, maize and lemon crops which were designated exclusively for subsistence.

Figure 2: Quantities of products marketed in the São Mateus Community of the years 2008 and 2018.

Source: Elaborated by the author (2018).

Table 3: Family farming production of the 2018 harvest in the São Mateus Community.

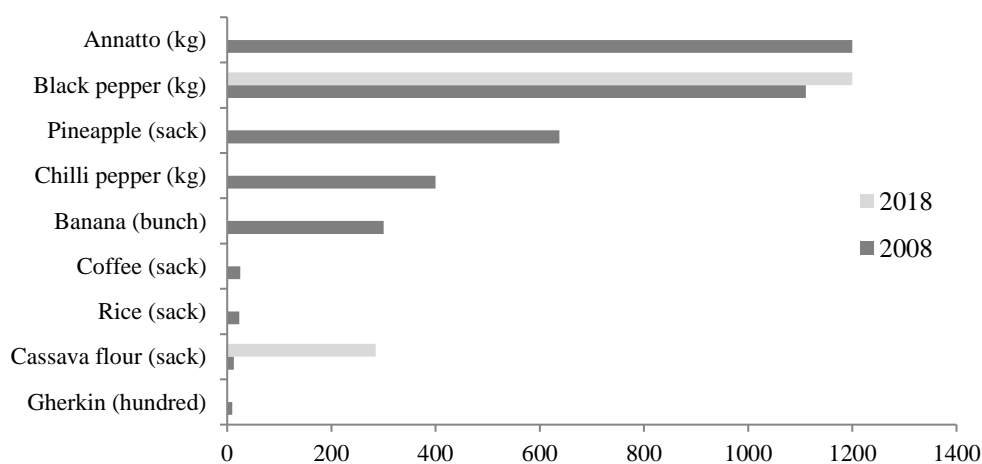| Products	Number of Producers (%)	Unit	Qty. year-1 Average	Destination (%) Sale	Destination (%) Consumption	Place of sale	Average price (R$)	Income (R$)	Harvest	DC1	For whom?2
Manihot esculenta	95	sack	336	10	90	Santarém and Rurópolis	120.00	4.032,00	Whole year	1	1 - 2 - 4
Piper nigrum	50	kg	3,000	90	10	Santarém and Rurópolis	4.50	12.150,00	Aug - Oct	3	1 - 2 - 4
Bixa orellana	50	kg	800	30	70	Santarém and Rurópolis	2.70	600.00	May - Oct	1	1 - 2 - 4
Phaseolus vulgaris	45	sack	-	-	100	-	-	-	May - Dec	0	4
Zea mays	45	sack	-	-	100	-	-	-	May - Dec	0	4
Citrus limon	5	unit	-	-	100	-	-	-	Whole year	0	4

Source: Elaborated by the author (2018). [1]Demand of Commercialization (DC): 0 - Does not market; 1 - Low; 2 - Average e 3 - High. [2]For whom?: 1 - Local market; 2 - Middleman; 3 - Wholesaler; 4 - Subsistence and 5 - Cooperative.

Thus, it was possible to verify that in 2018 there was an increase in average product prices in comparison to 2008, however, this scenario did not provide to an increase in local income due to the low demand of commercialization for products such as the cassava and the annatto (SANTANA

et al., 2015) (Table 3). In relation to the creation of small animals in the São Mateus Community were observed indices practically null of commercialization during the years 2008 and 2018, limiting the production around 10% of the families surveyed and characterized on average in the annual sales of 1 pig and 24 chickens.

With regard to farming production of the year 2018 of the Santo Antônio Community was verified an average reduction of 80% in the products marketed in comparison to 2008 (Figure 3), constituting the production of the family farmers in the species *Manihot esculenta* (cassava) e *Piper nigrum* (black pepper), and orientating the agricultural crops *Phaseolus vulgaris* (bean), *Zea mays* (maize) e *Oryza sativa* (rice) only for subsistence (Table 4). The place of sale of the products continued to be the Santarém market, with average price of R$4.50/kg of the black pepper and R$120.00/sack of the cassava flour (Table 4).

Figure 3: Quantities of products marketed in the Santo Antônio Community of the years 2008 and 2018.

