American-Eurasian J. Agric. & Environ. Sci., 21 (1): 11-21, 2021
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2021.11.21

Evaluating the Effect of Non-Timber Forest Products on Rural Livelihoods in Macula-Marrupa Corridor Niassa Special Reserve, Mozambique: Implication for Income and Food Security

[1]Lubega Gerald, [2]Mario Paulo da Silva Falcao, [1]Ssekaandi Joseph and [2]Natasha Ribeiro

[1]Faculty of Agriculture, Uganda Martyrs University, P.O. Box: 2341, Kampala, Uganda
[2]Department of Forest Engineering, Faculty of Agronomy and Forest Engineering, Eduardo Mondlane University, P.O. Box: 257, Maputo, Mozambique

Abstract: Contemporarily, there has been a growing interest in the role played by Non-Timber Forest Products (NTFPs) towards improving livelihoods among rural populaces. This has been facilitated by the fact that communities living close to forest solely rely on NTFPs at a great extent for their livelihoods and thus, any effort in conserving such resources as a requirement in understanding how the host communities get to interact with them. The study employed a multistage sampling technique including proportionate and convenience sampling. A sample of 377 households was surveyed using a questionnaire. Key informant interviews with NTFP traders were conducted as well as observation on the commonly used NTFPs. Univariate and linear logistic regression analyses were employed in analyzing and summarizing collected data. The study revealed that 45.9% of community members are involved in selling NTFPs. Additionally, the collection, production and selling of NTFPs had a positive and significant influence on rural livelihoods in terms of food security and household incomes of people in Mecula-Marrupa Corridor (ß=0.368; p=0.010). For instance, collection, production and selling of firewood (ß=0.762; p=0.017); wild vegetables (ß=0.701; p=0.013); medicinal plants (ß=0.576; p=0.007); spices (ß=0.559; p=0.020), charcoal (ß=0.521; p=0.003); sisal (ß=0.649; p=0.037) and forage (ß=0.430; p=0.011); honey (ß=0.459; p=0.007), wild tubers (ß=0.399; p=0.022), wild fruits and nuts (ß=0.372; p=0.046) and ropes (ß=0.372; p=0.021) had a positive and significant influence on both food security and incomes of rural households. Even though, the collection of these NTFPs had contributed largely on food security (38.6%) and income generation (24.5%), production and selling of these products has remained less and on subsistence basis. It can be recommended that there is a need to provide domestic cooking energy alternatives such as biogas locally made energy saving stoves can reduce on the pressure of gathering fuel woods and charcoal.

Key words: NTFPs Collection · Household Income · Food Security · Livelihoods

INTRODUCTION

Forests are a great resource in providing products of several uses for households and industries [1, 2]. These products range from Timber Forest Products (TFPs) toNon-Timber Forest Products (NTFPs), However much the value of timber forest products is high world over and command more attention when compared to NTFPs, the role of NTFPs in supporting the livelihoods of communities staying around forest covers has been highly neglected with minimal attention. Even though NTFPs are not necessarily the major source of livelihoods for people living around forests, they are considered important sources of household income, food security, healthcare as well as helping communities in accomplishing a multiplicity of social and cultural values [3, 4]. Given the above importance of NTFPs, there still a major challenge which persist in evaluating the role or influence of NTFPs on the livelihoods of indigenous population [5].

In the context of this study, it should be noted that Food and Agriculture Organization [6] defines food

Corresponding Author: Lubega Gerald, Faculty of Agriculture, Uganda Martyrs University, P.O. Box: 2341, Kampala, Uganda and Department of Forest Engineering, Faculty of Agronomy and Forest Engineering, Eduardo Mondlane University, P.O. Box: 257, Maputo, Mozambique.

security as “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”. This definition comprises four key dimensions: availability, stability, access and utilization. On the other hand, according to Wood *et al*. [7], income is “money (or some equivalent value) that an individual or business receives, usually in exchange for providing a good or service or through investing capital.” For individuals, income is most often received in the form of wages or salary. Business income can refer to a firm’s remaining revenues after paying all expenses and taxes. In this case, income is referred to as "earnings” obtained from NTFPs.

There is limited information about the extent to which NTFPs contribute or influence household income and food security. This is because of less utilization of clear and definite data collection system to follow up this influence at local and national level in a number of developing countries like Mozambique [8], The results from evaluation studies of the contribution of NTFPs can provide important insights in guiding formulation of policies, enforcing policies and sustainably managing forest resources, The value of NTFPs keep varying from place to place due to their economic and cultural settings. In developed economies, NTFPs are majorly for recreation functions, conservation of biodiversity and development of rural economy [3].

Whereas in developing countries, NTFPs are majorly used for subsistence purposes and income generation [5, 9] In Africa, NTFPs are taken as safety nets which fill the gaps in shortfalls in food insecurity and all other forms of emergencies [10, 11]. As argued by Wood *et al.* [7], if activities based on NTFPs are maintained and priotized by governments and local authorities, these can contribute significantly to forest conservation and socio-economic wellbeing of communities staying around and in the forest

Globally, the role played by NTFPs in rural based households in terms of income generation is very significant. For instance, Kaoma and Shackleton [12] found out that the amount of revenue received monthly from NTFPs was much higher than a salary of a teacher (Minimum Wage) in central and West Africa. Theyalso indicated that NTFPs traders in Democratic Republic of Congo obtained close to USD 30-200 every week. Those who were producing NTFPs earned over 75% of that amount weekly.

