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Food Security from the Forest: The Case of the Commodification of Baobab Fruit (*Adansonia digitata* L.) in Boundou Region, Senegal

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Abstract: Wild edible fruits from the forest have often been regarded as poverty food; however, there has been a notable shift in recent years as these wild edible fruits have gained increasing recognition for their significance in global food security, especially in agricultural societies such as Senegal. This paper contributes to the debate on how the forest plays a role in diets and nutrition security using the example of wild fruit (Baobab) found in the Boundou Region in Senegal. The livelihood strategies of people in this region have been subject to external influences, such as climate shock and restrictions enforced as the area became a protected area in 2009. These external influences have resulted in the loss of pasture use and the prohibition of hunting. Restriction of access to these previous commons (pasture, wildlife) diminishes the resilience of the local population. However, a new alternative of seasonal usage of wild fruit, specifically baobab, for commercial purposes has emerged as everybody in the community has unrestricted access to collecting these wild edible fruits within the protected area, which is uncommon in other protected areas. The commodification and commercialization of these wild fruits bring essential cash income to many households, thereby improving food security.

Keywords: food insecurity; food system; wild fruits; livelihood strategy; green grabbing; domestication of wild fruits; commercialization of wild fruits



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1. Introduction

Wild edible fruits and plants have often been regarded as poverty food [1,2]. However, there has been a notable shift in recent years as these wild foods have gained increasing recognition for their significance in global food security [3]. This growing interest highlights the changing perception of wild fruits and plants from being seen solely as subsistence foods for impoverished communities to being valued for their potential contribution to addressing broader food security challenges worldwide. Furthermore, despite the widespread acknowledgement that wild edible plants and fruits play a vital role in the diet of people, particularly within rural communities [4], there has been an examination of the collection of these fruits from a perspective of resource management, where factors such as conservation restrictions, land tenure, community involvement, overexploitation of available resources, and environmental factors play a role, all of which have been linked to the changes in the consumption of wild edible fruits and plants [5–8].

This paper contributes to the debate on the importance of wild edible fruits in diet and nutrition security using the example of baobab fruits found in the Boundou region of Senegal, in relation to conservation and rural livelihoods. It highlights the changing perception of the use of wild fruits from being considered only as a famine food to being recognized as a potential contribution to rural livelihoods and income generation in addressing broader food security challenges. This paper further provides a critical examination of the interactions of land use changes and conservation restrictions leading to green grabbing in the

context of the collection and utilization of wild edible fruits such as baobab, particularly in protected areas. Food insecurity is a global issue affecting millions of people across the world. Access to sufficient and nutritious food is a fundamental human right, yet many households around the world continue to experience food insecurity and the challenges to ending hunger keep growing [9]. In 2021, hunger affected 278 million people in Africa, 425 million in Asia, and 56.5 million in Latin America and the Caribbean. While most of the world's undernourished people live in Asia, Africa is the region where the prevalence is the highest [9].

While the utilization of wild fruits and plants is prevalent, there are still lingering questions regarding their role, particularly in terms of supporting rural livelihoods to achieve food security. An aspect of concern in the context of rural households, particularly those residing in protected areas, is the role of wild edible fruits in enhancing resilience. Rural communities that lack resilience and are highly sensitive to environmental disruptions tend to rely on a range of strategies to mitigate their vulnerability [10]. These strategies can be different depending on their culture and where they live. The issue of household resilience has gained significance as forested tropical regions continue to witness a growing trend of biodiversity conservation efforts, resulting in limitations to the viability of alternative ways of food production. Conservation measures and regulations play a crucial role in safeguarding biodiversity and protecting natural ecosystems. However, strict conservation restrictions may inadvertently limit the collection and utilization of wild edible fruits and plants. These restrictions may hinder the traditional practices of relying on these resources for food as well as reducing the resilience of the local population. Therefore, balancing conservation goals with the needs of local communities is essential to ensure the sustainable use of these resources while preserving their ecological integrity.

