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The Influence of Proximity to Wild Resources and Markets on the Utilization of Wild Edible Plants in Kondoa District, Tanzania

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Abstract

Wild edible plants (WEPs) are important not only as a source of nutritional supplements but also as a source of income, serving as safety nets during household shocks in central Tanzania. This article examines the influence of proximity to wild resources and markets on the utilization of WEPs. Quantitative and qualitative methods were used in data collection and analysis. These included household survey, focus group discussions, and interviews. The results revealed that proximity to forest/wild areas influences the collection of WEPs over space and time. Subsistence utilization is influenced by proximity to wild resource areas, culminating in the lack of adequate markets and job opportunities. Cash income from WEPs trade is influenced by climate change, processing, means of transport and membership in social networks. Extension services to smallholder farmers can attribute to the synchronization of indigenous knowledge in modern farming systems for natural resource integrity. There is a need to harmonize the development and sustainability of natural resource management, food security and income portfolios, particularly in rural livelihoods, and promote the utilization of wild resources.

Keywords: *wild edible plants, subsistence, income, proximity, markets*

1. Introduction

Wild edible plants (WEPs) collected from forests and the wild are of paramount importance to rural livelihoods. They have a value more or less to that of some staple crops when compared to national figures (Broegaard et al., 2017; Bakkegaard et al., 2017). WEPs are renowned for their contribution to food security and income during household shocks such as inadequate harvests and bad weather (Mavengahama et al., 2013). WEPs are stored as dry leaves or powder. They contribute to livelihoods as nutritious foods and sources of income mainly to poor households (Beyene et al., 2019). The utilisation of WEPs for household food and income is in part contingent to inclusiveness of their culinary uses in nutrition surveys, as a result of their specific identification and categorization (Tata Ngome et al., 2017). Their seasonal utilisation partly accounts for their lack of inclusiveness in these nutrition surveys (Feyssa et al., 2011).

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The history of studies on the contribution of forests and non-forests to livelihoods and food security is long indeed (Pirot et al., 2000; Seydack, 2000; Kahyarara, et al., 2002). It encompasses qualitative studies based on conceptual frameworks predominantly documenting lists of wild food species or their inventories (Shackleton et al., 2009; Feyssa et al., 2011). Some studies show that the average contribution of the environment to household income is between 28% and 77%, and this comes from natural forests (Angelsen et al., 2014). The synthesis of case studies that explore environmental incomes and their significance to livelihoods cover both natural forests and the non-forest environment (Hickey et al., 2016; Bakkegaard et al., 2017; Broegaard et al., 2017), with significant influence on diversification of rural livelihoods. In particular, rural livelihoods are often diversified due to seasonality, differentiated labour markets, coping behaviour, credit market imperfections, inter-temporal savings, risk, and investment strategies (Ellis, 1998). Ellis further argues that, unlike in Asia, livelihood diversification in Africa largely addresses poverty which tends to be locational, as a result of the lack of array of services and opportunities, as well as environmental constraints.

Proximity to forests and wild resources has been widely associated with their utilisation as a sources of water, wild foods, timber/logs, mushrooms, among others (Kahyarara et al., 2002; Belcher et al., 2015; Newton et al., 2016). The extent to which forests are used in improving standards of living depends on markets that determine their extraction (Feyssa et al., 2011). People tend to rely more on forest resources when they are closer to forests due to reduction of labour and transport costs. Remoteness impedes resource extraction through increased costs, as well as lower probability of entitlement to the forest and wild resources (Mamo et al., 2007).

Markets may influence the extraction of forests resources in two ways. First, it can be through wage employment, which offers off-farm income earning jobs, hence reducing pressure on environmental resources extraction. Second, markets can as well perpetuate resource extraction when people are willing to pay for environmental services (Haab & McConnel, 2002). Studies have reported the localized nature of WEPs markets (Tata Ngome et al., 2017), or a complete absence of markets (Broegaard et al., 2017) as the key challenges obstructing WEPs trade. Little is known with regard to the influence of proximity to wild resources and markets on the utilisation of WEPs. In addressing this gap, we seek to advance the discussion on the contribution of forests and wild foods to household livelihood. A point of departure is whether the extraction of WEPs is influenced by proximity to forests and market conditions in the transitioning forest-agriculture landscapes in Kondoa district, in central Tanzania. We seek to prove whether the following assumptions hold:

(a) Households in resource areas have more subsistence income than those which are far off;

(b) Households in resource-endowed areas have higher wild resource income than those farther away;
(c) Controls over natural resources utilisation impairs extraction of WEPs and supply;
(d) Households having similar access to wild/forest resources have different market access; and
(e) Infrastructure, postharvest management and value addition influence the WEPs harvest and trade.

2. Materials and Methods

2.1 Study Area

The article is based on a study conducted in Kondoa district, Dodoma region. The district lies within latitudes 4^0 12′ and 5^0 38′ South of the Equator and within longitudes 35^0 06′ and 36^0 02′ East of Greenwich. To the west, the district borders Singida district, and to the north Babati district. To the east stands Kiteto, whereas Chemba lies to the south (Figure 1). Six villages—Damani, Kwamlisi, Mlua, Tumbuju, Iyoli and Msui—were selected for the study. The villages were chosen to represent different degrees of proximity to Kondoa town, proximity to the markets, and proximity to where wild vegetables are widely sold. They also represent areas where WEPs can be collected from non-forest environments. The uplands of Tumbuju village are much colder and less dry in most times of the year, whereas Mlua is drier throughout the year. Vegetation in Tumbuju village entails shrubs and grasses, whereas grasslands form the main vegetation cover in the rest of villages, and sometimes a mixture of grasses and woody plants.

