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SOCIO-ECONOMIC POTENTIALS AND THREATS TO THE AFRICAN WALNUT IN TROPICAL LOWLAND RAINFORESTS OF SOUTHWEST NIGERIA

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ABSTRACT

*The African walnut, *Plukenetia conophora* Mull-Arg (Syn. *Tetracarpidium conophorum*) is an important climber species that contributes immensely to food security and poverty alleviation in communities within the humid tropical forests of West and Central Africa. However, the challenges facing its year-round availability have not been fully documented and precise data on its contributions to livelihoods of forest dependent households is lacking. Therefore, this work was carried out to fill this knowledge gap as well as make suggestions on ways to promote the use and sustainable development of this valuable product. Snowball and simple random sampling techniques were used to collect data from harvesters (8) and marketers (51) within and around Omo and Shasha Forest Reserves, Southwest Nigeria. Data obtained were analysed by means of descriptive and inferential test statistics. An estimated 30.01kg of African walnut was extracted per month between May-September each year in Omo and Shasha Forest Reserves, contributing about ₦615,833.30 to the rural economies of both areas. About 17.0% of respondents generated income between ₦11,000.00 - ₦20,000.00 per month, representing up to 50.0% of their monthly income during production period. Factors and threats affecting product availability were: seasonality (64.3%), destruction of parent plants (28.6%), consumption of nuts by wild animals (28.6%), pest and diseases infestation (7.1%), and spoilage during storage (7.1%). Income generated by respondents were impacted by sex ($\chi^2 = 7.714$, $df = 2$, $p = 0.021$), level of education ($\chi^2 = 8.476$, $df = 2$, $p = 0.014$) and trading experience ($r = 2.413$; $p = 0.019$). An improvement in the production, processing and marketing of African walnut will better the living conditions and enhance the status of both harvesters and marketers. These will have multiplier effects on the conservation of the available germplasm in the wild.*

Keywords: African walnut; NTFPs; household income; tropical lowland rainforest.

INTRODUCTION

The rural populations across the tropics are increasingly reliant on farm and off-farm sources in order to meet their food and other needs. Forest-based activities, which are mostly in the non-timber forest products (NTFPs) sub-sector have repeatedly been found to provide one of the main sources of food security and income to rural households (Phuong and Duong, 2008). However, the progressive fragmentation of tropical high forests in Africa threatens the availability of forest foods and the ability of the continent's rural households to achieve food

self-sufficiency. Nevertheless, various authors have continued to describe the contributions of wild fruits, nuts, seeds and vegetables to the African diet and their potential towards overcoming or ameliorating the problems of inadequate food supply and nutrient deficiencies among the people (Ladipo, 2001; Ahenkan and Boon, 2010). One of such forest resources originating in the humid tropical forests of West and Central Africa is the African walnut, *Plukenetia conophora* Mull-Arg (Syn. *Tetracarpidium conophorum*).

The African walnut is a strong rambling vine, and one of the most important non-timber forest products in the tropical lowland rainforest zone of Nigeria. It is widely harvested from natural forests and sparingly cultivated for its oil-rich fruits that serve as a good source of income to the rural populace (Awodoyin *et al.*, 2000; Amusa and Jimoh, 2012). Within the West and Central Africa regions, the African walnut is commonly known as *ukpa* (Igbo), *awusa* or *asala* (Yoruba) or conophor nut in Nigeria and *kaso* or *ngak* in the central and western parts of Cameroon. The seeds of the African walnut are rich in fat, with nearly eighty percent of it being polyunsaturated and with proven cholesterol-lowering properties. In Nigeria, they are reportedly used to treat male infertility. The bark and leaves are also used in traditional medicine to ease dysentery and other diseases (Ajaiyeoba and Fadare, 2006; Jiofack *et al.*, 2013).

The contribution of the African walnut to food security lies in the edibility of its oil-rich seeds or nuts, while its role in the rural economy is primarily based on the income it generates through fruit or nut sales. However, there are several threats facing the sustainability of the African walnut including: forest clearance for farmlands (loss of habitat), increasing demand, low level of domestication and lack of proper integration of the plant in the agro-ecosystems (Jiofack *et al.*, 2013). Despite the socio-economic potentials of this important forest vine, the challenges facing its year-round availability have not been fully documented and precise data on its contribution to food security and poverty alleviation of those households that depend on this species is lacking. Therefore, this work was carried out to fill this knowledge gap as well as make suggestions on ways forward to promote the use and sustainability of this valuable food and income source.

