v. 68, p. 454-476, Jul./Dec. 2026 http://doi.org/10.5380/dma.v68i.101741 e-ISSN 2176-9109

DMA Desenvolvimento e Meio Ambiente

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Cassava familiarization in indigenous people's agroecosystems in Oiapoque

A familiarização da mandioca nos agroecossistemas dos povos indígenas do Oiapoque

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Article received on **October 19, 2025**

Final version accepted on **February 1, 2026**

Published on **October 7, 2026**

Abstract: Given the fast changes in the global agricultural context, its trend towards monoculture, homogenization and the loss of cultivated species' genetic variability, the aim of the present study is to highlight the relevance of indigenous knowledge on agrobiodiversity management, with emphasis on cassava's familiarization. The research mostly followed the qualitative methodology based on applying an interdisciplinary approach. A discussion about cassava's familiarization was herein proposed and it was intertwined with anthropological debates. It was done by taking into consideration the concept of domestication, which, somehow, did not fully explain the relationship between Oiapoque's indigenous peoples and plants, mainly when it comes to mama maiõk (wild mountain cassava). The main research conclusions clearly showed that the indigenous swidden, also known as 'roças', is more than a cultivated space; it is an indigenous knowledge and socialization place for knowledge production. Yet, it presents multiple dimensions that strengthen social relationships in and outside indigenous territories. Therefore, this study is expected to help establishing the necessary exchange between indigenous and scientific knowledge, in addition to strengthening Amazonian scientific production.

Keywords: agrobiodiversity; indigenous swidden ("roças"); dialogue.

Resumo: Frente às aceleradas mudanças nos contextos agrícolas mundiais, com tendência ao monocultivo, à homogeneização e à perda da variabilidade genética das espécies cultivadas, o presente estudo teve como objetivo demonstrar a importância dos conhecimentos dos povos indígenas no manejo da agrobiodiversidade, com ênfase na familiarização da mandioca. A pesquisa foi de natureza predominantemente qualitativa, através de uma abordagem interdisciplinar. Propusemos uma discussão sobre a familiarização da mandioca, em diálogo com as discussões antropológicas sobre o tema, considerando que o conceito de domesticação apresentou algumas lacunas para explicar a relação dos povos indígenas do Oiapoque com as plantas, sobretudo com a mama maiõk (mandioca selvagem da montanha). Dentre as principais conclusões da pesquisa, ficou evidente que a roça indígena é mais que um espaço cultivado, é um locus de produção do conhecimento e de socialização indígena, com múltiplas dimensões que fortalecem as relações sociais dentro e fora da terra indígena. Com isso, esperamos ter contribuído para estabelecer o necessário diálogo entre os conhecimentos indígenas e o conhecimento científico, além de fortalecer a produção científica amazônida.

Palavras-chave: agrobiodiversidade; roça; diálogo.

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1. Introduction

Indigenous peoples' agroecosystems in Oiapoque reflect the complexity of indigenous knowledge on cultivation and agrobiodiversity management. Cassava (*Manihot esculenta Crantz*) was chosen as plant to highlight how knowledge, practices, and processes are entangled, continuously subjected to rethinking, besides supporting this system. According to Waí'keén (2016), the agroecosystem extends from the cultivated space, or the indigenous swidden, to food and its consumption modes in different social life scenarios.

Van Velthem and Emperaire (2016) emphasized that going from the agriculture sense to that of agroecosystem means highlighting interactions between this activity and other social, cultural and material life domains. However, it is not limited to the functional aspect of its components. The indigenous agroecosystem is multifaceted and encompasses its peoples' cosmology, health, security and food sovereignty.

Values associated with indigenous or traditional agroecosystems are significant for the planet as a whole, rather than just for local populations. It is so, because they provide extremely important environmental services, such as keeping the forest standing, conserving the soil, maintaining river sources, increasing agricultural diversity and avoiding the use of chemical inputs and genetically modified seeds.

Cassava (*Manihot esculenta Crantz*) is the main plant cultivated by these peoples, given its high dynamism in generating new varieties, mainly through exchanges enabling plant and knowledge circulation. Despite its definition, agrobiodiversity is herein understood as "set of species or varieties cultivated in a given site" (Emperaire et al., 2008, p. 3). Therefore, cultivated plants are those mobilizing a set of knowledge and practices, resulting from their intentional presence in a given site.

Indigenous peoples' agroecosystems in Oiapoque are seriously threatened y aggressive attack of fungus *Rhizoctonia theobromae*, which accounts for the so-called cassava witches' broom. This fungus was officially detected in 2024 (Empresa Brasileira de Pesquisa Agropecuária [EMBRAPA], 2024); however, according to reports from indigenous people living along BR 156 highway, its symptoms were already observed in some swiddens in early 2018. Currently, this disease is widespread over Amapá State and has environmental, economic and social impacts. This scenario forced the Ministry of Agriculture and Livestock (MAPA) to declare phytosanitary emergency in Amapá and Pará states back on January 29, 2025 (Mapa, 2025).

Accordingly, assessing cassava management and familiarization process can find ways to give some hope to recover indigenous peoples' cultivated fields in Oiapoque. The familiarization concept was developed by some anthropologists (Cunha, 2019; Fausto & Neves, 2018) to define the reciprocal relationship between indigenous peoples and biodiversity management.

2. Methodology

The research was carried out in Uaçá Indigenous Territory (I.T.), in Oiapoque municipality, Amapá State, Brazil (Figure 1). Uaçá I.T. is duly demarcated and covers 470,164 hectares (Fundação Nacional dos Povos Indígenas [FUNAI], 2019). Oiapoque is located in Far North Amapá State, and its territorial covers 23,058.224 km^2; the region houses a population of 27,482 people (Instituto Brasileiro de Geografia e Estatística [IBGE], 2022). Oiapoque River spring is located in Tumucumaque Mountain, which extends from Amapá State and flows for approximately 350 kilometers until reaching the Atlantic Ocean (Moraes, 1964), on the border of Uaçá Indigenous Territory, at Cabo Orange National Park.

