NON-TIMBER FOREST PRODUCTS AND THEIR INCOME CONTRIBUTIONS TO RURAL HOUSEHOLDS IN KALU DISTRICT, NORTHEAST ETHIOPIA

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ABSTRACT

Non-timber forest products (NTFPs) are crucial for rural livelihoods either for subsistence or income generation. However, the natural vegetation and forests in the study area have been degraded by human impacts leading to habitat loss. Therefore it is essential to study and document evidence about NTFPs and their value in the study area. The main aim of this study is to assess non-timber forest products and their income contributions in Kalu District, Northeast Ethiopia. Three Kebeles were purposively selected based on NTFP availability, household reliance on NTFP collection and time. A total of 149 sample household respondents were selected using simple random sampling methods from the three Kebeles (Ancharo, Keteteya, and Gedero) in proportionate allocations. Data were collected through key informant interviews, focus group discussions, direct observations and structured and semi-structured household interviews. The collected data were analyzed using descriptive statistics. The study identified six major types of NTFPs used by households, namely: energy sources (fuel-wood and charcoal), medicinal plants, household utensils, wild edibles, wild spices, and fodders. The most important NTFPs included honey, fuel wood, charcoal and others (household utensils, edible fruits), contributing 39 %, 31 %, 25 %, and 5 % of forest income, respectively. NTFPs contributed 13.3 % of the total annual household income in the study area. The findings of this study revealed that incomes derived from NTFPs in the study area were relatively low compared to other sources of income. Therefore, polices and strategies aimed at improving the well-being of the local people should pay attention to the contribution of NTFPs to their livelihoods.

Keywords: collection, contribution, income, livelihoods, non-timber forest products.

INTRODUCTION

Non-timber forest products (NTFPs) refer to any plant or animal product aside from valuable timber that is produced by natural ecosystems, forests, and non-forest trees. These products can be harvested without the need to fall trees and provide goods and services for human needs (CIFOR, 2011). Examples of NTFPs include firewood, building materials, fodder, spices, food, honey, medicinal herbs, and wild edible plants, all of which play a significant role in people's income, and overall prosperity globally (Shackleton *et al*., 2007). NTFPs encompass a wide range of forest extracts such as bark, roots, tubers, leaves,

fruits, flowers, seeds, resins, honey, mushrooms, and firewood (Sunderland *et al*., 2013). Rural communities living in or near forests rely on these products for food, fodder, medicines, and wood for energy and construction, whether for personal use or for generating income (Quang & Noriko, 2008). According to United Nations data, over 1.6 billion people livelihoods are dependent on forests, with trade in forest products estimated at $327 billion in 2009. Forests also serve as the home for 300 million people worldwide (UNEP, 2011). NTFPs are crucial resources for rural communities, particularly during times of scarcity, helping to alleviate poverty and potentially leading to socio-economic advancement (Ojea *et al*., 2016; Suleiman *et al*., 2017).

Rural populations around the world gather a variety of NTFPs from forested areas and other sources, either for personal or economic purposes. The focus on NTFPs research and development is based on three key recommendations (Arnold & Ruiz-Perez, 2001): First, NTFPs significantly contribute to the livelihoods and welfare of families residing in and near forests; second, the exploitation of NTFPs is less environmentally damaging than timber harvesting and other forest uses; and third, the production and development of NTFPs could help reduce tropical deforestation by fostering sustainable economic development. These recommendations underscore the importance of dedicating significant time and effort to assessing the economic benefits of NTFPs and their overall impact on livelihoods. Developing countries have been found to rely on forests for 28 % of their total household incomes (Angelsen *et al*., 2014). Approximately 60 % of the population in Sub-Saharan Africa lives and works near forested areas, depending on NTFPs to meet their basic needs such as income, food, medicine, wood, fodder for animals, shade and soil fertility (Belem *et al*., 2007). For instance, fuel wood is collected for subsistence and income generation while wild fruits and leaves are gathered as a primary source of micronutrients for rural households (Sunderland *et al*., 2013). Therefore, NTFPs play a crucial role in the lives of rural households in developing countries by contributing to their nutrition and providing income that can be used to purchase food for the family (Shackleton & Shackleton, 2004).

