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Agrobiodiversity in peasant swidden fields and home-gardens in the Mearim valley, Maranhão state

Agrobiodiversidade em roçados e quintais camponeses no Médio Mearim, Maranhão

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ABSTRACT: This study analyzed characteristics associated with the agrobiodiversity maintained by farmers in babassu areas in the Médio Mearim, Maranhão, identifying local varieties of the main species cultivated in traditional swiddens, as well as the frequency of fruit tree species, vegetables, and medicinal and condiment plants present in home-gardens. Based on interviews conducted in 1,025 households in 207 villages, varieties of rice (36), cowpea (31), maize (20), and cassava (35) were reported. In the home-gardens, 46 fruit tree species, 29 vegetables, and 73 medicinal and condiment species were identified. To better understand aspects that influence the diversity of species and varieties, the results were analyzed according to 11 variables used as stratification criteria. The analysis indicated that significant differences in the average number of vegetables were observed in relation to landholding area and retirement benefit. For medicinal and condimental vegetables, differences were observed for age group of the household head, dependence on babassu extraction, and monetary income of the household. Regarding the diversity of fruit trees cultivated, differences occurred for all the variables analyzed, except for the education of the household head. Analyzing jointly the four main species of traditional swiddens, a positive association for greater diversity occurred in quilombola territories, and a negative association for beneficiaries of the Bolsa Família Program. These results confirm that swidden field is a peasant institution that persists, featuring a significant diversity of traditional varieties, which is not sufficiently affected by factors endogenous to the domestic unit of production.

RESUMO: *Este estudo analisou características associadas à agrobiodiversidade mantida por camponeses em áreas de ocorrência de babaçu no Médio Mearim, Maranhão, registrando variedades locais das principais espécies cultivadas nos roçados tradicionais, assim como a frequência de espécies frutíferas arbóreas, hortaliças, e plantas medicinais e condimentares presentes nos quintais. A partir de entrevistas realizadas em 1.025 domicílios de 207 povoados, foram registradas 36 variedades de arroz, 31 de feijão-caupi, 20 de milho e 35 de mandioca. Nos quintais foram contabilizadas 46 espécies frutíferas arbóreas, 29 de hortaliças, e 73 entre medicinais e condimentares. Para melhor compreensão de aspectos que influenciam a diversidade de espécies e variedades, os resultados foram analisados conforme 11 variáveis utilizadas como critérios de estratificação. A análise indicou que diferenças significativas no número médio de hortaliças foram observadas em relação à área do estabelecimento e ao recebimento de aposentadoria. Para medicinais e condimentares, diferenças foram observadas para faixa de idade do responsável pelo domicílio, dependência em relação ao extrativismo do babaçu, e renda monetária do domicílio. Em relação à diversidade de árvores frutíferas cultivadas, diferenças ocorreram para todas as variáveis analisadas, exceto escolaridade do responsável. Analisando conjuntamente as quatro principais espécies dos roçados tradicionais, associação positiva para maior diversidade ocorreu em territórios quilombolas, e negativa para beneficiários de Bolsa Família. Tais resultados ratificam que a roça é uma instituição camponesa que persiste, tendo como característica uma expressiva diversidade de variedades tradicionais, que não é suficientemente afetada por fatores endógenos às unidades familiares de produção.*

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1 Introduction

Agrobiodiversity was defined at the 5th Conference of Parties of the Convention on Biological Diversity (CBD), as "[...] a broad term that includes all components of biodiversity that have relevance to agriculture and food; it includes all components of biodiversity that constitute agroecosystems: the variability of animals, plants and microorganisms, at the genetic, species and ecosystem levels, necessary to sustain the key functions of agroecosystems, their structures and processes" (Stella *et al.*, 2006).

The term results from the interaction of four levels of complexity: a) cropping systems; b) species, varieties and breeds; c) human diversity; and d) cultural diversity, aggregating the three levels of complexity related to biodiversity (diversity among species, within species and of ecosystems) (Machado *et al.*, 2008).

As mentioned by Emperaire (1999), the perpetuity of plant genetic resources is associated with the cultural continuity of the social groups that produced them and their farming systems. Family farmers and traditional populations, such as quilombolas (Afro-Brazilian communities who resisted slavery and have territorial rights granted by a clause in Brazil's 1988 Constitution) and indigenous peoples, are important subjects in the conservation of seeds of traditional varieties, developing empirical techniques of sociocultural nature for the rescue, maintenance, and dispersion of traditional materials, whose practices are passed from generation to generation (Bevilaqua *et al.*, 2014).

Carvalho (2013) posits that peasants remains capable of acting as agrobiodiversity guardians, because "... wisely, they have always implemented the diversity of crops and livestock, the conservation and improvement of soils and forests, the biological diversity in the waters, the constructive and respectful anthropic coexistence with nature, even in cases of restricted and selective extractivism".

Maranhão is the Brazilian state with the highest rate of rural population: 38% in 2010, while the national average was 16% (IBGE, 2010). This population is predominantly made up of peasant families who practice traditional agriculture, animal husbandry, and vegetal extraction of the babassu palm (*Attalea speciosa* Mart. ex Spreng.). Médio Mearim stands out in Maranhão as one of the territories with the highest expression of this peasant population (Porro & Porro, 2020). More than 130,000 people live in the rural area of Médio Mearim, with a strong presence of family farmers, settlers, and quilombola communities. The territory is a transition zone between the Amazon, Cerrado, and Caatinga biomes, where, in the last five decades there have been significant changes in natural resource use. The predominant landscapes, initially primary forests, were transformed into secondary forests with dominance of the babassu palm, covering vast areas called babassu groves (*babaçuais*) that became the basis for the livelihood of thousands of families (May, 1987). Progressively, secondary forests have been converted into pastures associated with babassu, with distinct palm densities (Porro, 2005; Porro & Porro, 2015).

Even with the expansion of pastures, traditional swidden agriculture is still critical for the food security of this important social group. However, few studies analyzed in detail the local knowledge related to the use, management, and conservation of agrobiodiversity in peasant swidden fields and home-gardens in Maranhão. Among the ethnobotanical studies conducted, surveys associated with indigenous ethnic groups and quilombola communities stand out (Balée, 1986; Monteles & Pinheiro, 2007).