The research was authorized by the Ethics and Research Committee of the Federal University of Amazonas – CEP/UFAM, submitted to, and approved by, Brazil Platform (Opinion No. 3.167.107 CEP/CONEP). It followed that case study methodology (Gil, 2002; Yin, 2015) and was carried out in Uaçá Indigenous Territory. The case study approach is featured by in-depth and exhaustive reasearch focused on one or few aims to help achieving a broad and detailed understanding of the assessed case, itself (Gil, 2002; Yin, 2015). This methodology allows using several evidence sources

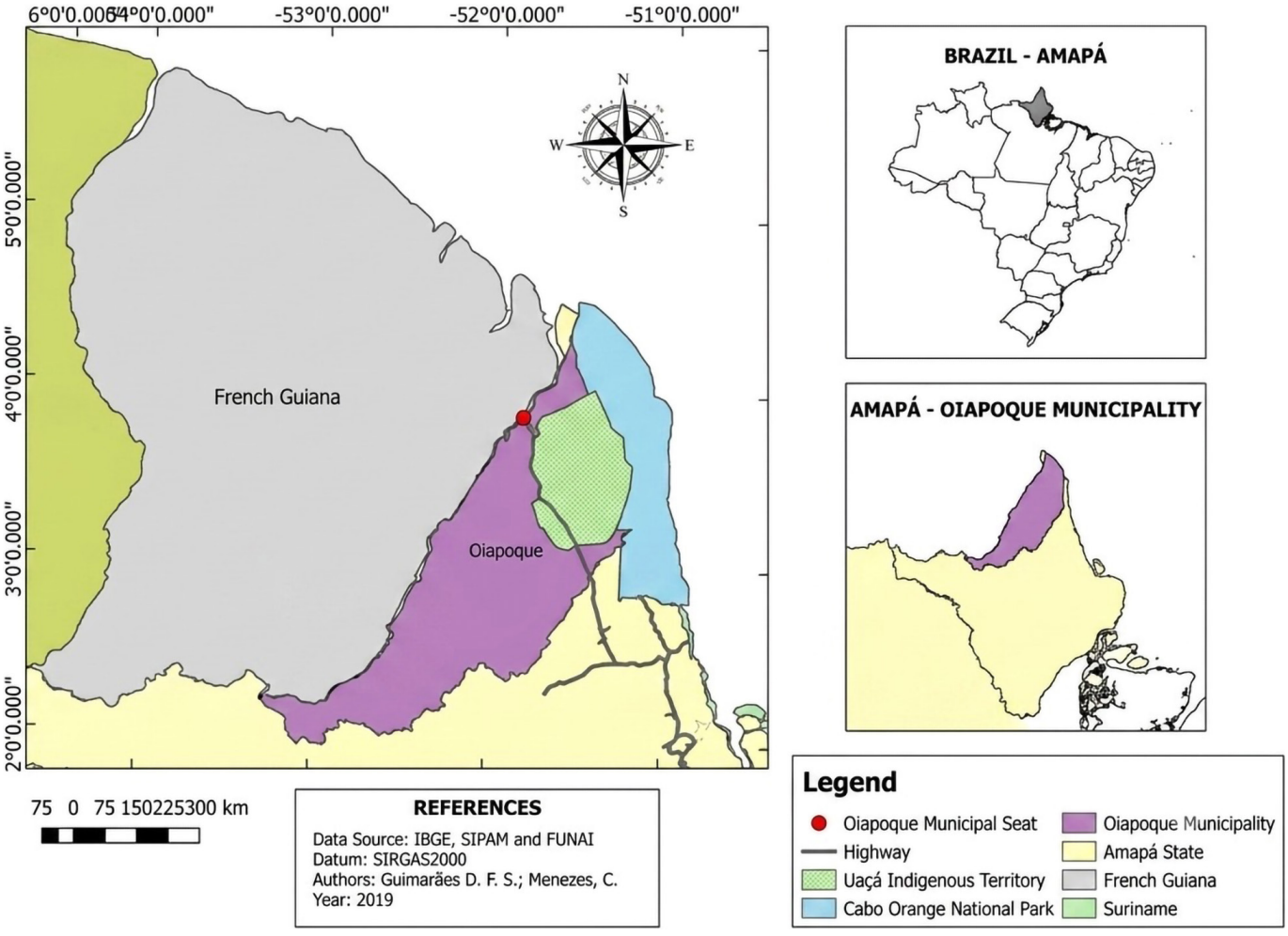


Figure 1

Location of Uaçá Indigenous Territory, Oiapoque – AP, 2025.

Source: Guimarães & Menezes (2019).

and multiple research techniques (Noda et al., 2013). Interdisciplinary techniques (free listing, direct observation, participatory observation, understandable interviews, bibliographic and documentary research) were adopted during the fieldwork.

Forty-seven adults belonging to the male and female sex were interviewed. Each adult belonged to a different family. All interviewees were born in Uaçá Indigenous Territory and they mainly live on '*roça*' farming. The interview guidelines allowed accessing information about the number of '*roças*' owned by each family, their sizes, the choice for their locations, the time the site has been used, their distance from the village, the adopted agricultural calendar, the social work organization in them, the networks set for exchanging cultivated species/seedlings/seeds, the knowledge and practices applied to the swiddens, identifying food types coming from them and the destination of their products. Only seven interviews were recorded (in a smartphone) because the other participants did not authorize their interviews to be recorded.

A descriptive field survey was carried out after the interviews. The survey took place through guided visits to 20 cultivated plots: 16 plots in Kumarumã village, Uaçá River; and 4 plots in Ikawakun village, on the BR-156 highway. The researchers took random walks in the assessed sites to survey the cultivated plant varieties. It was done by taking into account the morphological features set by participants, themselves, in order to differentiate one plant from another. All information was recorded in a field journal.

Direct and participatory observations were performed after the interviews. The direct or simple observation (Gil, 2002) allowed spontaneously observing the events taking place in Kumarumã and Ikawakun villages. The survey focused these two villages and took into account all information about them: social behavior and the environment. The researchers dove into the local routine throughout the participatory observation and joined several activities conducted at the study site (Viertler, 2002). Thus, it was possible better understanding their reality from within. The researchers got involved in farming activities, flour production, fruit picking in the forest, cooking and local rituals.

Finally, other sources of evidence, such as documental search in the database of Project Digital Archive of Indigenous Peoples Memory in Oiapoque by the Federal University of Amapá, Oiapoque *campus,* were also used. This database holds documents from Indigenous Protection Service (SPI) units in the Uaçá Indigenous Territory issued from 1940 to 1970. Their analysis provided important information about the attempt to implement several productive activities introduced from outside the community in Uaçá Indigenous Territory.

3. Results and discussion

3.1. Indigenous peoples of the Uaçá Indigenous Territory, Oiapoque

Three indigenous peoples live in the Uaçá Indigenous Territory, namely: Karipuna, Palikur and Galibi-Marworno. They total 8,368 indigenous people (Distrito Sanitário Especial Indígena do Amapá e Norte do Pará [DSEI], 2021). They speak different languages and keep different cosmological markers. These three peoples share common features to safeguard their autonomy, security and food sovereignty through cassava crops in their swiddens.

Karipuna people have Tupi origin and are mainly organized in villages along Curipi River, by BR 156 highway and in Oiapoque municipality. They speak *Kheuol*[1] and Portuguese. According to stories told by some Karipuna leaders, such as former Chief Luciano dos Santos, the Karipuna people ascend from different indigenous and non-indigenous groups, mainly from those that fled the violent colonization processes imposed by Europeans in states like Pará and Amazonas.