In Ethiopia, NTFPs make a significant contribution to the rural economy. They play a crucial role in enhancing household income, the national economy, ecosystem health, and environmental sustainability (Gonfa, 2019). Studies have shown that NTFPs contribute between 10 % and 60 % of household income (Abdurahman, 2008; Sultan, 2009). Honey, gum and resins are the primary NTFPs in Ethiopia, providing substantial income for rural families and foreign currencies, while the value of other NTFPs is not as clearly defined. In the northeastern part of Ethiopia, particularly in the Kalu district rural households collect, produce and utilize various NTFPs, yet scientific studies on the types of NTFPs available and their contributions to rural livelihoods in the area have been lacking. Most of the natural vegetation and forests in the study area have been severely degraded primarily due to human activities. Based on this evidence, the study aims to assess non-timber forest products and to evaluate their contributions to the income of rural households in the district.

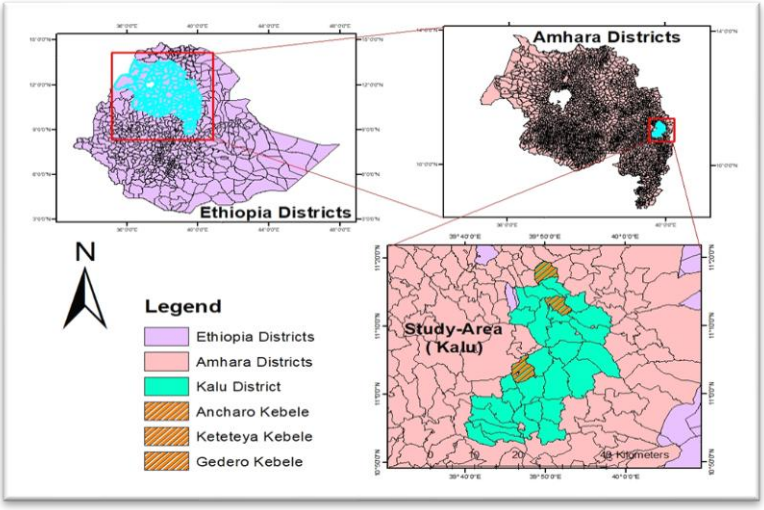
MATERIALS AND METHODS

Description of the Study Area

Location

The research was carried out in the Kalu district of the South Wollo zone of Ethiopia, Amhara national regional state. It lies between 10º 48′ 00″ and 11º 11′ 00″ N and 39º 41′ 00″ and 39º 55′ 59″ E (Fig. 1). This area's elevation ranges from 800 to 2450 meters above sea level. It is bounded by Bati on the east, Dessie Zuria on the west, Werebabu on the north, Albuko on the southwest, and the Argoba special woreda on the southeast. The district has 34 kebels, (30 rural and 4 urban), and the administrative center is Harbu town which is 346 km away from Addis Ababa.

Fig. 1: Location of the study area showing study Kebeles (Sources; own construction)



Population

Based on the CSA (2021) projection data, the Kalu District has a total population of 240,778 of which 121,702 are men and 119.076 are women, with 25619 or 10.64 % living in cities and 215111 or 89.34 % living in rural areas. The majority of residents are Muslim (98.73 %) and 1.17 % are Christians.

Topography

The district's elevation ranges from 800 meters above sea level in the lowlands bordering the East of Bati district to 2450 meters above sea level at the foot of the mountains north of Kombolcha town. The district has rugged topography, with 55.5 % undulated (rugged), 23.5 % hilly, 16 % valley mountainous, and 5 % of the total area being plain. Agro-ecologically, the district is classified as mid-altitude/weina-dega 64 %, high altitude/dega 19 %, and lowland/kola 17 %, with the Cheleleka and Borkena Rivers being the most important (KWARDO, 2014).

Climate

The District's climatic conditions range from dry sub-humid to semi-arid agro-climatic conditions. The district's average annual rainfall ranges from 750 to 900 mm. The district's

minimum and maximum annual temperatures are 8.9 °C and 30.8 °C, respectively, with a mean annual temperature of 19.9 °C. The daily temperature range typically increases in April, May, June, and July. The study area has bimodal rainfall, with two rainy seasons: Kiremt (the main rainy season, which typically occurs between July and September) and Belg (small rainfall occurs mainly in March and April).

Vegetation types

The Kalu district has a total land area of 87,523 hectares. The district's land use pattern includes 27,454 ha of cultivated land, 974 ha of grazing land, 51,614 ha of forest and bushland, and 3786 ha of building and settlement. Different acacia species (*Acacia tortilis*, *Acacia seyal*, *Acacia brevispica*, and *Acacia nilotica*), dedeho (*Euclea racemosa*), kitkita (*Dodonaea viscosa*), digita (*Cassia siamea*), qurqura (*Ziziphus spina christi*), qundo berbere (*Schinus molle)*, agam (*Carissa spinarum*), Grevillea (*Grevillea robusta*), girangire (*Sesbania sesban*), wanza (*Cordia africana*) and weira (*Olea europaea*) of these species are found in both Kola and Weina-dega agroecology. While, the plant species of key bahirzaf (*Eucalyptus camaldulensis*), nech bahirzaf (*Eucalyptus globulus*) and kulkual (*Euphorbia abyssinica*) are mainly found in Dega agroecology rather than other agroecology of the study area (KWARDO, 2014).

