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Underutilised Oyster Nut *(Telfairia pedata)*: Farmers' Knowledge, Practices and Utilisation in Northern Tanzania

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ABSTRACT

Oyster nut [*Telfairia pedata* (Smiths ex Sim)] Hook is a regularly cultivated crop in East African countries such as Tanzania (including Zanzibar Island), Uganda, Angola, Mozambique, and along Kenya's coast, which is regarded to be underutilised. Despite its relevance to small-scale farmers in terms of conservation, income creation and food security, little is known about the farmer's knowledge, practices and utilisation in Northern Tanzania. Therefore, this study aimed at investigating aspects of its production, including farmers' practices, utilisation and preferences. Data collection was carried out through semi-structured questionnaires in the regions of Arusha, Kilimanjaro and Tanga. Descriptive analysis was done whereby frequencies, means and percentages were calculated using SPSS from the farmers' responses. The results on oyster nut preferences, knowledge, cultivation and utilisation were presented in the form of tables and graphs. The findings revealed that 87% of respondents who were knowledgeable about oyster nuts were female, 89% of interviewed farmers grew the nuts on inherited family lands, 24% of respondents stored oyster nuts in perforated plastic bags, and 90% of the farmers used recycled seeds as their primary method of propagation without the use of any agricultural inputs. Conclusively, the study gives significant baseline data for future research on oyster nuts and development projects in Tanzania to enhance its conservation and sustainable usage while ensuring nutritional security for the majority of resource-poor people.

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1.0 Introduction

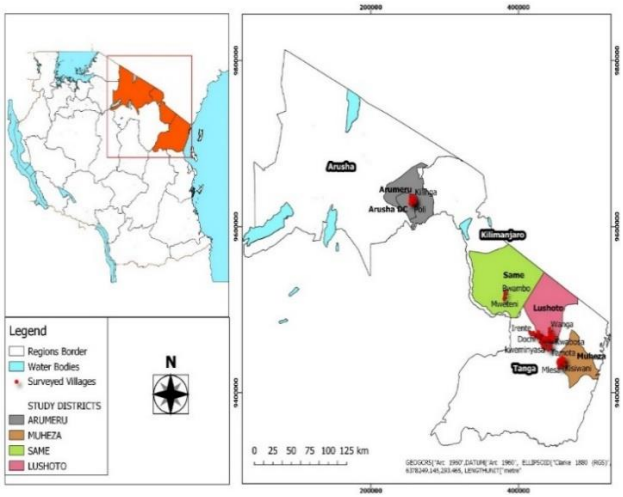
Oyster nut, also known as *Telfairia pedata* (Smiths ex Sim) Hook, is under the Cucurbitaceae family, native to Tanzania (Bondoli *et al.,* 2021). It is a dioecious plant and herbaceous woody vine which carries fruits which resemble gourds, having big and nutritious oily seeds. Fayeun *et al.* (2018). It is related to *Telfairia occidentalis* (Hook F.), which is grown in Nigeria, West Africa, and *Telfairia batesii* of Cameroon and Equatorial Guinea (Odiaka & Odiaka, 2011). Oyster nuts can be consumed raw or boiled, cooked, ground into a paste to thicken traditional foods or roasted for confectionaries. They contain carbohydrates, fat, minerals, protein and essential amino acids (Mwakasege *et al.,* 2021). Because of the remarkable lactogenic qualities, nursing mothers highly treasure the nuts, which are highly valued by the East African communities (Nwonuala & Obiefuna, 2015 and Mwakasege *et al.,* 2021). The climber intertwines the hardwood trees or wooden trellis, which are part of the rich agroforestry systems, with a combination of coffee (*Coffea sp.*) and banana (*Musa sp.*) along Mount Kilimanjaro and Mount Meru in Tanzania (Garrity, 2012). Because of their ecological and economic significance, they also maintain and safeguard forests, trees and saplings in areas where the nuts are cultivated (Ajayi *et al.,* 2004). Despite its nutritional and environmental values, oyster nut is considered a neglected and underutilised crop because little research has been done by scientists and researchers (Aregheore, 2007). According to Hammer *et al.* (2001), underutilised crops are those which were formerly grown and consumed but have subsequently fallen out of favour, while neglected crops are those that were believed to be used in areas where they are competitive and well adapted. Thus, the objective of this study was to provide baseline data on oyster nuts and attempt the following tasks: (a) identify oyster nut preferences, seed sources, producers and sellers related to gender (b) determine farmers' management practices, including types of storage facilities, oyster nut utilisation, preferred host tree species and associated challenges.