In Mozambique, since the country is endowed with forest and woodlands resources, catchment forests occupy a total of 32 million hectares which offer direct and indirect NTFPs which support both rural and urban communities [13]. Non-Timber Forest Products (NTFPs) include wild fruits, poles, fodder, honey, firewood and vegetables, medicinal plants. Thereby, NTFP collection provides an important source of income for poor households and a temporary safety net in times of food or income scarcity [14].

Furthermore, Jimoh *et al*. [1] found that rural households in Kaduna Nigeria obtained over 80% of their incomes from selling NTFPs. Additionally, Zaku *et al.* [15] also found/reported that over 70% of households depended on fuel wood in the country as their major source of energy with an estimated consumption of 27.5million Kilogram on daily basis in Nigeria. This thus informs us that dealing in NTFPs in several countries is shifting from subsistence exploitation and selling locally and nationally to an international trade.

In Western part of Nigeria, game meat and snail harvesting for selling were found to be the main income generating activities for close to a whole year [16, 17]. In Eastern Arc Mountains in Tanzania, honey, firewood, locust beans, gum Arabic and charcoal provide a lot of income for rural based households [1, 18]. These form of contribution are mentioned in different countries in Africa like Nigeria, Kenya, Uganda and Tanzania [17, 19]. The world is struggling with a multiplicity of problems in forest-based communities ranging from poverty and lack of employment. These communities are living in areas which are remote with no access to important social services. In consequence, these communities find themselves relying on natural resources in their proximity. In the context of Mozambique, according to Jimoh *et al.* [1] and Suleiman *et al.* [18], over 55% of incomes and food received by people in Niassa province is generated from NTFPs. Therefore, forest resources especially the NTFPs can be considered as a potential solution to communities to obtain required income and food. The objective of this study was to evaluate the contribution of NTFPs on rural livelihoods of households in Mecula Marrupa corridor Niassa Special Reserve.

This study was guided by Resource use theory of Mcfadden [20], This theory posits that the dependency of people on any given resource depends on three factors, that is, ecological, economic and cultural factors. This interacts with each other and contributes the interdependence level among the people and their environment. In this case, those communities which have been living around protected areas in a number of developing countries have an historical reason of being there [21]. First, these people have historically depended on resources from these forests to meet their livelihoods,

particularly during hardship. For instance, many people who tend to lack enough food for survival through agriculture tended to resort to forests for survival. Others historically decided to stay around protected rain forest for other emergencies [22]. For a big number of households, forests act as a bank where they obtain another form of income while consuming and selling NTFPs [22, 23]. This means that NTFPs sustainable extraction can be promoted as a strategy for developing rural areas and biodiversity especially rich forested areas [23]. In Mozambique, forest covers have been used by adjacent populations as a great resource in supplementing incomes for their households [24]. This thus necessitates an analysis of this nature to understand the extent to which communities depend on NTFPs and how this is influencing their livelihoods in form of food and income generation for a sustainable development of rural areas and conservation of biodiversity.

MATERIALS AND METHODS

Study Area: Niassa Special Reserve is a nature reserve laying partially in provinces of Cabo Delgado and Niassa, Mozambique. This reserve covers over 42, 000 square kilometers (10, 000, 000 acres), it is the largest protected area in the country [25]. The reserve is part of the Trans-Frontier Conservation Area and links to the Tanzanian Lukwika-Lumesule Game Reserve [26]. Niassa Special Reserve is part of the Eastern Miombo woodlands, which also encompasses parts of Tanzania and Malawi. The reserve is one of the largest Miombo woodland preserves in the world [25], with Miombo forest covering half of the reserve. The remainder is mostly open savannah, with some wetlands and isolated patches of forest. 95% of the Reserve's biomass is vegetation, which includes 21 types of plant matter and 191 species of trees and shrubs [27]. The selection of Mecula-Marrupa Corridor was due to the fact that majority of forest covers lost are found in this district (close to 41.4km^2 (0.9%) [28]. The forest cover has been lost due to communities practicing shifting agriculture.

Research Design: This study utilized both quantitative and qualitative research designs. Data was obtained from households from selected villages in Marrupa-Mecula corridor using NSR woodlands, local leaders, traditional healers and official managing Niassa Special Reserve.