MATERIALS AND METHODS

Study Area

The study was carried out in Omo and Shasha Forest Reserves (Figure 1) located within the tropical lowland rainforest zone of southwestern Nigeria. Omo Forest Reserve (OFR) is located on longitude 6°35' N–7°05' N and latitude 4°19' N–4°40' E. The Reserve covers about 130,500 ha forming common boundaries with Osun, Ago-Owu and Shasha Forest Reserves in Osun State and Oluwa Forest Reserve in Ondo State. It was legally gazetted a forest reserve in 1925 as part of the Old Shasha Forest Reserve. This was amended in 1952 (Bada, 1999). The vegetation of the Reserve is a mixed moist semi-deciduous rainforest. Large chunk of the forest were converted to *Gmelina arborea* monoculture in the early 80s. There are pockets of farming encroachments in several locations. The rainy season in the Reserve usually commences in March with an annual mean of about 1,600 to 2,000 mm with two annual peaks in June and September. Temperature ranges from 21.40°C to 32.15°C and a minimum relative humidity of 76.34% (Amusa and Jimoh, 2012). Estimated total population in the area is between 20,000 and 25,000. Farming, fishing, hunting and non-timber forest products

(NTFPs) gatherings are the predominant occupations for the majority of the enclaves' population.

The map displays the study area in Oyo State, Nigeria, with the following details:

- Geographic Context:** An inset map shows the location of the study area within Nigeria.
- Forest Compartments:** The study area is divided into three forest compartments: Omo Forest Reserve, Shasha Forest Reserve, and Oluwa Forest Reserve.
- Communities:** Communities shown include Araromi, Alabameta, Abeku, Olojo, Onimisan, Omo Saw Mill, Esina, Alapandele, and Akila.
- Rivers:** Rivers shown include R. Shasha, R. Oluwa, and R. Oshun.
- Roads:** Roads are shown connecting the communities.
- Legend:**
 - ▲ Communities
 - Rivers
 - Roads
 - Forest Compartments
 - Study Area Forest Reserves
 - Omo Forest Reserve
 - Shasha Forest Reserve
- Scale:** A scale bar indicates distances in Kilometers (0, 3.5, 7, 14, 21, 28).
- Coordinates:** The map is bounded by coordinates 4°03'45.0"N to 4°16'00.0"N and 4°03'45.0"E to 4°16'00.0"E.

Figure 1: Map of Omo-Shasha Forest Reserve Complex

The target populations for the study were harvesters and marketers of African walnut within and around OFR and SFR. Due to the fact that African walnut harvesting within the Reserves is mostly informal with neither a legal nor an institutional framework, the snowball method (Marshall *et al.*, 2006), in which one respondent provides the name and contact of another, was used to access information among harvesters. All eight harvesters involved in the collection and trade of African walnut within the Reserves were interviewed. For marketers' survey, the number of markets (all markets that fall within 20km radius of the reserve) and market days were determined based on information obtained from key informants in the study area. The surveyed markets adjoining OFR and SFR include: Oke-Aje, New Market,

Ogbere, Oja Orita J4, Itawade and Oja Mushin. Others were: Olode, Omifunfun, Egbejoda, Olohunda, Araromi-Owu, Araromi Oke-Odo and Apomu. Simple random sampling technique was used to select respondents among the marketers. A total of fifty-one marketers were sampled. Structured questionnaires were administered on the respondents in both reserves and selected markets. Data were collected on demographic characteristics of respondents, product harvesting and utilization patterns, units of marketing of the products and pricing, influence of seasonality on product availability, average quantity of products harvested and sold in a month as well as percentage contribution of products to household income among others. Information obtained through the questionnaire survey was complemented with participant observation on the field.

Data were analyzed by means of descriptive statistics including frequency tables, percentages and histograms. The relationship between demographic characteristics of respondents and income generated from sales of product was also tested using the chi-square and multiple linear regression analyses.

