Núcleo de Meio Ambiente
Universidade Federal do Pará
Rua Augusto Corrêa, 01, Guamá
Belém, Pará, Brasil
https://periodicos.ufpa.br/index.php/agroecossistemas

Geysiane Costa e Silva
Universidade Federal do Pará
costa.biodiversidade@gmail.com

Flávia Cristina Araújo Lucas
Universidade do Estado do Pará
copaldoc@yahoo.com.br

Received: 2021-12-10
Evaluated: 2022-01-08
Accepted: 2022-01-18

RIVERINE AGROECOSYSTEMS FROM XINGU AND THE CONSERVATION OF BIODIVERSITY

ABSTRACT: The construction of Belo Monte hydroelectric powerplant caused the eviction of riverine populations who inhabited the islands along Xingu River. Ever since their lifestyle has changed, they have been struggling to rebuild their territories in Xingu region. The goal of this work was to carry out a diagnosis of the agroecosystems formed by the resettled riverine families and to identify their role in the conservation of biodiversity. A field research was carried out in local communities encompassing interviews, guided tours and an ethnobotanical survey. A total of 71 family units took part in this study, and 42 of them were resettled in 10 communities, representing the analyzed sample. We reported a high diversity of crops, managed plants and animals, as well as work strategies and products in each family involved in agroecosystems. We identified 93 species of food plants, preserved in agroforestry areas. The riverine communities are directly related to agrobiodiversity, which is a vital part of biodiversity. Therefore, assuring their territories is an efficient precursor for the formation of agroecosystems.

KEYWORDS: Agrobiodiversity, Amazon, Traditional communities, Hydroelectric.

AGROECOSSISTEMAS RIBEIRINHOS NO XINGU E O SEU PAPEL NA CONSERVAÇÃO DA BIODIVERSIDADE

RESUMO: A hidrelétrica Belo Monte causou o deslocamento territorial dos ribeirinhos que habitavam as ilhas ao longo do rio Xingu. Com a interrupção dos modos de vida, passaram a lutar pela reconstrução do território. O objetivo do presente artigo foi realizar um diagnóstico dos agroecossistemas ribeirinhos na região Xingu e identificar o seu papel na conservação da biodiversidade. Realizaram-se pesquisa de campo nas comunidades com entrevistas, turnês guiadas e levantamento etnobotânico. Participaram 71 unidades familiares, das quais 42 estavam reassentadas em 10 comunidades, perfazendo a amostra da presente análise. Observou-se diversidade de campos manejados, de espécies vegetais e animais, de trabalho e de produtos em cada agroecossistema familiar. Os ribeirinhos estão plantando agrobiodiversidade, que é parte vital da biodiversidade. Identificaram-se 93 espécies de plantas alimentícias, conservadas em espaços agroflorestais. O território garantido na beira do rio é o grande precursor para a formação dos agroecossistemas.

PALAVRAS-CHAVE: Agrobiodiversidade, Amazônia, Comunidades tradicionais, Hidrelétrica.

AGROECOSISTEMAS RIBEREÑOS EN EL XINGU Y SU PAPEL EN LA CONSERVACIÓN DE LA BIODIVERSIDAD

RESUMEN: La hidroeléctrica de Belo Monte provocó el desplazamiento territorial de las comunidades ribereñas que habitaban las islas a lo largo del río Xingú. Con la interrupción de sus modos y medios de vida, comenzaron a luchar por la reconstrucción del territorio. El objetivo de este artículo fue realizar un diagnóstico de los agroecosistemas ribereños en la región del Xingu e identificar su rol en la conservación de la biodiversidad. Se realizó una investigación de campo en las comunidades con entrevistas, visitas guiadas y levantamiento de información etnobotánica. Participaron 71 unidades familiares, de las cuales 42 estaban reasentadas en 10 comunidades, conformando la muestra del presente análisis. En cada agroecosistema familiar se observó diversidad de campos manejados, tanto de especies vegetales como animales, y destinadas tanto al trabajo como a la alimentación. Se identificaron 93 especies de plantas alimenticias, preservadas en corrales agroforestales. Los ribereños están plantando agrobiodiversidad, que es una parte vital de la biodiversidad. El territorio garantizado a la orila del rio es el gran precursor para la formación de agroecosistemas.

PALABRAS-CLAVE: Agrobiodiversidad, Amazonia, Comunidades Tradicionales, Hidroeléctrica.

INTRODUCTION

Agroecosystems are defined as a family or individual productive unit that might comprise nearby units, thus forming a community (GLIESSMAN, 2001). These communities include domesticated plants and animals, biotic and abiotic elements from soil and areas of natural vegetation, where man acts as both producer and consumer (TOEWS, 1996). Such systems only exist because people create them to achieve nutritional and socioeconomic goals; therefore, they encompass social, economic and environmental dimensions (TOEWS, 1996).