Palikur-Arukwayene people ascend from Arawak origin and are mainly concentrated in Urukauá River headwaters and along BR-156 highway. They speak the Parikwaki language and Portuguese (Associação dos Povos Indígenas do Oiapoque [APIO], 2009). Based on the molecular study by Schroeder et al. (2017), Palikur-Arukwayene people are the closest living relatives to the *Tainos*, which is a pre-Columbian indigenous people that lived in the Antilles and Bahamas. They are organized into seven clans: *Kamuywene*/People of the Sun, *Waxeyene*/People of the Mountain, *Kwakyeyene*/People of the Pineapple, *Wayveyene*/People of the Caterpillar, Kawokyene/People of the Jaguar and *Wakavunhene*/Baptiste.

Galibi-Marworno people come from the Caribbean and are distributed in villages along Uaçá River, by BR-156 highway and in Oiapoque City. They speak *Kheuol* and Portuguese. Santos (2019) stated that this ethnic group emerged from interethnic fusion, mainly between the *Maraon* and *Aruã* indigenous peoples and the Saramaca – *quilombola* people from the French Guiana. *Maraon* people have been mentioned by travelers in the Oiapoque region since the 17th century. *Aruã* people, in their turn, came from Marajó Island, in Pará State. They migrated to Amapá in the 18th century fleeing the Portuguese persecution and exploitation.

3.2. Cassava familiarization in indigenous peoples' agroecosystems in Oiapoque.

The agroecosystem in Uaçá Indigenous Territory is called '*roça*' (indigenous swidden). This agricultural management type is one of the oldest land-use forms and it has lasted in several regions worldwide, mainly in the tropics, under different socio-ecological conditions (Cardoso, 2018). "*Roça"*

1 Indigenous language, a French and Creole variation spoken in French Guiana.

is more than just a cultivation field; it is a place for indigenous knowledge construction and transmission. It is so, because it involves multiple dimensions of the indigenous life, such as *maiuhí* (collective work, in *Kheuol*), education, ecological forest management, cosmology, besides the production of healthy food, which drives the indigenous economy.

Maiuhí is an important '*roça*' (swidden) dimension, as it refers to collective labor in "*roça*" fields like clearing land, felling trees, burning the vegetation, slash-and-burn agriculture, planting, weeding and harvesting, as inferred from the excerpts below:

> *We do the "maiuhi" (a traditional gathering for cassava cutting) to carry out several activities in the "roça" fields, such as planting; we bring families together in our fields. "Maiuhi" planting takes approximately 4 hours because there are several cassava- cutting bundles. The men must dig the holes, the children throw the cuttings inside and, finally, the women just go and pull the soil over the cuttings.* (M. Silva, personal communication, September, 2019).

> *When we make maiuhí, the work is faster and happens during the time it takes to clear the land, fell the trees, plant the crops and prepare the flour.* (A. dos Santos, personal communication, March, 2020).

With respect to education, indigenous knowledge about the soil, climate, plants and animals is transmitted in the countryside, as Professor R. Galibi Marworno explains (Instituto de Pesquisa e Formação Indígena [Iepe], 2011, p. 16):

> I grew up working in '*roça*' fields. Nowadays, I'm a teacher and I attend school assignments in them. We work with the child's reality in comparison to the countryside: dimensions, shape, measurements, planting season – you can work on all subjects in the countryside.

The '*roça*' field belongs to the family, but, according to S. dos Santos (personal communication, March 2022), the woman in charge of it knows everything. This finding has shown that female knowledge prevalence is very relevant for education procedures in the countryside.

> *I've been following my mother to the 'roça' fields since I was a child. She taught me that it's better to plant in black or red soil, as these soils produce more cassava, peppers and yams. She also taught me that we should always observe the animals, because they always tell us what might happen in the fields. For example, if the cicada sings, it means summer is beginning and it is time to prepare the new planting.* (D. Batista, personal communication, March, 2020).

Forest ecologic management exemplifies the new clearing land practice, which aims cultivation crops. The land is carefully chosen to start a new clearing procedure; it must preferably be where there are not many trees of local relevance. Fire is a very important tool for soil fertilization before planting. Therefore, it is carefully managed, in a controlled manner. This site is used as '*roça*' for three consecutive years. Then, it becomes an old or

resting '*roça*'. They must remain under recovery for 10 years, until the forest regenerates itself and has the vitality to produce again. Therefore, this area works as pathway to other clearings. It is often visited for fruit picking, hunting and firewood collection before it can be used as clearing again.

> We practice crop rotation in the Uaçá Indigenous Territory. We take special care of sacred trees and medicinal plants, not allowing them to be cut down. Thus, we, Indigenous people, not only take things from nature, but also contribute to its maintenance, manage fruit-bearing plants in the sites of our fields or dwellings. We leave marks where we cross, limit the territory borders and ensure fruit availability for animals and people who cross these places (Ioiô & Santos, 2020, p. 36).

Karuanas are non-human beings who help taking care of, and maintaining the fields in balance. According to indigenous peoples in Uaçá, *Karuanas* dwelling place is an example of the cosmological dimension observed in cultivated '*roças*'. Any disrespect to *karuanas* has consequences for plants grown in the fields. Not observing the mourning week when someone dies in the village is an example of disrespect. In this case, whoever accounts for the disrespect will have its plants attacked by pests in their fields or, their branches may wither and die, as described below:

> *When there is death in the village, no one can go to the fields; the family mourns for a month and, for someone not as close, for a week. A cross is placed in front of/at the "roça" entrance, so that the plants do not feel it, do not become sad and do not die (S. Santos, personal communication, March, 2020).*

The '*roça*' field is also a source of healthy food as it provides food diversity, mainly food prepared with cassava (flour, beijus, tucupi, tapioca starch). These food types have high quality as they are not subjected to chemicals' application. Overall, they are taken on a daily basis and at some celebrations like the *Turé* ritual. Caxixi, which is a regional variation in the *Kheuol* language, means fermented cassava beverage, and it is consumed at the *Turé*. These food types help ensuring food security and sovereignty.

> We, the indigenous people, don't use fertilizer when we plant. We wait a year for cassava to mature before planting. Pineapple, banana, sugarcane, yam and potatoes are crop types known for producing faster. We heavily depend on these plant types in our everyday life. They are very important to us, because they are, first and foremost, quality food on our table (Karipuna, 2019, p. 5).