Source: Elaborated by the author (2018).

Table 4: Family farming production of the 2018 harvest in the Santo Antônio Community.

Products	Number of Producers (%)	Unit	Qty. year-1 Average	Destination (%) Sale	Destination (%) Consumption	Place of sale	Average price (R$)	Income (R$)	Harvest	DC1	For whom?2
Manihot esculenta	90	sack	285	10	90	Santarém	120.00	3.420,00	Whole year	1	1 - 2 - 4
Piper nigrum	70	kg	1,200	70	30	Santarém	4.50	3.780,00	Aug - Oct	2	1 - 2 - 4
Phaseolus vulgaris	60	sack	-	-	100	-	-	-	Jul - Dec	0	4
Zea mays	75	sack	-	-	100	-	-	-	Apr - Dec	0	4
Oryza sativa	75	sack	-	-	100	-	-	-	May - Dec	0	4

Source: Elaborated by the author (2018). [1]Demand of Commercialization (DC): 0 - Does not market; 1 - Low; 2 - Average e 3 - High. [2]For whom?: 1 - Local market; 2 - Middleman; 3 - Wholesaler; 4 - Subsistence and 5 - Cooperative.

In this context was observed that the family producers of the Santo Antônio Community in the year 2018 were in the expectancy of the beginning of the activities related to the Community Forest Management Plan agreed between the local association and the company Maflops (MENTON et al., 2009; AMARAL-NETO et al., 2011), which may have determined to the reduction in the revenue of rural families and in the quantity of agricultural products marketed in comparison to 2008 (Table 4).

In all, the two communities studied showed a high level of dissatisfaction (97%) as regards the lack of public technical assistance in order to plan their productions, combining diversified agroforestry systems with programs that effectively compensate the rural communities by economic losses related to strengthening family farming and to subsistence and income potential, as well as food security characterized in the perspective of self-consumption service and expansion of the

marketable surpluses (BUAINAIN et al., 2003; SANTANA et al., 2015; ALVES-PINTO et al., 2018; RODRIGUES et al., 2018).

The productive systems of the years 2008 and 2018 of the São Mateus and Santo Antônio communities demonstrate that it is possible to create new operational visions in a concept of development rural sustainable based in the diversity of the cultures of family farmers with the consequent the improvement of living conditions of the rural producers in the Amazon (BARBIER, 1987; SEN, 1988).

Use of the forest resources

In the forest inventory realized in the year 2018 of the São Mateus Community were sampled 704 individuals in 9 parcels, distributed in 146 species and 49 botanical families (Figure 4). The families with the highest number of species were Fabaceae (73), Sapotaceae (18), Lecythidaceae (14), Moraceae (14), Lauraceae (12). These families together totalled 55.61% of the inventoried species, finding similar results with Oliveira et al. (2008), Tunholi et al. (2013), Freitas et al. (2015) e Carim et al. (2017) which evidenced the Fabaceae family as the higher in number of species in rural settlement and in flooded and non-flooded forests in the Amazon.

Figure 4: Species-area curve of the forest inventory in the São Mateus Community.

$$y = 25.584Ln(x) + 28.94$$
$$R^2 = 0.9923$$
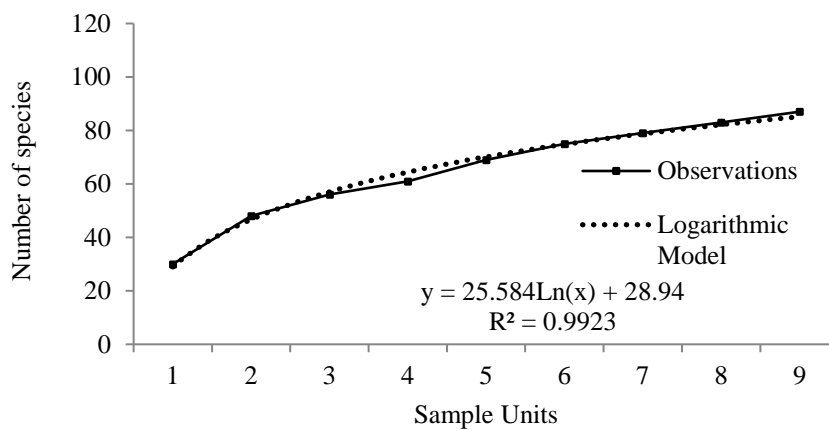
Source: Elaborated by the author (2018).