To be formed, agroecosystems should select and conserve a diversity and variety of animals, plants and microorganisms. As a result, the interaction among environment and genetic resources, management systems, knowledge and human practices leads to the conservation of agrobiodiversity, also referred to as agricultural biodiversity or genetic resources for food and agriculture (FAO, 2004a). Consequently, agrobiodiversity derives from selection and development processes carried out by farmers, rural populations, fishermen and other culturally diverse communities (FAO, 2004a). In spite of their importance, previous studies have reported a remarkable loss of agricultural diversity, both at genetic and cultural levels, caused mainly by the uncontrolled expansion of industrial agriculture based on monocultures (FAO, 2004b; MACHADO; SANTILLI; MAGALHÃES, 2008; BEVILAQUA et al., 2014; MARCHETTI et al., 2020) and other initiatives that threaten local food production systems along with their associated culture and knowledge (FAO, 2004b). In the Brazilian Amazon, some projects have been established under the agenda of economic development, but several of them are inappropriate to their regional context, generating conflicts and injustice, mainly along the most socioeconomically vulnerable populations (FAINGUELERNT, 2013).

In the Xingu region, the riverine populations have developed agroecosystems along riverbanks, where they perform a set of important traditional activities to obtain food and income sources. However, at this same location – the Xingu River basin – the national government implemented the Belo Monte Hydroelectric Powerplant, the fourth largest dam in the world in relation to installed capacity. The project has begun in 2011 and the production of electricity started partially in 2015. The construction of Belo Monte dam caused the eviction of more than 320 riverine families from riverbanks and, ever since, they have been experiencing a long period of uncertainties regarding the continuity of their culture practices and existence.

Inter-institutional studies with this community have shown that the eviction of families from their territories resulted in the interruption of their traditional ways of life and that the cash compensation, as well as their resettlements in urban regions or areas far away from rivers were neither able to recover their lifestyle nor their housing and working conditions, incomes, and previous community interactions (MPF, 2015; MAGALHÃES; CUNHA, 2017). Between 2015 and 2016, in order to restore the living conditions of affected families, the Norte Energia company started their resettlement along the banksides of Xingu River and the remaining islands after the formation of the Belo Monte reservoir, but this initiative comprised only 121 families.

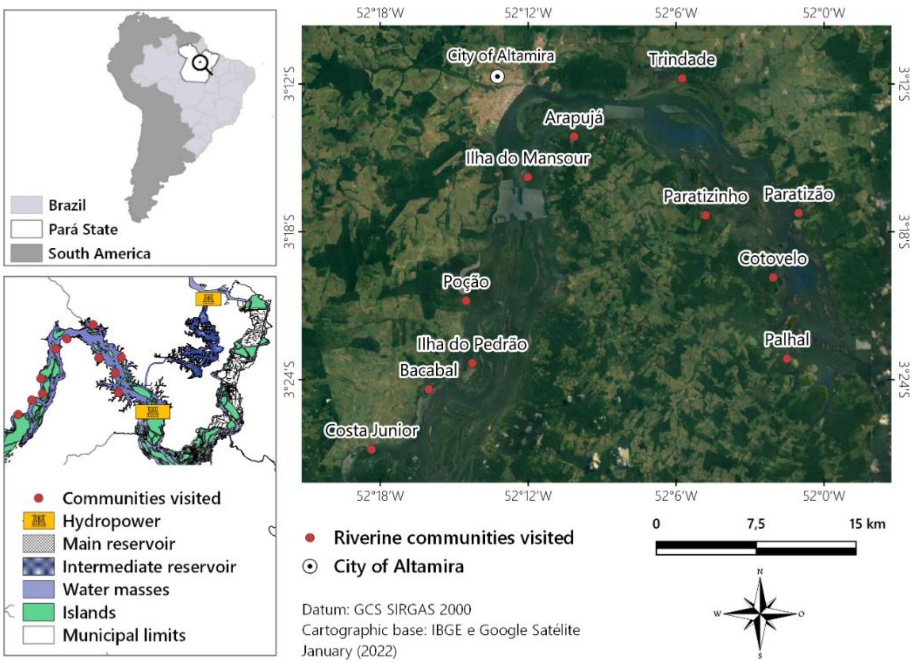
Since then, families have started rebuilding their homes and agroecosystems, reestablishing their way of life in a territory that was environmentally modified by the construction of the hydroelectric powerplant. The present study provides a diagnosis of riverine agroecosystems formed by families resettled in this modified territory in order to identify their role in biodiversity conservation and relevance to food security of local communities.

MATERIAL AND METHODS

This survey was carried out in the municipality of Altamira, southwestern Pará, the main urban center of the Xingu Integration Region, representing the largest municipality in Brazil (159,533.328 km^2) (IBGE , 2021). Historically, this area has been a main target of major projects, being severely disturbed by distinct impacts mainly driven by the construction of the TransAmazon Highway in the 1970s, continuous mining and logging activities (ESCADA et al., 2005), and more recently, by the construction of Belo Monte Hydroelectric Powerplant.

Field trips were performed along rivers in 10 local communities where riverine families were resettled (Figure 1) to identify the participants from the present research.

Figure 1. Map indicating the main reservoir of Belo Monte Hydroelectric Power and the 10 riverine communities visited during field trips in Altamira - PA.



Source: Present research.

The field work took place between April 2016 and June 2019, with periodic visits to the local communities. The participants were interviewed at their home and the family unit (FU) was adopted as research subjects, applying the form to one or more family members who were willing to participate in this study.