People in these villages are predominantly smallholder farmers who depend on rain-fed agriculture. Various crops are grown, particularly food crops like maize, legumes, rice, bananas, fruits and vegetables. Cash crops include sunflower and beans. Animal husbandry is also an important source of income in the area. There are permanent farming areas but land tilling is less practised by farmers. Shifting cultivation is predominant to allow fallowing. The per capita income in Kondoa district was estimated to be TZS850,000 (about US$362) by 2018; and the average life expectancy was 53 years (KDC, 2018). Poverty is widespread, with inadequate basic services. Contrary to what Bharucha and Pretty (2010) had claimed about the questionable relationship between poverty and the use of WEPs, the low per capita nature in the area provides a clue on the possible use of WEPs as a source of income.

The selected villages differ significantly in terms of accessibility to roads, whereby Tumbuju is more remotely positioned, rendering poor accessibility, and so is Mlua. The roads leading to both Mlua and Tumbuju villages are earthen, and are intercepted by a seasonal river that makes the villages hardly accessible during heavy rains because there is no bridge connecting the villages to Kondoa town, which is an important market for WEPs. Although the roads

are earthen, their connectivity to Kondoa town reduces the risk of postharvest losses of WEPs. On the other hand, the good connection of Kondoa to the great north-south road from Dodoma to Manyara and Arusha regions guarantees transportation of goods. Currently, the road network in the district covers 457km of gravel and 385km of earth (KDC, 2018).

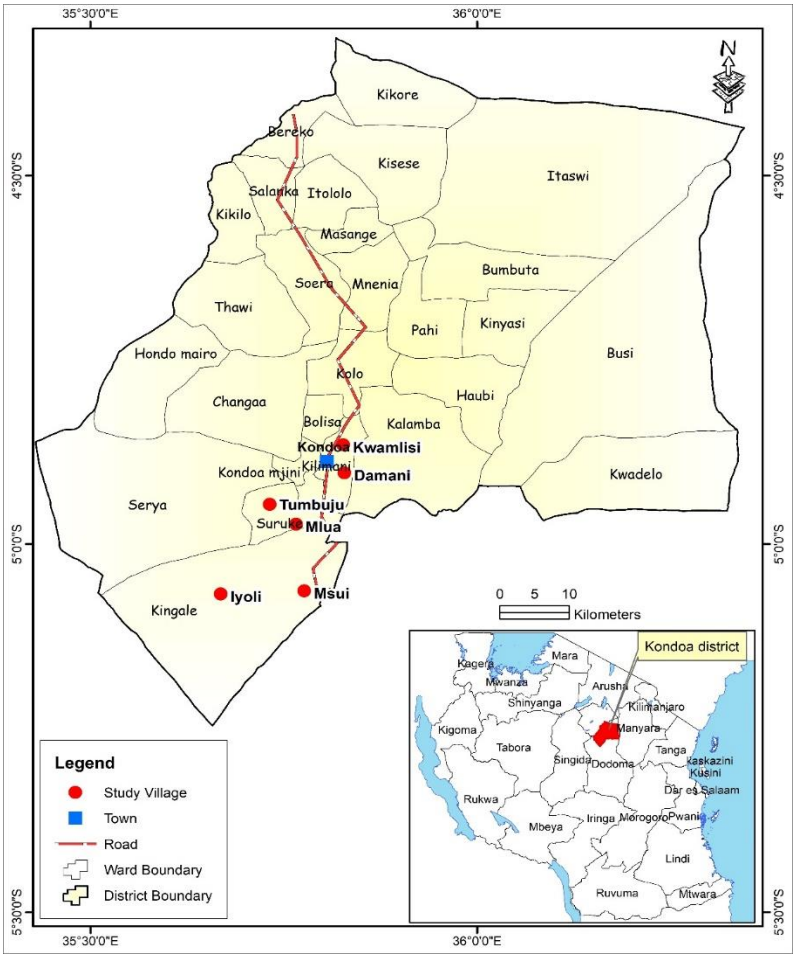

Figure 1: A map Kondoa District showing the study villages
Source: IRA, University of Dar es Salaam

2.2 Data Collection and Analysis

Research on the relationship between environmental resources and community livelihoods has shifted from qualitative techniques based on inventories of plant species and conceptual frameworks to more quantitative approaches based on measurements (Angelsen et al., 2014; Hickey et al., 2016; Bakkegaard et al., 2017;

Broegaard et al., 2017). Datasets used for analysis in this article were collected through a mixed design where both quantitative and qualitative approaches were employed. Quantitative data was collected through a household survey using a questionnaire as the main instrument. Questionnaires were translated into a vernacular language to ease communication with respondents. Training of research assistants was eventually conducted to familiarise them with the questionnaires and the context of the study. The number of households for each village was obtained from the village executive officer (VEO) to form the sampling frame. The total number of households in all six villages was 2,394 (Table 1). A total of 343 households, equivalent to 14.32% formed the sample for the study. According to Kothari (2004), a sample size between 10% and 15% is a representative sample in social science studies. Proportional sampling was performed to obtain households that were involved in the household survey from each study villages (Table 1). Random sampling was employed to obtain households to be included in the study. Names of heads of household of the selected villages were obtained from the VEO. Eventually, names of heads of household were written on pieces of paper, and one person was asked to pick one piece of paper at a time, and without replacement, until the number required for the sample was reached for each village.