RESULTS

Demographic characteristics of harvesters and marketers of African walnut

All the actors involved in harvesting and marketing of African walnut were found to belong to the Yoruba ethnic group. Majority (62.5%) were native, especially among the harvesters. The production activities were female dominated (harvesters-87.5%; marketers-84.3%). Among harvesters, the modal age category was found to be 41-50 years (37.5%), while modal age category for marketers was in the range of 21-30 years (41.2%) and 31-40 years (41.2%). Majority of the actors were married (harvesters-75.0%; marketers-84.3%). Those with household sizes of 3 and 4 have the highest frequencies (both accounting for 50.0% of all respondents) among the harvesters, while those with 3 had the highest frequency (35.3%) among marketers. The primary occupation of harvesters were farming and trading. Trading in different farm and forest products was the primary occupation among marketers (72.5%). About 50.0% of harvesters have First School Leaving Certificate as their highest level of educational attainment, with majority of marketers (92.5%) also found in this category. The rest have no formal education. Most of the actors (harvesters-62.5%; marketers-64.7%) possessed 5-6 years trading experience in the product (Table 1).

Harvesting, processing and marketing of African walnut

Harvesting of African walnut was carried out in different forest types, particularly the plantation and disturbed natural forests as well as cultivated farmlands. The procedure for harvesting involves allowing the fruits to ripen and fall from the woody climbers to the ground where they are gathered by collectors. The gathered fruits are cracked open using a sharp knife following the natural lines of cleavage on the fruit. Each nut of African walnut contains up to four seeds. The average weight of the nut was estimated to be 0.63g. On the average 2.50kg of the nut yields 1.00kg of the seed. The peak production and marketing period for African walnut is May – September. Products were at times stored to await buyers who engaged in final processing. The unit of measurement for sale of product was the local basin and other containers that are direct fractions of the basin. A basin of African walnut seeds weighs about 6.00kg and is sold for between ₦2,000.00 – ₦3,000.00. Quite often, the harvesters of African walnut nuts engaged in further processing which involves washing and cleaning. Thereafter, the product is put in a big pot and cooked.

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Table 1: Demographic characteristics of harvesters and marketers of African walnut

Variables	Harvesters		Marketers	
	Frequency	Percentage	Frequency	Percentage
<i>Ethnic group</i>				
Efik	-	-	-	-
Ibo	-	-	-	-
Ibibio	-	-	-	-
Yoruba	8	100.0	51	100.0
Total	8	100.0	51	100.0
<i>Residency</i>				
Native	5	62.5	25	49.0
Immigrant	3	37.5	26	51.0
Total	8	100.0	51	100.0
<i>Sex</i>				
Male	1	12.5	8	15.7
Female	7	87.5	43	84.3
Total	8	100.0	51	100.0
<i>Age (years)</i>				
≤ 20	-	-	1	2.0
21 – 30	2	25.0	21	41.2
31- 40	2	25.0	21	41.2
41 – 50	3	37.5	7	13.7
> 50	1	12.5	1	2.0
Total	8	100.0	51	100.0
<i>Marital status</i>				
Single	2	25.0	8	15.7
Married	6	75.0	43	84.3
Widowed	-	-	-	-
Total	8	100.0	51	100.0
<i>Household size</i>				
0	2	25.0	7	13.7
2	-	-	6	11.8
3	2	25.0	18	35.3
4	2	25.0	9	17.6
5	1	12.5	7	13.7
6	-	-	3	5.9
7	1	12.5	1	2.0
Total	8	100.0	51	100.0
<i>Primary occupation</i>				
Farming	4	50.0	14	27.5
Trading	4	50.0	37	72.5
Total	8	100.0	51	100.0
<i>Level of Education</i>				
No Formal Education	4	50.0	4	7.8
First School Leaving Certificate	4	50.0	47	92.2
Total	8	100.0	51	100.0
<i>NTFP Trading Experience (year)</i>				
1	-	-	-	-
2	1	12.5	5	9.8
3	-	-	-	-
4	1	12.5	6	11.8
5	3	37.5	11	21.6
6	2	25.0	22	43.1
7	-	-	-	-
8	1	12.5	7	13.7
Total	8	100.0	51	100.0

The cooked African walnut seeds are taken directly to nearby markets for sales. Seeds are laid out on trays in batches of four or more. This could also be done by tying the batches in transparent nylon stockings. A batch (between four and five pieces) of African walnut nuts weighs 0.25g – 0.30g and sold for ₦20.00. Generally, seasonality affects volume of products available in the market with slight variation in the market price (Table 2).