In order to reduce this gap, the objective of the present study was to understand and analyze the agrobiodiversity maintained by peasants in the Medio Mearim, as well as the factors that influence this diversity. To this end, the diversity of local varieties was recorded for the four main species cultivated in traditional fields reported by family farmers: rice (*Oriza sativa* L.), maize (*Zea mays* L.), cassava (*Manihot esculenta* Crantz), and cowpea (*Vigna unguiculata* (L.) Walp), as well as the frequency of fruit tree species, vegetables, medicinal and condiment plants grown in family home-gardens.

For a deeper understanding of aspects that influence the diversity of species and varieties, such diversity was analyzed according to discriminant variables used as stratification criteria. In this way, we investigated which features of the household and/or landholding are relevant to maintain diversity. This understanding aims to support actions and policies promoting the conservation of regional agrobiodiversity, contributing to food sovereignty and the social reproduction of local communities.

2 Material and methods

The data analyzed in this study were obtained from a structured questionnaire applied in the second half of 2017 to 1,025 households in 16 municipalities of the Médio Mearim Territory, in addition to the municipalities of Alto Alegre do Maranhão and Peritoró (Figure 1). The questionnaire was used in an assessment aimed at understanding the diversity of socioeconomic situations and to support programs and policies aimed to enhance the livelihood of family farmers in these 18 municipalities, the area of operation of the Association in Settlement Areas in the State of Maranhão (Assema).

The unit of analysis used in this study is the rural household. Sample stratification was based on data from the 2006 Agricultural Census (IBGE, 2006). The relative importance, in each municipality, of the number of family farms, and of landholdings in which babassu extraction occurred, were assigned equivalent weights, determining the expected number of households per municipality, corresponding to about 3% of rural households (IBGE, 2010) and 6.5% of landholdings in the study area (IBGE, 2017).

The identification of target villages in which visits were carried out was done through consultation with leaders of the Rural Workers' Unions (STTRs). Considering the search for heterogeneity, the number of

households in each village was limited to a maximum of ten, resulting in a total of 207 localities visited.

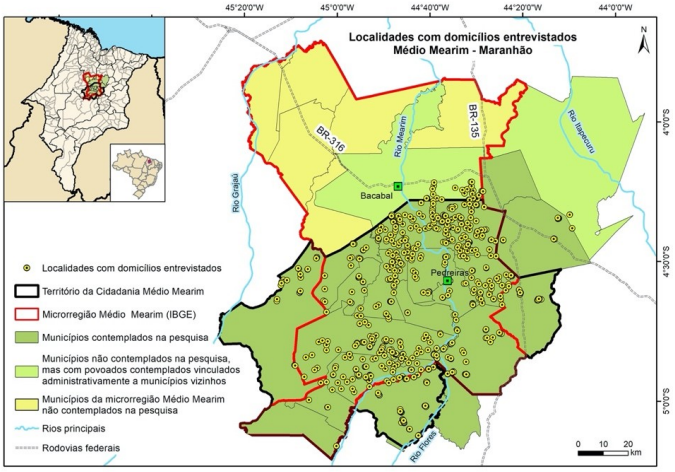

Figure 1. Study area, Médio Mearim, Maranhão. Map: Renan Miranda Matias.

Figura 1. Área de estudo, Médio Mearim, Maranhão. Mapa: Renan Miranda Matias.

A team of six secondary-level or university technicians was trained to apply the questionnaire, and interviews took place between August and November 2017. Whenever possible, interviews were conducted with both spouses. Of the total 1,025 interviews, 32.5% were answered by men, 28% by women, and 39.5% by the couple. The data obtained were recorded directly on tablets in which a system developed with Apache/PHP technologies had been installed for reading and interpreting the source code, and MySQL for data persistence. The structure of the questionnaire, developed in a web platform, synchronized in the tablets, allowed the offline filling of data collected in interviews and, later, its submission to the server. After the interviews, the data were consolidated into .csv files and exported to the statistical program Stata 14.0, in which analyses were performed according to independent variables, including aspects related to features of the household, landholding, socioeconomic status, economic activity, and two social programs: Bolsa Família, a conditional cash transfer program, and pension/retirement benefits (Table 1).

Regarding the terminology adopted in the questions about the diversity existing in the fields, it was considered that the term "cultivar", according to Brazilian legislation (Cultivar Protection Law), refers to formal genetic improvement, developed by private companies, research institutions or universities (Pereira, 2017). We thus opted to use "variety", the term mostly used by farmers to denote different types of the same cultivated species. Yet, it should be noted that the scope of this study did not include to distinguish whether or not genetic improvement was performed in the development of the materials.

Table 1. Variables used in this study's stratified analyses.

Tabela 1. Variáveis utilizadas em análises estratificadas desta pesquisa.

Variable	Specification	Values/classes
Age	age range of the person responsible for the household	< 25 years old 25 to less than 35 35 to less than 45 45 to less than 55 55 to less than 65 > 65 years old
Education	level of education of the person responsible for the household, presented in years of study	0-1 2-4 5-8 9-18
Ethnic identification	color or race declared by the person responsible for the household	white brown (pardo) black
Tenure category	classification of the landholding's tenure category	private property land reform settlement quilombola territory undocumented possession another
Landholding area	area in hectares (ha)	0 - 5 ha 5.1 - 20 ha 20.1 - 40 ha 40.1 - 400 ha
Size of annual field	area of traditional swidden cultivated by the household, in Linhas (L): 1 Linha = 0.32 ha	0 0.0 1– 1.5 L 1.51–3 L 3.1–6 L > 6 L
Wealth (household wealth or assets)	total combined value of consumer goods, productive goods, productive infrastructure, animal herd, fruit trees in production, house	R$ 0 – 6,000 R$ 6,001 – 12,000 R$ 12,001 – 18,000 R$ 18,001 – 172,000
Monthly monetary income	household's average monthly income, in minimum wages (by adding 54 sources of cash reported to have been received in the previous 12 months)	up to 1 minimum wage 1 - 2 minimum wages 2 - 3 minimum wages > 3 minimum wages
Monthly expenditure (consumption)	average monthly value that the person in charge of the landholding reported for the following expenses, incurred in the month before the interview: food, clothing, health, education, electricity, transport, hygiene and cosmetics, hired labor	< R$ 750 R$ 751–1,500 R$ 1,501–2,500 > R$ 2,500
Dependence on babassu products	derived from the total annual value received by the household from the commercialization of babassu products	very low: R$ 0 - 120 low: R$ 120 – 1,200 average: R$ 1,201 – 2,400 high: R$ 2,401 – 4,800 very high: > R$ 4,800
Bolsa Familia	household receives Bolsa Família benefit	yes, no
Retirement	household receives retirement or pension benefit	yes, no