Table 1: Sampling strategy for household survey

Ward	Village	Sample Frame	Sample Size	Percentage
Kilimani	Damani	296	42	1.75
	Kwamlisi	307	44	1.83
Suruke	Mlua	429	62	2.60
	Tumbuju	218	31	1.29
Kingale	Iyoli	460	66	2.76
	Msui	684	98	4.10
Total		**2,394**	**343**	**14.32**

Source: Field survey, 2020

The household survey captured data and information on household characteristics, assets, and access to natural resources and management initiatives, markets, institutions, transport and infrastructure. Other data and information collected included shocks that households had experienced in the past, and household incomes and their sources.

Qualitative data and information were collected through focus group discussions (FGDs) and key informant interviews. FGDs were conducted, one for each village. There were six sessions each comprising 8-10 members. Kumar (1989) argues that focus groups consisting of 4-12 discussants are usually manageable. With the aid of an interview guide, key informant interviews were conducted with district officials, including two agricultural officers, one

community development officer, one natural resources officer, and a nutritionist. Information obtained from interview sessions was used to triangulate data and information obtained through questionnaires, hence increase data validity.

Data analysis was consistent with the nature of data. Thematic content analysis was used to analyse qualitative data under themes consistent with the objectives of the study. Upon such subjection, patterns emerged that portrayed similarities and differences. Such similarities and differences were deduced to discern the extent of variation. The quantitative data was edited, cleaned, coded and classified (Kothari, 2004). The analysis of the quantitative data employed the use of descriptive statistics in discerning rates and magnitude of households' dependence on the utilization and trade of WEPs. To ensure comparability between study sites, one-way analysis of variance (one-way ANOVA) was used to compare amounts of WEPs harvests and mean incomes across villages, to deduce trends and patterns of utilisation. Post-hoc Tukey tests were used to compare means and standard deviations to discern variations across the study sites. WEPs income in this study refers to the total income generated by the sale of WEPs across their species diversity.

Exploration of all factors influencing the extraction of WEPs for both subsistence and cash income, and the extent household's engagement in WEPs extraction, was done using logistic regression under $x\ /\ (1-x)$ transformation centring subsistence and cash incomes. Chi square tests were used to explore the relationships between variables, for example, amounts of WEPs extracted and the localities where they were found (villages). Principal axis factoring under Varimax rotation was used to discern underlying factors influencing WEPs utilization across scales. Since the Kaiser-Meyer-Olkin measure of sampling adequacy had a value of $0.784 > 0.5$, the sample met the criteria for factor analysis (Field, 2005). A total of 15 variables were reduced to 5 cluster variables loaded on 1, 2, 3, 4 and 5 underlying factors. The principal assumption underlying factor analysis lies in the premise that given a set of variables, there are underlying factors that explain their interrelationships (George & Mallery, 2019). These factor loadings in a factor score matrix are presented as Appendix 1.

The first factor had high loadings on opportunities, that is WEPs demands, particularly the existence of buyers, quantity of production, and its dependence on market conditions by the government. Moreover, sustained environmental management for continued resource availability and knowledge on environmental management were interpreted as market opportunities for WEPs and as influencers to natural resources management. The second factor had high loadings on the need for support to growing WEPs from the government and/or non-governmental actors, interpreted as institutions and policies. The third factor had high loadings on the nature of processing of WEPs, as well as WEPs processing skills interpreted as value addition. Support to extraction of WEPs from the government and support to collection/growing of WEPs from non-

government actors clustered around a factor interpreted as support to farmers. Norms and rules in extraction of WEPs, and rules and regulations in the management of natural resources centred around the second factor, which is termed as controls over natural resources utilization. The whole statistical analysis was done using the Statistical Package for Social Sciences (SPSS) Version 23.

3. Results

3.1 Contextual Aspects Influencing Extraction of WEPs

There are several factors that influence extraction of WEPs, including socio-economic and spatial characteristics, the subsistence economy and cash income in the study area, transportation, and infrastructure. These are elaborated in the subsequent sections.

3.1.1 Socio-economic and Spatial Characteristics

Smallholder farmers (95.9%) dominated the surveyed households in the study villages. Over 90% of both male- and female-headed households collected/ produced WEPs/traditional vegetables in varying degrees, which was mainly dependent on the proximity of these households to the markets. According to estimates from respondents, 63.1% reported that they accessed market places within a distance ranging from 0.5 to 5km, while 36.9% of the respondents estimated that they accessed market places within a distance further than 5km. Since distances to village-based market places in all study villages did not exceed 5km, any distance greater than 5km implied an urban-based market place. More or less, access to market places varied depending on the spatial distribution of households, relative to the spatial orientation of village markets. On average, an individual could go on foot for 30 minutes to reach the market. Given that villages had similar access to wild products and forests, those closer to the markets collected a larger share of WEPs.

3.1.2 Subsistence Economy and Cash Income in the Study Area

Figure 2 shows cash and subsistence incomes for households surveyed at the location of wild resources, both for remote places and others close to the urban-based markets. A majority of respondents (84.3%) indicated that their households used WEPs for subsistence, while only 15.7% used WEPs for cash income. There was more extraction for subsistence in Iyoli (96.9%) and Tumbuju (87.5%) villages, and more for cash in Msui (23.1%) and Mlua (39.6%) villages. Iyoli and Tumbuju are more remotely located, whereas Msui and Mlua are close to the road. These findings show that villages that are far away from the road tend to use WEPs for subsistence than those located close to the roads. A Chi square test shows significant difference between cash and subsistence incomes ($\chi^2 = 32.547$, $p < 0.05$) based on proximity to the roads. Figure 1 is a representation of how much the six villages extract WEPs for cash and for subsistence.