Wild edible fruits and plants hold great potential for improving human diets and constitute a substantial proportion of food consumption in households, especially in agricultural societies such as Senegal. About one billion individuals globally rely on the collection of wild foods from the forest, including edible plants and fruits, as a means to ensure food security and enhance dietary diversity [11,12]. Almost 80% of rural households across Asia, Africa, and Latin America collect wild fruits from the forest [13]. Studies have shown that wild foods found in forest–agriculture landscapes offer valuable and varied additions to local diets [14–18]. In African countries, particularly in rural areas, people often engage in collecting and consuming edible wild fruits and plants from the forest [19,20], which play a critical role in supporting household nutrition, especially during times of food scarcity. During times of famine, when agricultural crop production is insufficient, wild edible fruits often function as a source of security, with communities relying on gathering and processing these fruits and plants to supplement their foods [21–23]. Thus, despite the fact that wild edible plants and fruits are an important dietary resource in rural areas, their contribution to food security is often overlooked by conservation projects and under-appreciated by policymakers, leading to formal policies on access, extraction, and sale which can lack an understanding of local conditions [24].

Additionally, it is also important to note that there are also issues regarding institutional arrangements concerning the accessibility and availability of these wild fruits and plants in areas that have been designated as protected areas. Protected areas have been shown to serve as a medium for wild fruit production such as the baobab fruits; however, though buffer zones within and around protected areas have become increasingly common, many fortress-style protected areas still forbid the collection of wild fruits and plants within their boundaries. Access to wild fruits and plants is an important determinant of their use, as well as to their contribution to the household economy and food security in rural communities [25,26]. Institutional conditions of local tenure systems of land and land-related common-pool resources (pasture, wildlife) can influence the availability and accessibility of these wild fruits which might have direct or indirect implications on food security. Public forest management often reduces local community access to resources such as wild edible fruits and plants, which tends to have disproportionately negative effects on

more vulnerable populations and poorer households within the community [9]. Institutions are central to balancing social and ecological issues and resources if food security in the face of global environmental change is to be managed as an integrated system [27,28]. However, when government and community regulations fail to consider the significance of wild edible fruits and plants to food security, the food production potential of their habitats is ignored and household nutrition suffers [29].

Besides the contribution of wild edible fruits to household diet, the commercialization of wild edible fruits can be an important source of cash income, particularly for poor and cash-constrained households [30–32]. Wild edible fruits are typically found in remote areas with little employment [33–35]; such opportunities may also present potential for value addition and enterprise development in rural areas, which, in turn, can lead to additional employment and income generation [36–38]. Increasingly, people living in rural areas are selling wild edible fruits or plants that were traditionally used for subsistence, and this shift is being driven by a higher need for cash as households and individuals face economic hardship and unemployment [39–41]. Interest in commercialization and identifying new market opportunities for wild edible fruits have been expressed by governments as a means to improve rural livelihoods while protecting the environment [42].

The baobab fruit (*Adansonia digitata* L.) is native to the semi-arid regions of Africa. It has multiple uses and is appreciated throughout Africa as a food and a medicine. Its potential to enhance household food security has led to it being recommended for domestication and commercialization [22,43]. According to Sidibé and Williams (2002), the baobab tree possesses a broad ecological adaptability, rendering it a valuable species of tree in environments that are typically characterized by arid and harsh growing conditions. This species is capable of thriving in diverse soil types, ranging from stony and sandy soils to poorly drained and clay soils. The baobab tree can also withstand extreme climatic conditions, including high temperatures and low rainfall, owing to its ability to shed leaves early, its fire-resistant bark, and its water-absorbing trunk, which contracts during dry seasons [44]. The baobab fruit is a rich source of vitamin C, dietary fiber, calcium, potassium, and magnesium [45–47]. Apart from the fruits, different parts of the baobab tree have been found to be valuable for a variety of traditional uses, including medicine, food, craft items, and cosmetics [48–50].