The local indigenous economy is driven by cassava, as its cultivation is the main income source in the Uaçá Indigenous Territory. The locally produced flour is highly valued and demanded in the local market. Despite its fair price, it can be an income source to help acquiring what these peoples do not produce. In other words, it helps accessing industrialized products that are already part of local indigenous peoples' lives. The excerpt below describes farming relevance for the indigenous economy:

> "*Roça*" represents the life of everyone in the village, because flour is a food people will never stop making and living from, and it also strengthens this culture. According to most people in Kumarumã, it's where they yearn some money to afford their families. The flour represents a bank for each farmer in the community, since most of them don't have jobs, the farm is always a job in their lives (Pastana, 2019, p. 10).
>
> The farm represents something very important in terms of sustainability. Many people don't have jobs, but they live safely in the village because they cultivate their fields. It's what affords them. Without a '*roça*', a person is nothing. If you don't have a '*roça*', you have nothing to eat. I have a field where I planted this year. I make flour to eat, but sometimes I need to buy some until I have time to make it myself. Sometimes I sell it too. The '*roça*' organizes the community (Iepe, 2011, p. 18).

Therefore, '*roça*' expresses the very sustainability of indigenous lifestyle, "a miniature forest, a laboratory of knowledge, a history book, a showcase of memories, a field of encounters" (Robert et al., 2012, p. 367). There is an indigenous science to plant '*roça*'; it is not simply opening a clearing in the forest for a crop. Previous research, such as that by Emperaire (2006, 2008, 2010), Steward et al. (2016); Oliveira (2016), and Leão (2020), has already highlighted similar practices to set '*roça*' fields in the Amazon, but based on their local peculiarities. The clearing locations for '*roça*' fields depend on several factors. Among them, cosmology, soil, relief, vegetation and fauna. The indigenous criteria for choosing a land piece for a '*roça*' field in Uaçá Indigenous Territory are strict and related to the availability of solid ground islands. It is so, because the largest villages are located on islands in flooded fields:

> *So, we choose a place near our old farms to plant our crops. But the dry land is getting further and further away, because there are so many people in the village now, and the nearby areas are all occupied with farmland. We still have to choose a place with beautiful, red or black soil, and preferably high ground so it doesn't flood when the fields fill up during the rainy season* (S. dos Santos, personal communication, March, 2020).

Each family has its own pre-defined location, the place where they must open a new plot, on a yearly basis, usually on solid ground islands. "Davi's family's is *Soraimon*, Milton and Jaizinho's is *Kaimã*, Sérgio's is *Biskot,* for example. These families have to start a small '*roça*' to change locations when the solid ground ends, otherwise it would be too far to carry the cassava" (Iepe, 2011, p. 21). The '*roça*' sizes depend on family members' physical skills. If a family has many young people, its '*roça*' is larger. Currently, families have been making more efforts to find good cultivation lands closer to the villages because the population has been significantly increasing in Uaçá Indigenous Territory.

Similar to the *Pataxó* theory (Campos, 2016, p. 152), "earth is alive, it breathes and makes things grow, thus, it can get tired or rest, become good or bad to be used for agriculture". Indigenous peoples in the Uaçá Indigenous Territory share this same theory:

> *We can't overwork the land because it suffers, becomes sad, and it harms our plants. We have to use the same 'roça' for up to three years; after that, it doesn't produce anything good anymore. So, this old 'roça' will rest for a few years before we can use it again... after these years, it will be alive again...* (J. P. Batista, personal communication, October, 2019).

Therefore, one of the criteria for choosing the location of a new '*roça*' takes into account whether the old plot has "rested" enough. In other words, whether it has recovered its soil vitality to be reused as a new '*roça*' field. Another criterion for choosing the new '*roça*' is the presence of "mother" trees: medicinal and sacred plants. In this case, the site is avoided.

> When we choose a place to cultivate our land, we don't cut down large trees like *cupiúba, andiroba, cedar, aquariquara, angelim, yaya* and *tauari*. We look for another place to cultivate our land because these trees are very important to nature and greatly support the soil, making it firmer. We call them them mothers of the trees because they are larger than the others and they support the smaller ones until they grow enough to also become part of this group of mothers (Karipuna, 2019, p. 6).

"*Roça*" (swidden) is a unique farming form that highlights the sustainable relationship between indigenous peoples and their land. One often hears "there is too much land for too few indigenous individuals"; this idea comes from lack of understanding that indigenous peoples need large territories in order to avoid "exploiting" nature. Hunting, forest gathering and the rotation of swidden fields, for example, express this dynamics as the way to keep the forest standing. According to Oliveira (2016), the indigenous agriculture does not only play the role of providing food, but has great value for underpinning indigenous social life and contributing to the planet's environmental issues.

The Uaçá territory is for collective use; therefore, each family has its own piece of land. Most of the time, this land is located on dry ground islands surrounded by flooded fields. The '*roças*' are cultivated in dense rainforest areas by BR-156 highway. Each place has its own human or even non-human "owner" (*Karuanas*). As Santos (2020, verbal information) explained, before starting a "*roça*", we have to ask permission from the owners, the *Karuanas*, otherwise they get angry and the crop does not produce anything. Oliveira (2016) described that, according to the Wajãpi indigenous people, this process is an appeasement state set between cosmological beings. Thus, '*roça*' and the village are places that must be previously socialized and tamed.

Each family sets at least one new "*roça*' field per year. They have four '*roças*' at different stages in order to meet the family's needs: a newly planted, a maturing, a mature and a resting one (the old '*roça*'). The new planting field is basically a replica of the old one; it is a continuation of the previous one, i.e., a clonal reproduction in another location (Chernela, 1987). The opening of a new '*roça*' triggers a new yearly cycle, and this process points towards the systemic lifestyle that integrates everything.

Thus, the land-clearing method applied to farming is reproduced in different locations in the Amazon, and it takes into account the sociocultural and ecological peculiarities that have spanned centuries. The clearing aesthetics is well planned in order to mimic the forest. These areas are often circular and contrast the "pastures and soybean fields, which are ideally rectilinear, uniform and monospecific" (Robert et al., 2012, p. 367).

Each family has its preferred cassava varieties, which are mainly determined by root yield. Variety is herein understood as described by Emperaire (2013, p. 2), "a set of individuals considered sufficiently homogeneous and sufficiently different from other groups of individuals to receive a specific name and to be the object of a set of practices and knowledge throughout its cycle". This empirical concept goes far beyond the biological one. Descola (1996) stated that it is difficult distinguishing varieties of the same species when one has untrained eye, which is not the case for indigenous peoples.

The exchange and sharing of cassava cuttings is very common in the Uaçá Indigenous Territory. If the owner of a new '*roça*' is interested in a variety it does not have, it will seek to get it from someone else who does. Overall, cassava cuttings and cultivated plants are social-relationship vectors as they actively circulate among relatives and acquaintances (Emperaire, 2021). Peroni (2004) reported that cassava is the species accounting for the highest intensity of exchanges in these agricultural systems, and it helps avoiding the species' genetic erosion, in addition to increase species' local agrobiodiversity and intraspecific diversity. Exchanging cassava cuttings is a very old habit, besides following people and ideas' circulation in the Amazon region and in neighboring macro-regions, such as the Caribbean (Cascon, 2017).