Socio-economic activities

The Kalu district is one of the drought-prone districts in Amhara's national regional state. The district is characterized by a subsistence mixed farming system in which the production of both crops and livestock is a common economic activity. The district is endowed with diverse natural resources with the capacity to grow different annual and perennial crops. The major crops grown in the district are sorghum, teff, vegetables, haricot bean, chickpea, mung, bean and maize. The main livestock productions include cows, oxen, goats, sheep, camels, donkeys, horses and hens. Rural households also produce and utilize different natural resources like forests. From the forest, they produce forest products like fuel wood, charcoal, medicinal plants and other products used for household consumption and income generation (KWARDO, 2014)

Site Selection and Household Sample Size Determination

The study populations were selected using multistage sampling techniques (District, Kebeles, and sample households). Kalu district was chosen purposefully due to its diverse agroecology, presence of forest areas such as Yegof and Anabe forests used for NTFP availability, and rural households' reliance on NTFP collection and utilization. A reconnaissance survey was carried out to select potential Kebeles from three different agroecologies based on NTFP availability and household dependence on them. Field walks were conducted to verify the identified products through household (HH) interviews. First, the district was classified into three agro-ecological areas Kola (below 1,500 m.a.s.l.), Weina-Dega (1,500-2,300 m.a.s.l.) and Dega (above 2,300 m.a.s.l.) based on altitudinal ranges using stratified sampling techniques. Second, three Kebeles were selected purposefully from each agro-ecology: Ancharo from Kola, Keteteya from Weina-dega, and Gedero from Dega based on various criteria; including NTFP availability, households dependent on NTFP collection, and time and budget constraints for the thesis work. Finally, sample household respondents were chosen from the total number of households in each Kebele using simple random sampling techniques. The sample size of respondents from selected Kebeles was determined using the formula:

$$n = \frac{Z^2 \times p \times q \times N}{d^2(N-1)+Z^2 \times p \times q} \qquad \text{(Kothari, 2004)}$$

Where; n = Sample size, N= Size of population= 19220, Z= standard normal deviation (Significance difference (95 %) =1.96, P= proportion of the population to be included in the sample= 0.5, q= 1-p = 0.5, d= Margin error (5 % - 10 %) used 0.08 due to budget and time considerations.

$$n = \frac{1.96^2 \times 0.5 \times 0.5 \times 19220}{0.08^2(19220-1)+1.96^2 \times 0.5 \times 0.5} = 149$$

To determine the number of households to interview in each selected Kebele, a proportionate allocation sampling method was used.

$$ni = \frac{Ni \times n}{N}$$

Where: ni = the sample size proportion to be determined; Ni = the population proportion in the stratum; n = the sample size; N = the total population

Table 1: Proportion of the populations in each selected Kebeles

District	Kebeles	Number of populations	Number of household respondents	Altitude (m.a.s.l.)
Kalu	Ancharo	4,773	37	Below 1,500
	Keteteya	8,726	68	1,500-2,300
	Gedero	5,721	44	Above 2,300
Total	3	19,220	149	

Sources; Field survey, 2023

Data Collection

The data were collected through primary and secondary data sources. Primary data collection included qualitative and quantitative methods through household interviews, focus group discussions and key informant interviews. Secondary data sources included the review of literature, and governmental organizations at zone and district rural development offices regarding basic data.

Household interviews

Individual households were surveyed using open and closed-ended questionnaires to collect both quantitative and qualitative data. During the household questionnaire interviews information was collected - on the socio-demographic characteristics of households, the main types of NTFPs, the contribution of major NTFPs to household income, the value of NTFPs consumed and sold by the households, and various sources of households' income (NTFPs use and trade, off-farm income, crop production income and livestock production income). Qualitative data collection methods are used for such as key informant interviews and focus group discussions were used for PRA tools.

Focus group discussions (FGDs)

Three FGDs were conducted (one FGD for each Kebele with eight participants in each Kebele gather insights from all participants control meetings effectively, and record findings. A total of 24 participants were selected for the FGDs in all selected Kebeles including local leaders, NTFP traders, notable collectors of major NTFPs, and representation of gender and age. The group members discussed the major types of NTFPs, main income sources, and contributions of NTFPs to livelihoods. Information from FGDs was used to triangulate household survey tools and interpret results.