2.0 Materials and Methods

2.1 Study Area

The study was purposively carried out with 346 oyster nut growers (both females and males) in the Arumeru, Same, Muheza, and Lushoto (Bumbuli inclusive) districts in the Kilimanjaro, Tanga, and Arusha regions of Northern Tanzania. The Tanga region is located in the northeast corner of Tanzania between 5.3050° S, 38.3166° E below the equator. The Arusha region is located between latitudes 3.3869° S and 36.6830° E, below the equator. The Kilimanjaro region is situated south of the equator at 4.1337° S and 37.8088° E. It shares borders with Kenya to the north and east, the Tanga region to the south, the Manyara region to the southwest, and the Arusha region to the west (NBS, 2013), Figure 1.

Figure 1
Map of Study Area Showing the Geographical Locations of Surveyed Villages



2.2 Data Collection

The field survey was conducted between November 2019 and April 2020 using a semi-structured questionnaire approach that was adapted from Abtew *et al.* (2016) and Midega *et al.* (2016) and comprised field visits and household interviews. In order to document and assess farmers' knowledge, practices and utilisation of oyster nuts, structured and semi-structured questionnaires were designed to collect data across 346 farmers. The farmers

were interviewed by trained enumerators who were familiar with the study area, conversed in their local language and understood cultural norms and provided comments during the interview process. Agricultural Extension Officers and local leaders helped choose the majority of the farmers using a snowball sampling technique (Loko *et al.,* 2019). The data were collected from every responder prior consent, and trust was upheld during the field measurements and interview procedures. The information gathered mainly concentrated on the (i) farmers sociodemographic attributes of the interviewees (household size, age, gender, education, sex and farming experience in the production of oyster nuts); (ii) knowledge and preference for cultivating oyster nuts; (iii) sources of seeds and storage methods and facilities and their associated challenges; and (iv) types of preferred host hardwood tree species.

2.3 Data Analysis

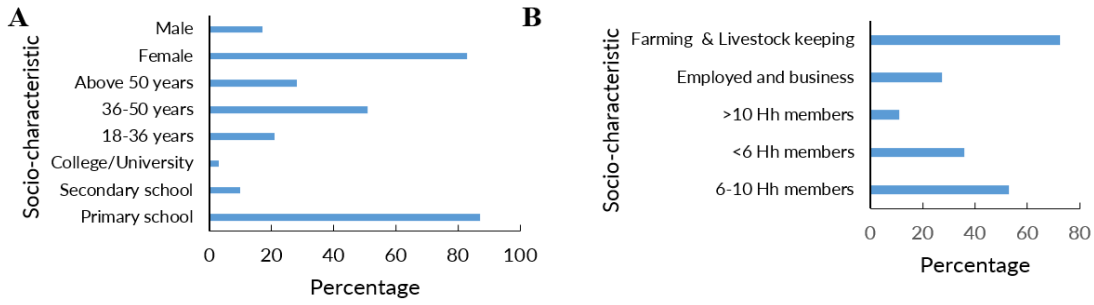
For all collected data, they were coded, organised, and analysed both qualitatively and quantitatively using Statistical Package for Social Sciences (SPSS, 2021). Descriptive statistics (response frequencies, means and percentages) were used in the analysis and inferential statistics (T-test and Chi-square-X^2), and the results were presented as tables and graphs. Excel software (Microsoft Office 2016) was used to examine the relationship between the sociodemographic features of the households and the variations in age, districts, education levels and gender. The analysed data on socio-demographic characteristics of surveyed farmers (age, gender, education level, size of household, land size, farming experience), storage containers and methods (perforated plastic sacks, buckets, earthen jars, sisal sacks, on the floor surfaces and under the roofs) using Jamovi version 1.1.9.0 computer software (Loko *et al.,* 2019).

3.0 Results and Discussion

3.1 Socio-Demographic Characteristics of Respondents

In this study, a total of 346 respondents were interviewed, with 87% and 13% being female and male, respectively. The majority of the respondents were between the ages of 18 and 75 years, with an average age of 35 years for women and 50 years for men. More than 40% of those surveyed were in the middle age category (36-50); 20% were above 50 years, and 12% were youths between the ages of 18 and 35 years. The majority of respondents, more than 80%, had completed primary school. Furthermore, more than 40% of the household members had 6-10 individuals; 20% had less than six family members, and 10% had more than 10 family members (Figure 2 A and B).