3.3. Cassava varieties cultivated in 'roças' in the Uaçá Indigenous Territory

Indigenous peoples are collectors of diversity (Carneiro da Cunha, M., 2019, verbal information[2]). Based on the Amazonian ethnography, keeping cassava varieties is a way to set close relationship with the indigenous knowledge (Cascon, 2017), as it was already shown in several studies carried out with indigenous peoples. Boster (1985) identified more than 100 cassava varieties among the *Aguaruna* in Peru; Carneiro (1983) identified 46 varieties among the *Kuikuro* in the Xingu; Chernela (1987) reported 137 varieties among the *Tukano*; Emperaire et al. (2008) found 73 cassava varieties in multiethnic farms in Upper Rio Negro region; Fleury (2016) referred to 65 varieties among the *Wayana* in the French Guiana. Participants in a workshop to train indigenous researchers in Oiapoque (Iepe, 2011) reported 56 cassava varieties grown in Indigenous Lands in Oiapoque. In total, 40 cassava varieties were identified in the present research (Table 1).

In total, 21 of the 40 identified varieties, had yellow tuberous roots,

2 At the 3rd International Congress of Indigenous Peoples – CIPIAL, in Brasília, July 3-5, 2019.

Table 1 Cassava varieties cultivated in the Uaçá Indigenous Territory, Oiapoque – AP, 2025.

Variety names	Location in the Uaçá Indigenous Territory
A. Yellow cassava roots	
1. Agamim	Taminã Village (Curipi River)
2. Batõ bij	Aruatu Village (Uaçá River)
3. Batõ sec	Taminã Village (Curipi River)
4. Batõ sesel	Kumarumã Village (Uaçá River)
5. Batõ uaçá/lô	Curipi Village (BR 156)
6. Buhgik	Flecha and Kumenê Village (Urukauá River)
7. Shrimp	Curipi and Ikawakun (BR 156); Santa Isabel and Taminã (Curipi River) Villages
8. Brandy	Curipi Village (BR 156)
9. Fei fine jõ	Tukay, Samaúma, Ikawakun and Curipi (BR 156); Kumarumã (Uaçá River); Aldeias Taminã and Santa Isabel (Curipi River) Villages
10. Iuminã	Tukay and Samaúma (BR 156); Aldeia Kumarumã (Uaçá River) Villages
11. Kunamba	Kumenê Village (Urukauá River)
12. Lapot	Taminã Village
13. Lesa	Santa Isabel and Taminã Village (Curipi River)
14. Khã Maiõk (macaxeira)	Kumenê Village (Urukauá River)
15. Papai	Santa Isabel, Txipidõ and Taminã Village (Curipi River)
16. Sansã Jõ	Kumarumã and Aruatu Village (Uaçá River)
17. Sãzo	Kumarumã and Magia Village (Uaçá River)
18. Tê ble	Kumarumã (Uaçá River); Tukay and Samaúma (BR 156) Villages
19. Tucumã	Kumarumã (Uaçá River); Tukay, Samaúma and Ikawakun (BR 156); Santa Isabel and Taminã (Curipi River); Flecha and Kumenê (Urukauá River) Villages
20. Velho Xico	Curipi Village (BR 156)
21. Waiã	Kumenê Village (Urukauá River)
B. White cassava roots	
1. Baiana	Taminã Village (Curipi River)
2. Big balls	Curipi and Ikawakun (BR 156); Kumarumã (Uaçá River); Santa Isabel (Curipi River) Villages
3. Small balls	Curipi and Ikawakun (BR 156); Kumarumã (Uaçá River) Villages
4. Calixa	Kumarumã (Uaçá River); Flecha and Kumenê (Urukauá River) Villages
5. Caxim	Tukay, Samaúma and Ikawakun (BR 156); Kumarumã and Aruatu (Uaçá River) Villages
6. Fei fine blã	Tukay, Samaúma, Curipi and Ikawakun (BR 156); Kumarumã (Uaçá River) Villages
7. Khã Maiõk (cassava)	Santa Isabel and Taminã (Curipi River); Flecha and Kumenê (Urukauá River); Tukay, Samaúma, Curipi and Ikawakun (BR 156); Kumarumã and Aruatu (Uaçá River) Villages
8. Phoag (French Guiana)	Taminã, Santa Isabel and Espírito Santo (Curipi River) Villages
9. Sansã Blã	Taminã (Curipi River); Tukay, Samaúma and Ikawakun (BR 156); Flecha and Kumenê (Urukauá River); Kumarumã and Aruatu (Uaçá River) Village
10. Sauauá	Taminã, Santa Isabel and Espírito Santo (Curipi River); Kumarumã (Uaçá River); Flecha (Urukauá River) Villages
11. Xingu	Taminã and Santa Isabel (Curipi River) Village
12.Six months	Taminã and Santa Isabel (Curipi River); Curipi and Ikawakun (BR 156) Villages
C. Cassava plants, parent plants of agrobiodiversity (without tuberous root) resulting from sexual reproduction.	
1. Mama Maiõk (Wild mountain cassava)	Montanhas Hox ble, Estrela and Tixpoca
2. Gen Maiõk (Seed cassava)	Crops in T.I. Uaçá
D. Cassava without information on the tuberous root color.	
1. Cai cai	Santa Isabel and Taminã Village (Curipi River)
2. Lapo ros – purple hair	Santa Isabel and Taminã Village (Curipi River)
3. Pacuí	Taminã Village (Curipi River)
4. Txikuhipi	Arauatu and Kumarumã Villages (Uaçá River)
5. Zohug	Aruatu VIllage (Uaçá River)

Source: Elaborated by the authors based on field data and on the research by AGAMIN 2018.

12 were white, 5 varieties were not identified by color and 2 were considered parent varieties that did not produce tuberous roots. The yellow varieties prevalence seemed to be related to preference for "very yellow" flour. Variety Mama Maiõk (wild mountain cassava) was mainly found in the local mountains and variety Gen Maiõk (seed cassava) often grows spontaneously in the fields, but it does not produce tuberous roots. It is added to the collection of local varieties for future production. Galibi/tabirin is an example of variety coming from 'wild mountain' cassava parents. According to Iepe (2011), this variety was brought from the Hox Ble mountain by hunter ancestors. However, its presence was not identified in any of the herein assessed 'roças', although there are records of its traditional used in beiju and caxixi preparation.