Sampling and Data Collection Procedure: The collection of data was conducted by the researcher and three other field research assistants who were trained prior to data collection. The data collection process took four months (November 2019 to February 2020). A multi-stage sampling technique was employed to select 377 households [29], Eight communities/villages were selected purposively (Figure 1). This is because they had a good number of community members engaged in collecting and selling NTFPs. Secondly, the selected villages had the highest number of people and were nearer to each other. Proportionate sampling was employed in selection of 377 household members selected for the study. Convenience sampling was employed in selecting who to interview in a household survey. The household survey was structured with three sections; - Section A collected demographic characteristics of respondents, Section B collected data on NTFPs and Section C collected data on livelihoods. Community meetings/Focus Group Discussions (FGDs), with an average of between 7-12 attendants (local leaders, traditional healers and official managing NSR) in each village were held through regular and repetitive village visits. In the meetings, the researcher presented his research purpose, assessed local interest and asked for villagers' participation, then later validated his findings. Meetings were held in a suitable area/ spot close to the forest from where whole forest and village was visible. FGDs were used for interactive explanation of the NTFPs harvesting and its impact on Rural Livelihoods. During the community meetings, we tried to keep gender balance, so that women, who play a major role in NTFP harvesting and trade, could express their concerns and wishes. To do so, we used the ''talking stick'' method [30]. The speakers passed a small bamboo stick to each other to use like a microphone. We used men and women assisting in the meetings, especially with the people who were always quiet. Attendance for these meetings varied among villages and according to the total population and villagers' free time.

Statistical Analysis: Qualitative data analysis involved both thematic and content analysis, this was based on how the findings related to the research questions. Content analysis was used to edit qualitative data and reorganize it into meaningful shorter sentences. Thematic analysis was used to organize data into themes and codes were identified [31]. After data collection, information of same category was assembled and their similarity with the quantitative data created after which a report was written. Qualitative data was interpreted by composing explanations or descriptions from the information. It was further illustrated and substantiated by quotation or descriptions.

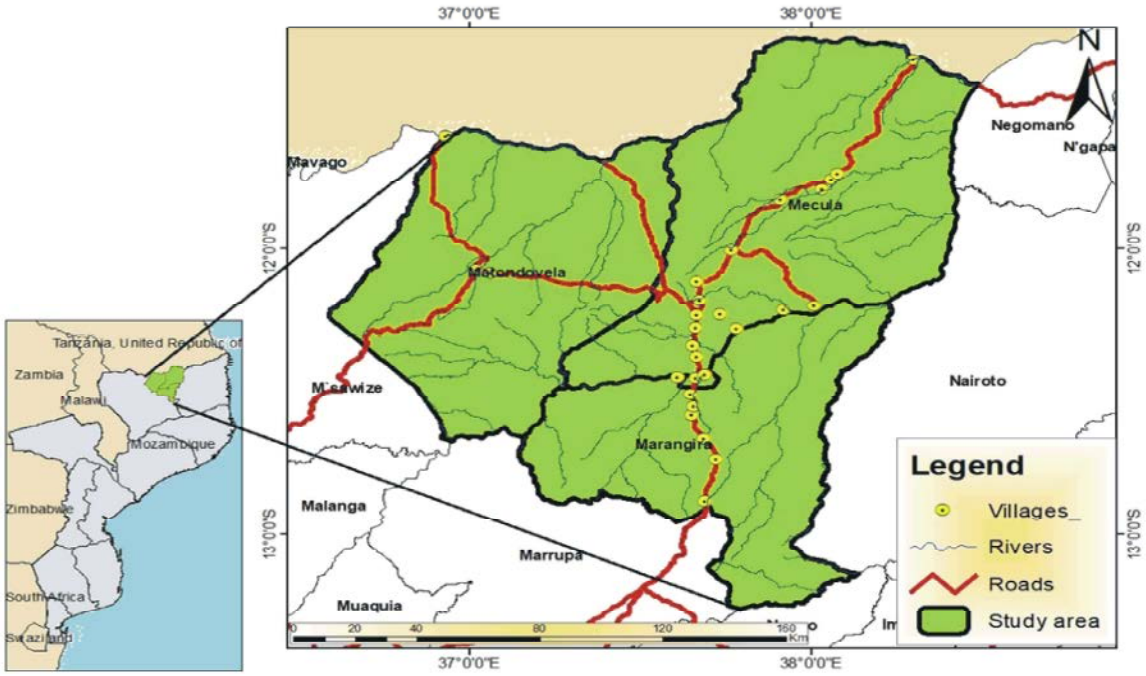

Fig. 1: Map of the Study Area

SPSS (Version 22) was employed in data analysis [32] basically for quantitative data. Here, univariate and multivariate analyses were conducted [33]. A linear regression model was used in presenting findings on the influence of NTFPs on rural livelihoods with a focus on food security and income. The model is as follows.

$$Y_q^p = a_0 + a_1 X_1^p + a_2 X_{2q}^p + a_3 X_{3q}^p + a_4 X_{4q}^p + a_5 X_{5q}^p + a_6 X_{6q}^p \cdots\cdots\cdots\cdots + e$$

In this equation, Y_q^p represents the average output for food and income (livelihoods) generated (average mean or output from food, income, construction materials and employment). X stand for the various NTFPs collected (firewood, poles, ropes, charcoal, wild fruits and nuts, grass, bamboo shoots, wild tubes, medicinal plants and fish). a_0 is the constant while a_1..... a are the independent variables' coefficients. e is used as an assumed error term. The linear regression approach was used because the dependent variables were measured on a continuous scale.

RESULTS

The age of the respondents was normally distributed with a mean age of 42.5years and standard deviation of 14.5 years. Table 1 shows that males took the highest percentage of 61% of the respondents. Regarding the highest attained level of education, the highest proportion 56.8% of respondents had no education. 99.7% of the respondents were Muslims. Further, the highest proportion 76.7% of respondents was married with a family size of 5 people and below constituting 53.1%. Lastly, 35.3% had been living in the area for 20-30 years.