The plant diversity associated with the riverine communities was inventoried based on questions available in semi-structured forms, using the "free list" technique, in which the interviewed subjects mentioned the plants he kept in their agroecosystems. Whenever allowed, guided tours were carried out during interview when the owners conducted the researchers in accompanied visits to the areas where the mentioned species were found (ALBUQUERQUE; LUCENA; ALENCAR, 2008).

Botanic samples (MARTINS-DA-SILVA et al., 2014) were identified by taxonomists and their assistants from the Emílio Goeldi Museum in Belém, state of Pará. The scientific nomenclature was updated using the virtual database available in the List of Flora Species from Brazil (JBRJ, 2021), Missouri Botanical Garden - MOBOT (TROPICOS, 2021), The Plant List (2013), New York Botanical Garden (NYBG, 2021) e SpeciesLink (2021). All sampled material was deposited in the collection from the Herbarium MFS Prof.ª Dr.ª Marlene Freitas da Silva at the State University of Pará.

The project was submitted to the Research Ethics Committee (CEP) of Brazil, identified under the protocol CAAE 68990017.1.0000.5174, and approved according to official document #2.270.475. Inasmuch as this study involved the traditional knowledge associated with plants, the present project was also registered in the National System for the Management of Genetic Heritage and Associated Traditional Knowledge (SISGEN), under the number A476196.

DATA ANALYSIS

In total, 71 riverine family units were interviewed; 29 of them were living in the city awaiting authorization for resettlement while the remaining 42 units have already been moved to their communities. Only the group of resettled people were incorporated in the present analysis, since they had available territories along riverbanks to develop their agricultural systems.

The Field trips with interviews, guided tours and personal notes on diary reports allowed us detailing the agroecosystems for further comparison with the international principal and agreements on biodiversity conservation published by the United Nations for the Food and Agriculture Organization (FAO), Convention on Biological Diversity (CDB), Agenda 2030 for Sustainable Development and other scientific publications retrieved in public databases such as Scopus, Elsevier and Capes Periodicals.

The collected data were systematized and categorized using the Content Analysis technique, as described by Bardin (2010) that comprises three main steps: pre-analysis, analytical description and referential interpretation. The technique allowed the elaboration of analytical categories for respondents' answers in relation to the question "What is your life project in relation to the land?". The categorization was based on key elements found in the speeches (CARLOMAGNO; ROCHA, 2016).

RESULTS AND DISCUSSION

The Xingu river banks play a major biocultural role, being significantly related to the survival of local families by encompassing both material and immaterial values. The Xingu River provides fisheries resources, water for domestic activities, leisure and the expression of traditional habits for these communities. It is also essential as a route to the city by and to the outflow of small-scale production. These families organize themselves into communities along the riverbanks, where they build life stories, parenthood and neighborhood relationships, besides accumulating and exchanging traditional knowledge about the environment and local culture.

A total of 10 communities composed of resettled families were visited. These communities are located either upstream or downstream de urban area of Altamira, being locally referred to as: Arapujá, Trindade, Paratizão, Palhal, Cotovelo, Paratizinho, Mansour, Poção, Bacabal, and Pedrão. These communities were alreadt presente before the construction of Belo Monte hydroelectric powerplant, but they have been invariably evicted by this entrepreneurship from 2012 to 2014. Their resettlement took place in 2015 and, ever since, local families have begun rebuilding their homes and agroecosystems. In the following topics, we characterize these agroecosystems and the diversity of their activities, managed crops and vegetal species, along with their role in the conservation of biodiversity. Further challenges and limiting aspects related to the reinforcement of such areas as also pointed out.

AGROECOSYSTEMS AND PLANT DIVERSITY

The assurance of riverbank territories is a key feature to the settlement of local families and, eventually, to the formation of agroecosystems. We reported a remarkable diversity of managed fields (agroforestry backyards and crops), plants, small animals (mainly ducks, chickens and other birds), work activities (fishing, agriculture, extractivism) and products from each family production unit (Figure 2).

Figure 2. Representative example of a riverine agroecosystem in Xingu riverbanks. A) dock; B) family house; C) cocoa plantation; D) banana tree plantation interspersed with an area for the cultivation of soursop; E) corn field where an ipe tree has spontaneously grown; F) poultry.

Source: Present research.

In the abovementioned example, the owner built his house near the dock (Fig. 2-A, B), and divided the area into three productive sectors: the cocoa plantation, which already existed before the resettlement (Fig. 2-C); an orchard with a variety of agricultural crops - banana, corn, cassava, beans, watermelon, orange, papaya, peanut, lemon meringue pie fruit and soursop (Fig. 2-D, E); and a poultry farming (Fig. 2-F). Cocoa seeds are sold (in Kg) in local trade markets; the chickens are used for commercialization, exchange and/or consumption; while the other products are mostly used for consumption and sale, as well as "give-and-take" items among friends and relatives. The corn is also used to feed the poultry that produces manure for the fertilization of crops. The goal is to increase and diversify their products, but the owner complains about the lack of financial support and reduced workforce.

The diversity of plants proved to be a fundamental support to the development of agroecosystems and as food resource to for all riverine communities. A total of 93 species of plants used for feeding were identified, distributed in 40 families and 71 genera. Under this category, we took into account both cultivated and extracted vegetables - roots, stems, leaves to fruits - consumed either *in natura* or as processed foods to the diet of local families.