The great diversity of cassava varieties must be related to selection, maintenance and sharing practices for material propagation. This process concerns stem pieces regionally called "*manivas*", in cassava planting. This propagation type depends on human actions and produces clones of varieties showing the features of interest for the material holder, such as ecological adaptation, agronomic quality and advantages for particular uses, which justify its perpetuation and share with other interested farmers (Cascon, 2017). All families grow cassava in their '*roças*' and have at least two ones, a newly planted '*roça*' and a mature one. Cassava is the prevailing crop in these '*roças*', mainly in the Galibi-Marworno and Palikur-Arukwayene ethnic groups. These were the groups chosen for the present participatory fieldwork. However, sugarcane, bananas, yams and other cultivated plant species could also be found.

Some species are grown around the houses, such as peppers. It is also common having a specific clearing called "*maricagem*" in the secondary forest; it is specific for fruit orchards. "*Maricagem* is any clearing that is not normal", which is not specific for cassava planting, it is a clearing type outside the forest. It is always implemented in areas under rest for 2 to 3 years (Musolino, 2000, p. 80). "*Maricagem*' is the first access to the clearing after the fallow period, which is reused to cultivate bananas, ginger, sweet potatoes, yams, sugarcane, taro, gherkins and watermelon after three-year rest, on average. During the visitation to the Palikur-Arukwayene clearing of an indigenous person, the farmer was asked about cassava prevalence in it. He replied: it's because we open a "*maricagem*" to plant bananas, peppers and other fruits.

Capoeira is the local name to fallow, i.e., letting the land "rest". *Capoeira* grows over the rest period and the vegetation accumulates soil and atmosphere nutrients (Forsberg, 2018). The planted fields in Uaçá Indigenous Territory are used for three consecutive years; then, the "rest" period begins. This time holds a succession process to recover soil fertility and re-establish the flora, fauna and microfauna. However, it is still seen as cultivated field, as the "old" cultivated field. This finding reinforces the inadequacy of using

the term 'shifting cultivation' for indigenous peoples' agricultural system in Oiapoque, as well as for most Amazonian agroecosystems, since the cultivated fields are never abandoned.

Uaçá indigenous peoples do not have a specific vocabulary for each old clearing (secondary forest) regeneration stage as the Wajãpi do: *kookwerã pyau* (new secondary forest), *kookwerã omãna* (old secondary forest) and *isawypa* (final growth, forest again). This is "a refined perception of the forest succession process, which begins with ground cover and shrubby plants" (Oliveira, 2016, p. 127). The old clearings visited in the Uaçá Indigenous Territory showed that *batoto* or camapu (*Physalis sp.*) is the first plant starting the succession process, similar to the secondary forests of the Wajãpi (Oliveira, 2016).

The old local '*roças*' are featured by the prevailing presence of inajá palm trees (*Attalea maripa*). Its fruits attract small-sized preys, such as agouti (*Dasyprocta*), paca (*Cuniculus paca*) and monkeys (*Primates*). The fallow period in the Uaçá Indigenous Territory lasts from three to fifteen years, it is much longer than fallow periods described in other Amazonian regions, such as two to five years in Lake Janauacá, Amazonas State (Forsberg, 2018); three to five years in Lake Araras, in this same state (Castro et al., 2006), and three to ten years in Igarapé Grande, Pará State (Hora et al., 2015). However, these studies have shown shorter fallow period due to the scarcity of cultivation sites, which are becoming scarce due to intense production to meet market demands.

According to the local cosmology, old cultivated '*roças*' (secondary forests) are not abandoned, they remain as part of the universe of cultivated fields, as they keep on being inhabited and cared for by invisible beings, the *karuanas*, who often visit them for fruit picking (inajá, for example) and for the hunt of small mammals like paca and agouti. Oliveira (2016, p. 126) described the role of spirits' secondary forests ecological succession among Wajãpi people in Southern Amapá: "the cultivated 'roças' are deliberately abandoned to weeds, *cecropia* trees, thorns, among others. Little by little the forest surrounding the fields invades them and their rightful owners, the *ka'ajarã* and spirits of all kinds, take them back".

According to studies by Altieri (2012), the old clearing (*capoeira*) is an example of how the agriculture of indigenous peoples follows all the sustainable agriculture principles advocated for by Agroecology, mainly when it comes to soil and biodiversity conservation and recovery. Each family has a particular collection of varieties in the clearings. On average, 9 cassava varieties were identified per clearing in the current study. This finding is quite similar to what was found in Wayana indigenous people clearings in the French Guiana, where each family grows from 7 to 11 cassava varieties per clearing (Fleury, 2016), as well as to indigenous peoples in upper Rio Negro region, that grow from 11 to 33 varieties per clearing (Emperaire & Eloy, 2008). The specific name of each variety is defined

by a sensitive perception of the plant's morphological details. Oftentimes, there is a tomemic[3] correlation between the plant's shoot and animal parts. Variety *batõ sesel* (duck leg), for example, refers to the association between the sprawling aspect of the plant's branching and the shape of a duck's leg.

They also name the varieties by associating them with their place of origin – variety Xingu (Mato Grosso), *Phoag* (a stream on the border with French Guiana) or with some specific morphological feature such as *fei fine* (thin leaf) and *sansã* (gray). Thus, based on Emperaire and Peroni (2007), a new universe of biological diversity emerges in the 'roças' based on the names of cassava varieties, which comprise a set of independent elements. Therefore, the concept of variety goes far beyond a biological idea within the local indigenous sciences. It is an open and dynamic concept embedding a multitude of features (origin, history, morphology, among others); it is an intercultural concept.

The name given to cassava varieties points out exchanges and social networks (Fleury, 2016). One specific variety in the current study indicated the sharing of the Xingu variety, and of two other varieties, with indigenous people at the Xingu Indigenous Park due to exchanges with non-indigenous people. These varieties were 'Velho Chico' and 'Baiana', in addition to an international variety from the French Guiana, the *Phoag* variety. Any displacement is an opportunity to enrich and renew plants and outspread associated knowledge; therefore, the variety's name is an essential plant identity feature (Emperaire, 2021). Cassava cuttings do not circulate alone; people circulate, share their knowledge, keep, embody and broaden the varieties; as Lévi-Strauss ([1962] 2008) said, it is a true scientific spirit.

Plants' morphological features are the main descriptors used by people in the Uaçá Indigenous Territory to differentiate cassava varieties, namely: shape of the leaf and leaflets, distance between nodes, and the color of the leaves, stem and tuberous root[4]. It takes into account two aspects; first, it is a common language among peoples living the Indigenous Lands at the lower Oiapoque River – it prevails in commercial and exchange relationships. Second, the present research focused the Kumarumã Village, of the *Galibi Marworno* people, where this is the prevailing language.