The density of the individuals was estimated at 509.12 individuals ha^{-1} and the basal area was 29.10 m^2 ha^{-1}. Among the 146 species identified, 71 presented absolute density (AD) equal or superior than 2.0 individuals/ha. The 10 most abundant species (AD ≥ 10 individuals/ha) were *Eschweilera coriacea*, *Nectandra* sp., *Bixa arborea* Huber, *Protium* cf. *heptaphyllum*, *Licania kunthiana* Hook.f., *Pouteria guianensis*, *Tetragastris altíssima* (Aubl.) Swart, *Pouteria cladantha*, *Duguetia* sp. and *Richardella macrophylla* (Table 5) which together contributed with 36.81% of the total absolute density. According to Silva et al. (2016) the terra-firme dense ombrophyllous forest is characterized by high plant species diversity and elevated occurrence of rare species.

**Table 5:** Phytosociological parameters of the 10 most abundant species in the São Mateus Community.

Scientific Name	Regional Name	AF	AD	ADo	IVI
Licania kunthiana Hook.f.	Caripé	64.7	18.2	0.7	2.6
Pouteria cladantha Sandwith	Abiurana	73.3	16.2	0.6	2.3
Eschweilera coriacea (D.C.) S. A. Mori	Matamatá-branco	73.3	30.1	0.9	3.7
Protium cf. heptaphyllum Aubl.	Breu-vermelho	73.3	18.6	0.4	2.7
Nectandra sp.	Louro-preto	91.2	23.1	0.8	3.2
Pouteria guianensis Aubl.	Abiurana-vermelha	91.2	17.3	0.4	3.2
Bixa arborea Huber	Urucum-da-mata	73.3	21.3	0.5	1.6
Tetragastris altissima (Aubl.) Swart	Breu-branco	100.0	17.3	0.4	1.9
Richardella macrophylla (Lam.) Aubrév.	Abiu-cutite	45.8	11.7	0.3	1.9
Duguetia sp.	Ata-brava	54.5	13.6	0.4	1.8
Subtotal	-	740.6	187.4	5.4	26.4
Other species	-	3294	321.7	23.7	73.6
Total	-	4035	509.1	29.1	100

Source: Elaborated by the author (2018). AF: Absolute Frequency; AD: Absolute Density; ADo: Absolute Dominance; IVI: Importance Value Index.

In relation to the Importance Value Index (IVI), the 10 species with the highest indices were: *Eschweilera coriacea* (3.70%), *Nectandra* sp. (3.20%), *Pouteria guianensis* (3.20%), *Protium heptaphyllum* (2.70%), *Licania kunthiana* (2.60%), *Pouteria cladantha* (2.30%), *Tetragastris altíssima* (1.90%), *Richardella macrophylla* (1.90%), *Duguetia* sp. (1.80%) and *Bixa arborea* (1.60%) which together contributed with 26.40% of the total value of importance (Table 5).

Concerning the use of the forest resources timber and non-timber of the São Mateus Community, the five main species that stood out were: *Tetragastris altissima* (Breu-branco), *Mezilaurus itauba* (Itaúba), *Manilkara huberi* (Maçaranduba), *Manilkara bidentata* (Maparajuba) and *Protium heptaphyllum* (Breu-vermelho). The specie *Tetragastris altissima* occurs in primary and secondary forests, presenting regeneration in shadows and clearings and density around 0.71 g cm^{-3} (OBERMÜLLER et al., 2011).

In the Santo Antônio Community were found 1306 individuals in 12 parcels, distributed in 176 species and 43 botanical families (Figure 5). The Fabaceae family presented the highest number of species (52), followed by Sapotaceae (16), Lauraceae (11) Lecythidaceae (10) e Annonaceae (9). These five families together represented 72.35% of the inventoried species. The results obtained in the two rural communities confirm the floristic inventories realized in terra-firme forest in the Amazon, highlighting these families among the most predominant (STROPP et al., 2011), as well as demonstrate that the high heterogeneity of the forests were maintained, based on in the São Mateus e Santo Antônio communities, thus corroborating the forest management as maintenance warranty of the diversified floristic composition (YARED et al., 2000; JARDIM; QUADROS, 2016).