In the last few decades, there has been rapid growth in the production of baobab-based products, in particular, seed-derived oil for cosmetic applications, as well as the processing of baobab fruit pulp into a powdered form to meet nutritional needs [51]. These products have gained significance in foreign markets as essential components as well, and they are currently shifting from traditional use to more lucrative market segments even within the African continent [51–53]. The baobab tree plays a vital role in generating income and ensuring food security and contributes to household nutrition, especially for rural populations. The inhabitants of Bondou region collect baobab fruit from the forest during the dry season when there is a shortfall of agricultural products and then process the fruit to a powdered form, which they sell to the cities where it is used to produce a wide range of products, including ice-lollies, candy, fruit juice, coffee, and cosmetics. The demand for baobab collection and commercialization has increased significantly in the last decade in the Boundou region since this region became a protected area. It is thus of interest to see how this plays a role in diets and nutrition security. This understanding is pivotal to formulating comprehensive food security policies and interventions that take into account the vital role of wild foods within food systems. Moreover, enhancing our understanding of the role of wild edible fruits in the diets and food security of individuals, particularly those residing in protected areas, can greatly contribute to improved conservation management. By recognizing the significance of these fruits in sustaining local communities, conservation efforts can be more effectively tailored to support both human livelihoods and the preservation of natural resources.

2. Methodology

2.1. Study Setting

Senegal is a country located in the western area of the African continent. It is bordered on the north by the Republic of Mauritania, on the east by Mali, on the south by Guinea and Guinea Bissau, and on the west by the Atlantic Ocean [54]. This research was carried out in the Boundou region (Figure 1), which is located in Tambacounda, the eastern region of the modern-day republic of Senegal between the Upper Senegal River and the Faleme River. The data for this study were collected in the context of a larger research project on foodways in Senegal during a three-month exploratory phase between January 2021 and April 2021. Two seasons mark the climate of the region: a short rainy season from June to September and a long dry season from October to May. During the year, maximum temperatures range from 30 °C to over 40 °C. The hottest months are April and May. The Boundou region became a protected area in 2009 and was named Boundou Community Nature Reserve (RNCB). It is located between two departments: Goudiry and Bakel. This reserve covers about 120,000 hectares and straddles four municipalities: Koussan, Dougué, Toumboura, and Sinthiou Fissa. Before this area became a reserve, it used to be a former hunting ground for tourists. The villages in the Boundou region are located on the outskirts of the reserve; only Dide and Bacouba are located in the heart of the reserve. The major ethnic groups in this region are the Peul or Fulbes and Jakhankes. Agriculture and animal husbandry are the main economic activities carried out in the area. Koussan (Fulbe village) and Dide (Jakhanke village) were selected for the study. These two communities were selected based on the fact that Koussan is the most populous village and the headquarters of all the communities in this region, while Dide was one of the two community located in the heart of the reserve.