Types of NTFPs Collected and Most Preferred NTFPs by the Community: Table 2 indicates that all community members were collecting firewood, medicinal plants, fish, species, grass, ropes. Those which were less collected included oil and bush meat. These were important NTFPs which directly and indirectly contributed to food security, health security, economic security and overall survival and economic growth of the area. It was evident that most of the community members preferred firewood, poles, ropes, wild fruits and nuts, grass, bamboo shoots, wild tubes, medicinal plants, fish and these were reported by above 80%. For instance, one of the key informants was quoted saying,

> *"In addition, health services are quite far we either go to Mecula or Mussoma which is also far and we don't have good means of transport to these places apart from walking so in most cases we resort to local medicine collected from the forest."* Key informant 3.

Table 1: Socio-demographic characteristics of respondents (N=377)

Variable	Frequency (N)	Percentage (%)
Age (years)		
Below 18	4	1.1
18-27	64	17.0
28-37	64	17.0
38-47	86	22.8
48-57	63	16.7
58-67	40	10.6
68++	56	14.9
Gender		
Male	230	61.0
Female	147	39.0
Level of education		
None	214	56.8
Primary	147	39.0
Secondary	16	4.2
Religion		
Christian	1	.3
Muslim	376	99.7
Marital status		
Married	289	76.7
Single	52	13.8
Widowed	12	3.2
Divorced	24	6.4
Family size		
Below 5people	200	53.1
5-10	165	43.8
More than 10	12	3.2
Duration of respondents in the area (years)		
0-10	48	12.7
10-20	72	19.1
20-30	133	35.3
30-40	28	7.4
40++	96	25.5

These NTFPs (firewood, poles, ropes, wild fruits and nuts, grass, bamboo shoots, wild tubes, medicinal plants, fish) that were most preferred (Table 2 above) were associated with the value they play in relation to food security (ß=0.368; p=0.010) (Table 4). Those which are least preferred or less talked about included, bush meat, oil, rubber, forage, sisal, tree oils and resins and charcoal. These were reported by 25% of respondents and below. Further, parameters were analyzed and statistics related to the quantity of NTFPs collected were established. It was concluded that by rate of quantity of NTFPs collected, firewood, medicinal plants, fish, berries, grass and ropes emerged on top. (Table 2). These were associated with the nutrition, culture, lifestyle, trading and economic wellbeing of the households in the area.

Table 2: Types of NTFPs collected and Most Preferred NTFPs by the community

Variables	Frequency (N=377)	Percentages (%)
Types of NTFPs		
Firewood	377	100
Medicinal plants	377	100
Ropes	377	100
Spices	377	100
Fish	377	100
Grass	377	100
Poles	376	99.7
Bamboo shoots	372	98.7
Wild Vegetables	370	98.1
Wild fruits and nuts	369	97.9
Honey	367	97.3
Mushrooms	360	95.5
palm leaves	348	92.3
Wild tubers	345	91.5
Forage	285	75.6
Berries	234	62.1
Rubber	216	57.3
Sisal	212	56.2
Charcoal	211	56
Tree oils and resins	145	38.5
Oil	78	20.7
Bush meat	57	15.1
Most Preferred NTFPs by the community		
Firewood	377	100
Poles	372	98.7
Grass	371	98.4
Wild fruits and nuts	367	97.3
Ropes	367	97.3
Bamboo shoots	360	95.5
Spices	325	86.2
Wild tubers	320	84.9
Fish	317	84.1
Medicinal plants	303	80.4
Mushrooms	309	82
Honey	292	77.5
Wild Vegetables	286	75.9
Palm leaves	249	66
Berries	101	26.8
Charcoal	91	24.1
Forage	64	17
Sisal	64	17
Tree oils and resins	54	14.3
Rubber	34	9
Bush meat	18	4.8
Oil	11	2.9

Table 3: Reasons for Collecting NTFPs

Reason for collection	Frequency	Percent
Source of food	200	53.1
Source of Income	93	24.7
Construction material	51	13.5
Source of Medicine	33	8.8
Total	377	100.0

Reasons for Collecting NTFPs: It was evident that majority of respondents were collecting NTFPs as a source of food (53.1%). Table 3 further shows that 24.7% were collecting Non-Timber Forest Product as a source of income, 13.5% as construction material and 8.8% as a source of medicine.