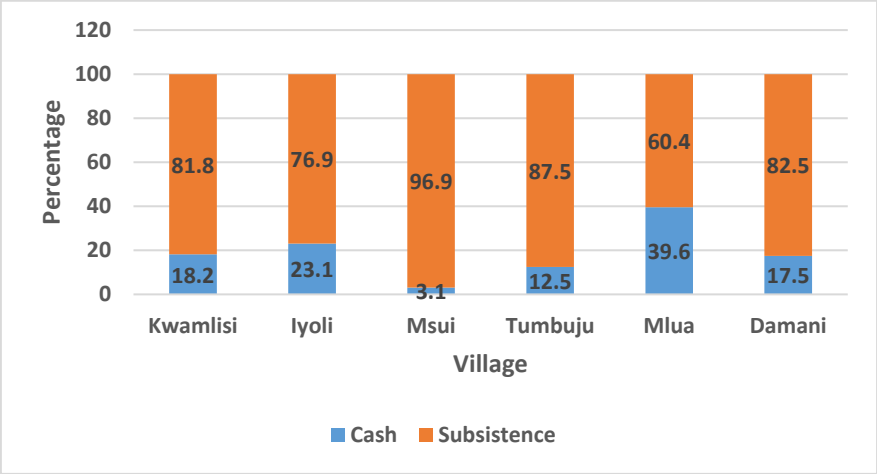

Figure 2: ***WEPs Based Subsistence and Cash Incomes***

Source: Field survey, 2019

The findings further reveal that a majority of the surveyed households (97.1%) use WEPs which they collect from the wild, while 2.9% reported to obtain these resources through buying from local markets and vendors. Logistic regression results (Table 2) show that climate change has more influence on WEPs extraction for cash income than on WEPs extracted for subsistence income. This is more likely because climate change has negative impacts on crop production, leading to the decline of crop yields.

Table 2: Determinants of WEPs Based Household Subsistence and Cash Incomes

Dependent variable: subsistence income (based on x/(1-x) transformation)	
Climate variability	-0.352(0.703)
Female headed household	-0.210(0.811)
Processed WEPs harvest	-19.518(0.0)
Farming experience	-0.145(0.865)
Membership in social networks	-1.466(.231)
Presence of household means of transport	0.2(1.222)
Presence of livestock	0.082(1.086)
Access to financial services	-0.402(0.669)
Total observations	**343**
Dependent variable: cash income (based on x/(1-x) transformation)	
Climate variability	0.176(1.193)
Female headed household	-0.46(0.955)
Processed WEPs harvest	19.612(323.679)

Farming experience	0.105(1.111)
Membership in social networks	1.383(3.985)
Presence of household means of transport	-0.184(0.832)
Presence of livestock	0.051(1.052)
Access to financial services	0.382(1.465)
Total observations	**343**

Source: Field Survey, 2019

Respondents reported that households that processed WEPs harvest were more likely to increase cash income. Likewise, households with membership in social networks and access to financial services were more likely to increase cash incomes, and hence engage in WEPs trade. This is a surprising result because one would expect that the presence of a robust cash income sources would potentially decrease household dependence on WEPs for cash income. However, to the extent these households are exposed to awareness campaigns on nutrition and income sources, extraction and commercialization of WEPs becomes a better choice. Nonetheless, and in the same vein, households with livestock were more likely to extract WEPs for subsistence. This is because livestock in the study area is linked to cash, and hence where it is difficult to collect WEPs from the wild they buy them from markets and local vendors.

3.1.3 Transportation and Infrastructure

Transportation is necessary for ferrying people and goods. Respondents informed that 26% of the surveyed households owned bicycles, 10.5% owned motorbikes, 2.6% owned animals (oxen and or donkeys), while a majority of the respondents (60.9%) relied on public transport (Table 3).

Table 3: Possession of Means of Transport by Respondents

Means of transport	Kwamlisi	Iyoli	Msui	Tumbuju	Mlua	Damani	Total
Bicycle	12 (3.5%)	23 (6.7%)	33 (9.6%)	4 (1.2%)	6 (1.8%)	15 (4.4%)	**89 (26%)**
Motorbike	4 (1.2%)	10 (2.9%)	10 (2.9%)	8 (2.3%)	2 (0.6%)	2 (0.6%)	**36 (10.5%)**
Animal	-	-	4 (1.2%)	3 (0.9%)	-	2 (0.6%)	**9 (2.6%)**
None	28 (8.2%)	33 (9.6%)	51 (14.9%)	16 (4.7%)	54 (15.7%)	23 (6.7%)	**209 (60.9%)**
Total	**44 (12.8%)**	**66 (19.2%)**	**98 (28.6%)**	**31 (9.0%)**	**62 (18.1%)**	**42 (12.3%)**	**343 (100%)**

Source: Field Survey, (2019)

In Msui village, 9.6% of the households own bicycles, while in Tumbuju village only 1.2% of the households own bicycles. On the other hand, Msui and Iyoli villages have a good number of households that own motorbikes (21.9% each), while Mlua village has the least number (0.6%) of households that own motorbikes. Mlua and Msui villages have more households that do not possess any means of transport (15.7% and 14.9%, respectively). Households that do not own any means of transport rely on public transport.

3.2 Markets for WEPs and Related Conditions

WEPs markets did not always make use of conventional units of measure; more often they used locally adopted measuring tools such as spoons, cups, bowls and bundles, with prices determined at the farm following the market value. It was more or less a barter system, whereby WEPs are exchanged with other crops such as cashew nuts, coffee, and maize. In the Kondoa township market, WEPs sellers tended to gather at the same place, a majority being women. Sellers of WEPs isolate themselves from sellers of more formal products probably as a strategy to give the products a higher monetary value. The value of the 'wild' vegetables fluctuates: they are sometimes cheaper or more expensive that the more exotic ones, depending on the season, palatability and knowledge on their nutritional status.