The most representative species were mango (*Mangifera indica* L.), cashew (*Anacardium occidentale* L.) and guava (*Psidium guajava* L.), mentioned by 76%, 75% and 75% of respondents, respectively. These species are perennial fruits easily found in family backyards and along riverbanks, being usually eaten fresh, or used for the preparation of juices or sweets. In addition to feeding, these vegetables were also mentioned as therapeutic items: leaves of both cashew and guava tree are infused in teas to treat gastrointestinal diseases while the leaves of mango tree are components of the "scented bath", a preparation of water with a set of aromatic plants used to bath and to reduce flu symptoms.

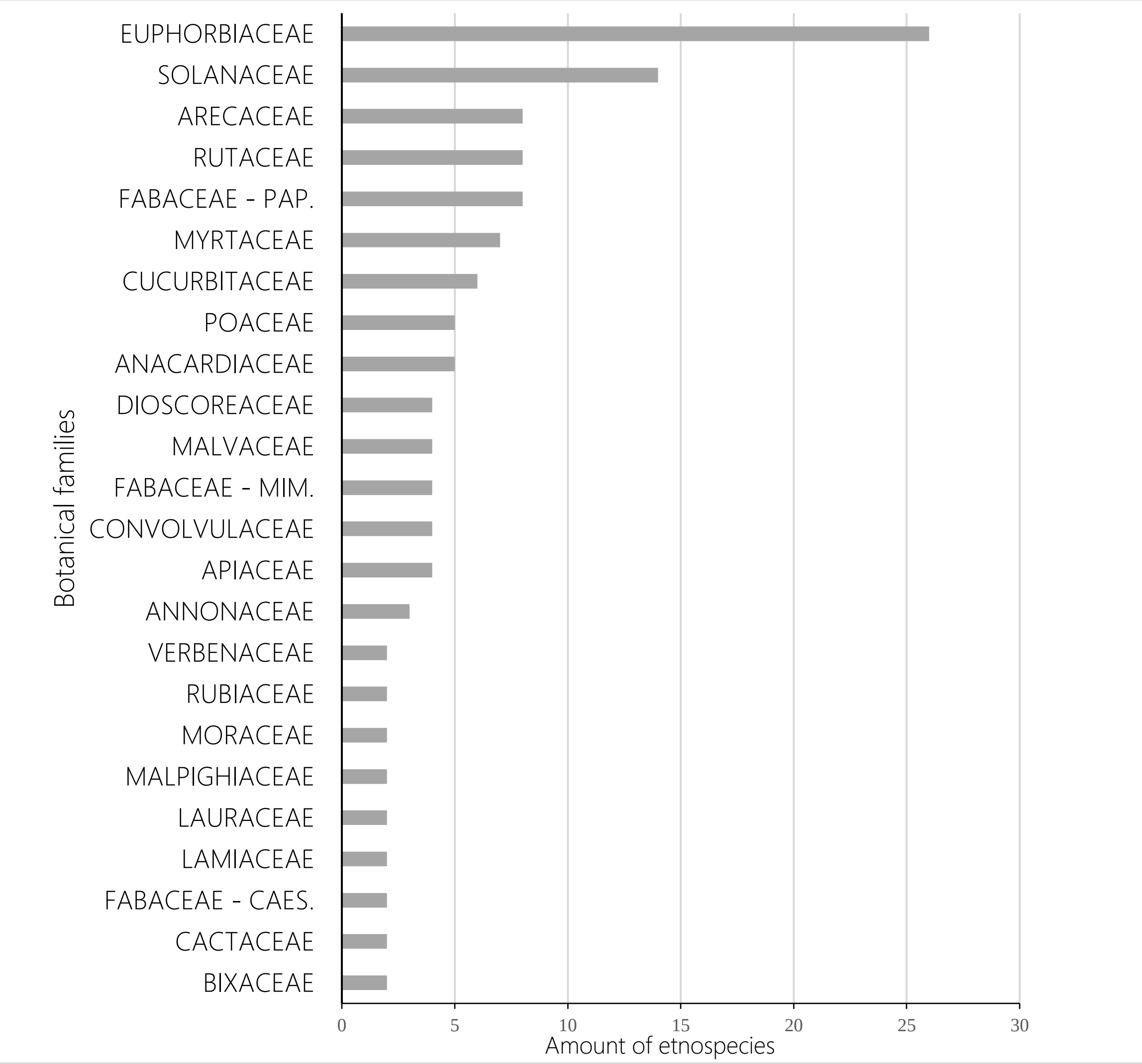
Other plant species that comprised more than 50% of citations were: onion (*Allium fistulosum* L., 66%); parsley (*Petroselinum crispum* (Mill.) Fuss, 63%), banana (*Musa* spp., 68%), lime (*Citrus* spp., 62%), nance (*Byrsonima crassifolia* (L.) Kunth, 62%), orange (*Citrus x aurantium* L. 56%), cassava (*Manihot* spp., 54%), coconut (*Cocos nucifera* L., 52%), corn (*Zea mays* L., 52%), papaya (*Carica* spp., 51%) and watermelon (*Citrullus lanatus* (Thunb.) Matsum & Wakai, 51%).