The Palikur-Arukwayene have their own names for cassava varieties in their Parikwaki language. Three varieties had *Khéuol* names in Flecha and Kumenê villages, on the Urukauá River, the land of the Palikur-Arukwayene: sansã, sauauá and calixa. This finding suggests exchanges with other peoples in the same Indigenous Territory. However, it was not possible visiting the fields on the Urukauá River to check whether they were the same varieties in *Khéuol*. Therefore, only varieties whose distinction from the others could be reliably confirmed, such as *Waiãn* (tortoise) and *Buhgik*, were included in the table. Assumingly, there are many com-

3 They often associate it with an animal or with another plant.

4 Indigenous language varying from French to French Guianese Creole.

mon cassava varieties between *Khéuol* and *Parikwaki* speakers, but with different names, due to exchanges, sharing and the donations of varieties among local indigenous peoples.

Genetic material sharing among ethnic groups within the Indigenous Territory itself, or varieties from other regions and neighboring countries, fosters diversity through cassava genetic material circulation and exchange. The stem is the shared part and cassava cuttings are responsible for the species' asexual propagation. Shoots are cassava cuttings embodying the concept of broad diversity (Guimarães & Souza, 2015).

Similar studies have suggested that cassava cuttings flow is broad. Varieties *tucumã* and *seis meses*, for example, have also been identified in Upper Rio Negro region (Emperaire & Peroni, 2007; Emperaire & Eloy, 2008; Ramos, 2014), in Middle Solimões (Lima et al., 2012) and on the Brazil-Guyana border (Oliveira, 2017). Varieties exchange enhances gene flow, which is essential to keep diversity. It has also helped to clarify this species' evolutionary dynamics (Pereira, 2008).

The comparison of number of cassava varieties identified in the Indigenous Researchers Course (Iepe, 2011) led to 56 varieties and, now, we found 40 varieties. This finding allowed assuming a decline in the diversity of cultivated varieties. According to interviews in the Kumarumã Village, cassava varieties *Batõ paca*, *Batõ palikur*, *Ni ple* and *Baixinha/basé* have recently disappeared. It is very likely that this reduction is related to the economic pressure aimed at increasing flour production to supply the markets in Oiapoque City and in Saint George, in the French Guiana. It is so, because, according to local information, varieties that are disappearing often produce little tuberous root and little *tucupi*, which is a byproduct widely used and traded.

Assumingly, this reality is quite different now and the number of varieties has drastically dropped down due to the attack of cassava witches' broom disease (Rhizoctonia theobromae). This disease affected the '*roça*' fields in 2018, although its identification by Embrapa only took place in 2024. Almost all 'roças' in the Uaçá Indigenous Land were destroyed by the witches' broom disease, and it has caused great food insecurity in the region.

3.4. Familiarization with cassava varieties in the Uaçá Indigenous Territory

Family farmers, indigenous peoples and other traditional communities select new cassava varieties based on empirical knowledge, experience and innovation. They keep genetic variability and resist the homogenization process encouraged by the market-driven agriculture (Emperaire, 2021). Cassava selection in the Uaçá Indigenous Territory combines the use of clones (cuttings) with sexual reproduction (seeds). These two mechanisms provide plants known for having maximum species–conservation potential

(Kerr, 1987). Cassava is the species with the greatest intraspecific diversity among cultivated plants in the indigenous peoples' agricultural system, similarly to the agricultural system observed on upper Rio Negro, where cassava is a key crop species (Emperaire et al., 2008).

The recent concept of plant familiarization was developed in Anthropology (Cunha, 2019; Fausto & Neves, 2018) to address the relationship of Oiapoque indigenous peoples with plants, mainly with cultivated cassava varieties. The concept of plant familiarization emerged from the need for contrasting the process achieved by the native peoples with that described in the literature, from a Eurocentric perspective, since domestication presupposes the mastery of plant manipulation. Clement (1999) argued that Amerindian peoples domesticated the landscape in order to make it more productive and suitable for humans. Cunha (2019), however, understood that one cannot attribute a colonizing posture to Amerindian farmers regarding forest heritage to the point of making it dependent on humans.

Oiapoque indigenous peoples do not intend to dominate the plants. They are incorporated into agricultural practices through agreements between humans and non-human beings (*karuanas*). This agreement involves specialized individuals known as *shamans*, who set communication means between these two different worlds. Landscape production and familiarization with plants in the Amazon is carried out by its traditional peoples, and it must be interpreted in their own terms. It is so, because, in opposition to domination and monoculture, indigenous cosmologies show their appreciation for making alliances with non-human beings and for agroforestry diversity at all production and harvesting levels (Cunha, 2019).

Thus, according to Neves and Heckenberger (2019), it is necessary rethinking this domestication process within the pan-Amazonian context, since it does not take into account the gigantic biocultural diversity, as it would mean neglecting the specific historical and cultural choices of peoples throughout the centuries. With respect to the relationship of Oiapoque indigenous peoples with cassava varieties, and to the way they incorporate the plant into their traditions, the concept of familiarization was herein adopted because the cassava they take from the mountains to generate new varieties has not been domesticated, but rather familiarized. They bring it from the mountains to their '*roças*', crossbreed it with cultivated varieties, new varieties emerge and, at the same time, it keeps on spontaneously growing in the mountains, without domination, independently.

Therefore, familiarizing oneself with cassava in the Uaçá Indigenous Territory is an important mechanism to keep cassava diversity, and it is done by incorporating what is locally called *mama maiõk* (Mother of cassava, deer cassava or mountain cassava), a local wild cassava variety (Figure 2). This variety was harvested from the local mountains and grown in corners or in the center of the '*roça*' fields: "we buried the wild cassava in the center of the 'roça' to attract more roots to our field" (Iepe, 2011, p. 23). Gradually,



Figure 2

Mama maiõk – wild cassava in the mountains, Box Blue, Kumaruma Village, Oiapoque – AP.

wild cassava was incorporated into the 'roça' fields. Bringing wild cassava to the field, in the local cosmology, would increase productivity and diversity in the '*roça*' fields:

> My grandmother used to tell me that in the old days there was only wild cassava. They planted it. The next year they harvested the cassava cuttings and planted them again, and the next year the same thing. Only after five years did they start making flour from this cassava (Iepe, 2011, p. 26).

According to this practice, incorporating wild cassava into the fields is an important mechanism to exchange genetic material, and conserve and broad local diversity. The interviewees also mentioned that, in addition to cassava, other fruit species come from the mountains; *as* (Marworno, R., 2020, verbal information) *my grandmother used to say*, *cassava comes from the mountains, as do the cassava cuttings, pineapple, cashew, yam, pepper; they are all plants from the indigenous people who lived in mountain caves, many years ago*.