Figure 2A&B
Sociodemographic Characteristics of Respondents in the Research Area (N=346)



The findings of the study revealed that women are the main oyster nut growers, as in line with Dansi *et al.* (2012), who reported that *T. occidentalis* is largely grown by women in West Africa. Moreover, even in the production of other nuts, such as bambara ground nuts (*Vignasubterranea* (L.) Verdc.)

in the County of Kakamega, Kenya, women are known to be the primary cultivators, hence it is completely a female crop, and their male counterparts have forgotten to farm it (Ashagidigbi *et al.,* 2018; Ibrahim *et al.,* 2018). However, from this study, there was no statistical significance between prior knowledge and gender influence on oyster nut production, meaning that whether being a man or a woman does not influence your prospect of knowing about oyster nuts. On the other hand, participation of women in agricultural activities, particularly on the African continent, is highly valued (Harouna *et al.,* 2019). Consequently, this implies that women were the majority of the population and that agricultural technology and innovations are more effective and efficient for prosperity. Additionally, they could cultivate oyster nuts because they were literate enough (primary school level).

3.2 Prior Knowledge about Oyster Nuts

Binary logistic regression analysis (Table 1) was used with the farmers' socio-demographic attributes as explanatory variables and prior knowledge of oyster nuts as a dependent variable, which demonstrates a good fit with the data (p = 0.633 > 0.05) (Hosmer-Lemeshow goodness-of-fit test). This explains that there is a significant difference in the outcome (X2 = 40.632, df = 19, p. 003) (Omnibus Tests of Model Coefficients), whereas the results also revealed that there is no significant association between the gender and prior knowledge of oyster nuts (Wald = 0.062, df = 1, p > 0.05) (Table 1). Although there was no significant relationship between the age groups of the farmers and their prior knowledge of oyster nuts (Wald = 2.554, df = 8, p = 0.116 > 0.05 and Wald = 3.277, df = 8, p = 0.854 > 0.05), there was a marginally significant relationship with the middle age group (36–50) (Wald = 0.498, df = 8, p = 0.074), as shown in Table 1. The test also revealed that there was no significant relationship between secondary school education (Wald = 0.723, df = 1, p = 0.723) and the college education (Wald = 1.789, df = 1, p = 0.494); however, there was a slight significant relationship between the primary education level (Wald = 0.495, df = 1, p = 0.025) and the length of time the farmers have resided in the village cultivating oyster nuts (Wald = 2.59, df = 1, p = 0.009).

Table 1
Binary Logistic Analysis for Oyster Nuts

Variables in the Equation								
Variables	**B**	**S.E**	**Wald**	**Df**	**Sig.**	**Exp(B)**	**95% C.I. for EXP(B)**	
							Lower	***Upper***
Gender	.169	.3672	0.062	1	0.876	1.184	-.0637	.9946
Age								
Age(18-35)	.452	.4143	2.554	8	0.116	1.919	-.4417	.3767
Age(36-50)	.865	.260	0.498	8	0.074	1.592	-1.332	.2.554
Age(50-abo)	.711	.9914	3.277	8	0.854	1.842	-2.506	.0445
Education lev								
Primary sc	0.55	.8511	0.495	1	0.025	0.259	-9.720	-1.033
Secondary sc	0.22	1.859	0.723	1	0.491	1.246	2.534	.3467
College	.351	.0444	1.789	1	0.494	1.420	.7894	.9261
V.Reside	1.25	.0281	2.59	1	0.009	3.49	.8751	.6521

B-> Represent the values for logistic regression equation for predicting the dependent variables from the independent variables; S.E: Standard Error associated with the coefficient; Wald: Wald-χ^2; Df: degree of freedom for each of the test of the coefficients; Sig: Significant level (p-value); Exp. (B): Exponential of the coefficients (odd ratio for the predictors); C.I.: Confidence Interval.

Oyster nut farming involved more middle-aged and older participants. This indicates that younger generations (18–36 years old) were not very interested in farming oyster nuts or other crops. On the other hand, because the participants in the middle and older age groups, i.e., 36-50 years old and above 50 years old, had a significant influence on growing and passing on to the younger generation about oyster nut cultivation and its advantages. This suggests that the development,

application and acceptance of oyster nuts as a significant agricultural oilseed crop may not be influenced by education or farming experience. On the other hand, *Telfairia occidentalis*, a closely related crop, is a valuable cash crop in West Africa due to the sale of its leaves and nuts (Odiaka & Odiaka, 2011).