Table 4: Influence of NTFPS on food security of rural dwellers

					95% Confidence Interval for B	
Predictors	B	Beta	t	Sig.	Lower Bound	Upper Bound
(Constant)	2.487		3.814	.003	.540	3.976
Firewood	.501	.421	1.208	.001	.133	1.177
Bamboo shoots	.022	.013	.302	.128	.002	.131
Charcoal	.304	.255	1.009	.023	.130	.766
Honey	.532	.479	2.501	.015	.147	1.118
Medicinal plants	.536	.488	1.359	.005	.025	1.028
Wild Vegetables	.711	.632	2.142	.017	.033	.939
Bush meat	-.103	-.068	-.369	.112	-.035	.006
Wild fruits and nuts	.714	.598	1.399	.016	.116	1.157
Wild tubers	.487	.377	.700	.043	.222	1.027
Ropes	.502	.419	.904	.030	.306	1.009
Poles	-.401	-.388	.842	.227	-.052	1.002
Mushrooms	.853	.456	1.174	.034	.519	1.902
Rubber	.030	.011	.676	.065	.005	.1904
Tree oils and resins	.302	.273	.126	.095	.106	.806
Forage	.756	.666	1.173	.034	.509	1.002
Berries	.503	.449	1.540	.003	.107	1.002
Spices	.902	.865	2.044	.000	.210	1.003
Fish	-.404	-.387	.489	.084	-.212	.003
Oils	.206	.133	.049	.064	.029	.604
Grass	.599	.501	1.093	.019	.109	1.007
Sisal	-.201	-.182	.711	.077	-.106	1.068
Palm leaves	-.232	-.153	.455	.089	-.009	.521

a. Dependent Variable: as source of food (Adjusted R value: 0.386)

Table 5: Influence of NTFPS on income of rural dwellers

					95% Confidence Interval for B	
Predictors	B	Beta	t	Sig.	Lower Bound	Upper Bound
(Constant)	1.533		2.828	.005	.467	2.600
Firewood	.888	.762	2.803	.017	.396	1.021
Bamboo shoots	.037	.022	.931	.094	.002	.073
Charcoal	.627	.521	2.607	.003	.105	1.160
Honey	.573	.459	1.654	.007	.184	.938
Medicinal plants	.669	.576	1.077	.007	.105	.860
Wild Vegetables	.799	.701	2.043	.013	.105	1.240
Bush meat	-.088	-.043	-1.062	.077	-.016	1.021
Wild fruits and nuts	.415	.379	1.003	.046	.134	.963
Wild tubers	.427	.399	1.034	.022	.105	.860
Ropes	.414	.372	1.039	.021	.236	.708
poles	-.027	-.019	-.076	.683	-.005	.060
Mushrooms	.564	.770	1.043	.055	.104	1.885
Rubber	.287	.195	.943	.118	.105	.960
Tree oils and resins	-.009	-.001	-.223	.803	-.001	.019
Forage	.544	.430	1.386	.011	.139	.951
Berries	.345	.298	.832	.089	.104	.861
Spices	.605	.559	1.111	.020	.095	.916
Fish	-.091	-.039	-1.022	.184	-.012	.003
Oils	-.006	-.001	-.049	.164	-.000	.004
Grass	.501	.466	1.093	.019	.109	1.007
Sisal	.701	.649	1.011	.037	.106	1.008
Palm leaves	.204	.185	.865	.089	.010	.402

a. Dependent Variable: as source of income (Adjusted R value: 0.245)

Influence of NTFPS on Food Security: Based on the linear regression model, Non-timber forest products explained 38.6% of variation in food security (Table 4). This means that NTFPs potentially provided food used by rural dwellers in Niassa Special Reserve by a margin of 38.6% (Adjusted R value: 0.386). Particularly, the NTFPs which had the greatest influence on food security was spices with ß=0.865 (p=0.00). This increased food security in Niassa Reserve with a margin of 86.5%. Forage was found with an influence of 66.6% (ß=0.666; p=0.034). The collection of wild fruits and nuts contributed 59.8% on food security of collectors and collection of wild vegetables contributed 63.2%. Other significant NTFPs towards food security of community members included medicinal plants ß=0.488 (p=0.005), grass ß=0.501 (p=0.019), firewood ß=0.421 (p=0.003), honey ß=0.479 (p=0.015), berries ß=0.449 (p=0.003), ropes ß=0.419 (p=0.030), wild tubers ß=0.377 (p=0.043). All these significantly predicted food security. However, those NTFPs which were established with no significant relationship with food security, included, bush meat, poles, fish, rubber, sisal and palm leaves (Table 4).

Influence of NTFPS on Income of Rural Dwellers: Based on the model, Non-timber forest products explained 24.5% of variation in income generation (Table 5). This means that NTFPs have a likelihood of providing income by a margin of 24.5% (Adjusted R value: 0.245). Particularly, the NTFPs which had the greatest influence on income was firewood with ß=0.762 (p=0.017). This implies that community members who collected firewood were high likely to have growth in income by a margin of 76.2%. The second NTFPs which significantly influenced income generation was wild vegetables ß=0.701 (p=0.013). This suggests that community members who collected wild vegetables increased their income by a margin of 70.1%. The collection of medicinal plants contributed 57.6% on income generation. Further, spices contributed 55.9% (p=0.020), charcoal had an influence of 52.1%, sisal contributed 64.9% and forage 43%. In addition, other NTFPs showed a significant relationship and these included honey ß=0.459 (p=0.007), wild tubes ß=0.399 (p=0.022), wild fruits and nuts ß=0.372 (p=0.046) and ropes ß=0.372 (p=0.021). All these significantly predicted income generation or increase. However, those NTFPs which were established with no significant relationship with income generation, included, bush meat, tree oils and resins, poles, berries, bamboo shoots, rubber, fish, oils and palm leaves. These had no significant influence on income (Table 5).