Figure 5: Species-area curve of the forest inventory in the Santo Antônio Community.

$$y = 33.47 \text{Ln}(x) + 35.66$$
$$R^2 = 0.9945$$
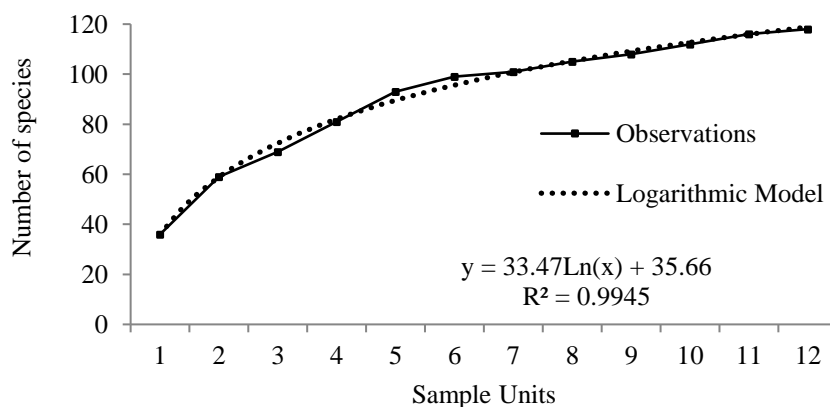
Source: Elaborated by the author (2018).

The density of the individuals was estimated at 297.7 individuals ha^{-1} and the basal area was 22.1 m² ha^{-1}. Among the 176 species identified, 75 presented absolute density (AD) equal or superior than 2.0 individuals/ha. The 10 most abundant species (AD ≥ 10 individuals/ha) were *Franchetella anibaefolia* (A.C. Smith.) Aubr., *Pouteria guianensis* Aubl., *Rinorea guianensis* Aubl., *Protium paniculatum* var. *riedelianum* (Engl.) Daly, *Protium* cf. *heptaphyllum* (Aubl.) Marchand, *Inga alba* (Sw.) Willd., *Endlicheria longicaudata* (Ducke) Kosterm., *Eschweilera coriacea* (D.C.) S.A.Mori, *Eschweilera amazonica* Knuth and *Sclerolobium* sp. (Table 6) which together contributed with 35.5% of the total absolute density.

Table 6: Phytosociological parameters of the 10 most abundant species in the Santo Antônio Community.

Scientific Name	Regional Name	AF	AD	ADo	IVI
Franchetella anibaefolia (A.C. Smith.) Aubr.	Abiurana	68.1	8.3	1.2	2.9
Pouteria guianensis Aubl.	Abiu-vermelho	93.4	9.1	0.7	2.6
Rinorea guianensis Aubl.	Acariquarana	83.7	25.8	0.9	4.6
Protium paniculatum var. riedelianum (Engl.)	Breu-manga	69.3	7.1	0.5	1.9
Protium cf. heptaphyllum (Aubl.) Marchand	Breu-vermelho	69.3	9.7	0.3	2.1
Inga alba (Sw.) Willd	Ingá	59.3	9.3	0.5	2.2
Endlicheria longicaudata (Ducke) Kosterm.	Louro-amarelo	77.2	7.5	1.4	1.8
Eschweilera coriacea (D.C.) S. A. Mori	Matamatá-branco	66.3	12.9	1.1	3.8
Eschweilera amazonica Knuth	Matamatá-cí	52.1	6.9	1.1	1.7
Sclerolobium sp.	Taxi	73.8	9.2	0.9	2.7
Subtotal	-	709.5	105.8	8.6	26.3
Other species	-	4680	191.9	13.5	73.7
Total	-	5390	297.7	22.1	100

Source: Elaborated by the author (2018). AF: Absolute Frequency; AD: Absolute Density; ADo: Absolute Dominance; IVI: Importance Value Index.