3.3 Farmers' Practices

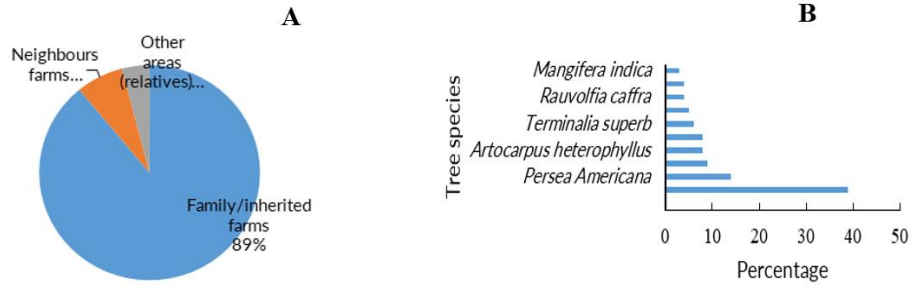
The findings on land allocation for oyster nut production and cropping systems indicated that the majority of farmers, 89%, grew the crop on family lands that were primarily inherited, while only seven per cent of farmers used their own lands (Figure 3A). Furthermore, only 4% of farmers planted oyster nuts on their relatives and neighbours lands. All farmers embraced intercropping with important crops, including coffee (*Coffea sp.*), maize (*Zea mays*) and banana (*Musa sp.*). Since women were the principal oyster nut farmers, they planted the crop in marginal lands or around farms because they lacked access to land and hardwood tree species that support their large and heavy hanging fruits. *Albizia schimperiana* accounted for 39% of the tree species in this study, followed by *Persea americana* (14%), *Croton megalocarpus* (8%), *Artocarpus heterophyllus* (6%) and *Cordia africana* (6%) (Figure 3B).

From the study, it indicates that oyster nut farmers used no other propagation methods except for the seeds, and no pesticides, fungicides, industrial fertilisers or organic manures were used in cultivating oyster nuts. This indicates that oyster nuts are cultivated based on their indigenous knowledge and are organic, as the crop is grown without the use of any inputs. This is in line with studies that indicate that no agrochemicals or fertilisers are used to grow oyster nuts (Ajayi *et al.* 2007). However, in many parts of Africa, certain crops are cultivated all year round, although main crops like cereal grains and tubers, such as potatoes, are frequently seasonal crops (Midega *et al.,* 2016). Consequently, food collected in a short period of time that might last for a few weeks must be preserved for progressive consumption until the next harvest. Additionally, if any surplus products are achievable in an uncontrolled market, their value tends to increase during the off-season. Therefore, keeping the produce in optimal condition for as long as possible must be the primary goal of any storage method (Abtew *et al.,* 2016). In addition to minimising losses, the handling and storage methods should be reasonable when considering other aspects, including manpower, equipment, building expenses, and economies of scale. Despite the nutritional values of *Telfairia* species, the seeds are recalcitrant in nature, hence difficult to store (Odiaka *et al.,* 2008). In order to fulfil family requirements or prevent storage losses, most oyster nuts are sold one to three months after harvesting, and only a small amount are stored. If present challenges with traditional postharvest methods and procedures are not addressed, *Telfairia occidentalis* and related crops may experience significant losses in the crop production chain and storage (Igbozulike, 2015).