Key informant interviews (IFI)

Key informants were selected using a snowball sampling method with a total of nine key informants interviewed from the three selected Kebeles. Three key informants were selected from each Kebele representing agricultural office representatives, local leaders, and elder persons. Key informants were chosen based on their knowledge of forest resources, close interaction with those who rely on forest product resources, involvement in the management and utilization of forest products and familiarity with the study sites. Information was collected on major types of NTFP, availability, utility, present condition and situation of NTFPs, local households' main sources of income, contributions to livelihood improvements, and the presence/absence of policies for NTFPs utilization as alternative methods.

Data Analysis

The primary data collected from respondents regarding household demographic characteristics and major types of NTFPs were analyzed using descriptive statistics such as tables, frequency, percentage, and figures. Household income sources from different activities (crop, livestock, NTFP income, and off-farm income) were compared using one-way ANOVA.

NTFP contributions to household incomes were calculated by estimating the total volume of all types of non-timber forest products collected by a household per month, estimating totals per twelve months and multiplying by the local market price of each product per unit volume. Gross income was estimated during the study due to respondents not measuring the input and output incomes. Relative NTFP incomes (NTFPI) were calculated as the proportion of total income originating from each NTFP income and with the total household income of NTFP.

$$RNTFPI = \frac{\text{NTFPI}}{\text{THI}} \times 100$$

In general, data collected from primary sources was analyzed using descriptive (mean, percentage) and inferential statistics and summarized using (tables, and figures) using SPSS version 20 software and Microsoft Excel.

RESULTS AND DISCUSSION

Demographic and Socio-Economic Characteristics of the Respondents

The socio-economic characteristics of the respondents are presented in Table 2 below. The results showed that 85.2 % of respondents were male-headed, while the remaining 14.8 % were female-headed respondents in the study area. This implies that males were more involved in collecting NTFPs in the study area. The majority (45.6 %) of households fall into the active age groups, with ages ranging between 41 to 55 years. The age range of respondents varied from 25 to 70 years. Out of the total households, 69.8 % are married, indicating an increase in family size and demand for various resources. In terms of wealth category, medium respondents make up the majority at 43.6 %. Regarding educational status, 42.2 % of respondents have not received formal education.

Table 2: Demographic and socio-economic characteristics of respondents

Variables	Categories	Frequency	Percentage
Gender	Male	127	85.2
	Female	22	14.8
Age	25-40	49	32.9
	41-55	68	45.6
	56-70	32	21.5
Marital Status	Single	5	3.4
	Married	104	69.8
	Divorced	22	14.8
	Widowed	18	12.1
Wealth Status	Poor	51	34.2
	Medium	65	43.6
	Rich	33	22.1
Educational Level	Not read and write	63	42.2
	1-8th	43	28.9
	9-12th	28	18.8
	Diploma and Above	15	10.1

Sources; Field survey, 2023

Major Types of Non-Timber Forest Products and Their Income Contributions

Major Types of Non-timber Forest Products

The non-timber forest products (NTFPs) in the study area were important for the well-being of rural households in terms of consumption and economic contributions. More than half of the interviewed households in the study area extracted various NTFPs for their daily subsistence and income generation. The six major NTFPs utilized by local communities in the study area include medicinal plants, wild edible plants, energy sources (fuel wood and charcoal), fodder plants, household utensils, and wild spices (see Fig. 2). However, the utilization of these NTFPs varies from product to product and location. Medicinal plants are one of the major NTFPs utilized by the household respondents in different sites of the study area. In Gedero (97.7 %), Ancharo (97.3 %) and Keteteya (94.1 %) sites, a high proportion of

respondents utilized medicinal plants for various purposes. This high utilization rate exceeds that reported by Ayinalem (2017), who found that 68.1 % of respondents utilized medicinal plants as NTFPs in the Babiya Folla district. Medicinal plants were highly used by rural households due to poor accessibility to hospitals and other health facilities in the study area. Additionally, the need to manage common mild diseases within the community promoted the acquisition and preservation of knowledge about medicinal plants and their uses. Respondents utilized medicinal plants for traditional medicinal purposes for both human and animal diseases, such as diarrhea, gonorrhea, eye diseases, bone fractures, back pain, fever, dandruff, evil eye, common cold, tumors, arthritis, menstrual problems, jaundice, abdominal pain, wounds, teeth and head-aches, swelling, hemorrhoids, tapeworms and others.