Note: December 2017 exchange rate: 1 USD = R$ 3.32

Nota: Taxa de câmbio em dezembro de 2017: 1 USD = R$ 3.32

3 Results and Discussion

Annual crops in traditional swiddens

For decades, cultivation by family farmers positioned Maranhão as one of the states with the highest production of rice in Brazil. At the height of this period, Maranhão ranked second among Brazilian states in both production and area under rice cultivation. In 1980, one million tons of rice produced on 737 thousand hectares (ha) in Maranhão represented about 13% of the national total (IBGE, 1983). After almost four decades, rice production in Maranhão in 2017 (135 thousand tons) represented just over 1% of the total in the country, in an area that did not reach 83 thousand ha (5% of the total) (IBGE, 2017). The 2017 productivity (1.6 t/ha) exceeded less than 20% that of 1980. In the same period, rice grown in the state of Rio Grande do Sul, which in 1980 represented 28% of production and 11% of the cultivated area, rose to 76% of the quantity harvested, and 63% of the total area, while the 2017 productivity of 7.7 t/ha was 114% higher than in 1980. However, the approximately 82,000 landholdings in Maranhão that produced rice in 2017 still represented 46% of the national total, and this production is markedly carried out by family farmers cultivating an average of only one hectare with rice, contrasting with 117 ha in Rio Grande do Sul.

As for rice cultivation in the municipalities of Médio Mearim, Table 2 indicates that landholdings that registered this activity in 2017 were about 21% of the 1980 total, a rate similar to that verified in the state of Maranhão as a whole (23%), while an even smaller proportion was verified at the national level (12%). The downward trend was more pronounced in relation to the harvested production of rice in Médio Mearim and in the state of Maranhão, which in 2017 represented, respectively, only 8% and 13% of the 1980 total, while the opposite trend was seen at the national level, with an increase of 137% in the same period. Finally, the area cultivated with rice in 2017 in Médio Mearim, Maranhão state, and in the country was, respectively, 5%, 11%, and 30% of that of 1980.

In the current study, 90% of the interviewees reported swidden fields, with an average size of 1.3 ha (and a median of 1 ha), totaling 1,163 ha. Table 3 shows the most frequent annual crops, mostly cultivated through slash-and-burn, where rice, maize, and cassava are intercropped. Predominant crops are maize (82% of the households, total area of 1,017 ha), cowpea (67%, 606 ha), rice (59%, 724 ha), broad beans (45%, 560 ha), and cassava (28%, 355 ha). Cassava varieties, or landraces, are classified in 'sweet' cassava (*aipim, macaxeira*) and 'bitter' cassava. This classification is related to the capacity of cyanide (HCN) release, a toxic substance if ingested. Bitter cassava contains more than 100 $mg.kg^{-1}$ of cyanogenic compounds per fresh root (Araújo *et al.*, 2010). In this study, except when expressly mentioned, the term cassava refers to both types.

Table 2. Paddy rice: number of agricultural landholdings, cultivated area and quantity produced (1980 and 2017). Source: IBGE 1983, 2017.

Tabela 2. Arroz em casca: número de estabelecimentos agropecuários, área cultivada e quantidade produzida (1980 e 2017). Fonte: IBGE 1983, 2017.

	1980			2017		
	Land-holding	production (t)	harvested area (ha)	Land-holding	production (t)	harvested area (ha)
Médio Mearim*	66,633	207,317	262,554	13,892	15,707	12,895
Maranhão	365,862	1,026,084	737,753	82,842	135,538	83,756
Brasil	1,530,8	8,086,747	5,712,072	179,881	11,056,71	1,716,600

Note: * Some Médio Mearim municipalities created after 1985 were dismembered from Bacabal, Codó and Coroatá. To allow comparison between dates, information from these municipalities was added to Médio Mearim's total.

Nota: * Alguns municípios criados no Médio Mearim após 1985 foram desmembrados de Bacabal, Codó e Coroatá. Para permitir comparação entre as duas datas, informação desses três municípios foi somada ao total do Médio Mearim.

The average total swiddens' area of 1.3 ha is slightly higher than the median of 1 ha. Information for each species refers to the total area of the plot where this crop is cultivated, including other intercropped species. Thus, informed areas for each annual crop in Table 3 do overlap, resulting in average areas of rice, maize, cassava, and broad beans greater than or close to 1 ha, while total intercropped area reaches only 1.3 ha. Cowpea is generally cultivated at the end of the rainy season (June-August), while sweet cassava is grown in home-gardens or areas near the house. Production of sweet corn has recently increased in mechanized and even irrigated fields, for more capitalized producers. Some 7% to 13% of the households grow vegetables within their swiddens, usually in rows, near firebreaks or on the edges of the field.

Table 3. Frequency and area of annual crops for interviewed households, Médio Mearim (N = 1025). Source: Assema, 2018.

Tabela 3. Frequência e área de cultivos anuais nos domicílios entrevistados, Médio Mearim (N = 1025). Fonte: Assema, 2018.

	Households		Area (ha)					
	n	%	min	max	md	mn	sd	total
Annual	922	90.0	0.015	22	1.0	1.3	1.4	1.163
Maize	841	82.0	0.015	13	1.0	1.2	1.2	1,017
Cowpea	691	67.4	0.015	10	0.6	0.9	0.9	606
Rice	608	59.3	0.10	10	1.0	1.2	1.0	724
Broad beans	458	44.7	0.08	10	1.0	1.2	1.0	560
Bitter	284	27.7	0.08	14	1.0	1.3	1.2	355
Sweet	257	25.1	0.06	14	0.7	0.9	1.0	232
Pumpkin	131	12.8	0.15	10	1.0	1.1	1.2	149
Okra	103	10.0	0.06	3	0.6	0.7	0.5	71
Watermelon	89	8.7	0.08	4	1.0	1.1	0.7	94
Cuchá	75	7.3	0.08	3	0.6	0.7	0.5	50
Maxixe	73	7.1	0.08	2	0.5	0.6	0.5	47

n: frequency; min: minimum; max: maximum; md: median; mn: mean; sd: standard deviation.

n: frequência; min: mínimo; max: máximo; md: mediana; mn: média; sd: desvio padrão.