The botanical families with the highest amount of ethnospecies were Euphorbiaceae and Solanaceae. The former includes the cassava (Manihot spp.), which represent essential annual crops in agroecosystems, whose roots are the raw material for the production of manioc flour, starch for tapioca and tucupi, used for both consumption and sale. Cassava roots are also commonly boiled, fried or as ingredients of cakes for daily meals. In the case of plants from the family Solanaceae, riverine families invariable cultivate many pepper species (*Capsicum* spp.) and tomatoes (*Solanum* spp.) in their backyards to be largely consumed with fish products.

Palm trees (Arecaceae) are recognized as an abundant floristic and ecological component in the analyzed region, providing a range of benefits both as food (fruit parts) and handcraft material (sieves, baskets and fans) or as roof (babassu leaves). The fruit from babassu (*Attalea speciosa* Mart. ex Spreng.) is also a source of oil for cooking or as charcoal for wood stoves. The açaí palm (*Euterpe oleracea* Mart.) represents a particular delicacy since its fruit is used to preparation of drinks, which are also commercialized to complement the income from local families. Other palm trees worth of attention include: coconut (*Cocos nucifera* L.), turu palm (*Oenocarpus. bacaba* Mart) and peach palm (*Bactris gasipaes* Kunth). Their multiple uses indicate the biocultural value of palm trees for the communities inhabiting the Amazon region (GERMANO et al., 2014) and can provide a bioeconomic opportunity for these populations (SILVA; MIRANDA, 2020).

In Figure 3, the 24 most expressive botanical families in terms of ethnospecies are shown. The other 16 families were represented by a single species and have not been incorporated in the graph. These include: Amaryllidaceae, Asteraceae, Brassicaceae, Bromeliaceae, Caricaceae, Lecythidaceae, Lythraceae, Musaceae, Oxalidaceae, Passifloraceae, Pedaliaceae, Piperaceae, Portulacaceae, Sapindaceae, Sapotaceae, and Vitaceae.

Figure 3. Graph showing the amount of ethnospecies per botanical family.



Source: Present research.

Understanding the abundance of botanical groups for riverine communities (Figure 3) means to recognize the dependence of these populations on inhabiting productive territories, managed according to their knowledge. Simultaneously, these data are useful to gather information about native and introduced species and varieties used food crops and their role in environmental services and regulation. Even in face of the uncertainties of further scenarios related to the construction of Belo Monte Hydroelectric powerplant, the riverine populations have maintained their right to food production along with environmental conservation and the recovery of degraded ecosystems.

Each family unit has been committed to provide as many ethnovarieties as possible in their crops, composing a collection. This aspect was particularly noteworthy in relation to the diversity of cassava (*Manihot* spp.), sweet potato (*Ipomoea* sp.), yam (*Dioscorea* spp.), banana (*Musa* spp.) and pepper (*Capsicum* spp.) types. Such productive diversity is regarded as a principle of satisfaction in collecting a certain resource, facilitating the access and the availability of assorted and abundant food types.

Both seeds and seedlings are acquired in multiple ways: in the case of some species, the seeds are bought (e.g., cocoa and corn) while other are purchased as seedlings (e.g., orange, tangerine and lemon). According to the crop, the seeds are planted directly on the ground (corn, pumpkin, watermelon, gherkin) or they produce the seedlings (guava). They also collect propagules from the forest to compose the agroecosystems (e.g., ipe, mahogany, and crabwood trees), thus expanding the composition of native species. Other varieties of seedlings and seeds are obtained from acquaintances, while some others are hard to obtain depending on where the family lives.

The ability in selecting distinct species of interest, preparing agricultural crops, diversifying their production, while protecting and using agroecosystem products indicates a remarkable potential for food sovereignty. As described by Bermeo (2015), this definition implies the right of each people and/or country to define their agricultural and food policies in accordance with environmental sustainability and food security, assuring the access to nutritious and culturally relevant food sources.

HOW DO THE RIVERINE COMMUNITIES CONTRIBUTE WITH THE ECOSYSTEMS?

The riverine population are cultivating agrobiodiversity. Such community effort is a way found to assure food security for those whose survival relies on natural resources. According to the Food and Agriculture Organization of the United Nations (FAO, 2004a), agrobiodiversity is an important aspect of biodiversity, being actively developed and managed by farmers, shepherds and fishermen. In addition, FAO states that "many components of agricultural biodiversity would not survive without human interference; local knowledge and culture are integral parts of agrobiodiversity management" (*ibid*.).

Over the period of the present research, we observed a remarkable growth of agroforestry systems along the resettled family units. In 2016, many families were initiating the construction of their homes and agricultural systems and, after a careful and persistent daily work, they have been able to resettle their territories. In 2021, when the same places were revisited, we reported new green areas in previously deforested localities that have been turned into agroforests (Figure 4).

Figure 4. A comparative illustration based on pictures of the same house from a riverine family unit taken in January 2019 and November 2021.

Source: Present research.

Each individual from these family units rebuilt their identity in this geographic and temporal space stimulated by their sense of property. Thus, the cultivation and the conservation of agrobiodiversity, besides preserving ecosystems, play an important role in maintaining biological diversity.

