Biodiversity for Food and Nutrition: Promoting Brazilian Underutilized Edible Plants into Food and Nutrition Security National Policies

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1 Introduction

Brazil is considered the main country among the 17 megabiodiverse countries, holding 15 to 20% of the world's biodiversity. The country has the greatest wealth of flora in the world, as well as the largest remnants of tropical ecosystems (Ulloa Ulloa et al. 2017). In addition to possessing an immense biodiversity, Brazil also has a rich sociocultural diversity, represented by many traditional peoples and communities, such as indigenous, *quilombolas*, riverine communities, artisanal fisherfolk, *caçaras*, *sertanejos*, and *pantaneiros*, among others, that have a strong relation with the biodiversity of the environment in which they live and are guardians of a huge body of traditional knowledge (knowledge, beliefs, and customs) about their use and conservation (SEDS 2020; MMA 2018a).

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Paradoxically, for decades, because we have not been valuing our natural resources, we are reducing the use of biodiversity and the use of the species that surround us, thereby increasing the fragility of the food system. The country's agriculture and food security are very reliant on exotic or introduced crops or species from other regions of the world, such as sugar cane, soy, orange, and rice from Asia; coffee originating in Africa; or maize from Central America (Cunha Alves & Azevedo 2018). There is a steady expansion of export-oriented agribusiness, characterized by large land concentration, monoculture prevalence, and expansion of livestock production, reinforcing unsuitable and unsustainable land management practices that contribute to the destruction of natural habitats and to the loss of native biodiversity in Brazil (Beltrame et al. 2018).

At the same time, Brazil faces dietary simplification and high levels of malnutrition, even though much of this neglected native biodiversity is highly nutritious. As we use a smaller number of species, the proper consumption of food and nutrients needed to promote the growth, development, and maintenance of our health is put at risk. This was evidenced in the Household Budget Survey (POF 2008–2009) (IBGE 2010): only 10 fruits (orange, banana, apple, papaya, mango, watermelon, tangerine, grape, pineapple, and *açaí*) correspond to 91% of total fruits consumed by Brazilians. Of these, only pineapples and *açaí* are native to Brazil; the other eight species originate from other countries. In addition, only 25% of Brazilians consume the amount of fruits and vegetables recommended by the World Health Organization (400 g per day), that is, foods that provide important nutrients for health, such as vitamins, minerals, and dietary fiber.

It is worth mentioning, however, that markets continue to demand new product options, which is why Brazilian biodiversity presents an enormous potential to satisfy these demands and generate wealth. Exploring these food sources could also help to provide sustainable solutions to diversifying diets, also tackling malnutrition problems, and promoting agricultural development through local food procurement, while also promoting biodiversity conservation and climate change adaptation and resilience.

To this end, the need to develop new public policies that could, on the one hand, contribute to ensuring the protection of native biodiversity and, on the other hand, improve the food security of the population was evident. It is easy to verify, in the different regions of Brazil the existence of a great number of species of current economic value or of potential use, whose use remains restricted to local or regional level. Increasingly, initiatives dedicated to meeting market demands for new products occupy a prominent position. Thus, it was clear that the country needed to intensify investments aimed at increasing knowledge about native species, including better utilization of this rich biodiversity, so that native species could become better known and used by society.

Knowledge and evidence gaps still needed to be addressed to better integrate biodiversity for enhancing food and nutrition security, including scientific data on the nutritional value and composition of native neglected species. To this end, the

Biodiversity for Food and Nutrition Project (BFN) in Brazil worked from 2012 to 2018 to strengthen the conservation and sustainable use of biodiversity by providing evidence of its benefits for nutrition and well-being, mainstreaming biodiversity into national food and nutrition policies and strategies, and increasing awareness of the potentials offered by native biodiversity. The Project generated food composition data, influenced policies, developed recipes, and helped to increase appreciation of the value of underutilized, nutrient-rich biodiversity through strategic research partnerships with universities and research institutes and advocacy and lobbying at policy and regulatory frameworks related to food and nutrition security.