Table 4 presents production descriptive statistics for the five main staple crops, showing modest average totals that do not reach one ton per household. Considering that average cultivated areas per household range between 0.9 ha (cowpea) and 1.3 ha (cassava), the average productivity of these crops does not exceed 1t/ha.

Table 4. Frequency and production of annual crops for interviewed households. Source: Assema, 2018.

Tabela 4. Frequência e produção de cultivos anuais nos domicílios entrevistados. Fonte: Assema, 2018.

Cultivo	Households		Production (kg)					
	n	%	mi	max	md	mn	sd	total
Rice	571	55.7	10	12.400	750	989	995	564.924
Maize	802	78.2	7	18,000	420	794	1,330	636,442
Cowpea	789	77.0	1	3,000	80	139	216	109,631
Cassava / flour	179	17.5	4	8,500	400	816	1,218	146,079
Broad beans	484	47.2	1	900	40	67	92	32,478

n: frequency; min: minimum; max: maximum; md: median; mn: mean; sd: standard deviation.

n: frequência; min: mínimo; max: máximo; md: mediana; mn: média; sd: desvio padrão.

Although maize is the most frequent crop, 47% of the interviewees stated that rice is the most relevant one. Rice is the main staple food for nearly all households. Ranked next are cowpea (24%), maize (20%), and cassava (6%). Maize is planted in lower densities intercropped with rice, being mainly used for animal consumption.

Regarding the origin of the propagation material, self-production prevails for rice and cowpea (73%), followed by maize (71%) and cassava (78%) (Table 5). When considering sourcing from other families in the same or in neighboring communities, the total reaches 87% for rice and 95% for cassava. The purchase of seeds in the market or its sourcing through government donation occurs more frequently for maize (8% and 9%, respectively) and cowpea (11% and 8%). Such scenario characterizes the prevalence of so-called local varieties in which germplasm (whose origin can be other countries or other regions of the country) is multiplied over time, or is the result of exchange in the same region, and whose local cultivation leads to specific adaptations to the local environment as a result of natural selection, selection by the farmer, or a combination of both (Bevilaqua *et al.*, 2016: p. 105).

Table 5. Origin of seeds and seedlings, interviewed households. Source: Assema, 2018.

Tabela 5. Origem de sementes e mudas, domicílios entrevistados. Fonte: Assema, 2018.

Origin os seeds	Rice		Maize		Cowpea		Cassava	
	n	%	n	%	n	%	n	%
Self production	481	73.2	648	71.3	632	72.6	346	78.1
Community	62	9.4	47	5.2	22	2.5	74	16.7
Nearby community	31	4.7	17	1.8	13	1.5	19	4.3
Purchased from producer	51	7.8	35	3.9	34	3.9	2	0.5
Market purchase	11	1.7	75	8.3	97	11.2	1	0.2
Government donation	20	3.0	81	8.9	71	8.2	--	--
Company's donation	--	--	1	0.1	--	--	--	--
Other sources	1	0.2	5	0.6	1	0.1	1	0.2
Total	657	100	909	100	870	100	443	100

The reduced number of commercial varieties and the fact that large areas are occupied by a single variety are pointed out as critical factors for the instability of farming systems (Bevilaqua *et al.*, 2014). Results of the present study show that in Médio Mearim such a situation does not seem to occur yet, as 36 varieties of rice, 35 of cassava, 31 of cowpea, and 20 of maize were reported by the 1,025 interviewed households (Table 6).

Although these are significant results that demonstrate the diversity of genetic resources managed by family farmers in Médio Mearim, subsequent studies should be carried out for a detailed characterization of this agrobiodiversity. Suggested procedures include the examination whether reported varieties are the result of formal genetic improvement, or seeds derived from traditional management for at least three generations, along which historical and cultural values are incorporated (Albarello; Silva; Görgen, 2009). In the latter case they can be named as traditional varieties (in Portuguese: *variedades crioulas*) (Fernandes, 2017) or ethno-varieties (Martins, 1994).

Table 6. Reported varieties of rice, cowpea, maize and cassava. Source: Assema, 2018.

Tabela 6. Variedades informadas de arroz, feijão-caupi, milho e mandioca. Fonte: Assema, 2018.

Rice			Cowpea		
variety	n	% hholds	variety	n	% hholds
agulhinha	254	37.3	vermelho	219	22.0
ligeiro	90	13.2	central	213	21.4
lajeado tardão	68	10.0	branco	135	13.5
bico ganga	56	8.2	sempre verde	108	10.8
comum	54	7.9	vagem roxa	85	8.5
mariá	22	3.2	40 dias	57	5.7
cana roxa	20	2.9	quarentinha	41	4.1
lajão branco	19	2.8	piçarra	15	1.5
vermelho	16	2.3	enrica pobre	12	1.2
lajeado ligeiro	15	2.2	manteiga	11	1.1
subtotal	614	90.2	subtotal	896	89.9
others: goiano, taboca, mato grosso, palha murcha, bacaba, paulista, cana branca, fininho, jatobá, c12, buriti, canela de ferro, setenta, rabo de burro ligeiro ou miúdo branco, ac, tardão, zebu, lajeado branco, muruim, mearim, carolina, pingo d'água, cutião, chatão, agulhão			others: feijão de corda, caupi (genéricos), comum, corujinha, paulista, carioca, mulatinho, trepa-pau, santa rosa, periquitinho BRS-guaribas, pandanguinha, serrinha, engana ladrão, batatinha, preto, catador, santo antônio, chico moreira, boi deitado, quebra cadeira		
Maize			**Cassava / macaxeira**		
variety	n	% hholds	variety	n	% hholds
comum	604	64,7	inajá/najá	270	55.8
ligeiro	156	16,7	rosa	56	11.6
tardão	98	10,5	macaxeira genérico	35	7.2
safrinha	15	1,6	preta	15	3.1
hibrido RG3	15	1,6	branca	14	2.9
AG105, biomatrix vermelho	11	1,2	joão prego	12	2.5
	10	1,1	manusprego	11	2.3
			paruara	9	1.9
			bambuzinha	9	1.9
			peixe	7	1.4
subtotal	909	97,4	subtotal	438	90.5
others: dente de burro, zebu, transgênico, ligeiro vermelho, dacá, pipoca, branco, ferro, gigante mexicano, panaru, passarinho, quiriba, sabugo fino			others: roxona, maria joana, água morna, mandioca genérico, amarelinha, carema, jatobá, pipoca, jaíbara, ligeirinha, mineira, grelo roxo, engana ladrão, goela de jacú, baé, todo tempo, maciolina, guagiru, flor do brasil, japonesa, mineira, paraibana, catajuba		