The Convention on Biological Diversity (CBD) recognizes that "*in situ* conservation of ecosystems and natural habitats, as well as the maintenance and recovery of viable populations of species in natural environments" is a *si ne qua non* step for conserving biodiversity (BRASIL, 1994). According to this premise, a large part of biological diversity has been fostered by *ex situ* conservation, such as germplasm banks, but also by the sustainable use and *in situ* or on-farm conservation, usually carried out by family agricultural systems (NODARI; GUERRA, 2015).

The assured rights to the persistence of farmers and communities in their territories bring hope to the development of their long-term continuity both in material and immaterial terms, besides being beneficial to either *in situ*, *ex situ* or on-farm conservation. On-farm strategies support *ex situ* conservation, especially in cases of technical, financial or administrative failures, since these systems provide sources of germplasm for replacement and can be used to update *ex situ* collections. On the other hand, *ex situ* conservation is also helpful to on-farm systems, especially in cases of losses of genetic material caused by ecological disasters or socioeconomic and cultural changes.

The agrobiodiversity maintained by rural communities in Amazon region is particularly relevant to support on-farm conservation strategies (LIMA et al., 2013). According to Brown (2000), in this perspective, agricultural diversity is maintained within and between populations of many species exploited by agriculture. As a matter of fact, the definition of on-farm conservation commonly refers to the use and cultivation of genetic resources according to the interests of farmers (CLEMENT et al., 2007).

Among other benefits, previous reports and investigations have shown that agrobiodiversity is able to: i) increase productivity, food security and economic income; ii) increase the stability, robustness and sustainability of agriculture systems; iii) conserve the soil and increase its fertility and natural health; iv) improve human nutrition and provide sources of medicines and vitamins; and v) conserve ecosystem structure and species diversity (FAO, 2004a). Furthermore, the relevance of agrobiodiversity is recognized to the development of efficient global scientific goals to promote healthy, sustainable and accessible food systems for populations (PNUD, 2015; WILLETT et al., 2019; FAO; INRAE, 2021).

The Content Analysis technique used in the present work allowed us creating analytical categories based on the answers provided by the respondents in relation to the question: "What is your main life project in relation to the land?". A total of 39% of the 18 people who answered this question affirmed that they are going to prioritize cocoa plantations along with other crops; 22% of them intend to form an orchard with fruit trees (e.g., guava, lime, orange, açaí palm) while 22% want to invest on culturally relevant annual crops (cassava, beans, corn and others). In addition, 11% of respondents reported their intention in maintaining or implementing agroforestry systems and fish ponds; and the remaining 6% reported no specific goals, stating that they would like to make their living on what they plant, which is a unanimous opinion among the interviewed families. Based on these responses, their planning for the land utilization is based on social reproduction, sustainability and the increase of agrobiodiversity systems.

In general, three main aspects were identified to support the studied agroecosystems: the territory, the conservation of agrobiodiversity and the family/community activity. The conservation of species is a key factor to maintain their productive capacity and, consequently, to provide sustainability. Conservation also implies in maintaining agroecological integrity, otherwise everything else would perish.

The family activity is also a fundamental component: the involvement of families and communities in these activities influences the maintenance of agroecosystems which, in turn, benefits the population by providing food sources.

CONCLUSION

Among the main social and environmental impacts experienced by the population presently studied, we should highlight the displacement of their original homes and the interruption of their way of life. After social struggles, families have been assured the right to return to their territories along Xingu River and to rebuilt their spaces for housing, planting and conservation of agrobiodiversity.

The agroecosystems formed by family units encompass multi-dimensional diversity aspects, such as biological species, managed fields, labor activities and products. The riverine populations are committed to cultivate a wide variety of plants as a strategy for obtaining food and income, thus forming collections of biocultural value. Such interest in cultivating a wide variety of resources is an efficient way to ensure food security for those who rely on what nature offers besides contributing to the conservation of their local ecosystems.

As an outcome, the construction of Belo Monte hydroelectric powerplant jeopardized the food sovereignty of local populations. Nonetheless, the valorization and documentation of agrobiodiversity used as food sources from riverine communities might strengthen the development of agroecosystems in this territory and the improvement and accessibility of sustainable food systems of cultural and nutritional importance.

ACKNOWLEDGMENTS

The authors are grateful to the riverine communities from Xingu, the “forest guardians”, that took part in this study, to CAPES for the financial support, to the herbarium MFS Prof.ª Dr.ª Marlene Freitas da Silva for the assistance in the identification and record of samples species and every

single person that contributed with this study.

REFERENCES

ALBUQUERQUE, U. P.; LUCENA, R. F. P. de; ALENCAR, N. L. Métodos e técnicas para coleta de dados etnobiológicos. *In*: ALBUQUERQUE, U. P. de; LUCENA, R. F. P. de; CUNHA, L. V. F. C. da. (Orgs.). **Métodos e técnicas na pesquisa etnobiológica e etnoecológica**. Recife, PE: NUPPEA, 2008. p. 41-64.

BARDIN, L. **Análise de conteúdo**. Lisboa: Edições 70, 2010. 280 p.