The GEF-funded Biodiversity for Food and Nutrition Project was led by Brazil, Kenya, Sri Lanka, and Turkey and was coordinated by Biodiversity International with implementation support from the United Nations Environment Program (UNEP) and the Food and Agriculture Organization of the United Nations (FAO).

The four countries participating in the project represent some of the world's most megadiverse countries thanks to the extraordinary diversity of ecosystems and species existing within their borders. They each contain unique biological diversity and have associated traditional ecological knowledge that supports a large proportion of the world's food supply in a range of ecosystems that are global priorities for conservation. The project sought to address the issue of diminishing the use of local agrobiodiversity by contributing to the improvement of global knowledge of biodiversity for food and nutrition and, in so doing, enhancing the well-being, livelihoods, and food security of target beneficiaries in the four countries through the conservation and sustainable use of this biodiversity and the identification of best practices for up-scaling.

Globally, the BFN has made a number of highly significant contributions to global policy, including the Voluntary Guidelines for Mainstreaming Biodiversity into Policies, Programmes and National and Regional Plans of Action (FAO 2016) and inputs to the document UNEP/CBD/SBSTTA/19/INF/1: "Strategic Scientific and Technical Issues Related to the Implementation of the Strategic Plan for Biodiversity 2011-2020: Biodiversity, Food Systems and Agriculture" (CBD 2015).

Through the focus on mainstreaming biodiversity in the different sectors, the project contributed to multiple environmental outcomes linked to Sustainable Development Goals (SDGs) and Aichi Biodiversity targets, as well as social and economic benefits. These include limiting biodiversity loss; mitigating climate change; strengthening seed systems to ensure that biodiversity is conserved, available, and accessible; developing markets that ensure that a diversity of foods is available and affordable; reviving traditional knowledge and cultural heritage; supporting rural development; and strengthening local economies. A food system transformed in this way contributes to environmental conservation while providing income generation benefits, especially for the youth and for vulnerable groups, including women, smallholder farmers, indigenous people, and local communities, as a result of diversification options (FAO 2019).

2 Project Components and Key Interventions

2.1 *Knowledge Base*

The starting point for increasing the knowledge base about Brazilian neglected species was the Plants for the Future, an ongoing initiative from the Ministry of the Environment that aims to prioritize native flora species of current economic value or potential use, as well as to raise the attention of the Brazilian people to the enormous possibilities and opportunities of using these species. The initiative was established in Brazil in the early 2000s and was designed to respond to the concerns and aspirations of the society and to change the current scenario regarding the use, conservation, and benefits that can be generated from native species. This initiative aimed at offering to the society new options to meet the growing demand for new species of food, aromatic, medicinal, and cosmetic interest, among other possible uses. It identified and prioritized native species from the Brazilian flora of current or potential use, allowing new choices to farmers and, in the case of food species, creating new gastronomic possibilities, rescuing traditional knowledge, and diversifying options for the Brazilian cuisine. The initiative was developed through the implementation of five subprojects, one for each of the five major geopolitical regions of the country, in order to value and draw attention to the importance of the native species of each region as well as for regional traditions. The species were prioritized through a careful work conducted in partnership with specialists from all different regions of Brazil, based on predetermined criteria for each of the defined groups of use for each region (food, aromatic, fibrous, forage, medicinal, oleaginous, and ornamental, among others).

Books from the Plants for the Future collection are available in the Ministry of Environment's publications website.¹ From this work, new species of Brazilian flora are being made available to farmers, with special attention to family agriculture, which can find new options to diversify their crops. In the same way, new investment opportunities for the business sector are being generated in the development of new products to help to boost the Brazilian bioeconomy, as well as offering new perspectives and incentives for the use of native species in governmental policies and programs.