Wild edible plants are NTFPs utilized by rural households in various sites of the study area. In Ancharo (83.8 %), Keteteya (79.4 %), and Gedero (75 %) sites, a significant proportion of respondents' utilized wild edible plants (see Fig. 2). This high utilization rate contrasts with Brhane Meles *et al*. (2016), who reported that 69.3 % of local communities utilized wild edible plants as NTFPs in the Humera district. In the Ancharo site wild edible plants were more utilized by household respondents than in the other two sites due to the sites lowland areas providing their suitable environments for plant growth. Wild edible plants were used by households as a supplement for staple foods, to fill food gaps, and during times of normal diet in the study area. Children's and females were the main users of the plant species, as reported during group discussions.

Energy sources, including fuel-wood and charcoal were utilized by rural household respondents in different sites of Ancharo (100 %), Gedero (100 %) and Keteteya (97.1 %). This study aligns with findings by Meles *et al*. (2016) and Demie (2019), who reported that 100 % and 98.1 % of respondents used fuel wood and charcoal as energy sources in the communities of Humera and Westshewa areas of Ethiopia. Almost all respondents utilized these energy products in all study sites due to the lack of access to power (electricity and biogas) in the study area, leading them to use three-stone stoves for cooking. Fuel-wood and charcoal were the most preferred energy sources for household consumption and income generation by rural inhabitants.

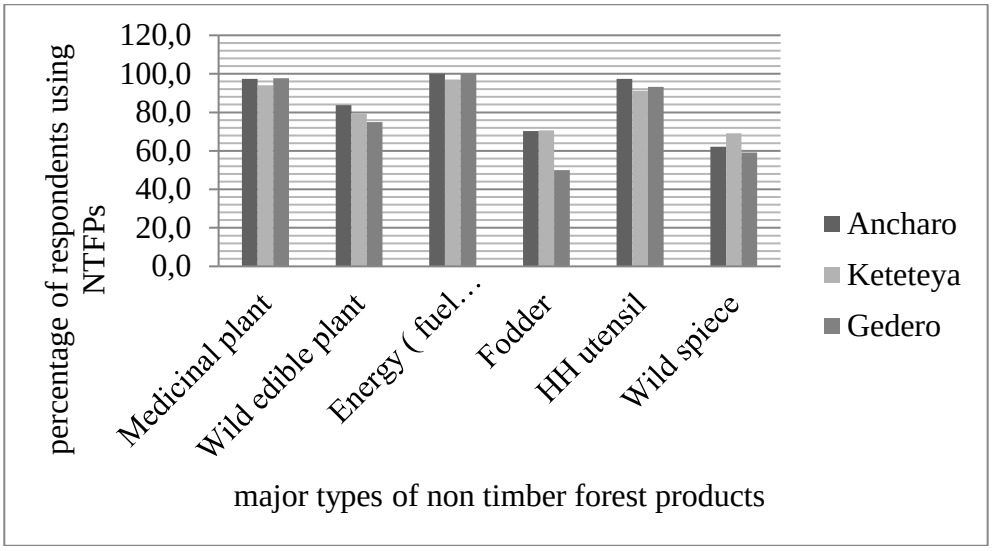
Fodders plants were also identified as NTFPs by household respondents in various sites of the study area. In Ancharo (70.3 %), Keteteya (70.6 %) and Gedero (50 %) sites, a proportion of respondents utilized fodder plants for livestock feedings (see Fig. 2). This finding is consistent with Ayinalem (2017), who stated that 70.3% of respondents utilized fodder plants for livestock feedings in the Babiya Folla district. Fodder was used for livestock feedings in different forms such as grazing, cuttings and standing trees. Grazing and cutting grasses were fed to livestock like cows, oxen, goats, sheep, and donkeys, while standing trees were fed to livestock during times of drought, and sometimes the leaves of fodder plants were fed to goats, sheep and camels, as reported in key informant interviews.

Household utensils, including farm implements and homemade materials were other types of NTFPs utilized by household respondents in the study area. The proportion of utilization of these materials varied from site site. In Ancharo (97.3 %), Gedero (93.2 %) and Keteteya (91.2 %) sites, a proportions of the respondent utilized household utensils as NTFPs (see Fig. 2). This finding is similar to that of Meles *et al*. (2016), who reported that 100 % of respondents utilized household utensils in the Humera district. This indicates that the households in the study area were mostly farmers with cultivated lands. Household utensils used as NTFPs included mofer, kember, maneqo, erif, degir, qitrit, jiraf and axe handles. Mofer, for example, is a plowing material prepared by farmers, connected to erif (a thin wood product) and degir (a flat-sized wood with a whole). Kitrit is a short stick used to connect

mofer and degir. Kember is a type of farming material used for hanging oxen and, Jiraf, is a rope used for tethering oxen.