In relation to the Importance Value Index (IVI), the 10 species with the highest indices were: *Rinorea guianensis* (4.6%), *Eschweilera coriacea* (3.8%), *Franchetella anibaefolia* (2.9%), *Sclerolobium* sp. (2.7%), *Pouteria guianensis* (2.6%), *Inga alba* (2.2%), *Protium heptaphyllum* (2.1%), *Protium paniculatum* (1.9%), *Endlicheria longicaudata* (1.8%) and *Eschweilera amazonica* (1.7%), which together contributed with 26.3% of the total value of importance (Table 6).

Concerning the use of the forest resources timber and non-timber of the Santo Antônio Community, the five main species that stood out were: *Aniba canelilla* (Preciosa), *Pouteria bilocularis* (Goiabão), *Carapa guianensis* (Andiroba), *Tabebuia impetiginosa* (Ipê-roxo) e *Hymenaea courbaril* (Jatobá). The specie *Aniba canelilla* occurs in terra-firme forests in the Amazon. The bark tea is medicinally used in the treatment of gastrointestinal disorders by the rural families (SILVA et al., 2007); and *Pouteria bilocularis* is specie also occurring in forests of the Amazon region. The timber use occurs in sawmills, in addition to its fruits being appreciated by the local fauna (VIEIRA et al., 2014).

With regard to the use of flora, of the 322 species identified in the São Mateus and Santo Antônio communities, 23 species were utilized for the treatment of inflammatory processes; 13 species used for food and restorative; 8 species used for gastritis treatment and 5 species used for the treatment of worms and hypertension, these results being similar to those obtained by Macedo et al. (2019) when conducting a survey on the use of species by rural communities in the Amazon.

In this scenario, the values obtained by the Shannon Diversity Index (H') were 4.09 for the São Mateus Community and 3.65 for the Santo Antônio Community. Condé and Tonini (2013) also in dense ombrophyllous forest in Amazon found H' = 3.27, being these indices below the expected averages for Amazonian forests (KNIGHT, 1975), as well as the value obtained by Oliveira et al. (2008) in terra-firme dense forest in Central Amazonia, which was H' = 5.10. In reference to the Sorensen Similarity Index among the native species of the two studied communities, the result corresponded to 0.65, with both areas showing a total of 101 species in common. Therefore, the floristic similarity was 65% comparing the existing species in the managed forests of São Mateus and Santo Antônio.

Therefore, the results of this study reveal a stock of species with potential timber and not timber with consequent socioeconomic improvements in the São Mateus and Santo Antônio communities, however, in contrast to programs and public policies destined to the settlement Moju I and II, which, in turn, were precarious in most of the rural communities of the settlement (INCRA,

2004). Some government actions observed in the region were: The "Light for All" program; "Our Water" Project, executed by Amazon Environmental Research Institute (IPAM) in partnership with the National Institute of Colonization and Agrarian Reform (INCRA); and the National Rural Housing Program (PNHR) that financed the construction of houses in the Estrela da Bica II community of the settlement Moju I and II (IPAM, 2015).

Folhes et al. (2012), in study realized in the Vila Brasil community of the Lago Grande Agroextractive Settlement Project, observed an absence in technical assistance services and credit lines, as well as precarious transport, energy, health and education infrastructure. Sobral et al. (2013), also assessing the socio-environmental development indicators in rural settlement areas in northeastern Brazil, identified 13% of the families without any type of basic infrastructure, such as piped water, electricity and sanitation; thus proposing a greater mobilization of families through community associations, in order to obtain access to the public policies aimed at the rural area, such as Brasil Sem Miséria, Luz para Todos and Fundo Clima.

Conclusions

In integration of the socioeconomic and environmental information with the effectiveness in the public policy proposals for rural communities of the Amazon region have become detectable and were able to be researched from a systemic conception.

Thus, the main contribution of the analysis of family farming production was the possibility of articulating these actors in a rural development approach based on standardized socioeconomic concepts and in the State support to local farming systems in order to structure the production chains and suggest them for other rural settlements.

Similarly, the information obtained in this research may contribute to the public policies aimed at subsidizing the potential use of these forest resources in this rural settlement based on the maintenance of species diversity, as well as to promote the formation of participatory programs to incentive sustainable development, considering the current market, adding value to the products and in the more efficient land and capital use by the family farmers.

Acknowledgements

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