Despite the reduction in the area cultivated with rice, the situation described four decades ago in Maranhão state persists. The state holds the largest number of traditional varieties of rice conserved by family farmers in the country. Due to its genetic variability and adaptation to growing conditions, these varieties constitute a source of genes of tremendous value for improvement programs (Fonseca *et al.*, 1982). Among future studies to be carried out, it would be relevant to compare the 36 rice varieties reported in Médio Mearim, with results from the expedition conducted in 1979 for germplasm collection by Embrapa and Empresa Maranhense de Pesquisa Agropecuária, in which 110 rice samples were collected in traditional growing areas in the state, resulting in 38 local denominations, only one of which corresponded to a product of formal genetic improvement (Fonseca *et al.*, 1982).

For cowpea, the typology defined by Freire Filho (2011), composed of four classes and 17 subclasses based on the color of the grain tegument, should be used to classify the 31 varieties identified in this research. In order to identify and exclude possible duplicities, further studies may associate terms locally used in the designation of these 31 varieties to the little more than 70 improved varieties released in the country since the introduction of cowpea in Brazil (Freire Filho, 2011).

The results for cassava varietal diversity in Médio Mearim, where about 56% of families cultivate the variety inajá/najá and another 12% the variety rosa, corroborate the statement of Emperaire (1999), that in general two or three varieties occupy 70 to 80% of the cultivated area in each context. Although on a different scale, the results of the current study are also in line with the systematization performed by the same author, from sources of information on cassava cultivation in eight social groups of non-indigenous farmers in the Amazon, with an average of 37 distinct local varieties for each group (Emperaire, 1999). As the author had already warned more than two decades ago, although varietal diversity is high, conditions that allowed the creation and conservation of this diversity are changing dramatically. By studying traditional communities in the Cuiabana lowlands, Mato Grosso state, Marchetti *et al.* (2013) demonstrated that socioeconomic changes have reduced cassava diversity. Since conservation of genetic resources results from the cultural and material functioning of the society that created it, factors and pressures that negatively transform these conditions should be closely analyzed.

More than a thousand local varieties of maize were catalogued in Brazil (Abadie *et al.*, 2000), corresponding to a small fraction of the wide global genetic variability of the species. Despite this abundance, in the present study maize was the species for which the smallest number of varieties, including hybrid and transgenic seeds, was reported. As a reference for future research, more scrutiny should be given to the characterization of local varieties, and the names given to them. The same name can refer to more than one variety, which was found, for example, in research conducted as part of the "*Raças de Milho*" project in the Zona da Mata region of Minas Gerais state, where 86 traditional varieties were characterized and given 48 different names (Elteto, 2019).

The conservation of agrobiodiversity, understood as positive for improving livelihoods, goes through complex interactions of a set of practical and reflective elements, complementary and dynamic factors and is adapted to each local reality, categorized in the socioecological, socioeconomic and political, and cultural and ethical dimensions (Pereira & Dal Soglio, 2020). In a complementary approach, the present study included a preliminary analysis aimed at identifying features associated with resource users and landholdings, which may act in support or opposition to the conservation of local agrobiodiversity.

Table 7 presents the diversity of rice, cowpea, maize, and cassava varieties according to classes of the 11 discriminant variables. The parameter used to assess the degree of diversity is the direct ratio between the number of households in each subclass and the total number of varieties reported (the higher the ratio, the lower the diversity). This ratio would be hypothetically equivalent to the number of households required to inform a different variety. Interpretation of the data on rice varieties by age group of the household head indicates, for example, that greater relative diversity is found in the 119 households with older household heads, with 19 distinct varieties (V=19), resulting in one distinct variety for every 6.3 households (N/V=6.3).

Results suggest that quilombola territories have a greater diversity of varieties for the four crops, supporting what was stated by Mouzer (2015) in his analysis of quilombola farms in Limoeiro, Rio Grande do Sul, that ancestral knowledge accessed in the agricultural practices of people of African origin, by merging culture and nature, build spaces of various traditional managements, "inventing" the local, native and unique agrobiodiversity, through more ecologically acceptable forms of cultivation. On the other hand, less diversity for the four staple foods is observed in households who access the Bolsa Família program, and in those who do not receive pensions. This result suggests that the condition of greater social vulnerability, featured by Bolsa Família beneficiaries, is a constraining factor for the full expression of practices oriented to the conservation of agrobiodiversity, which does not occur in the case of retirement benefits, due to the significantly higher amount of cash earned under this social policy.

Regarding rice, greater variety diversity is also linked to older household heads. This endorses the need to involve younger people for the sustainability of practices that enable the conservation of traditional varieties. Other indicators of socioeconomic status do not seem to interfere with the diversity of rice varieties, which seems to be higher in the two extreme classes regarding monetary income, monthly consumption, and landholding size. For cowpea, greater diversity occurs in larger landholdings, when heads of households are from extreme age groups, and identify themselves ethnically as white. Greater variety diversity of maize occurs in households

with higher levels of household consumption and monetary income, and in larger landholdings. Finally, in relation to cassava, greater diversity is observed for older, better educated, white household heads that own larger areas, cultivate larger fields, and have higher levels of consumption, monthly monetary income, and assets.