The BFN project selected 78 underutilized edible species identified by the Plants for the Future to carry out nutritional composition analysis, in partnership with public universities and research institutes across the country. The food composition work followed methodologies developed by the Food and Agriculture Organization of the United Nations and the International Network for Food Data Systems (FAO/INFOODS). Initially, data was compiled from scientific literature, documents, and reports from local universities and research institutes. Gap analysis revealed lack of reliable data for many nutrients for most fruit species, especially dietary fiber,

¹Available at: <https://www.mma.gov.br/publicacoes/biodiversidade/category/54-agrobiodiversidade>

vitamins, and minerals. Therefore, in a second stage, laboratorial analysis was carried out. The results were made available online on the Biodiversity and Nutrition² tool (SiBBR 2018), a food composition database developed by the BFN Project in partnership with the Information System on Brazilian Biodiversity (SiBBR) at the Ministry of Science, Technology and Innovation (MCTI).

Numerous students, professors, and researchers were involved in the food composition research and results proved that many of the prioritized native species were richer in nutrients compared with more commonly consumed exotic foods in Brazil (Beltrame et al. 2016). For example, the fruit camu-camu (*Myrciaria dubia* (Kunth) McVaugh) contains 30 times more vitamin C than oranges (1620 mg/100 g versus 53 mg/100 g) the flour from the babaçu (*Attalea speciosa* Mart. ex Spreng) mesocarp contains 18,3 mg of iron per 100 g, compared to 1 mg in the same amount of wheat flour or 2,3 mg in maize flour, while the baru nut (*Dipteryx alata* Vogel) contains 30 mg of protein/100 g, compared to 14 mg in walnuts and 18 mg in almonds (NEPA 2011; SiBBR 2018). Being non-domesticated wild species, the nutritional value of these underutilized foods can vary greatly depending on the harvest location. For example, samples of camu-camu are reported to contain up to 6112 mg of vitamin C/100 g of pulp (Yuyama et al. 2002).

Working through regional partners ensured the development of capacities in different regions of the country and scaling up research and extension activities that were already developed regionally. It also helped to raise awareness among students, researchers, and professors about the importance of food composition and the role of Brazilian underutilized edible species. These groups acted as multipliers within education and research institutions, building additional human capacity.

Federal ministries linked to initiatives such as the National School Feeding Program (PNAE), the Food Procurement Program (PAA), and the Minimum Price Guarantee Policy for Sociobiodiversity Products (PGPM-Bio) can benefit from the food composition data to demonstrate the value of native species as sources of nutritious foods and, potentially, sources of income for family farmers and communities. Similarly, the nutrition benefits of native biodiversity to diversify and improve the nutritional content of diets can be demonstrated to consumers.

2.2 Influencing Policies

Another key component of the BFN Project and one of the strategies to address the barriers identified by the Project Preparation Phase, such as “poorly developed infrastructure and markets,” “trade policies that undermine promotion and consumption of BFN,” and “inadequate agricultural and food security policies and strategies,” was mainstreaming biodiversity into public policies related to food and nutrition security, agriculture, rural, and social development, education, and health.

² Available at: <https://ferramentas.sibbr.gov.br/ficha/bin/view/FN>

At an early stage of the BFN Project, the partners involved – which included representatives of the ministries of the environment, agriculture, social development, agrarian development, science and technology, education, and health, as part of the federal framework at the time – identified an already established federal multi-sectoral institutional framework and associated federal initiatives and policies as a strategic opportunity to enhance the mainstreaming of biodiversity for improved food and nutrition outcomes. A project governance mechanism – the National Steering Committee – was established to coordinate and manage this partnership transparently and included the abovementioned ministries as well as representatives of the National Supply Company (CONAB), the Brazilian Agricultural Research Corporation (EMBRAPA), and the National Food and Nutrition Security Council (CONSEA).

Through partnership with these institutions, the BFN project team was involved in a series of national activities promoting the importance of biodiversity for food and nutrition within the following federal government initiatives: the Food Procurement Program (PAA), National School Feeding Program (PNAE), Minimum Price Guarantee Policy for Sociobiodiversity Products (PGPM-Bio), National Plan for the Promotion of Sociobiodiversity Value Chains (PNPSB), Development of Organic Agriculture (Pro-Orgânico), National Plan for Agroecology and Organic Production (PLANAPO), and National Food and Nutrition Policy (PNAN). This framework of public policies was not static, so new plans and programs were created or concluded during the lifetime of the BFN Project.