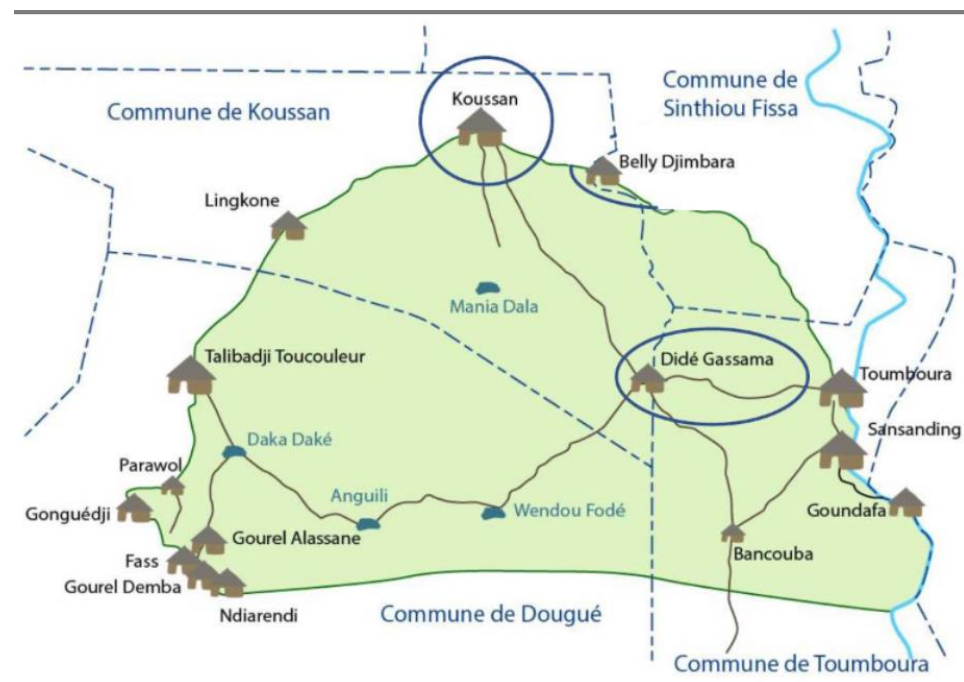


Figure 1. Map of the study areas in Senegal.

2.2. Study Design and Data Collection

As a qualitative research project, the research relied heavily on participant observation in combination with narrative interviews, informal conversations, diary keeping, and focus group activities with both men and women. In addition, we used biographies in combination with the oral history of stories and reminiscences of a person who has first-hand knowledge of any number of experiences [55,56]. Participant observation is the central method of data collection in social anthropology, and it is one of the core

instruments during the whole research period as it produces both experiential and effective positivistic knowledge.

By participating in local people's daily activities, the aim was to actively engage in the daily activities of the local community, providing assistance in various aspects of their livelihoods. This involved helping them in agriculture activities, cattle breeding, or animal husbandry, and assisting with the collection of firewood and baobab processing. Daily diary-keeping was employed as a method to capture and document the impressions and experiences related to livelihood strategies. We carried out discussions with older people over the ages of 70–110 years ($n = 20$) who had experience with the postcolonial period on food coping strategies. Informed consent was obtained from each participant before the start of the interview. Each interview took between 30 to 60 min, and a trained research assistant/translator aided in all interviews and discussions, which were conducted primarily in French and the local languages Pulaar and Jakhanke. In addition, unstructured conversations and focus group activities were carried out with men and women involved in baobab collection and processing.

2.3. Data Analysis

The interviews conducted during the study were recorded using audio recording devices and subsequently transcribed verbatim. The transcriptions, along with the accompanying diary notes, were carefully reviewed multiple times to gain a comprehensive understanding of the gathered information. To analyze the data, qualitative content analysis method was employed, utilizing the ATLAS.ti software version 8 for coding and organizing the interview transcripts. The transcripts were coded by (B.O) and were revised with (S.M).

3. Results and Discussion

3.1. In the Bondou Region

Land use changes can affect the availability of wild food as forests and agricultural fields are converted to more protected areas [57,58]. When households experience food insecurity, they often adopt coping strategies to manage the situation. These coping strategies can vary based on cultural and geographical differences [59,60]. People may turn to wild plants and animals as alternative sources of food. Throughout history, households have employed various coping strategies to manage food scarcity and ensure their survival. The Boundou area, known for pastoralism (dryland area), has traditionally lived off agriculture and livestock. These livelihoods have been subjected to diverse external influences such as climate shocks and the implementation of restrictions following the designation of the area as a protected area (PA) in 2009. While protected areas are often portrayed as places that conserve biodiversity and consequently support the communities' livelihood, many of these affected communities have faced constraints and prohibitions on their traditional practices of using the flora and fauna in the spaces that have been designated as PAs [61,62]. However, some of these traditional practices, such as the local agroforest pastoral practices, which have been refined over generations, have shown their potential in promoting biodiversity and maintaining ecological balance by preserving diverse habitats and providing valuable ecosystem services.