DISCUSSION

The study findings established that collection of NTFPs generally contribute 38.6% to food security in Niassa Special Reserve. Mulenga *et al.* [34] and Shackleton *et al.* [35] supported the above study since they had earlier ascertained that NTFPs contributed over and above 40% on food security in South Africa and Zambia, respectively. Specifically, the study also showed that spices contributed much to securing daily food at home. They found out that they not only use spices for food but also income generation. The natural flavor found in these spices influences a good number of consumers to use these spices. In Kano, Nigeria, many NTFPs collectors add value on spices which makes them marketable [18]. In the context of NSR conservation action and rural development, the harvesting of spices is central in continued preservation of the woodland. In addition, forage was also found to have a significant influence on food security ß=0.666 (p=0.034). This suggested that community members who collected forage increased their food security through looking after their domestic animals. This tallied with the findings of Suleiman *et al.* [18] who had earlier ascertained the role of forage collected as NTFPs on food security from Tropical Rain forests in Wudi in Nigeria. The collection of forage was essential in preservation of NSR because they act as a good substitute for community members to look after their animals without tampering with forests. This can also improve rural developments in form of increased ability to rear animals needed on national markets. Furthermore, study findings established that the collection of wild fruits and nuts contributed 59.8% on food security of collectors. This is congruent with Saha and Sundriyal [23] who found out that wild fruits and nuts provide daily food consumption to children and youths. This was found as a great contribution of NTFPs towards food security. This also serves as a way of respect to NSR by the community since it is a breeding ground for fruits. It was also established that collection of mushrooms was found to contribute close to a margin of 45.6% on food security. This has a potential to improve rural development by acting as a good source of sauce for most of the families who would have gone for important wild animals. Collection of wild vegetables was found to contribute close to a margin of 63.2%. Shackleton *et al.* [35] confirmed these findings in their study done in non-timber forest products in the Eastern Arc Mountains in Tanzania, these found out that collection of wild vegetables, medicinal plants and grass had a positive and significant

influence on food security. These can act as harbors for environment degradation because the rural households collectively benefit from them.

The study found out that Non-timber forest products explained 24.5% of variation in income generation. This means that NTFPs have a likelihood of providing an indirect income by a margin of 24.5%. This finding is congruent with Elena *et al*. [36] who had conducted a study in Rain Forests in Lesotho. They had also established a contribution of 33% of NTFPs on income generated by farmers indirectly from rain forests since they would save the money, they would use to buy firewood to do something else, in either way, it is a contribution to income generation. This study found out that firewood had greatly contributed to savings among households with ß=0.762 (p=0.017). This implied that community members who collected firewood were high likely to have growth in income by a margin of 76.2%. These findings concur with earlier studies done by Steele *et al.* [32], they found out that firewood took first priority among the NTFPs consumed in Ecuador and Peru. These were consumed both at household or subsistence and commercial levels by majority of rural dwellers. These were contributing to 70% of income generated by a good number of community members who relied on forests for a living. In addition, in line with the above study, Zaku *et al.* [15] conducted a study in Kaduna State, Nigeria. These also found that wild vegetables constituted a frontline position in generating incomes just like how this current study established. For instance, this study found out a significantly influence of wild vegetables on income generation ß=0.701 (p=0.013). This suggests that community members, who collected wild vegetables like greens, pepper, eggplants etc., increased their income by a margin of 70.1%. Further, collection of mushrooms was found to contribute 77.7% on income. The collection of medicinal plants contributed 57.6% on income generation, this tallied exactly with what Schaafsma *et al.* [37] and Newton *et. al.* [38] established that medicinal plants like garlic, gingers, feverfew, ginseng etc. contributed 51.2% on the incomes generated by neighboring communities in Eastern Arc Mountains in Tanzania. Secretariat of the Convention on Biological Diversity [17], also found out that charcoal was contributing 35% on the incomes generated from NTFPs which is not far different from this current study which found a significant relation of 52.1%. Spices contributed 55.9% (p=0.020) which tallies with Munanura *et al.* [39] who did a study in Rwanda on forest dependence at Volcanoes National Park. These found out that the number of people selling spices collected from the volcano forest was high and this contributed on employment and income generated. The acquisition of income and food security from the above NTFPs is central to NSR conservation action and rural development.

CONCLUSIONS

Collection, production and selling of NTFPs were found to have a positive and significant influence on rural livelihoods in terms of food security and household incomes of people in Macula Niassa province of Mozambique. These practices pose a great motivation to conserve forests in the area since they always fight to ensure that their source of income and food is never interrupted. These can be important practices in addressing concerns of food insecurity, unemployment and poverty alleviation in Macula-Marrupa Corridor, NSR, Mozambique and other parts of Sub-Saharan Africa. For instance, collection, production and selling of firewood, wild vegetables, medicinal plants, spices, charcoal, forage, honey, wild tubers, wild fruits and nuts and ropes had a positive and significant influence on both food security and incomes of rural households. This means that they contributed largely to communities' survival and the survival of the forests. Even though, the collection of these NTFPs had contributed largely on food security and income generation, production and selling of these products has remained less and on subsistence basis.