Many of these federal initiatives presented entry points for improving nutrition or livelihoods with links to underutilized species, for example, the PAA and PNAE, two long-lasting and robust food procurement programs: at least 30% of the food purchased through PNAE with federal funds must be bought directly from family farmers, while both the PNAE and the PAA pay a premium of up to 30% in the price of organic or agroecological produce and prioritize purchases from settlers of the agrarian reform and traditional communities, such as *quilombolas* and indigenous communities. These were key incentives and subsidies for procuring native neglected and underutilized food species for public food procurement. In doing so, these programs created unique opportunities for the use of natural resources from the various Brazilian ecosystems and promoted the opportunity for the development of new institutional markets for underutilized plants and their products while provided incentives for the management and sustainable use of Brazilian food and agricultural biodiversity (Beltrame et al. 2016).

A major achievement in Brazil and critical to the success of public policies to increase the attention given to native neglected species was the development of a new supporting policy, the *Official list of native Brazilian sociobiodiversity species of nutritional value* published by Ordinance N°163/2016 (Brazil 2016) and updated by Ordinance N° 284/2018 (Brazil 2018a), which officially defined and recognized over 100 Brazilian underutilized food species. This was the first policy of its kind in the country able to incentivize the production and consumption of nutritious neglected and underutilized species, facilitating greater procurement of these species and their integration into school feeding and other federal initiatives.

The list of sociobiodiversity species was a response to meet the demands by the institutions responsible for the PAA, whose employees struggled to identify neglected and underutilized native species that were valid for incentives reserved for regional food products. Ministries now refer to the ordinance list to monitor PNAE and PAA institutional purchases of native biodiversity species as well as to expand the number of species included in PGPM-Bio, initiatives which support production and marketing (with a fair price) for family farmers. The inclusion of target underutilized species in the ordinance has greatly increased their marketing potential and ultimately, and smallholders are encouraged to conserve, use, produce, and commercialize local native species.

Many steps were taken in this direction, as one example, on the supply side, the ordinance has provided the 25 million communities of gatherers and family farms who continue managing and growing the native species (MMA 2019) with a dependable market outlet for their produce. A derived public policy has created additional market incentives by establishing a sociobiodiversity label for all produce and products in the list of native Brazilian sociobiodiversity species. The label was initially created in 2018 by Ordinance N° 129/2018 and updated by Ordinance N° 161/2019 (Brazil 2018b; Brazil 2019a). The label can be requested by family farmers, cooperatives, and small and medium enterprises with a strong participation in family farming who have registered with the National Program to Strengthen Family Farming (PRONAF). Together, the registration to PRONAF and the sociobiodiversity label open up additional market opportunities for family farmers and communities of gatherers.

The promotion and monitoring of the use of native biodiversity in school procurement has also benefited from the creation of a food quality index called Food and Nutrition Security Quality Index (Índice de Qualidade da Coordenação de Segurança Alimentar e Nutricional – IQ COSAN) (FNDE 2018), a tool developed to guide nutritionists that develop school menus. It allocates point-based ratings to school meals depending on levels of dietary diversity and the absence of unhealthy foods such as sugars, sweets, and processed and fried foods. An additional 2.5 points are allocated if meals include any number of the native species listed by Ordinance N° 284/2018. IQ-COSAN is acting as both a regulatory mechanism for healthy eating in schools, in line with the country's nutrition guidelines, and an incentive for school nutritionists and school managers to incorporate underutilized native species into school meals to increase their ratings (FNDE 2018).

Another significant achievement in the Influencing Policies component was the BFN's contributions to the second edition of the Dietary Guidelines for the Brazilian Population (Fig. 1) (MS 2014), launched by the Ministry of Health and its National Food and Nutrition Policy (PNAN). The Dietary Guidelines highlighted Brazil's rich heritage of neglected and underutilized species, their associated traditional knowledge and food cultures, and also considered that healthy diets derive from socially and environmentally sustainable food systems. Among the supporting documents developed to assist the implementation of the revised dietary guidelines in Brazil was the BFN's contribution to the new edition of Brazilian Regional Foods (Fig. 1) (MS 2015), including a chapter on "Biodiversity for Food and Nutrition."

sustainable use of biodiversity to achieve food sovereignty. Some recommendations focused especially on expanding public policies and actions to ensure self-sufficiency for family farmers through agroecological practices and promotion of biodiversity, such as the creation of organic seed banks and the promotion of value chains for non-conventional vegetables and native fruits.