Table 7. Frequency of cultivation and diversity of rice, cowpea, maize and cassava varieties reported according to discriminant variables, Médio Mearim (N = 1025). Source: Assema, 2018.

Tabela 7. Frequência de cultivo e diversidade de variedades de arroz, feijão-caupi, milho e mandioca informados conforme variáveis discriminantes, Médio Mearim (N = 1025). Fonte: Assema, 2018.

Household features	N	Rice			Cowpea			Maize			Cassava		
		n %	V	N/V	n %	V	N/V	n %	V	N/V	n %	V	N/V
	1025	63.3	36	28.5	84.9	34	30.1	88.2	21	48.8	42.7	34	30.1
Age range (years)													
18 - 35	163	66.3	16	10.2	83.4	19	8.6	90.8	8	20.4	38.0	12	13.6
36 - 50	363	65.6	21	17.3	85.4	24	15.1	88.7	14	25.9	43.8	23	15.8
51 - 65	380	61.3	23	16.5	86.3	28	13.6	88.7	17	22.4	45.0	21	18.1
> 65	119	58.8	19	6.3	80.7	17	7.0	81.5	6	19.8	38.7	16	7.4
Education (years of study)													
0 - 1	319	68.0	23	13.9	83.7	26	12.3	85.3	15	21.3	41.1	21	15.2
2 - 4	296	60.5	25	11.8	86.1	25	11.8	90.2	14	21.1	44.3	20	14.8
5 - 8	224	62.1	18	12.4	83.9	20	11.2	89.7	8	28.0	42.4	16	14.0
9 - 18	185	61.1	16	11.6	85.9	18	10.3	88.1	10	18.5	43.8	18	10.3
Ethnicity													
black	270	71.5	22	12.3	83.3	23	11.7	89.3	12	22.5	43.0	18	15.0
"parda"	567	61.7	31	18.3	85.0	28	20.3	88.5	17	33.4	42.5	28	20.3
white	188	56.4	17	11.1	86.7	22	8.5	85.6	12	15.7	43.1	14	13.4
Tenure category													
settlement	273	81.3	25	10.9	83.9	21	13.0	89.7	11	24.8	53.5	19	14.4
quilombola	40	80.0	12	3.3	85.0	9	4.4	95.0	4	10.0	42.5	8	5.0
private	391	51.7	22	17.8	84.1	26	15.0	83.4	17	23.0	43.0	24	16.3
squatter	248	59.7	17	14.6	85.9	22	11.3	90.7	13	19.1	32.3	12	20.7
other	73	61.6	14	5.2	89.0	13	5.6	95.9	7	10.4	37.0	9	8.1
Landholding size (ha)													
0 – 5	253	53.0	16	15.8	84.2	23	11.0	85.0	12	21.1	35.2	19	13.3
5.1 – 20	308	64.0	23	13.4	85.4	24	12.8	89.9	11	28.0	46.8	18	17.1
20.1 – 40	336	75.0	23	14.6	86.0	26	12.9	92.0	15	22.4	46.7	18	18.7
40.1 – 400	128	51.6	17	7.5	82.0	17	7.5	80.5	9	14.2	37.5	15	8.5
Swidden area (linhas)													
0	103	30.1	13	7.9	29.1	9	11.4	40.8	8	12.9	8.7	5	20.6
0.1 – 1.5 L	181	33.1	16	11.3	88.4	23	7.9	83.4	10	18.1	32.6	11	16.5
1.5 – 3 L	375	70.7	19	19.7	91.7	26	14.4	95.2	12	31.3	41.1	21	17.9
3.1 – 6 L	279	82.4	29	9.6	92.8	26	10.7	97.5	13	21.5	57.3	22	12.7
> 6 L	87	72.4	14	6.2	88.5	13	6.7	94.3	8	10.9	64.4	15	5.8
Monthly cash income (minimum wages)													
> 1	227	67.0	24	9.5	85.5	22	10.3	88.5	10	22.7	33.9	18	12.6
1 - 2	414	67.1	24	17.3	84.3	27	15.3	87.7	14	29.6	45.9	21	19.7
2 - 3	237	61.6	23	10.3	85.7	22	10.8	91.1	12	19.8	41.8	20	11.9
> 3	147	49.7	16	9.2	84.4	18	8.2	84.4	12	12.3	49.0	14	10.5
Assets (R$ 1.000)													
0 - 6	229	69.0	23	10.0	84.3	21	10.9	89.5	8	28.6	38.4	14	16.4
6 - 12	366	64.5	24	15.3	84.4	26	14.1	86.9	14	26.1	43.4	24	15.3
12 - 18	194	63.9	18	10.8	86.1	21	9.2	90.7	11	17.6	41.2	14	13.9
18 - 172	236	55.5	17	13.9	85.2	22	10.7	86.9	13	18.2	47.0	21	11.2
Monthly consumption value (R$)													
< 750	181	76.2	21	8.6	85.6	19	9.5	87.3	9	20.1	37.0	14	12.9
751 – 1,500	440	64.1	29	15.2	84.5	25	17.6	90.7	15	29.3	46.1	27	16.3
1,501 – 2,500	265	59.2	22	12.0	87.2	26	10.2	89.1	11	24.1	41.1	16	16.6
> 2,500	139	51.8	14	9.9	80.6	20	7.0	79.9	13	10.7	42.4	13	10.7
Bolsa Família													
yes	631	67.2	30	21.0	87.3	31	20.4	90.0	18	35.1	44.4	25	25.2
no	394	57.1	24	16.4	81.0	25	15.8	85.3	15	26.3	40.1	25	15.8
Aposentadoria													
yes	435	60.7	26	16.7	81.6	30	14.5	86.2	18	24.2	41.6	27	16.1
no	590	65.3	27	21.9	87.3	27	21.9	89.7	14	42.1	43.6	25	23.6

N= total households in subgroup; n%= percentage of households cultivating that crop; V= number of varieties. Source: Assema, 2018.

N= total de domicílios no subgrupo, n%=porcentagem de domicílios que cultivam a espécie; V= número de variedades. Fonte: Assema, 2018.