Recommendations: It can be recommended that there is a need to promote off-farm income generating activities. These can range from adding value to NTFPs collected and engaging in handcraft. This promotion can be done by different stakeholders while prioritizing technical and financial support programs. These can in long-run promote diversification of these into formal sector employment, coupling them with education and development of skills. This will help reduce household overreliance on NTFPs for livelihoods and income generation. For effective conservation of NTFPs, strategies should take into consideration groups which were found to have more stakes, such as the men and youth, in planning and implementing sustainable utilization and management of forest resources. In addition, interventions aimed at conserving the forest should consider both in-situ and ex-situ

conservation of the mostly utilized plants and trees. For instance, trees and plants which provide NTFPs in form of spices, firewood and medicines need to be preserved to avoid extinction or relieve pressure on the wild stock. Provision of energy saving stoves, production of, biogas and kerosene as alternatives fuel is recommended to reduce household overreliance on the forest wood plant.

ACKNOWLEDGEMENTS

The authors greatly acknowledge the Wildlife Conservation Society Mozambique for both technical and financial support rendered for the success of this work. The authors also wish to acknowledge the Regional academic Exchange For enhanced skills in fragile ecosystems management in Africa for the scholarship and the general academic support. Special thanks go to Dr Franziska Steinbruch and Alberto Muchanga for all the support rendered towards field activities.

REFERENCES

1. Jimoh, S.O., T.O. Amusa and I.O. Azeez, 2013. Population distribution and threats to sustainable management of selected non-timber forest products in tropical lowland rainforests of south western Nigeria. Journal of Forestry Research, 24: 75-82.
2. Mujawamariya, G. and A.A. Karimov, 2014. Importance of socio-economic factors in the collection of NTFPs: The case of gum arabic in Kenya. Forest Policy and Economics, 42: 24-29.
3. Endamana, D., K.A. Angu, G.N. Akwah, G. Shepherd and B.C. Ntumwel, 2016. Contribution of non-timber forest products to cash and non-cash income of remote forest communities in Central Africa, International Forestry Review, 18: 280-295.
4. Ojea, B.M.E., M.L. Loureiro and M. Alló, 2016. Ecosystems services and REDD: estimating the benefits of non-carbon services in worldwide forests. World Development, 78: 246-261.
5. Malleson, R., S.A. Saha, M. Egot, M. Kshatriya, E. Marshall, K. Obeng-okrah and T. Sunderland, 2014. Non-timber forest products income from forest landscapes of cameroon, ghana and nigeria - An incidental or integral contribution to sustaining rural livelihoods. International Forestry Review, 16(3): 261-277.
6. Sophathilath, P., 2010. Assessment of the contribution of forestry to poverty alleviation in Lao People's Democratic Republic. Mak. For. Work poor Assess. Contrib. For. to poverty alleviation Asia Pacific, pp: 175-208.
7. Wood, E.C., G. Tappan and A. Hadj, 2004. Understanding the drivers of agricultural land use change in south-central Senegal. Journal of Arid Environments, 59: 565-582.
8. Hernández-Barrios, J.C., N.P. Anten and M. Martínez-Ramos, 2015. Sustainable harvesting of non-timber forest products based on ecological and economic criteria. Journal of Applied Ecology, 52: 389-401.
9. Godoy, R.A., D. Wilkie, A. Overman, G. Cubas, J. Demmer and K. McSweety, 2000. Valuation of consumption and sale of forest goods from a Central American rain forest. Nature, 406: 62-63.
10. Poppy, C., G.M. Chiotha, S. Eigenbrod, F. Harvey, C.A. Honzak, M. Hudson, M.D. Jarvis, A. Madise, N.J. Schreckenberg and K. Shackleton, 2014. Food Security in a Perfect Storm: using the Ecosystem Services Framework to Increase Understanding. Philosophical Trans Royal Soc B: Biol. Sci., 369(1639): 20120288.
11. Angelsen, A., P. Jagger, R. Babigumira, B. Belcher, J. Hogarth, S. Bauch, J. Börner, C. Smith-Hall and S. Wunder, 2014. Environmental Income and Rural Livelihoods: A Global-Comparative Analysis. World Development, 64: S12-S28.
12. Kaoma, H. and C.M. Shackleton, 2015. The direct-use value of urban tree non-timber forest products to household income in poorer suburbs in South African towns. Forest Policy and Economics, 61: 104-112.
13. Cooper, M., A. Zvoleff, M. Gonzalez-Roglich, F. Tusiime, M. Musumba, M. Noon, P. Alele and M. Nyiratuza., 2018. Geographic factors predict wild food and nonfood NTFP collection by households across four African countries. Forest Policy and Economics, 96: 38-53.
14. Mulenga, B.P., R.B. Richardson, G. Tembo and L. Mapemba, 2014. Rural household participation in markets for non-timber forest products in Zambia. Environment and Development Economics, 19(4): 487-504.
15. Zaku, S.G., A. Kabir, A.A. Tukur and I.G. Jimento, 2013. Wood fuel consumption in Nigeria and the energy ladder: A review of fuel wood use in Kaduna State. Journal of Petroleum Technology and Alternative Fuels, 4: 85-89.