Table 2: Average retail price for African walnut during the rainy and dry seasons

Year	Price per kilogramme (₦)		
	Rainy season	Dry season	Mean (X)
2009	600.00	700.00	650.00
2010	750.00	850.00	800.00
2011	1000.00	1200.00	1100.00

Source: Field Survey, 2009-2011

Contributions of African walnut trade to household income

In OFR and SFR, an estimated 30.01 kg of African walnut seed is extracted per month between May and September each year. This contributes about ₦615,833.30 to the rural economies of both areas. As shown in Figure 2, average sales per month for African walnut among harvesters ranged from < 5kg (50.0%) and 5kg – 10kg (50.0%). For marketers, the average sales ranged from < 5kg (37.3%), 5kg – 10kg (43.1%) and 11kg – 15kg (19.6%) per month. About 17.0% of respondents generated income between ₦11,000.00 and ₦20,000.00 per month, representing up to 50.0% of their monthly income during production period (Figure 3). The average percentage contribution of African walnut to respondents' household income ranged from 10% – 20% (37.5% of respondents) and 31% – 40% (62.5% of respondents) for harvesters. For marketers, average percentage contribution of the product to respondents' household income ranged from < 10% (15.7% of respondents), 11% – 20% (11.8% of respondents), 21% – 30% (15.7% of respondents), 31% – 40% (15.7% of respondents), 41% – 50% (17.6% of respondents), 51% – 60% (9.8% of respondents) and 61% – 70% (13.7% of respondents; Figure 4).

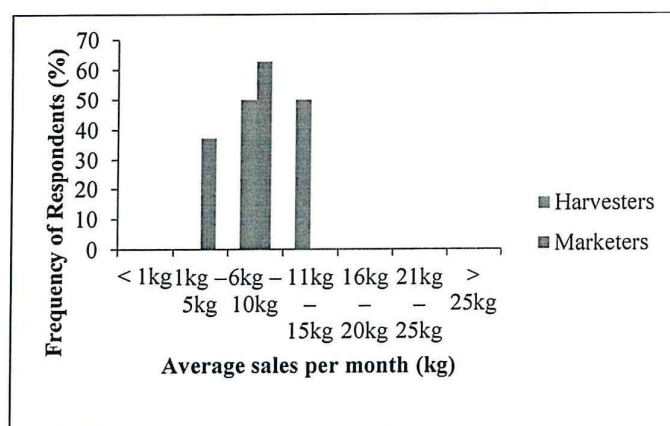


Figure 2: Respondents' sales per month (kg) for African walnut

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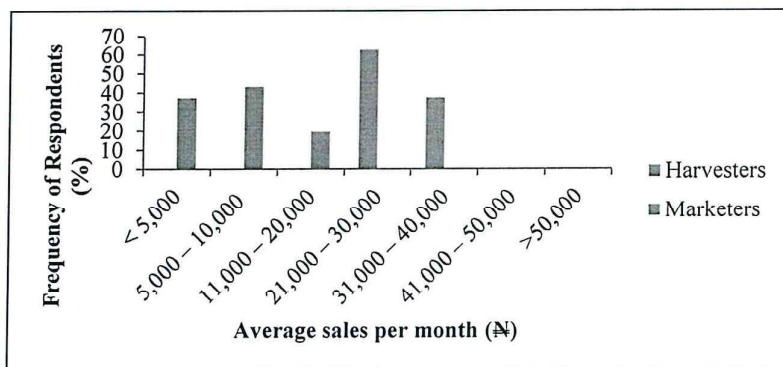