Therefore, besides the positive association in quilombola territories, and the negative one for the beneficiaries of Bolsa Família, other variables expressed no constant pattern of association in relation to the diversity of varieties for the four main staple crops cultivated in Médio Mearim's traditional swiddens. Such results, in the light of qualitative data of ethnographic nature obtained by the author over the last three decades in the territory, ratify that the swidden field (roça) is a peasant institution that endures, with a significant diversity of traditional varieties, a diversity that is not sufficiently affected by features endogenous to the domestic unit of production.

Vegetables, medicinals/spices, and fruit trees in family home-gardens

The 1,025 households informed 73 names of medicinal and condimental plants, 46 fruit tree species (which were in production stage), and 29 vegetable species grown in their home-gardens. Multiple arrangements were reported in which exotic perennial and annual species are associated with native species in these home-gardens. This survey does not include, however, native species obtained from extractivism, an important source, mainly for food and medicinal use species. On average, each family reported to grow 8 fruit trees, 4 medicinal or condimental species, and 3 vegetables. As shown in Table 8, eight fruit species were informed by more than 50% of the households, while four vegetables and six medicinal/spices are grown by more than 30% of the households.

Table 8. Vegetables, spices and medicinals, and fruit species, Médio Mearim (N = 1025). Source: Assema, 2018.

Tabela 8. Hortaliças, condimentares e medicinais, e espécies frutíferas, Médio Mearim (N = 1025). Fonte: Assema, 2018.

Vegetables	n	%	Medicinals and spices	n	%	Fruit trees	n	trees	%
scallion	671	65.5	chili pepper	616	60.1	mango	815	3,712	79.5
cilantro	537	52.4	*erva cidreira*	494	48.2	cashew	762	8,830	74.3
vinagreira	339	33.1	scented pepper	476	46.4	guava	709	2,585	69.2
okra	316	30.8	*mastruz*	414	40.4	*acerola*	691	2,651	67.4
bell pepper	252	24.6	*capim santo*	385	37.6	banana	678	159,040	66.1
maxixe	250	24.4	*boldo*	347	33.9	*ata*	631	2,331	61.6
tomato	235	22.9	*malva*	282	27.5	coconut	590	2,412	57.6
lettuce	222	21.7	*jucá*	280	27.3	citrus	540	1,627	52.7
cucumber	197	19.2	aloe	255	24.9	orange	495	2,453	48.3
kale	154	15.0	ginger	228	22.2	tamarind	384	663	37.5
arugula	30	2.9	*hortelã*	152	14.8	jack fruit	259	563	25.3
eggplant	28	2.7	saffron	138	13.5	lemon	177	518	17.3
pumpkin	18	1.8	basil	122	11.9	starfruit	163	222	15.9
			folha santa	37	3.6	olive	145	424	14.1
			vique	33	3.2	soursop	129	246	12.6
			black pepper	25	2.4	inga	128	511	12.5
						ciriguela	102	163	10.0
						avocado	80	129	7.8
						açaí	71	6,653	6.9
						jenipapo	60	155	5.9
						pitiomba	57	105	5.6
						pitanga	57	96	5.6
others: chili pepper, zucchini, watermelon, melon, parsley, yam, taioba, sweet potato, sweet corn, chicory, sesame, jiló, carrot, jambu, cabbage			others: pomegranate, alfavaca, *urucum, gervão, arruda, noni, jardineira,* chamomile, *cana-da-índia,* ambracint, citronella, *trevo, coquinho, meracilina,* rosemary, *anador, caboclinho,* coriander, chicory, fennel, *coronha,* castor bean, *insulina, crista-de-galo, pinhão-roxo, andiroba,* watercress, *cipó-de-escada, patixuri, zabumba-roxa, gervão verdadeiro, gonçalo-alves, cachorro-pelado, confrei, jalapa,* linseed, *terramicina, moringa, oriza, amoquecido, aroeira, açoita-cavalo, pinhão-manso, velame, vetiver, gliricídia, batata-de-purga,* mustard, *pata-de-vaca*			others: *buriti, cajá, cajarana, cupuaçu, noni, bacuri, jambo,* tangerine, lime, *murici, jabuticaba,* blackberry, *pupunha, caju-do-mato, sapoti, ajurú, cutitiribá,* plum, *abricó, inajá, guairú, araticum,* grape			

Ethnobotanical surveys of medicinal species have rescued forms of use, therapeutic indications, preparation methods and plant parts used by peasant communities in Maranhão. In the Sangrador Quilombola community, Munin River basin, Monteles & Urbano (2007) identified 121 species, 57 of which were cultivated, including 18 fruit trees and 6 vegetables. In a survey with 19 households from a land reform area in a municipality from the same Munin territory, 81 species were recorded for medicinal purposes (Rego *et al.*, 2016). A study conducted with 23 families from Quilombo Piratininga, in the municipality of Bacabal, Médio Mearim, identified 50 medicinal species (Guarçoni *et al.*, 2020).

Some medicinal species and spices reported in the current study originate from the Americas, such as chili peppers (*Capsicum* spp.), mastruz (*Chenopodium ambrosioides* L.) and boldo (*Peumus boldus* Mol.). Only the jucá (*Caesalpinia ferrea* Mart. Ex Tul.), also known as ironwood, originated in northeastern Brazil. Species with origin in other continents include capim limão (*Melissa officinalis* L.), erva cidreira (*Cymbopogon citratus* DC. Stapf), and malva (*Malva sylvestris* L.). As observed in the literature for other localities (Ferreira *et al.*, 2017), certain species are locally known by names that evoke industrialized medicines, when the desired effect of using their preparation is similar to that of the pharmaceutical drug. This is the case of plants known as anador (*Alternanthera dentara* Moench), terramicina (*Alternanthera brasiliana* L. Kuntze), and vick, or vique (*Mentha arvensis* L.).

Among the species of vegetables cultivated in home-gardens and most frequently mentioned by interviewed households, none is native to Brazil. Some were brought from Africa, such as vinagreira (*Hibiscus sabdariff*a L.), okra (*Abelmoschus esculntum* L.) and maxixe (*Cucumis anguria* L.); others originated in Europe, such as cilantro (*Coriandrum sativum* L.) and chives (*Allium schoenoprasum* L.), the most frequent of all. The only species of vegetables originating from the Americas is pumpkin (*Cucurbita* spp.).