Wild spices were also utilized as NTFPs by rural household respondents in different sites of the study area. The utilization proportions of these products in Keteteya, Ancharo and Gedero sites were 69.1 %, 62.2 % and 59.1 %, respectively (see Fig. 2). This high utilization rate contrasts with findings by Melaku *et al*. (2014) and Asfaw & Etefa (2017), who reported that 37 % and 20 % of the community utilized spices in the Bonga and Yayu districts, respectively. Respondents in the Keteteya site highly utilized wild spices compared to the other two sites due to its having suitable environments for growing wild spice plants. Wild spices in the study area were used in meat stews, shiro and pepper preparations, tea spice, and for better smelling, among other. During field observations, NTFPs were also used for soil and water conservation, construction, and fencing. Additionally, other types of NTFPs such as honey were used in traditional preparations of teji for drinking, while gesho was used to prepar tella, which the respondents consumed at home in the study area.

Fig. 2: Proportion (%) of respondents using different NTFPs



Income Sources of Households and their Income Contributions from Non-Timber Forest Products

The rural households in the study area rely on crops, livestock, NTFPs, and non-farm activities. Livestock, crop, and NTFP income sources significantly contribute to rural households at p-values less than 0.05, while, off-farm incomes are not significant to the households at p-values greater than 0.05 (Table 3). The total mean annual income gains for households are 251.46$, 205.68$, 75.47$, and 36.69$ for livestock production, crop production, NTFPs, and non-farm activities, respectively (Table 3). The mean annual household income varied from one site to another. Income from Livestock production (50.8 %) is the largest share of contributions followed by crop production (28.8 %), and both non-farm and NTFPs (10.2 %) of household incomes in the Ancharo site. In the Keteteya site crop production (50 %) is the highest income contributor followed by livestock (30.6 %), NTFPs (13.5 %), and non-farm (5.9 %). Additionally, in the Gedero site livestock production (61.9 %) contributes the most income followed by crop (18.4 %), NTFPs (15 %), and

non-farm (4.7 %) to household income in the study area (Table 3). This result indicates that livestock and crop production contribute more to income than NTFPs in all sites, as rural households use NTFPs as supplementary income sources.

Table 3: Mean annual household income in US Dollar ($) from different sources of activity

Income sources	Ancharo(N=37) Mean ± SE	Keteteya(N=68) Mean ± SE	Gedero(N=44) Mean ± SE	Total(N=149) Mean ± SE	P-value	R.C (%)
Crop	138.26 ± 23.57	307.36 ± 26.41	105.55 ± 13.65	205.68 ± 15.91	0.00	36.1
Livestock	243.56 ± 34.19	188.24 ± 19.09	356.72 ± 34.78	251.46 ± 16.85	0.007	44.2
Off-farm	48.91 ± 22.73	36.12 ± 10.21	27.27 ± 13.94	36.69 ± 8.36	0.430	6.4
NTFPs	86.47 ± 15.90	82.91 ± 14.49	49.00 ± 10.9	75.47 ± 6.02	0.005	13..3

Note; 1 US Dollar = 55 ETB Sources: Field survey, 2023.

Overall, rural households gain high incomes from Livestock production (44.2 %) followed by crop production (36.1 %), NTFPs (13.3 %), and non-farm (6.4 %), respectively (Table 3). NTFPs contribute 13.3% to total annual household incomes in the study area. This study aligns with Mohamed and Tesfaye's (2020) study, which reported a 13.1 % income contribution from NTFPs in Yeki woreda, Southwest Ethiopia. It is also higher than Meles *et al*. (2016) and Reshad *et al.* (2017), who reported 1.3 % and 10.11 % of NTFPs income shares from the total household income in Humera and Jello-Muktar districts, respectively. The low-income contributions of NTFPs in the study area are due to households earning more cash from livestock and crop production, consuming a larger amount of NTFPs at home (subsistence), lack of awareness among people about NTFPs contributions and the methods and approaches used. Therefore, governments should raise awareness among rural households and stakeholders about the contributions of NTFPs. According to Ros-Tonen & Wiersum (2003) in Germany, many rural households diversify their livelihoods and combine various strategies to obtain food, consumer goods, and income without focusing on a single activity. Similarly, Paumgarten (2007) in South Africa noted that livelihood diversification is a strategy for maximizing incomes from several of sources and opportunities as well as a coping mechanism through which households try to spread risk.