3.2.1 WEPs Extraction and Trade

Nearly all households (97.1%) collected or extracted WEPs from the wild/fields. This implies that all sampled households had access to the products. WEPs trade is done either at the farm or at the market level. One way ANOVA was used to compare the six villages in terms of farm prices at the farm and at market levels. There was a significant difference in both farm prices ($F(156) = 3.849$, $P < 0.05$) and market prices [$F(155) = 10.919$, $P < 0.05$)]. A post-hoc Tuckey test shows the lowest mean of farm price in Tumbuju (175.86, SD = 110.05), and highest mean at Kwamlisi (352.74, SD = 110.05), whereas the mean market price was lowest in Msui (534.41, SD = 146.60), and highest in Damani (799.42, SD = 111.47) (Table 4). The test shows further that Kwamlisi village differed significantly with Tumbuju village in terms of WEPs price at the farm level ($P < 0.05$), and so did Lyoli and Tumbuju villages. Likewise, there was a significant difference between Kwamlisi and Damani villages in terms of market prices ($P < 0.05$); and likewise, for Iyoli and Msui, as well as Iyoli and Damani. A significant difference also existed between Msui on one side, and Mlua and Damani on the other. As far as Mlua was concerned, there was a significant difference when compared with Msui, Tumbuju, Kwamlisi, and Iyoli.

Table 4: Comparison of Mean Farm and Market Prices in the Study Villages*

Price category	Kwamlisi	Iyoli	Msui	Tumbuju	Mlua	Damani
Farm Price (TZS)	352.74 (SD = 110.05)	312.14 (SD = 135.81)	253.26 (SD = 132.66)	175.86 (SD = 110.05)	262.72 (SD = 102.37)	262.96 (SD = 153.77)
Market Price (TZS)	600.00 (SD = 167.96)	645.11 (SD = 154.17)	534.41 (SD = 146.60)	536.43 (SD = 170.37)	690.56 (SD = 215.17)	799.42 (SD = 111.47)

Note: N = 343 households *significant at P = 0.05 Significance level

Source: Field survey, (2019)

The high market price paid for WEPs is obviously due to operational costs including labour, transport and marketing. Just like with other traditional crops, sellers of WEPs have to pay for transport costs, market levies and other charges. Results from focus group discussions revealed that market prices for WEPs are more often lower compared to traditional crops and exotic vegetables to offset operational costs from extraction to transport.

On average, farm price for WEPs in Tumbuju village was relatively lower compared to the rest of the villages. This was due to transport hardships and long distance from the accessible road to Tumbuju Village. Most of the surveyed households (95%) testified that the state of the roads connecting the village to the markets influenced WEPs prices at the farm level. Transport of WEPs from farms to the markets, as with traditional crops, faced some constraints including long distances from the village to the markets; poor road connectivity; high transport costs; inadequate post-harvest management infrastructure; as well as high levies and tariffs. All these factors accounted for the low prices of the WEPs produce from farms.

Factor analysis (Appendix 1) yielded conditions necessary for WEPs trade, notably value addition and market opportunities for WEPs. Other conditions include support to smallholder farmers, institutions and policies, and controls over resource utilization.

3.2.2 Value Addition

When asked about processing and packaging, about 67% of the respondents admitted that the surveyed households processed the WEPs as they had experience in processing and packaging. Apparently, Kwamlisi and Damani villages did not have such experience (Figure 3).

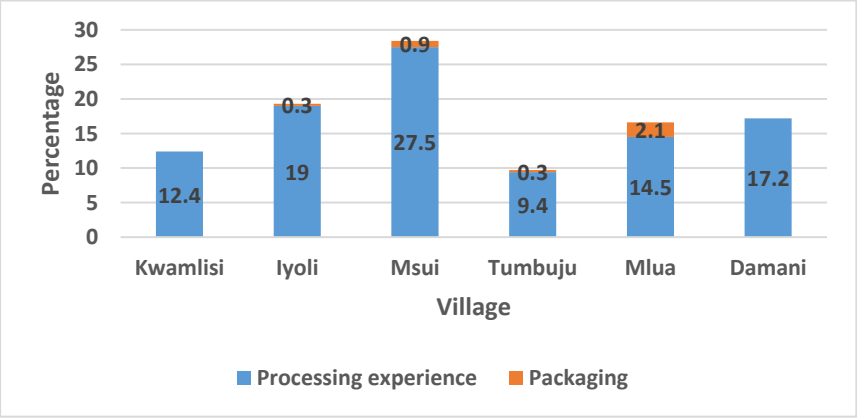

Figure 3: ***Respondents' Experiences in Processing and Packaging of WEPs***

Source: Field data, 2019

Boiling is commonly done by all respondents across the surveyed villages using firewood as the most affordable source of energy. Sorting is also a necessary step, and drying is mainly sun-drying although indoor drying is also done. Awareness about best processing and packaging approaches is yet to be raised with local villagers. The existing processing methods have implications on the quality of processed WEPs. As noted during the study, there was no refrigeration facility, which is necessary for postharvest management and throughout the post-harvest chain.

Results from key interviewees and focus group discussions revealed that surveyed households used traditional post-harvest processing methods such as boiling, and drying by smoke or in the sun. Boiling of WEPs is often done using charcoal and firewood. However, this form of processing is inadequate as it does not take into account quality of the final processed product, which is necessary for attracting new consumers. In this case, investments in processing would bring in alternative and more efficient sources of energy. Nonetheless, some community members had been trained how to store vegetables for use during the dry season. This training was done by non-governmental organizations in collaboration with the Ministry of Agriculture and Health. The training involved imparting skills on poultry farming and vegetable production (exotic and traditional).