Figure 3: Respondents' sales per month (₦) for African walnut

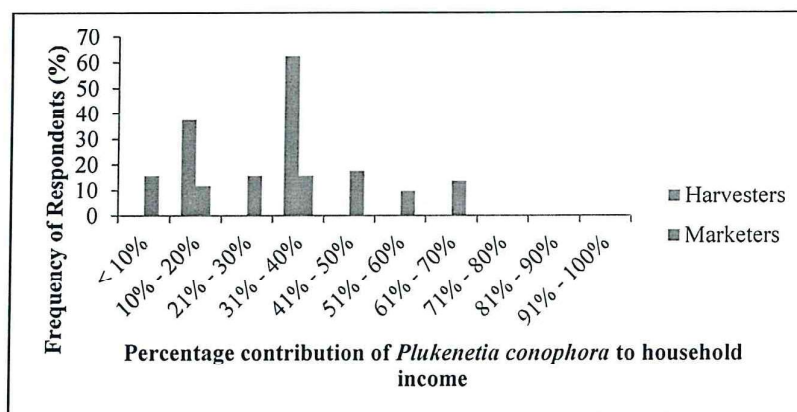


Figure 4: Percentage contribution of African walnut to household income

Perception and threats on availability of African walnut

Respondents' perception on product availability in the last ten years (2001- 2010) pointed towards a decreasing trend among harvesters of African walnut(100.0%). Some of the marketers (15.7%) were of the opinion that product availability has been on the increase since the past ten years due to steady supply from cultivated farm lands. However, majority (64.7%) disagreed. A segment of the marketers (19.6%) indicated no trend. In terms of factors affecting availability of the product, harvesters identified seasonality (28.6%), destruction of parent plants (28.6%), pest and diseases (7.1%), consumption of nuts by wild animals (28.6%) and spoilage during storage (7.1%). Marketers identified seasonality (100%) as the only factor affecting the availability of the product (Table 3).

Relationship between socio-economic characteristics of respondents and income generated from trade in African walnut

Examining the influence of socio-economic variables (including ethnicity, residency, sex, age, marital status, household size, primary occupation, level of education and NTFP trading experience) of harvesters and marketers on income generation from sales of African walnut;

it was revealed that most variables do not impact on income generation except for sex, level of education and respondent's trading experience (Tables 4 and 5). Generally, respondents' socio-economic characteristics were similar and there were consensus on units of marketing of products and their pricing.

Table 3: Perception and threats on availability of African walnut in the last ten years (2001 -2010)

Variables	Harvesters		Marketers	
	Frequency	Percentage	Frequency	Percentage
<i>Level of availability of species</i>				
Increasing	-	-	8	15.7
Decreasing	8	100.0	33	64.7
Can't say	-	-	10	19.6
Total	8		51	100.0
<i>Factors affecting availability of products*</i>				
Seasonality	8	28.6	51	100.0
Destruction of parent trees	8	28.6	-	-
Pest and disease infestation	2	7.1	-	-
Consumption of fruits by wild animals	8	28.6	-	-
spoilage during storage	2	7.1	-	-
Total	28	100.0	51	100.0
<i>Constraints to sustainable exploitation of NTFPs</i>				
Seasonality	6	75.0	51	100.0
Destruction of parent trees	2	25.0	-	-
Can't say	-	-	-	-
Total	8	100.0	51	100.0

*Multiple responses were allowed.

Table 4: Summary of chi-square tests of effects of socio-economic variables of respondents on sales income from African walnut

Socio-economic variables	DF	χ^2	P-Value
Residency status	2	3.891	0.143
Sex	2	7.714	0.021*
Marital status	4	6.770	0.149
Level of Education	2	8.476	0.014*

*Test is significant at $P < 0.05$.

Table 5: Summary of regression analysis of socio-economic variables of respondents on sales income from African walnut

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	.615	.537		1.146	.257
Age	.016	.014	.183	1.149	.256
Household size	-.034	.061	-.086	-.552	.583
NTFP trading experience	.140	.058	.316	2.413	.019*

*Test is significant at $P < 0.05$.