Figure 3

A. *Land Areas for Oyster Nut Cultivation*

B. *Names and Frequencies of Host Tree Species Preferred by Farmers*

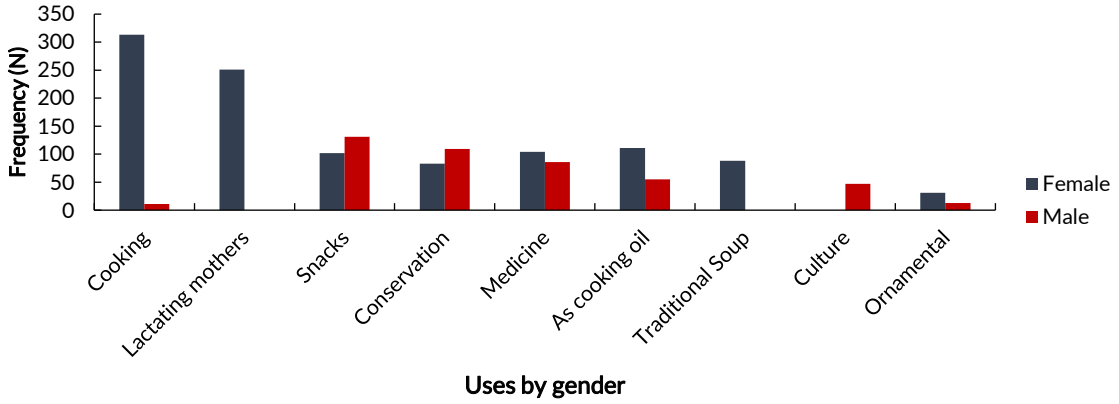


3.4 Utilization and Management of Oyster Nuts

According to the study, the majority of female respondents (313) used the nuts for cooking with staple meals, nursing mothers (251) used the nuts, whereas 131 men consumed the nuts as snacks, and 109 used them for conservation (Figure 4). The study indicated that there was a significant difference in the frequency of oyster nut use between male and female respondents ($\chi 2=435$, df=9, $p<0.001$), with the majority of oyster nut users engaged in production being female (Figure 5).

Figure 4

Uses of Oyster Nuts by Gender



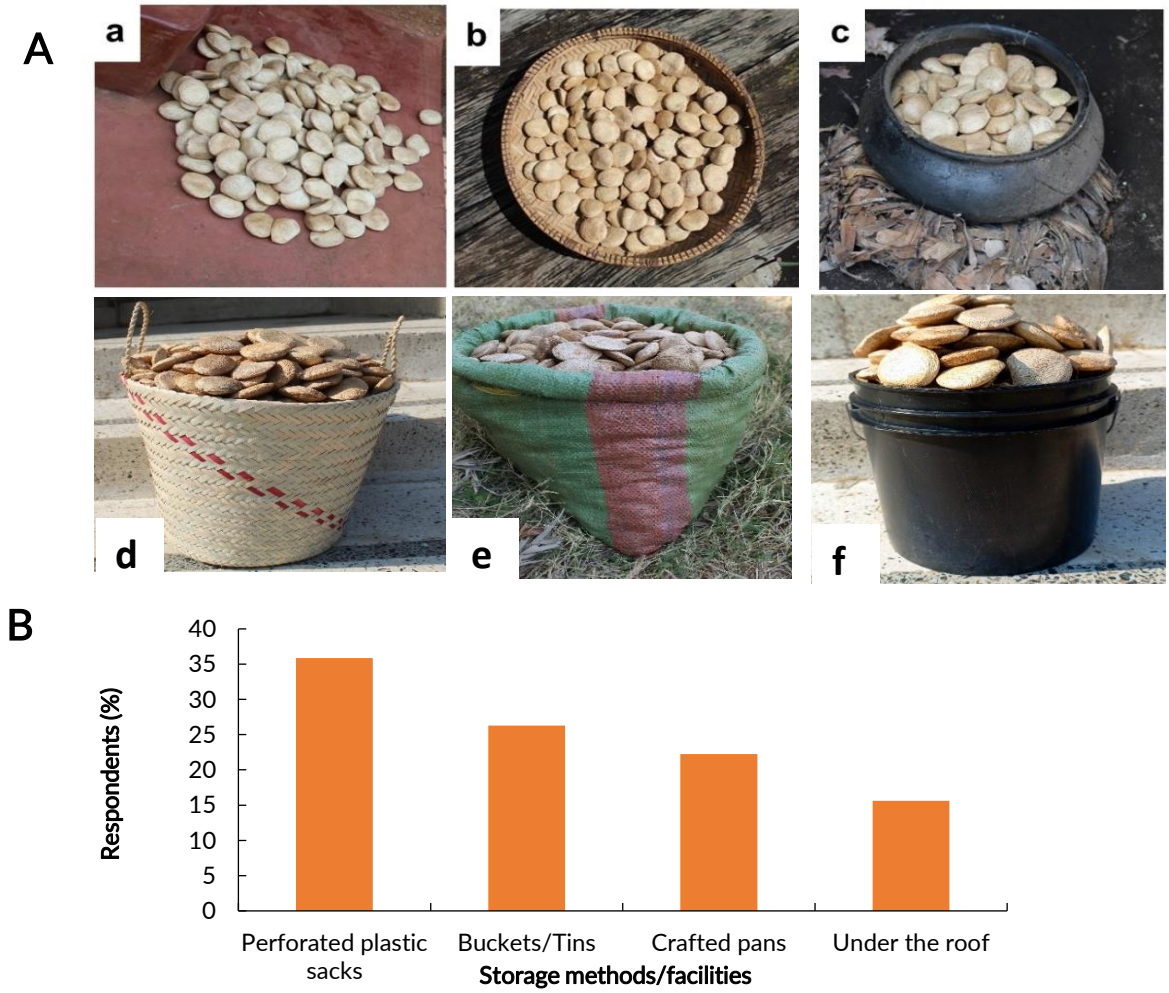
However, the findings indicate that oyster nuts were stored in perforated plastic bags by 35% of respondents; 25% kept them in plastic buckets or metal tins, and 22% stored nuts in artisan or crafted pans. The least preferred method of storing the nuts was by placing them under the roof by 13%, Figure 5. And also, it was obvious that storage containers also vary from farmer to farmer depending on the amount of stored seeds, availability, ease of use and cheapness to purchase, as the majority of the farmers, 89%, estimated that oyster nuts can be stored for more than two years, and 11% responded that the seeds can be stored from 6 to 12 months without being attacked by insects or fungi.