The expansion of conservation areas, particularly in Africa, continues to restrict the feasibility of alternative means of food production [63]. Food insecurity has been reported to be exacerbated by protected areas in a number of ways, including a lack of direct access to wild food harvesting [64], loss of livestock due to predation by wildlife [65,66], loss of access to water bodies used for irrigation or drinking water [67,68], loss of fuelwood for cooking [65], loss of traditional knowledge [69,70], and loss of access to markets and increased food prices due to tourism [71,72]. The Boundou region is rich in biodiversity and natural resources that the inhabitants of Boundou intend to protect. This region has an abundance of wild edible fruits such as baobab fruits, attracting people from neighboring countries coming to collect baobab fruit from its forest.

“some people are coming from Mali, Guinea, to collect this baobab fruit. Even some strangers also come to collect this Baobab fruit in the village and the numbers coming from outside are even more than those fetching the Baobab fruit in Koussan (Koussan Village, 3)”

Based on our findings, it appears that the Boundou region has benefited from its designation as a protected area. One notable benefit is the unrestricted access granted to collect wild fruits, including baobab fruits, within the protected area, which is not always the case in other protected areas. This has contributed to food security by allowing the population to access these nutritious foods when they may not have other sources of sustenance. Although there are rules guiding the harvesting of baobab and the access rights to collect the baobab fruit within this protected area may be officially regulated by forestry laws, in reality, it appears that the rules governing the collection of these baobab fruits were not negotiated with local people, based on the narratives on the people. As a result, the narrative is still unclear regarding the rules on how participatory the conservation plan was or the level of broader local involvement in the establishment of the reserve.

The practice of collecting forest food has been a part of human history for thousands of years; it has been one of the major contributions to local diets and food security as a safety net during times of shock or adversity [24,73,74]. The collection of forest food to eat or cook in various ways has been a longstanding coping strategy for communities facing food shortages and insecurity since precolonial times, especially among the Jakhanke and Fulbe tribes in the Boundou region. Studies have shown that wild edible fruits and plants have long served as a prevalent and vital food source for impoverished families residing in developing countries [75,76]. They are heavily relied upon to fill seasonal food shortages and act as vital sources of emergency sustenance in periods of famine [77–79].

“In the past, if there were no food, we go to first to collect fruit of baobab, samba or called mbohae. It may be used as food (Koussan village, 10)”

“yes, we do experience shortage of food in the olden days and when it happens, we go to the forest to bring the baobab fruit and carpe. If there is no food, we boil it and eat it (Koussan village, 6)”

“If there is no more food at home we go to the forest to look for baobab that never stop growing and also some traditional fruit like niambo (carpe) and honey (Dide Village, 4)”

“In the past, if there is no more food at home, we will go into the bush to look for fruits like Sito (which is called baobab), niambo or carpe, and dougouto (Cordyla pinnata). (Dide Village, 14)”

Our interviews with the elderly revealed that the baobab fruit (*Adansonia digitata* L.) was the most common wild edible fruit that was consumed in the past during food shortage as this baobab fruit was readily available and easy to find due to its abundance in the Boundou region. In the past, Baobab fruit could be eaten fresh (Figure 2), dried, or boiled in water. It could also be prepared with honey (Figure 3). However, the range of strategies people employ to deal with food shortages in the Boundou region today is very different from how they used to handle them before the colonial era.

3.2. From Green Commons Grabbing to New Market Alternatives: The Commodification of Baobab Fruit

While protected areas have been established globally with the objective to safeguard biodiversity, local communities, such as those in the Boundou region who have historically relied on these landscapes for their livelihood, have had to face the adverse consequences of being cut off from the resources that support their cultural heritage and physical livelihood. Furthermore, as argued in anthropological literature on the political ecology of food, changes in food security can be linked to changes in resource governance and property regimes associated with the global colonial and post-colonial processes of land use change, loss of land, and land related resources for local communities, an institutional change referred to as commons grabbing [63].



Figure 2. Baobab fruit from the forest.



Figure 3. Baobab fruit with honey prepared in precolonial times.