3.2.3 Technical Support to Smallholder Farmers

The availability of extension services reflects the relationship between smallholder farmers and extension officers, which is of paramount importance in increasing agricultural productivity and quality of yield. When asked about the availability of extension services, all respondents (100%) admitted that households had not received extension services in five years, nor had they been supported in their farm activities by public or private actors. In turn, about 84.2% of respondents had to apply indigenous knowledge in trying to deal with post-harvest losses along the WEPs post-harvest chain (Figure 4).

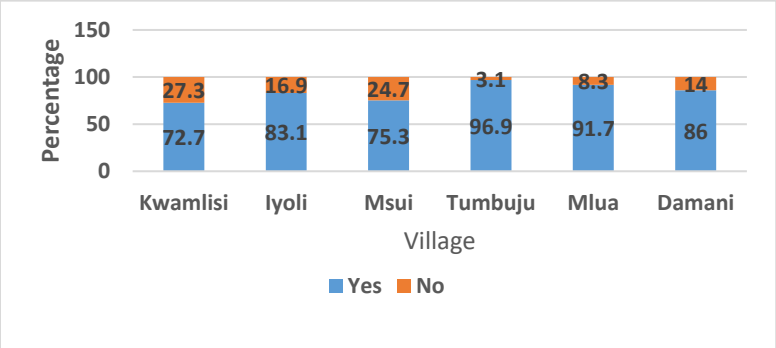

Figure 4: ***Use of Indigenous Knowledge in Local Farming Practices***

Source: Field survey, 2019

Furthermore, although climate change was reported to impact negatively on the availability of some WEPs species badly needed by smallholder farmers, there was a lack of guidance on how to deal with such challenge.

3.3 Constraints to WEPs Trade

The main constraints affecting the WEPs trade, as reported in the surveyed villages, included limited markets (49%), unsustainable environmental extractions (42.5%), and declining availability of WEPs species (8.4%) (Figure 5). Limited markets as a constraint was reported by 42%, 67.3%, 54.8%, 35.3%, 50.0%, and 29.8% of surveyed households in Kwamlisi, Iyoli, Msui, Tumbuju, Mlua and Damani villages, respectively. A Chi square test was statistically significant at $P < 0.05$.

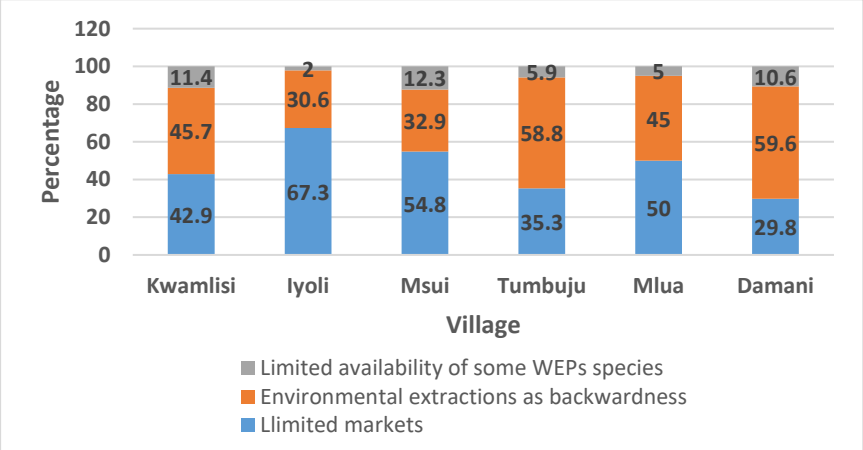

Figure 5: ***Constraints to Households' Participation in WEPs Trade***

Source: Field survey, 2019

Prices for WEPs were reported to motivate household engagement in sustainable environmental resource management and utilisation in general, and in WEPs trade in particular. In both cases, variation was statistically significant at $P < 0.05$ for households supporting this claim. On the other hand, transport costs for WEPs from wild resource areas to markets places were particularly high and could not be offset by the selling prices, a situation explained by the long distance between resource areas and markets places that inflated operational costs right from extraction to consumption. This was negative reinforcement for households as far as engagement in WEPs trade was concerned. In addition, inadequate markets and geographic orientation of the villages in relation to road connectivity, as mentioned earlier, made it very difficult for some households to extract WEPs for profit. These constraints are discussed further in the sections that follow.

3.3.1 Limited Markets

The manner in which WEPs were traded made use of highly localized markets mainly within perimeters of the area, whereas transporting WEPs for sale elsewhere was generally inadequate. In FGDs, it was agreed that as the WEPs trade tends to be highly localized, the expected market opportunities do not shed light on any possibility for growth in the near future; therefore, this results into limited collection/production. This observation accounts to some degree for the reason why smallholder farmers mainly target subsistence utilization of these edible WEPs than making them a source of income. A key informant in Kondoa Township Council pointed out this fact thus:

> *The big challenge with WEPs lies in the localized nature of the markets, which are often based within district perimeters. There are only few households transporting WEPs beyond the village perimeters, mainly to Dodoma and Arusha.*

3.3.2 Environmental Extractions

Discussions from FGDs made a connection between decline in the use and trade of WEPs to methods of extraction, processing and packaging that were viewed mainly by the youth as primitive. Results also indicate that there was a lack of awareness creation in advocating for the importance of WEPs as an important source of nutrition in the rural setting. Practitioners in public and private sectors are more concerned at district level and on macroeconomic policies particularly regarding private investment in agriculture.