Contribution of Non-Timber Forest Products to Household Income

As mentioned earlier, the forest provides various products that are important for household livelihoods through subsistence and cash income. The main products include honey, fuel wood, charcoal, wild edible fruit, spices and household utensils. The top three were the top three products in terms of their contribution to household income were honey, fuel-wood and charcoal (Table 4). The description of the collection and production of these major products and respective income contributions are described below.

Honey: According to the household survey, honey production in the study areas is mainly carried out by placing hives in forests and standing trees around home garden areas. Honey from the forest is harvested two to three times annually; with two to three kilograms of honey produced in one beehive per harvest. Households reported selling raw honey at nearby markets, without processing or adding value to the product. The average price of raw honey was report to be between ETB 400-500 per kilogram per households per year. Income from

honey contributed significantly to the annual forest income of households at the three study sites, according for 29.6 %, 36.4 % and 19.2 % respectively of the total forest income at Ancharo, Keteteya and Gedero, respectively (Table 4). Honey production and income generation were higher at the Keteteya site compared to the other two sites due to its suitability for bee keeping and honey production. Previous studies have reported rural households engaging in honey production in humid and sub-humid forest areas of Ethiopia, with no such engagement reported in dry forest areas.

Fuel wood: Income from fuel-wood collection was the second most important forest income source, accounting for 37 %, 31.8 % and 19 % of the annual forest income at Ancharo, Keteteya and Gedero sites, respectively (Table 4). Given that fuel wood remains a major energy source for rural and urban households, coupled with population growth and increased in wood demand, fuel-wood harvesting is a common livelihood activity. Participant's in-group discussions mentioned that one load of fuel-wood sells for between 150- 200 ETB per households per year, the activity of collecting fuel-wood for income has become widespread due to growing market demand driven by urban expansion.

Charcoal: Charcoal is a valuable non-timber forest products used as a domestic fuel in many developing contry. Charcoal production and sale of charcoal were observed as income source in the three sites, accounting for 22.2 %, 13.6 % and 38.5 % at Ancharo, Keteteya and Gedero sites, respectively (Table 4). The Gedero site generated higher incomes from charcoal production than the two sites, likely due to its remote location and production for sale rather than household consumption. Participants reported that one standing tree could produce two to three sacks of charcoal with half of a kuntal of charcoal selling for 250-350 ETB per households per year.

Other NTFPs: other non-timber forest products included household utensils, wild edible fruits and wild spices used by local communities in the study areas. These products accounted for 11.1 %, 13.6 % and 25.4 % of income at Ancharo, Keteteya and Gedero sites, respectively. The Gedero site generated more income from other products, particularly farm implements, compared to the other two sites. Ancharo had higher values of wild spices, while Keteteya gained more income from wild edible fruits.

Overall, non-timber forest products contributed 13.3 % to total household income in the study area. Honey (39 %) was the largest income contributor, followed by Fuel-wood (31 %) and charcoal (25 %). The remaining 5 % of income was shared among other non-timber forest products such as household utensils, wild edible fruits, and wild spices (Table 4). This study aligns with previous research that found honey to be the primary income source for local communities. Ancharo sites generated 40 % of non-timber forest product income, followed by Keteteya with 38 % and Gedero with 22 %. Ancharo site had more non-timber forest products available for production, consumers nearby and access to transportations and markets.

Table 4: Mean annual Household Incomes in US Dollar ($) from Major Non-Timber Forest Products

NTFPs	Ancharo(N=37)	Ketetya(N=68)	Gedero(N=44)	Total(N=149)	R.C
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	(%)
Wild honey	25.64 ± 4.68	30.14 ± 5.35	9.41 ± 2.28	29.69 ± 4.34	39
Fuel wood	32.03 ± 5.89	26.36 ± 4.67	9.41 ± 2.24	23.11 ± 2.16	31
Charcoal	19.22 ± 3.69	11.32 ± 2.07	18.82 ± 4.30	19.18 ± 1.70	25
Other products	9.60 ± 1.81	11.32 ± 2.01	12.43 ± 2.86	3.55 ± 0.77	5
Total	86.47 ± 15.90	82.91 ± 14.49	49.00 ± 10.9	75.47 ± 6.02	100
%	40	38	22	100	100

Note; 1 US Dollar = 55 ETB Sources: Field survey, 2023.

Contributions of NTFPs income by wealth category

It is interesting to see the mean difference in NTFPs income among the three wealth statuses. The purpose of wealth ranking in the study was to identify which wealth category was more dependent on forest resources. The relative NTFPs income shares among wealth statuses were 55 %, 30 % and 15 % for poor, medium and rich households respectively (Table 6). The one-way ANOVA shows that statistically there is a significant difference between the mean annual incomes from NTFPs across wealth categories with P-values less than 0.05.