Among fruit trees reported by at least 15% of the households, only the cashew tree (*Anacardium occidentale* L.) (74.3%) and the guava tree (*Psidium guajava* L.) (69.2%) are native to Brazil. Fruit tree species with the highest frequency were exotic: mango (*Mangifera indica* L.) (79.5%), acerola (*Malpighia punicifolia* L.) (67.4%), banana (*Musa* spp.) (66.1%) and soursop (*Annona squamosa* L.) (61.6%). Native species with greater frequency were the ingazeiro (*Inga edulis* Mart.), cirigueleira (*Spondias purpúrea* L.), açaizeiro (*Euterpe oleracea* Mart.), jenipapeiro (*Genipa americana* L.), pitombeira (*Talisia esculenta* A. St.-Hil. Radlk.) and pitangueira (*Eugenia uniflora* L.).

Table 9 presents the analysis of variance for the average number of species in each of the three plant categories, according to subclasses of the same 11 discriminant variables used to assess swidden fields. The results show a strong contrast between fruit species and the other two categories. While planting of fruit trees tends to be more affected by the factors studied, lower variation occurs for the other two. Statistically significant differences in the average number of vegetables were observed only in relation to the area of the landholding, with a significance level of 0.01 (error probability 1%), and to the receipt of pension/retirement, with a significance level of 0.1 (error probability 10%). In the case of medicinal and condimental crops, statistically significant differences were observed for age group of household head and dependence on babassu extraction, both with a significance level of 0.01 (error probability 1%), and for monthly household monetary income, with a significance level of 0.1 (error probability 10%).

Table 9. Analysis of variance for diversity of vegetable, medicinal and spice species and fruit trees grown by the household. Source: Assema, 2018.

Tabela 9. Análise de variância para diversidade de espécies de hortaliças, medicinais e condimentares e árvores frutíferas cultivadas pelo domicílio. Fonte: Assema, 2018.

Household features	Vegetables		Medicinals		Fruit trees	
	F	Prob >	F	Prob >	F	Prob >
Age range	3,28	0,0203	7,32	0,0001[a]	8,57	0,0000[a]
Education	3.41	0.0172	0.04	0.9895	0.76	0.5191
Ethnicity	0.14	0.8712	1.23	0.2919	14.44	0.0000[a]
Tenure category	2.97	0.0188	2.49	0.0415	4.98	0.0006[a]
Landholding area	11.48	0.0000[a]	1.80	0.1463	11.60	0.0000[a]
Size of swidden field	0.92	0.4522	1.36	0.2464	4.39	0.0016[b]
Monetary income	0.36	0.7835	3.95	0.0082[c]	12.98	0.0000[a]
Asset value	2.68	0.0459	3.15	0.0242	17.62	0.0000[a]
Monthly	2.11	0.0975	2.75	0.0414	10.29	0.0000[a]
Dependence on	2.19	0.0681	5.02	0.0005[a]	4.46	0.0014[b]
Bolsa Família benefit	0.64	0.4235	2.37	0.1241	11.75	0.0006[a]
Pension/retirement	8.90	0.0029[c]	6.01	0.0144	9.94	0.0017[b]

[a] p < .01 (Prob > F: < 0.001); [b] p < .05 (Prob > F: 0.001-0.005), [c] p < .1 (Prob > F: 0.005-0.01).

Absence of coefficient indicates non-significant difference.

Ausência de coeficiente indica diferença não significativa.

Results suggest greater diversity of species in home-gardens when the landholding has less than 5 ha. This would be in line with the trend of technological intensification in smaller farms, where families consider the cultivation of a wider range of vegetables an economic alternative that transcends consumption. On the other hand, the monetary income earned from retirement, associated with the tendency of less time devoted to the cultivation of swidden fields due to older age, would allow families who receive such benefits greater dedication to cultivation of orchards with a greater variety of species.

According to a similar rationale, the age of the person in charge would positively influence the diversity of medicinal and condiment plants, and of fruit species. Indeed, Marchetti (2018) argues that the maintenance of agrobiodiversity is mediated by interpersonal relationships and sociocultural structures responsible for the transmission of traditional knowledge, which is seriously harmed by the current trend of aging farmers and the non-replacement of labor in agricultural services due to the mobility of the youth.

When analyzing the cultivation of medicinal and condimental plants, greater diversity is maintained by households with very high dependence on babassu

extraction. That can be explained by the more vulnerable condition generally associated with these households, highlighting their need to use medicinal plants, in replacement of industrialized medicines.

On the other hand, in relation to the diversity of cultivated fruit trees, statistically significant differences were observed for all the variables analyzed, except for the years of education of the household head. Analyzing descriptive statistics, a rather eclectic composition of factors contributes to a higher diversity of species, namely: the household head being older than 65 years, being ethnically identified as white, residing in quilombola territory or private property, on landholdings larger than 40 hectares, having very high dependence on babassu and being a beneficiary of the Bolsa Família program, in addition to having higher monetary income, assets, and consumption levels.

4 Conclusion

The current study sought to identify features associated with peasant production units which act in support or opposition to the conservation of local agrobiodiversity in the Médio Mearim territory. Results presented ratify that the cultivation of the swidden field (roça) is a peasant institution that persists in the studied area, featuring significant diversity of traditional varieties of rice, maize, cassava, and cowpea, which is not sufficiently affected by factors endogenous to the domestic units of production. Similarly, the study recorded the wide diversity of native and exotic species cultivated for medicinal use, as well as fruit trees and vegetables present in family home-gardens.

The century-old history of resource use and management by peasant communities of the Médio Mearim results in a system that integrates traditional crops, pastures, and palm trees. Despite the countless difficulties faced, there is concrete evidence in these last four decades of the protagonist role of local producers and organizations in initiatives that have contributed to the reconstruction of their socio-environmental contexts. These traditional communities engaged in agro-extractive production centered on the babassu economy and on the cultivation of traditional crops hold an accumulation of knowledge and practices and, due to their vulnerable condition, demand greater prioritization of their requests by institutions related to research and agricultural development. The conservation and expansion of the genetic variability of crops, together with the identification of new varieties adapted to contemporary agroecological conditions is essential for the consolidation of sustainable production systems that enable the social reproduction of these communities.

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