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DISCUSSION

The collection and marketing of African walnut from the wild was influenced by ethnicity in the study area as most actors involved in both harvesting and marketing of the products were found to belong to the Yoruba ethnic group, majority of who are native. A greater percentage of them were also married and in their active age, and had considerable household sizes. This is consistent with the findings of Tajoacha (2008) who reported that 77% of NTFPs collectors in the Takamanda-Mone Forest Reserve in Southwest Cameroon are married and hence more stable. Observation on the product being dominated by females and forest dwellers is also similar to the findings of Sunderland *et al.* (2004). Arnold (2001) have also submitted that NTFP activities are important for women because they can be combined with regular family and household tasks, often at or near home, thereby allowing them to combine these income earning activities with other household chores such as child care. That most actors in the collection and marketing of NTFPs have First School Leaving Certificate as highest level of education could be explained as a consequence of the unskilled nature of collection and transformation of the various products. The findings on the contributions of African walnut trade to household income underscore the huge livelihood potential of trade in this product in the study area. On the whole, trade in the African walnut help in the stabilization of local incomes as well as providing seasonal employments to harvesters and marketers for a greater part of the year. The issue of seasonality also has significant influence on the potentials of the African walnut in income generating activities. This was obvious because it is a fruit/seed-producing species. Meanwhile, the average unit sales of African walnut were found to be generally higher among harvesters than marketers, without a corresponding higher revenue generation among harvesters. This shows that it is the marketers that derive greater benefit from product collection, trade and use, a pattern similar to that found by Godoy *et al.* (1995) working with the Sumu Indians in Nicaragua. This observation, according to Nkwatoh (2005), could also be attributed to a number of issues: The first is the lack of improved processing methods for most NTFPs that could add value and increase product selling prices. The second issue is the lack of market information, which often makes it difficult for harvesters to project quantity demanded. The third issue is the lack of storage facilities, which also makes it difficult for the harvesters to store the products beyond the peak production seasons, a period noted for low market prices.

The wide reflections of decreasing trend in the availability of African walnut from the wild particularly among harvesters portend great threat to the sustainability of the species. Destruction of parent plants and consumption of nuts by wild animals have been linked in this regard. Most of the vines available in the wild are also old. The lack of modern technology for processing and storage is also a major issue in harvesting and marketing of the product. For now, the current degree of transformation of the African walnut to finished product is low, i.e. the fruit is eaten without any value added. However, when extractives are obtained, the transformation may be high. Another major hindrance to improved production of the African walnut has been the unavailability of planting materials (Jiofack *et al.*, 2013). Though, the African walnut is now widely integrated into cocoa agroforestry systems (Babalola, 2011; Jiofack *et al.*, 2013), huge volumes of the product are still being extracted from the wild. Thus, product seasonality, lack of access to market information and capital are significant problems that still confront harvesters in the commercialization of the African walnut. Also variable market demands, as well as bad roads, are the principal problems facing the marketers of this product.

Clearly, there is need for work of improvement to obtain large quantities of African walnut seeds for planting. The need to select and breed for improved varieties for effective domestication is critical. These should also include the selection of germplasm for multiplication and conservation of the genetic resources for immediate and future needs. Since the African walnut has been traded for years in the study area, its global commercialization will encourage more cultivation. Thus, value chain development work is needed that will allow harvesters and farmers to derive appropriate livelihood benefits from cultivating the vine. There is need for research into better processing and storage methods that will allow a more steady supply and even pricing. There is no doubt that an improvement in the production, processing and marketing of the African walnut will better the living conditions and enhance the status of both harvesters and marketers. These will have multiplier effects on the conservation of the available wild materials, including wild relatives. Even at present, the contributions of the African walnut to the socio-economic benefits of harvesters and marketers cannot be over-emphasized. Its products supplement household food, income generation, medicinal benefits, and provide employment for a large number of people. The African walnut is especially valuable during the 'hungry season' - a period when staples are yet to mature and become ready for consumption. The socio-economic contributions of African walnut to farmers, harvesters, marketers and other stakeholders has been seen as an opportunity to conserve indigenous trees under which it is grown (Babalola, 2011; Jiofack *et al.*, 2013). This in turn is considered as a multiple land-use system and an approach to conservation agriculture in the tropics.

CONCLUSION

The role of the African walnut as a source of food and income that people can fall back on in times of crop failure, shortfall, or to cope with some other form of emergency is very important in rural livelihoods. However, several factors persist to constraint the year-round availability of the product. These include: seasonality, destruction of parent plants and consumption of nuts by wild animals, pest and diseases infestation, and spoilage during storage. Therefore, in order to further enhance the contributions of this product to household food security and income, it is important to intensify interest in its domestication, processing and commercialization activities.

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