By interacting with CONSEA and working with partner ministries on government plans such as the National Plan for Food and Nutrition Security (PLANSAN 2016–2019), the National Pact for Healthy Food, and the National Plan for Agroecology and Organic Production (PLANAPO), BFN promoted biodiversity as one of the solutions for combating food and nutrition insecurity, to promote healthy diets and improve producers' livelihoods (Beltrame et al. 2016).

2.3 *Raising Awareness*

Activities to promote and raise awareness of native biodiversity species, as a third component of the BFN Project, included the development of recipes using prioritized neglected and underutilized species. The collection of 335 recipes was made available online in the book *Brazilian Biodiversity: Tastes and Flavours*³ (Fig. 2) (Santiago and Coradin 2018). This recipe book was also a result of a participatory

Fig. 2 Book with the collection of 335 recipes using ingredients from neglected species from Brazilian biodiversity published by the BFN Project

³Available at: <https://www.mma.gov.br/publicacoes/biodiversidade/category/54-agrobiodiversidade.html>

process that involved researchers, chefs, and students from partner universities and research institutes across the country.

Sociobiodiversity species were also highlighted in the 2nd Best Recipes from School Meals awards, a competition promoted by PNAE with school cooks, and a chapter about Brazilian biodiversity was included in the book derived from the awards (FNDE 2018). The award saw school cooks from all over Brazil competing in the preparation of the healthiest and most nutritious school meal that is also appealing to students. In 2018, 2252 school cooks from Brazil's 5 regions took part in the competition.

Another example of capacity building and awareness raising was the establishment of partnerships with the Educating through School Gardens and Gastronomy Project (PEHEG) to diversify school curricula using school gardens and gastronomy as educational tools which helped to promote healthy eating habits, appreciation of regional ingredients and recipes, learning of cooking techniques, as well as experiencing flavors, food textures, and aromas of native neglected and underutilized species among schoolchildren. The inclusion of Brazilian underutilized edible plants in school feeding and school curricula through PEHEG represented a cultural appreciation of local resources and food practices, raising awareness and recognition of traditional knowledges and techniques of cultivation, rational extraction, production, and transformation. In addition, it contributed to the food and nutrition security of the communities involved with each school of this Project, as those foods were rich in micro and macronutrients. The PEHEG contributed to the process of educating, empowering, and engaging the educators and public agents, as well as the members of the school communities about those themes, through the implementation of school gardens and activities related to gastronomy as pedagogical tools for environmental and food and nutrition education. In short, this Project helped to create awareness about healthy eating and environmental issues, encouraging the students and communities to promote the necessary transformations to build a more sustainable society (Santos et al. 2020).

As part of the effort to improve the production chain of native biodiversity and add more value to the products, a series of booklets on best practices for the sustainable collection of wild, organic native products was published by the Ministry of Agriculture (MAPA 2014) and the Ministry of the Environment (MMA 2018b) for 21 species, 15 of which are species prioritized and proposed by the BFN project. The booklets were divided in two series, one targeting the producers themselves and the other with more technical information for extension workers who provide assistance to the producers. This was a main achievement to tackle one of the barriers for increasing markets and demand for native biodiversity identified, since most of these foods are not domesticated and cultivated, but collected from the wild, highly perishable and demand special care for their production, processing, transportation, and storage, in order to achieve the desired quality standards demanded by consumers (Beltrame et al. 2016).