Green grabbing or the expropriation of land or resources for environmental purposes is a major element of the current global trend of land grabbing [80]. Green grabbing adds a new dimension to the debate over land grabbing in that environmental reasons are used to justify the acquisition of land and associated resources [81,82]. These so-called “green grabs” refer to various practices of land or resource enclosure that claim to address the environmental issue, but in reality, operate under the guise of doing so. These conservation enclosures involve not only the physical appropriation of land but also the privatization of nature’s rights, the development of new commodities, and markets derived from nature [83]. Hence, the consequences of these conservation practices can be viewed as a manifestation of “primitive accumulation”, a concept introduced by Marx (1976). This concept encompasses various processes, including the transformation of land into

commodities, the privatization of communal property, and the infringement upon common rights [84]. These consequences highlight the socioeconomic and environmental impacts associated with conservation initiatives. While green grabbing does not always result in the complete displacement of existing landowners, it does involve the restructuring of rules and authority over the access, use, and management of resources that may have profound alienating effects.

Drawing from our case study in the Boundou region, our results show that green grabbing is transforming the local livelihoods and landscapes in ways that have restricted livelihood practices and resources of the communities. There are different variations of how biodiversity and wildlife conservation can lead to dispossession. One of the dimensions of green grabbing as a result of the Boundou region becoming a protected area is the loss of pasture use. The restriction on the use of grazing land has emerged as a notable aspect of the broader socioenvironmental changes occurring in the area. People have raised concerns regarding the availability and quality of fodder or pastures due to the prohibition of grazing within the protected area. This restriction has had an adverse impact on their livestock production, resulting in a subsequent decline in milk production. In certain instances, community members need to hire the services of herders from neighboring villages to transport their cattle to distant grazing areas, particularly during the dry season. Consequently, the declining forage base has the potential to contribute to increased household malnutrition.

Another loss is the prohibition of hunting, which was traditionally an integral part of local livelihood strategies, particularly as bushmeat hunting served as a crucial means of food provision. We argue that the prohibition of hunting in the Boundou region, which is a common conservation measure, can be seen as a manifestation of green grabbing in the context of wildlife management. From a political ecology perspective, the prohibition of hunting in this region can be seen as a form of environmental governance that aims to protect biodiversity and preserve ecosystems. However, it can also lead to the marginalization of local communities who have traditionally relied on hunting as a means of subsistence and cultural practice. Furthermore, the theoretical concept of green grabbing emphasizes the power dynamics and unequal distribution of resources in environmental decision-making processes. When hunting is prohibited, the control over wildlife and natural resources shifts to external actors such as conservation organizations or state authorities. This shift in control can perpetuate existing power imbalances and further marginalize already vulnerable populations.

The majority of the individuals we interviewed asserted that people have ceased hunting wildlife for both personal consumption and commercial purposes. Restriction of access to these previous commons (pasture, wildlife) diminishes the resilience of the local population. However, a new alternative of seasonal usage of wild fruit, specifically baobab, for commercial purposes has emerged as everybody in the community has unrestricted access to collect these wild edible fruits within the protected area, which is uncommon in other protected areas.

“We do eat baobab fruit back in the olden days then but in this present time, it has become a source of income. Few people still eat baobab fruit though . . . Most of the people now and even the children go to the forest to take baobab fruits; you may be able to have a bag of it, and sell it to have money” (Dide Village, 5).

“Some people that have money here can buy to re-sell. Some others from Dakar can bring millions of cephass with them to just buy the baobab fruits and sell them more expensive. There is a business around that fruit”. (Koussan village, 11).