Table 5: Criteria for household wealth ranking in Kalu district

	Wealth Category		
Wealth Category Criteria	Poor	Medium	Rich
Oxen	-	1	2 and more
Cow and large ruminants	1	1-2	More than 2
Small ruminants goat and sheep	Less than 4	4-8	More than 8
Land holding size	Less than 1 ha	1-2 ha	More than 2 ha
Camel	-	1	More than 1
Vehicles	-	-	1

Sources: Kalu district agriculture and rural development office, 2022.

In this study, poor households extract higher income than medium and rich households from the total income of 13.3 % NTFPs. This indicates that the poor get more income than the rich, which implies the poor depends more on the NTFPs. This can be explained probably because of a lack of access to alternative resources of income such as livestock, land and other income gaining opportunities. This study's results were similar to different NTFP studies by Bayesa & Bushara (2022) in Belete Gera forest, Asfaw & Etefa (2017) in Yayo district, Gore by Debela *et al*. (2019) and Meles *et al*. (2016) in Setit Humera, which reported that poor households gained more income than medium and rich households in all studies. However, this study finding is in the contrary with Ambrose-Oji (2003) whose study in the developing countries of southwest Cameroon indicates that the relative contribution of NTFP income to the total household economies is higher for the middle class of wealthy groups than for the richest and poorest class of wealthy groups.

According to Sjaastad *et al*. (2005), the poorest quintile has higher NTFP income than the wealthiest quintile. This demonstrates that NTFPs income contributes significantly to the poor group of the local community's annual total income. This shows the variation in the extent of dependency on NTFP income and also that it's the richer households that have

a large size of farm land and high crop production, as stated during focus group discussions. But in relative terms, the poor depend more on NTFPs than the rich. The poor are assumed to be more reliant on forest resources (Timko *et al*., 2010). This is mainly due to the fact that poor households have fewer asset bases and mostly depend on NTFP extraction and use to sustain their livelihoods than other household income categories. Thus, the results of this study indicate that there is a possibility that NTFPs can be an alternative means of income and/or be integrated with other activities for the livelihoods of the poor wealth groups in the study area.

Table 6: Relative income of NTFPs in US Dollar ($) among wealth status

Wealth status	N	Mean income	Standard error	Relative income
Poor	51	119.43	119.43	55%
Medium	65	65.69	65.69	30%
Rich	33	32.16	32.16	15%
Total	149	76.54	76.54	100%
P-value			0.006	

Note; 1 US Dollar = 55 ETB Sources: Field survey, 2023.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The results revealed that non-timber forest products (NTFPs) in the study area provided the basis for the lives of respondent households through the provision of various goods and services. The assessment of NTFP results showed that six types of NTFPs were used by local communities. A large proportion of sample households depend on NTFPs for consumption and income generation. Rural households depend on livestock rearing, crop production, forest product collection, and nonfarm activities. Agricultural activities (livestock and crop productions) play the dominant role in the rural household livelihoods in all study sites, while income from non-timber forest products supplements agricultural activity dominated livelihoods. The rural households' income gain from NTFPs is very low. Therefore, government bodies, NGOs and policy makers should make policies and strategies encouraging NTFPs as one of the alternative sources of income to diversify the livelihoods in the study area. Ancharo site households are relatively more dependent on NTFP-related incomes than Keteteya and Gedero site rural households. Honey, fuel wood, charcoal, household utensil, edible fruit and spices are the six major income sources, with honey being the top income contributor to rural households. In the study area, poor households are getting more NTFP incomes than medium and rich households, implying that the forest product utilization pattern varies with the value of the products among wealth categories. The findings of the study provide valuable information about NTFP types, available habitats and improving supplement income contributions of NTFPs to rural household livelihoods in the study area.

Recommendations

Based on the results the following recommendations are made:

- ✓ Poor households should be encouraged to collect and invest more in NTFP extraction and selling to take advantage of the growing of those products to

diversify the livelihoods. Governments should use NTFPs as poverty reduction strategies by cooperating with the poor in the study area.

- ✓ Income derived from NTFPs contributes to the annual income of total households in the study area, which is low. Therefore, policies and strategies that aim to improve the well-being of rural people should pay attention to the contribution of NTFPs to the livelihoods of local people.
- ✓ The study identified the types of NTFPs, and income contributions in the study area. Further studies should be done on the management and conservation of these identified NTFPs, and the income calculation of NTFPs should be based on empirical observation and measurement rather than respondents' estimation.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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