To raise awareness about native neglected food species with the general population, the BFN project also organized or participated in a number of cultural exhibitions and gastronomic events in different Brazilian cities (Fig. 3), for example,

Fig. 3 Examples of events and tasting sessions organized by the BFN project to raise awareness and about neglected food species from the Brazilian biodiversity. Photos credits: Shawn Landarz, Itamar Sandoval, Julceia Camillo

cooking demonstrations and tasting, promotion of farmers markets with native species, and campaigns such as the “Organic Food Week” organized by the federal government in different Brazilian cities. To celebrate the conclusion of project’s activities, the Biodiversity for Food and Nutrition International Symposium was held in Brasília in 2017, with the presence of government’s authorities and other partners from federal ministries, researchers, students, and chefs from Brazil and abroad. During the Symposium, the main results of the project were presented (including cooking demonstrations and a tasting session with the recipes developed by the partners for the “Brazilian Biodiversity: Tastes and Flavors” book), and ideas for future actions were discussed.

3 Outcomes

The BFN Project together with the Plants for the Future initiative has contributed to increase the knowledge and awareness about the role of native biodiversity for food and nutrition security in Brazil today so weakened by the restriction and strong dependence on few species. With the inclusion of new species in the agricultural system, the country begins to have new and unusual cultivation options, as well as a better condition to face the global environmental changes, including climate change. In addition to promoting conservation activities, encouraging the use of new options

of agricultural interest, and providing information on hundreds of native plants of real or potential value, these actions will certainly contribute to promote the formation of new productive chains. This work is critical to increase information and change society's perception of the strategic importance of conserving biodiversity and native genetic resources.

At the end of the BFN Project, changes in behaviors and attitudes were evident within ministries and federal institution partners of the BFN. *Undoubtedly, one of the great achievements of the Project in Brazil was providing to stakeholders in different levels involved with public policies related to institutional food procurement and school feeding programs an official list of native species of the Brazilian socio-biodiversity with current or potential nutritional value (Ordinance N° 284/2018) and the BFN Food Composition Database.*

Together, these two instruments facilitated the procurement of products from sociobiodiversity species, as well as greater incentives for family farmers to promote the production and sale of these products in the scope of the PAA and PNAE. Likewise, it is expected for a greater number of native food species to be included in the list of PGPM-Bio, as has occurred with buriti (*Mauritia flexuosa* L.f.), that became part of its 2018 subsidy list. This agricultural income policy compensates producers should their sociobiodiversity products not reach the market value established by the National Supply Company.

Increases in institutional expenditures on Brazilian native biodiversity and their products were documented, although investments remain small when compared to overall food purchases. For example, expenditures in sociobiodiversity products by PAA increased from 2,75% of the total expenditure in 2016 to 5% in 2017, and payments made by PGPM-Bio to sociobiodiversity producers grew steadily in recent years, growing from R\$ 5 million in 2014 to more than R\$ 13 million in 2019 (Brazil 2019b; CONAB 2020). These initiatives can be considered strategic tools to promote the conservation and sustainable use of sociobiodiversity and offer a glimpse of the market potential for expanding the amount spent in these products. This also means that there is a great opportunity to monitor how and if increasing the diversity of foods produced, purchased, and consumed will, in the longer-term, affect the livelihoods of the small-scale producers and promote better food and nutrition security while enabling climate change adaptation and biodiversity conservation.

Despite its importance, these initiatives represent only the beginning of a process. Other similar actions need and should be conducted at a local and regional level, so that it is possible to rescue and broaden the population's interest in the use of Brazilian underutilized edible plants. The continuity of actions of this nature should be developed not only because of the importance and necessity of the conservation of the rich biodiversity existing in the country but also with a view to promote greater participation of native species in our diet, to create new options for the use of these species, to consolidate new productive chains, and specially to show that native species can be much more nutritionally rich than the basic species that currently dominate our dietary habits.

The future development of new market chains and the increase of interest by the private sector are expected, especially now with a new era of bioeconomy in Brazil. In the long term, expanding production and marketing of native nutritious species have also the potential to increase the income of family farmers and gatherers, as well as the diversification and improvement of diets and nutritional status of beneficiaries of programs linked to food and nutrition security and the population in general. Decision-makers, family farmers and gatherers, and the general public will be able to recognize biodiversity's value, thus promoting greater conservation and sustainable use.

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