3.3.3 Declining Availability of Some WEPs Species

Results from FGDs and key informant interviews blamed land use and cover change as the causes of the disappearance of WEPs species in the surveyed villages. However, in some areas, land use and cover change led to sprouting of some new WEPs species around homesteads. Other WEPs species were reported to simultaneously diminish over time and space due to the impacts of climate change. Nonetheless, some extractive properties impair generativity of some WEPs, and so influence trade-offs between the current and future extractions, subsequently affecting the supply of precious WEPs species.

3.3.4 Control Over Natural Resources Utilisation

When asked about the form of control over WEPs resources, respondents noted that it was predominantly traditional as well as statutory. The levels of agreement with this claim across the surveyed villages were: strongly agree – 46.6% (N = 160), agree – 28.9% (N = 99), neutral – 16.6% (N = 57), disagree – 6.1% (N = 21) and strongly disagree 1.7% (N = 6). At the district level, the Kondoa District Council controls natural resource utilisation and management. Despite the use of customary laws by local communities, statutory laws are also used when there is no WEP species under strenuous control. Management of natural resources at the local level

predominantly employs indigenous knowledge. Farmers' ethnobotanical knowledge is used to identify plant species used as food in local names. They were able to recognize species at risk of disappearance due to environmental change.

3.3.5 Policy Implementation

To determine policy implementation with regard promoting the consumption and trade of WEPs with respect to resource management, respondents were asked whether there was any consistency between policy and implementation in the area. Only 2.5% of respondents admitted there were efforts on the ground to promote nutrition uptake sourced from WEPs. The initiatives to promote nutrition uptake came from the government (0.9%) and NGOs (0.6%). Of these, 0.3% were from Msui and 0.6% from Mlua villages, respectively. Thus 97.5% of the surveyed households were not covered by the initiatives, as illustrated in Figure 6.

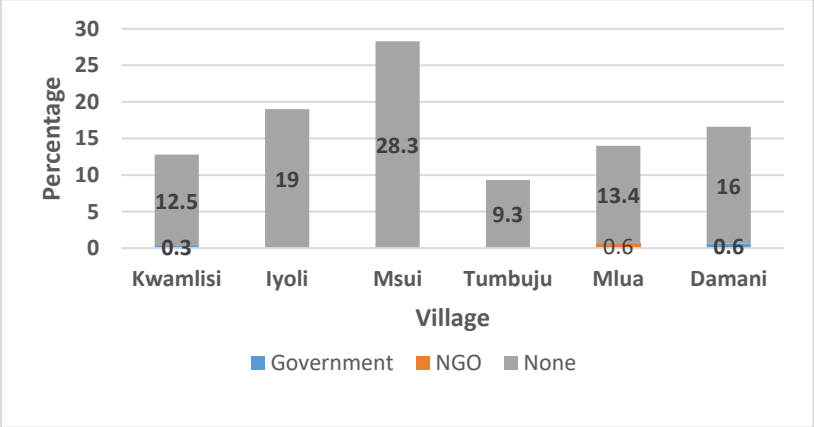

Figure 6: ***Percentage Distribution of Households That Received Awareness on Nutrition***

Source: Field survey, 2019

In the beginning, it was expected that participation in awareness programmes could influence knowledge and values of the villagers who participated in the initiatives. However, it was noted during FGDs that community members who had participated in such initiatives were mainly community leaders and village government committee members. In addition, there was no effort on the ground to advocate for the utilization of WEPs to ordinary villagers due to the lack of institutional support and inadequate community engagement in the process.

4. Discussion

Our empirical findings provide additional evidence on recent developments made by research to explore the contribution of forest/wild foods and a better

place of forest/wild foods in national, regional and international policies and programmes. Given that there is abundant empirical evidence to show the contribution of forest/wild foods in household food baskets (Angelsen et al., 2014; Hickey et al., 2016; Belcher et al., 2015; Broegaard et al., 2017; Bakkegaard et al., 2017), the extent that such contribution could be tapped to improve standards of living by alleviating social and ecological drivers that are acting to reduce wild food use is seldom considered. This is consistent with findings by Bharucha and Pretty (2010).

Results have shown how different factors influence subsistence and cash incomes at household level. Whereas climate change is likely to influence the collection of WEPs for cash income, this study focused on the semiarid environments as potential areas for the generation of these genetic resources. The findings also support the United Nations Framework Convention on Climate Change [UNFCCC] (2007) regarding the need to adopt measures to deal with any unexpected impacts of climate change on agriculture worldwide, and in developing countries in particular (Kangalawe & Lyimo, 2013). Adding to the study by Hickey et al. (2016) who analysed factors for household wild food income, this study portrays households that are members to social networks, households with farming experience and those processing WEPs after extraction as confined to WEPs collection for cash income.

4.1 Transportation and Infrastructure in Value Addition on WEPs Products

A productive rural agrarian community, particularly in developing countries, needs to be responsive to new technology, removal of barriers and constraints to raise farm outputs and incomes, as well as environmental sustainability (Ellis, 2000). Effective transport and infrastructure are vital in facilitating timely transport of agricultural crops, and thereby reduce post-harvest losses (Shackleton et al., 2009; Aulakh & Regmi, 2013). As reported in this study, challenges related to transport infrastructure can potentially affect the transportation of goods from remote areas to market places. Remoteness has the potential to limit access to alternative jobs and income generation. In addition, and consistent with other studies conducted elsewhere (e.g., Feyssa et al., 2011; Belcher et al., 2015), remoteness of markets leads to high transport costs for goods and people between production areas and markets; and in turn this necessitates that WEPs extraction is done for subsistence instead of for trade. This is in line with findings by Shackleton et al. (2009) who argued that in areas where transport to towns with shopping facilities is inadequate, people rely more on traditional vegetables. This points to a need of having a policy to improve rural infrastructure for better trade arrangements.