16. Onuche, P., 2011. Non-timber forest products (NTFPs): a pathway for rural poverty reduction in Nigeria. International Journal of Economic Development Research and Investment, 2: 28-37.
17. Secretariat of the Convention on Biological Diversity (SCBD), 2014. Sustainable management of non-timber forest resources. CBD Technical Series no. 6, 2001. Biotropica, 48(2): 1-33.
18. Suleiman, M.S., V.O. Wasonga, J.S. Mbau, A. Suleiman and Y.A. Elhadi, 2017. Non-timber forest products and their contribution to households income around Falgore Game Reserve in Kano, Nigeria. Ecological Processes, 6, Article number: 23.
19. Mbuvi, D. and E. Boon, 2009. The livelihood potential of non-wood forest products: The case of Mbooni Division in Makueni District, Kenya. Environment, Development and Sustainability, 11: 989-1004.
20. Mcfadden, D., 2001. Economic choices. The American Economic Review, 91(3): 351-378.
21. Belcher, B. and K. Schreckenberg, 2007. Commercialization of non-timber forest products: A reality check. Dev. Policy Rev., 25: 355-377.
22. Masozera, M.K. and J.R.R. Alavalapati, 2004. Forest Dependency and its Implications for Protected Areas Management: A Case Study from the Nyungwe Forest Reserve, Rwanda. Scandinavian Journal of Forest Research, 19(004): 85-92.
23. Saha, D. and R.C. Sundriyal, 2012. Utilization of non-timber forest products in humid tropics: Implications for management and livelihood. Forest Policy and Economics, 14(1): 28-40.
24. Dlamini, C.S. and C.J. Geldenhuys, 2009. The socio-economic status of the NTFP sub-sector in Swaziland, Southern Forests. Journal of Forest Science, 71(4): 311-318.
25. Niassa, N.R. and B. Mariri, 2018. A unique wilderness of Niassa National Reserve where carnivores continue to persist and thrive with the full participation and support of local communities. To Promote coexistence between carnivores, wildlife and people in Niassa National Reserve. Annual report 2017-2018. The Niassa Carnivore Project, Mozambique, TRT Conservation Foundation (NPC 2017/ 024322/08).
26. Zella, A.Y., J. Saria and Y. Law, 2018. Consequences of climate change and variability in managing selous-niassa transfrontier conservation area. Biodiversity International Journal, 2(6): 500-516.
27. Mate, R., T. Johansson and A. Sitoe, 2014. Biomass Equations for Tropical Forest Tree Species in Mozambique. Forests, 5(3): 535-556.
28. Immaculada, O. and M. Yadvinder, 2016. Many shades of green: the dynamic tropical forest-savannah transition zones. Philos. Trans. R. Soc. B Biol. Sci., 371(1703): 20150308.
29. Yamane, T., 1967. Statistics: An Introductory Analysis. 2nd Edition, New York, Harper and Row.
30. Colfer, C.J.P., 2007. Simple rules for catalyzing collective action in natural resource management contexts. CIFOR, Jakarta.
31. Sekaran, U., 2003. Research Methods for Business: A Skill-Building Approach. 4th Edition, John Wiley & Sons, New York.
32. Steele, M.Z., C.M. Shackleton, R. Uma Shaanker, K.N. Ganeshaiah and S. Radloff, 2015. The influence of livelihood dependency, local ecological knowledge and market proximity on the ecological impacts of harvesting non-timber forest products. Forest Policy and Economics, 50: 285-291.
33. Hayter, A.J., 1986. The Maximum Familywise Error Rate of Fisher's Least Significant Difference Test. Journal of the American Statistical Association, 81396: 1000-1004.
34. Mulenga, B.P., R.B. Richardson and G. Tembo, 2012. Non-Timber Forest Products and Rural Poverty Alleviation in Zambia. Food Security Collaborative Working Papers 123220, Michigan State University, Department of Agricultural, Food and Resource Economics.2.
35. Shackleton, B.N., C.M. Shackleton and S.E. Buiten, 2007. The importance of dry woodlands and forests in rural livelihoods and poverty alleviation in South Africa. Forest Policy and Economics, 9(5): 558-577.
36. Elena, O., L.L. Maria, A. Maria and M. Barrio, 2016. Ecosystem Services and REDD: Estimating the Benefits of Non-Carbon Services in Worldwide Forests. World Development, 78: 246-261.
37. Schaafsma, M., S. Morse, J.P. Posen, R.D. Swetnam, A. Balmford, I.J. Bateman, N.D. Burgess, S.A.O. Chamshama, B. Fisher, T. Freeman, V. Geofrey, R.E. Green, A.S. Hepelwa, A. Hernández-Sirvent, S. Hess, G.C. Kajembe, G. Kayharara and M. Kilonzo, 2014. The importance of local forest benefits: Economic valuation of Non-Timber Forest Products in the Eastern Arc Mountains in Tanzania. Global Environmental Change, 24: 295-305.

38. Newton, P., D.C. Miller, M.A.A. Byenkya and A. Agrawal, 2016. Who are forest-dependent people? A taxonomy to aid livelihood and land use decision-making in forested regions. Land Use Policy, 57: 388-395.

39. Munanura, I.E., K.F. Backman, D.D. Moore, J.C. Hallo and R.B. Powell, 2014. Household Poverty Dimensions Influencing Forest Dependence at Volcanoes National Park, Rwanda: An Application of the Sustainable Livelihoods Framework. Natural Resources, 5(16): 1031-1047.