BERMEO, F. E. La seguridad alimentaria y el desafío de los GAD provinciales. *In*.: BAROJA, *et al*. **Seguridad alimentaria:** responsabilidad de los Gobiernos Autónomos Descentralizados Provinciales. Quito: Ediciones Abya-Yala, 2015. p. 15-71.

BEVILAQUA, G. A. P.; ANTUNES, I. F.; BARBIERI, R. L.; SCHWENGBER, J. E.; SILVA, S. D. A.; LEITE, D. L.; CARDOSO, J. H. Agricultores guardiões de sementes e ampliação da agrobiodiversidade. **Cadernos de Ciência & Tecnologia**, Brasília, DF., v. 31, n. 1, p. 99-118, jan./abr. 2014. Disponível em: http://www.alice.cnptia.embrapa.br/alice/handle/doc/994218. Acesso em 10 nov. 2021.

BRASIL. Decreto Legislativo n.º 2, de 1994. Aprova o texto do Convenção sobre Diversidade Biológica, assinada durante a Conferência das Nações Unidas sobre Meio Ambiente e Desenvolvimento, realizada na Cidade do Rio de Janeiro, no período de 5 a 14 de junho de 1992. **Diário Oficial da União**: seção 1, Brasília, DF, 1994. Disponível em: https://www2.camara.leg.br/legin/fed/decleg/1994/decretolegislativo-2-3-fevereiro-1994-358280-publicacaooriginal-1-pl.html. Acesso em: 01 dez. 2021.

BROWN, A. H. D. The genetic structure of crop landraces and the challenge to conserve them in situ on farms. *In*: BRUSH, S. B. **Genes in the field**: On-farm conservation of crop diversity. Lewis Publishers: Florida; International Development Research Centre: Otawa, 2000. p. 29-48.

CARLOMAGNO, M. C.; DA ROCHA, L. C. Como criar e classificar categorias para fazer análise de conteúdo: uma questão metodológica. **Revista Eletrônica de Ciência Política**, v. 7, n.1, 2016. Disponível em: http://dx.doi.org/10.5380/recp.v7i1.45771. Acesso em 10 fev. 2021.

CLEMENT, C. R.; ROCHA, S. F. R.; COLE, D. M.; VIVAN, J. L. Conservação *on farm*. *In*: NASS, L. L. **Recursos genéticos vegetais**. Brasília: Embrapa Recursos Genéticos e Biotecnologia, 2007. p. 511-544.

ESCADA, M. I. S.; VIEIRA, I. C. G.; KAMPEL, S. A.; ARAÚJO, R.; VEIGA, J. B. D.; AGUIAR, A. P. D.; FEARNSIDE, P. M.; *et al*. Processos de ocupação nas novas fronteiras da Amazônia: o interflúvio do

Xingu/Iriri. **Estudos avançados**, v. 19, n. 54, p. 9-23, 2005. Disponível em: https://www.scielo.br/j/ea/a/crXwBbbPs4RbCJCD7GT8Mrp/?format=pdf&lang=pt. Acesso em 20 nov. 2021.

FAINGUELERNT, M. B. **Belo Monte**: o Estado democrático de direito em questão. 1 Ed. Rio de Janeiro: Apicuri, 2013. 74 p.

FAO. Food and Agriculture Organization of the United Nations. What is agrobiodiversity? *In*: FAO. **Building on Gender, Agrobiodiversity and Local Knowledge**. Rome, Italy: FAO, 2004a. Disponível em: https://www.fao.org/3/y5609e/y5609e01.htm#bm1. Acesso em: 21 nov. 2021.

FAO. Food and Agriculture Organization of the United Nations. What is happening to agrobiodiversity? *In*: FAO. **Building on Gender, Agrobiodiversity and Local Knowledge**. Rome, Italy: FAO, 2004b. Disponível em: https://www.fao.org/3/y5609e/y5609e02.htm#bm2. Acesso em: 21 nov. 2021.

FAO; INRAE. **Facilitando sistemas alimentarios sostenibles**: Manual para innovadores. Roma, Italy: FAO, 2021. ISBN: 978-92-5-133952-7. Disponível em: https://doi.org/10.4060/ca9917es. Acesso em: 25 nov. 2021.

GERMANO, C. M.; LUCAS, F. C. A.; TAVARES-MARTINS, A. C. C.; MOURA, P. H. B. de; LOBATO, G. J. M. Comunidades ribeirinhas e palmeiras no município de Abaetetuba, Pará, Brasil. **Scientia Plena**, v. 10, n. 11, p. 1-10, 2014. ISSN: 1808-2793. Disponível em: https://www.scientiaplena.org.br/sp/article/view/2217. Acesso em: 20 out. 2021.

GLIESSMAN, S. R. **Agroecologia**: processos ecológicos em agricultura sustentável. 2. ed. Porto Alegre: EdUFRGS, 2001.

IBGE. Instituto Brasileiro de Geografia e Estatística). **Território e Ambiente.** 2021. Disponível em: https://cidades.ibge.gov.br/brasil/pa/altamira/panorama. Acesso em: 17 de fev. 2021.