The big difference in the pricing of WEPs harvest between farms and market areas due low 'farm gate' prices in remote areas reported in this study reflects the status of transport infrastructure. On the way to the market from remote

fields, a smallholder farmer is confronted by several constraints that tend to elevate operational costs; including poor roads, high transportation expenses and unfavourable climate. Nonetheless, the low agricultural potential in these areas necessitates dependency on wild products as Belcher et al. (2015) attested.

The empirical findings in this study have further contributed to the debate underpinning linkages between environmental resources—of which WEPs are an integral part—and household incomes, as Shackleton et al. (2009) and Masarirambi, et al. (2010) have shown. The findings of this study show that the extraction and trade of WEPs did well in areas where infrastructure was available. Conversely, the use of these resources was more subsistence-oriented to households closer to resource areas, perhaps due to the prevalence of non-agricultural incomes. With an improvement of infrastructure, it is likely that the utilization of WEPs will be more commercialized. This is in line with results from other studies that examined the contribution of forests and non-forest resources to livelihoods, including Sunderlin et al. (2005), Hickey et al. (2016) and Wunder et al. (2014). This also calls for a policy to harmonize the development and natural resource management, so as to tap income potentials and sustainability in resource use.

Issues of post-harvest management—including loss prevention and climate effects – have been widely discussed with respect to food and income security (Affognon et al., 2015; Suleiman & Rosentrater, 2015). In addition to transport and communication infrastructure inadequacies impeding agricultural activities (Salami et al., 2010; Aulakh & Regmi, 2013), this study has shown how smallholder farmers recognize the importance of post-harvest processing. The use of local methods of processing has a long history indeed, for example, using indigenous knowledge through boiling, sun-drying, sorting and packaging, with fuelwood being used as a source of energy. Post-harvest storage facilities such as gourds, polythene bags and pots—all employing crude technology—are an indication of how postharvest handling is hampered by farmer incapacity to adopt postharvest management and processing technologies. Investigating African indigenous and traditional vegetable chain from production to marketing, Lotter et al. (2014) found that more that 92% of the people sold non-refrigerated produce.

4.2 Smallholder Farmers and Policy Implementation on WEPs Productivity

Knowledge on how to deal with climate risks and other factors to increase yield and household incomes in the agrarian society requires reliable extension services. Indigenous knowledge in agriculture and natural resources management need to be integrated. As communities noted, there was a decline of some WEPs species elsewhere, and findings in this study provide additional evidence by showing how farmers use indigenous knowledge to domesticate plant species that are at risk due to environmental change. This requires a policy

decision that would integrate indigenous knowledge into modern farming systems, whilst maintaining natural resource integrity. This entails the establishment of plant gene banks at the district level as recommended by Lado (2004), to alleviate the declining trend of some WEPs species of potential to farmers. Moreover, policy implementation has been inadequate to tap into this potential and bring it to a much higher degree. Equally, though policy recommends investments in agriculture, it needs to protect forests and wild areas from being converted to agriculture, underscoring the value of this hidden harvest which serves well during household shocks and complements adequately in household food basket and income portfolios. This is consistent with the advice given by Bharucha and Pretty (2010 and Mavengahama et al. (2013).

5. Conclusion

This article sought to examine the influence of distance between wild/forest areas and markets on the extraction of WEPs. More specifically, it explored the relationship between households' proximity to wild resources and markets on both WEPs subsistence and cash incomes. Our empirical findings have shown that there are variations between subsistence and cash-based incomes due to WEPs trade in the vicinity of wild/forest resources. Whereas there was more subsistence utilization of WEPs in villages that were remotely placed from roads, there were more WEPs for cash income in villages close to roads. Mediating between infrastructure development and resource integrity can guarantee better natural resource management, and more successful WEPs trade. Nonetheless, climate change, membership to social networks, financial services and processing influence WEP cash-based income. Despite the contribution of WEPs to the household food basket, when adequate marketing conditions prevail, WEPs harvest can significantly contribute to household cash-income generation.

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Appendix 1
Factors Influencing Utilisation of WEPs

Factor Score Coefficient Matrix

	Factor				
	1	**2**	**3**	**4**	**5**
Support to collection/production of WEPs from the government.	-.028	.480	.005	-.149	.099
Support to collection/growing of WEPs from the non-government actors	-.075	.516	.052	-.221	-.049
Controls in environmental collection/production of environmental resources	-.053	-.021	-.073	.762	.077
Norms and rules in management of natural resources	-.020	-.130	.062	.399	.004
There are buyers within the district of the processed and unprocessed WEPs	.010	.017	.231	.011	-.037
There are buyers outside the district of the processed WEPs	-.158	.038	.646	-.005	-.062
Adequate ethnobotanical knowledge on plant species management	.066	-.017	.021	-.021	.021
Existence of demands for WEPs rendering adequate collection/production	.066	.001	.124	.012	.056
Prospects for increasing demand of WEPs in the future.	.115	-.033	.089	.013	-.002
Adequate marketing thrust provided by the government	.570	-.029	-.124	-.040	-.093
Adequate community engagement in sustainable management of natural resources	.239	-.010	-.035	-.029	.105
Adequate links from WEPs producing areas to the markets.	.022	-.016	.022	.025	.004
Adequate knowledge to postharvest management of WEPs	-.115	.006	-.009	.153	.869
Adequate knowledge and skills of processing WEPs.	.104	.069	-.043	-.086	.051
Adequate policy measures to scale up collection/production of WEPs.	.122	.104	-.011	-.096	.074

Notes: Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.