Notably, the concept of transforming baobab fruit for commercial purposes arose in the Boundou region as a result of the region becoming a protected area. Based on our findings, it is reported that the reason why the area was designated a protected area was to rely on the preservation of the environment to promote local development and to improve the living conditions of local populations. Baobab’s transformation began in 2013 in Koussan

village as an empowerment program for the women of the community. The women were trained in how to process the baobab pulp fruit into locally produced powdered form. Interestingly, the men did not show interest in the training as they consider this process to be a woman's job, even at this present time. The men were only responsible for collecting the baobab fruit from the forest. To transform the baobab fruit into powdered form, the women must first separate the fruit pulp from the chaff (Figure 4), after which they grind it meticulously until it reaches the desired consistency. Our focus group conversation with the women of Koussan village revealed that in 2018, an NGO donated a grinding machine to the community to aid in the processing of baobab pulp fruit to powder. This machine was made freely available to all women's groups actively involved in the business across the Boundou region. However, at the time of our study, the machine was not functional, and the women had resorted to manually grinding the baobab fruit with a mortar and pestle.



(a)



(b)

Figure 4. (a) Women processing the baobab fruit pulp. (b) Women processing the baobab fruit pulp for grinding.

3.3. Gender-Related Task

Traditionally in the Boundou region, the men and the young boys are the ones who gather and collect these baobab fruits from the forest (Figure 5) during the dry season and offer them for sale mainly to women in the community. The women then purchase the baobab fruits from the men, process them into powdered form, and meticulously prepare and package the product for sale in the urban cities (Figures 6 and 7).

“when the men go to the forest to collect the baobab fruit from the forest, they bring it back to us first and we, the women select and buy it from them after which we the women grind it to a fine powdered form and then sell” (woman, Koussan)

This Baobab has a significant role to play in empowering marginalized individuals and communities, particularly women, who are largely involved in the trade baobab business. The commercialization of these baobab fruits provides crucial cash income to many households within the community in the Boundou region, which is primarily used to purchase food. This approach indirectly enhances food security and nutrition by enabling households to purchase other important foods that may be scarce, such as spaghetti or staples or protein, using the cash earned. Baobab fruits are becoming one of the most important non-timber forest products (NTFP) in the Boundou region.

“Someone has to go to the forest to have bags of Baobab fruits and sell them. We put them together and sell them. If I work two days, the money I get can buy for example two bags of rice. This is the way we live in the village. Joining efforts, joining foods, is the way we live” (Dide Village 1)

“As a family chief, you have to work to find money for our family, if money is lacking, we go to collect Baobab fruit from the forest and we sell it and use the money to eat. Some people come from afar, from Dakar to buy it” (Koussan village 2)



Figure 5. Sacs of baobab fruit pulps from the forest for sale.



Figure 6. Packaging of processed baobab powder.



Figure 7. Packaged baobab fruit powder for sale.

4. Discussion/Conclusions

Wild foods have been largely overlooked within discussions and policies surrounding food security, development, and natural resource management, despite their significant and potential contributions to resilient and sustainable food systems. This lack of attention has resulted in a failure to recognize and harness the value of wild foods in ensuring long-term food security and promoting sustainable practices [85]. Increasing commercialization of wild edible fruits from the forest, which could be an interaction with conservation initiatives, can potentially have effects on dietary outcomes. Food security can be correlated with the manner in which forests are conserved, as well as the extent to which wild foods from the forests are readily accessible and available, and our study highlighted the notable impact of the active collection and commercialization of baobab fruits in traditional agricultural societies such as the Boundou region in Senegal.

Our research findings showed that there has been a profound shift in the institutional dynamics concerning resource accessibility in the Boundou region, whereby the significant loss of common property emerged as a pivotal factor profoundly influencing local livelihoods and food. Globally, protected areas have been created to preserve biodiversity, yet they often have negative consequences for communities that rely on these areas. While biodiversity conservation provides numerous advantages at national and global levels, local communities often bear the costs of these protected areas, primarily through the loss of access to resources [86]. This can be attributed to the historical trend within conservation projects, wherein food security and biodiversity conservation have often been dissociated, disregarding the crucial contribution of natural resources to the diet of rural populations [87,88].