JBRJ. Instituto de Pesquisas Jardim Botânico do Rio de Janeiro. **Flora e Funga Brasileira**, 2021. Disponível em: http://floradobrasil.jbrj.gov.br/reflora. Acesso em: 05 out. 2021.

LIMA, P. G. C.; SILVA, R. O. da; COELHO-FERREIRA, M. R.; PEREIRA, J. L. G. Agrobiodiversidade e etnoconhecimento na Gleba Nova Olinda I, Pará: interações sociais e compartilhamento de germoplasma da mandioca (*Manihot esculenta* Crantz, Euphorbiaceae). **Boletim do Museu Paraense Emílio Goeldi. Ciências Humanas**, v. 8, n. 2, p. 419-433, 2013. Disponível em: https://doi.org/10.1590/S1981-81222013000200012. Acesso em: 10 set. 2021.

MACHADO, A. T.; SANTILLI, J.; MAGALHÃES, R. **A agrobiodiversidade com enfoque agroecológico:** implicações conceituais e jurídicas. Brasília, DF: Embrapa Informação

Tecnológica: Embrapa - Secretaria de Gestão e Estratégia, 2008. 98 p. Disponível em: http://www.alice.cnptia.embrapa.br/alice/handle/doc/123784. Acesso em: 10 set. 2021.

MAGALHÃES, S. B.; CUNHA, M. C. **A Expulsão de Ribeirinhos em Belo Monte**. Relatório da SBPC. São Paulo: Sociedade Brasileira para o Progresso da Ciência, 2017. Disponível em http://portal.sbpcnet.org.br/. Acesso em 09 set. 2021.

MARCHETTI, F.; MORUZZI, M.; DOS SANTOS, P. E., DOS SANTOS, D. J.; CAMPELO E SILVA, F. O. Caminhos da reforma agrária no Brasil e suas implicações para a agrobiodiversidade. Estudos Sociedade e Agricultura, Rio de Janeiro, v. 28, n. 2, p. 284-311, jun. 2020. Disponível em: https://doi.org/10.36920/esa-v28n2-2. Acesso em: 20 nov. 2021.

MARTINS-DA-SILVA, R. C. V.; SILVA, A. S. L.; FERNANDES, M. M.; MARGALHO, L. F. **Noções morfológicas e taxonômicas para identificação botânica**. Brasilia, DF: Embrapa, 2014. 115 p. ISBN 978-85-7035-332-0. Disponível em: https://www.embrapa.br/busca-de-publicacoes/-/publicacao/992543/nocoes-morfologicas-e-taxonomicas-para-identificacao-botanica. Acesso em 20 jun. 2021.

MPF. Ministério Público Federal. **Relatório de Inspeção interinstitucional:** áreas ribeirinhas atingidas pelo processo de remoção compulsória da UHE Belo Monte. Procuradoria da República no Pará, Altamira, 2015.

NODARI, R. O.; GUERRA, M. P. A agroecologia: estratégias de pesquisa e valores. **Estudos avançados**, v. 29, n. 83, p. 183-207, jan./abr. 2015. Disponível em: https://doi.org/10.1590/S0103-40142015000100010. Acesso em 20 nov. 2021.

NYBG. New York Botanical Garden. **Coleções e recursos.** Banco de Dados. Nova York, 08 out. 2021. Disponível em: https://www.nybg.org/. Acesso em: 08 out. 2021.

PNUD. Programa das Nações Unidas para o Desenvolvimento. **Objetivo 2**: Fome Zero. Nova York, set. 2015. Disponível em: https://www.undp.org/sustainable-development-goals#zero-hunger. Acesso em: 30 set. 2021.

SILVA, A. J. B. da; MIRANDA, I. P. de A. Potencial bioeconômico das palmeiras e seus insumos como oportunidade de desenvolvimento sustentável para as comunidades locais. **Meio Ambiente, Sustentabilidade e Tecnologia,** v. 3. Belo Horizonte: Poisson, 2020. ISBN: 978-65-86127-29-4. Disponível em: https://repositorio.inpa.gov.br/handle/1/36922. Acesso em 20 nov. 2021.

SPECIESLINK. **Sistema de Informação Distribuído para Coleções Biológicas**: a Integração do Species Analyst e do SinBiota. Centro de Referência em Informação Ambiental - CRIA. Fundação de Amparo à Pesquisa do

Estado de São Paulo. São Paulo, 2021. Disponível em: https://splink.cria.org.br/. Acesso em 08 out. 2021.

THE PLANT LIST. **Versão 1.1**. Publicado na internet, 2013. Disponível em: http://www.theplantlist.org/. Acesso em: 08 out. 2021.

TOEWS, D. W. Ecosystem health: a framework for implementing sustainability in agriculture. **Bioscience**, v. 46, n. 9, p. 686-689, 1996. Disponível em: https://watermark.silverchair.com/ Acesso em: 10 fev. 2021.

TROPICOS. Jardim Botânico do Missouri, Saint Louis, 2021. Disponível em: tropicos.org. Acesso em: 07 out. 2021.

WILLETT, W. *et al*. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. **The Lancet**, v. 393, p. 447–492, 2019. Disponível em: https://www.thelancet.com/action/showPdf?pii=S0140-6736%2818%2931788-4. Acesso em: 10 dez. 2020.