Farmers have their own traditional methods which typically involve breaking the dry pods, roasting the seeds on low heat, or smashing the seeds and extracting the kernel out. When the guard-shaped oyster nut fruit reaches maturity, it detaches itself from the host tree, falls to the ground surface, where it breaks open. Once the fruit ruptures, the full seeds are collected (the unfilled seeds are thrown away), the internal portion is taken out, the pulp is cleaned, and the nuts are sun-dried before being stored, eaten or sold. Additionally, fluted pumpkin leaves (*T. occidentalis*) are highly promoted and marketed with formal marketing, while oyster nuts are primarily sold as dried seeds with minimal formal marketing (Alegbejo, 2012). Besides, not only older and less educated farmers but also women in particular benefit widely from the use and sale of such products, as they cannot compete successfully in the formal job market (Shackelton & Gumbo, 2010). Nonetheless, the study found that all income earned from the sale of oyster nuts was used on domestic expenses. Additionally, it was discovered that oyster nut growers exclusively used seeds as a method of propagation and that no pesticides, fungicides, industrial fertilisers, or organic manure were used throughout oyster nut planting periods (Mwakasege *et al.,* 2021). Garrity (2012) found similar results in northern Tanzania, where bananas (*Musa sp.*) and coffee (*Coffea sp.*) are grown in an agroforestry system.

Figure 5

A. *Examples of Traditional Storage Methods/Facilities Used by Different Ethnic Communities (a-f): Placed on the Floor Surface (a); Stored on Crafted Pans/Weaved Basket (b); Stored in Earthed Pot (c); Stored in a Weaved Basket (d); Stored in Perforated Plastic Sack (e) and Stored in Small Plastic Bucket (f) and*

B. *Storage Methods and Facilities of Oyster Nuts*



4.0 Conclusion

The findings of this study demonstrated that women had an opportunity to plant oyster nuts close to family lands with hardwood tree species or on marginal lands because they were the primary oyster nut growers and lacked access to land. Oyster nut habitats have decreased due to human activities, including agricultural expansion and the overexploitation of trees for charcoal, fuel and timber. Apart from in addition to providing oyster nuts, trees offer ecosystem services such as shade, windbreak, rainfall, soil protection, and water source protection (rivers and streams), and increased soil fertility (Giliba *et al.,* 2011). Consistent access to markets (for selling oyster nuts) and opportunities for value-added processing is crucial for small-scale farmers (most of whom are women) and communities' long-term sustainability in Arumeru, Same, Muheza, Lushoto, and neighbouring districts. Oyster nuts can help reduce poverty among rural communities of Arumeru, Lushoto, Same, and

Muheza districts by generating extra income and improving nutrition and food security.

5.0 Recommendations

It is recommended that rural farmers, especially men, be encouraged to actively engage in oyster nut production and use even beyond this study area. The introduction of improved seed varieties through breeding programmes to increase productivity and dissemination of the improved varieties and appropriate management practices should be the focus for future research in order to increase oyster nut production. Farmers should be assisted with financial facilities, lands, inputs and training sessions on oyster nut cultivation and utilisation in order to ensure sustainable production of oyster nut for the benefit of present and future generations.

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8.0 Declaration of Conflicting Interests

The authors declare that they have no conflict of interest.

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