However, only the *shamans* could gather plants from the mountains, as they could communicate with, and ask permission from, the cosmological owners, who are invisible beings. Currently, because of the silence of the

shamans, it is no longer possible gathering this cassava for cultivation. They use the term "silence of the shamans" because they believe there are no longer any shamans in the local villages. Most of indigenous people living in the Uaçá Indigenous Territory have adopted the evangelical religion. Based on an oral account, a Palikur-Arukwayene elder reported that, before knowing the God they were introduced to, their 'God' was the moon, the sun, a tree, large birds... they also believed in the *shaman*. Thus, after the Western religion entered the daily lives of indigenous peoples of Uaçá, they underwent a symbolic and mythological transformation. The lack of *shamans* is one of the outcomes of this new reality. Religious conversion also disrupted the continuity of cultural practices due to the silence of the *shamans*, and it impaired these peoples access to the original propagation material, but their new religious orientation does not provide a solution for the void it has created.

They consider variety *mama maiõk* the "mother" of the cassava varieties they grow. From an academic and scientific perspective, this concept is close to the sense of wild-relative cassava (Manihot esculenta spp. flabellifolia), which is acknowledged as participant in the domestication process that gave rise to the now widely cultivated variety in Brazil and in the world. Further studies are needed for confirming this finding. However, based on the local indigenous science, it is a relative, "kin". This interpretation reinforces the need for including this territory as priority site for agrobiodiversity protection and conservation *in situ*.

Another way to familiarize and generate a diversity of cassava varieties in the Uaçá Indigenous Territory lies in incorporating cuttings deriving from the germination of dormant seeds in old '*roça*' fields (secondary forests). Keeping seed-production capacity through vegetative reproduction is the very game cassava and Amerindian peoples have been playing for about 9,000 years – the likely cassava domestication date observed in Upper Madeira River region (Alves-Pereira et al., 2018).

The fallow land (capoeira)/secondary cultivation practice is very important for cassava diversity. According to Peroni and Martins (2000), if the opening of '*roça*' fields always happen in primary forest, the possibility of increasing its variability would decrease as there would be no opportunity for crossbreeding between new genotypes arising from the seed bank. Accordingly, secondary forests work as true seed banks: cassava seeds remaining in the fields enter a dormant stage and become a reserve of these species' genotypes (Peroni & Martins, 2000).

According to Clement et al. (2010), although cassava have vegetative propagation, it has not lost its sexual reproduction ability; thus, it plays key role in the species' evolutionary dynamics. Because the cassava fruit is of the explosive type, the seeds are launched long distances and deposited on the soil; they germinate depending on the dormancy period (Pereira, 2008). Overall, seeds that have remained dormant in old '*roça*' fields germinate

right after the burning for space reuse. However, they do not develop a tuberous root, only a taproot, which requires successive vegetative propagation processes that have already been described in previous paragraphs.

A similar phenomenon was observed in several locations in the Amazon, such as in Benjamin Constant communities, in Alto Solimões, Amazonas State (Martins, 2016), among the Wajãpi people in Southern Amapá State (Oliveira, 2016), and in rural communities in the Mamirauá and Amanã Reserves in Amazonas State (Pereira, 2008). They are generically called *gen maiõk* (seed cassava) in local '*roças*'. Uaçá indigenous peoples have emerged as natural selectors for the generation of new varieties. "*Whenever we clear the field to replant the cassava cuttings for our subsistence, there are already some seeds, like little fruits, from the previous field; we leave them there, we don't touch them*" (Batista, J. 2020, verbal information). The *gen maiõk* is left in the same place where it sprouts, without interference. When it grows, the field owners realize that it does not have the same features of the cultivated cassava cuttings.

They branch out very quickly, as soon as they sprout. The cassava cuttings do not form roots when they are mature, or they develop very little (S. dos Santos, personal communication, March 2020). They are removed and incorporated into the next cassava cutting bunches to be cultivated in another '*roça*' field. When replanted and incorporated into the new field, its propagation begins through the vegetative part, which gives rise to a new variety that will be named according to its morphological features.

Similar behaviors were identified among several traditional farmers. This finding reinforced the idea of a network of interconnected and consolidated indigenous knowledge reproduced in different territories with their local specificities. Martins (2016, p. 98) pointed out that "if the behavior of the consciously selected material meets the family's expectations, it is multiplied and incorporated" by Benjamin Constant communities, in Alto Solimões, Amazonas State. Similarly, Emperaire and Peroni (2007, p. 765) highlighted the morphotypes, i.e., the appearance of plants incorporated into agricultural systems are important diversity sources in Northwestern Amazonia and in São Paulo State:

> Once a plant is successfully cultivated, its features are assessed and either discarded or incorporated into the existing stock of varieties. Subsequently, the plants are propagated by using the cuttings, as it is done for any other variety, and it will enter the network of variety circulation with a new name or, as it is usually the case, borrowing the name of the variety closest to its morphology.

Variety *batõ sesel* (duck leg) which, according to S. dos Santos, from the *Galibi Marworno* ethnic group (personal communication, March 2020), emerged after the *maiõk* gene was incorporated to his 'roça' in the Kumarumã Village (Uaçá Indigenous Territory). When he replanted the cassava cutting, it produced a "good" yellow tuberous root. He continued

to plant it to this day and to share it with his relatives. Genetic analyses have confirmed that this incorporation type generates high polymorphism in local varieties, as well as a prevailing clone and a set of morphologically identical, but genetically different, plants (Clement et al., 2010).

4. Final considerations

The process of familiarizing oneself with cassava in the Uaçá Indigenous Territory is constant and embodies the local cultural identity. Thus, it can be seeing that the agricultural system of Uaçá indigenous peoples is part of what might be called a differentiated agriculture, which is intertwined with other traditional agricultural systems through cognitive processes operating with the same rationality, but with small differences and cultural, environmental and social peculiarities. In addition to plants and artifacts' circulation, ancestral knowledge also circulates.

Indigenous peoples' agricultural system in Oiapoque is moored in cassava species (*Manihot esculenta*) and is closely related to cosmology and seasonality. The cultivated crops represent the greatest material and immaterial expression of the indigenous life. It is more than a cultivated crop; it also works as the dwelling place of the *Karuana* spirits. Plants are subjects and they have cosmological owners.

The knowledge of the three indigenous peoples living in the Uaçá Indigenous Territory is in constant interaction with biological diversity, a fact that reinforces the strong interconnectedness of agricultural and cultural diversity. The care given to their crops, mainly to cassava varieties, suggests that Uaçá indigenous peoples have strong mechanisms to generate diversity. It is important emphasizing the significant recursive episodes eithin this conservation process, in other word, socio-diversity is essential to agrobiodiversity, to the same extent that agrobiodiversity is essential to socio-diversity.

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