People have lost access to pastures and hunting grounds due to the Boundou area becoming a protected area, and when access to previous commons (such as wildlife and pasture) is restricted, people's resilience decreases. However, we find that the majority of the population of Boundou now depends on the gathering and processing of baobab fruits from woodlands. Unlike many other protected areas, where access to collecting wild plants or fruits within the protected areas is restricted or limited [89], the people of Boundou enjoy free access to gather and collect baobab fruits within the protected areas without restrictions. This inclusive approach fosters a unique environment where local residents can freely benefit from the nutritious resources available, setting the Boundou region apart from other protected areas. Furthermore, the commercialization of these baobab fruits was found to be a significant source of livelihood that represents an important source of income and a coping strategy, particularly during the dry season when agricultural crop production falls short. Domestication of wild edible fruits has been identified as a means of livelihood for the local population and a significant source of earning for rural households living in or around the forested area [90]. An analysis of data collected from 7975 households across 24 developing countries revealed that 77% of these households actively participated in the collection of wild foods from forests. Notably, it was observed that poorer households and households facing economic shocks obtained a greater proportion of their income from wild food sources [13]. Wild edible fruits have been found to improve household food coping strategies and food security during periods of crop scarcity [91]. Similar to our findings, a study conducted in Zimbabwe corroborated the recognition of wild foods, particularly wild edible fruits, as a coping mechanism in response to crop failure [92]. From our study, we found out that the cash income generated by many households from the commodification of the baobab fruits is usually expended on food, which is a basic need. This finding corresponds with another study that highlighted how selling wild edible fruits and plants provides an important source of income for poor households. They use the money they earn from selling these resources to buy food and meet their basic needs, especially when they do not have enough from their food production. This additional income helps them improve their food security and overall quality of life [93].

The commercialization of baobab fruits has significant value for rural communities in Africa as it generates income, alleviates poverty, enhances livelihoods, and promotes the inclusion of marginalized populations in a cash-based economy. However, results of our study revealed that the local processing industry of these baobab fruits is currently weak and underdeveloped, indicating the potential for economic benefits through supplementary efforts in the processing phase of the baobab fruits. Thus, providing financial support to establish small-scale processing factories in villages holds the potential to enhance the income levels of rural households.

A noteworthy aspect based on our findings that might warrant further exploration is that we anticipate that there might be an issue with the collection of baobab fruits in the future. This is because there is an ongoing discussion within the communities regarding the rules of the reserve and who gains from the whole value chain. Community leaders are considering imposing taxes on anyone involved in the collection of baobab fruits, but this proposal was met with resistance from community members who believe that the fruit is

a free resource from God, and that everyone is entitled to it without any cost. Currently, there are no difficulties in accessing the baobab fruits within the region. However, this situation may change in the future due to the ongoing dispute over regulations and taxation. Moreover, another concern that may arise is the potential for overexploitation of the baobab fruit. As people from outside the Boundou region also flock to gather this valuable resource, the increased demand may put a strain on sustainable harvesting practices. Therefore, it is imperative to closely monitor these developments to ensure a balanced approach that takes into account the needs and perspectives of both the community members and the long-term conservation of baobab fruit resources.

Furthermore, our study aligns with previous findings that demonstrate that food security is closely tied to the pattern of agricultural development, conservation efforts aimed at forests, and accessibility of wild foods. Given our research findings, we could posit or suggest that the integration of wild edible foods ought to be incorporated into poverty alleviation initiatives and also factored into the management of protected areas. While relying solely on the commercialization of these baobab fruits may not result in significant rural development in the Boundou region, establishing small-scale processing industries, as well as enhancing market connections, can have a positive effect on reducing poverty and food insecurity in rural households. In addition, ensuring equitable and ongoing access to natural resources could also play a vital role in preserving indigenous food traditions. Therefore, a better understanding of the collection of wild edible plants and fruit and the findings from our study on the collection of baobab fruits may contribute to improving conservation management. This is because they highlight the significance of forests not only in preserving biodiversity and mitigating climate change but also in ensuring food security. In conclusion, we know that the commodification of these wild fruits generates crucial cash income for many households; however, it still remains uncertain as to whether this practice is reducing food vulnerability and increasing the resilience of households or whether it fails to compensate for “green commons grabbing”.

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