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# *Characterization, Nutritional Value and Consumption Habit of Wild Mushroom in Tigray, Northern Ethiopia*

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***ABSTRACT:*** *Wild mushroom has been abundant and the consumption habit of mushrooms by local people has long history in northern Ethiopia though decreased with the prevailing degradation. The paper assessed the phenotypic species diversity, nutritional value and farmer's perception on consumption habit of wild mushrooms. Fifteen 1000 $m^2$ plots were established to analyze the phenotypic species diversity and nutritional value from four different micro habitats. Managed grassland encompassed greater mushroom species diversity. A total of 1.189 individual mushrooms belonging to two genera and eleven species were identified. Most mushroom species preferred open to slightly open canopy cover. The moisture, protein, carbohydrate, fat, ash, fiber and phosphorus content of mushrooms ranged from 81.8-87.9%, 23.4-37.2%, 32.4-43.9%, 1.9-4.4%, 14.9-19.6%, 12.3-18.1%, 0.6-0.9% respectively. There were significant difference in moisture, protein and carbohydrate contents between mushroom species ($P<0.05$). About 96% of the respondents had awareness about mushroom consumption. 95.3% of the respondents have attested that the current status of edible wild mushroom population decrease in distribution. 40% of the respondents whom were previously consuming mushroom have currently stopped to use it. There is sharp decline in distribution and consumption of mushroom. In order to protect the decreasing status of mushroom, grassland management and mushroom conservation should be promoted and encouraged.*

***Keywords:*** *Wild mushroom, phenotypic species diversity, nutritional value, farmer's perception, Tigray, Ethiopia.*

## INTRODUCTION

Mushrooms are the fruiting bodies of macro fungi (Abate, 2008). They include both edible/medicinal and poisonous species; however, originally, the word "mushroom" was used for the edible members of macro fungi and "toadstools" for poisonous ones of the "gill" macro fungi (Moore, 2005). Scientifically the term "toadstool" has no meaning at all and it has been proposed that the term is dropped altogether in order to avoid confusion and the terms edible, medicinal and poisonous mushrooms are used Ogbe and Obeka (2013). Edible mushrooms once called the "food of the Gods" and still treated as a garnish or delicacy can be taken regularly as part of the human diet or be treated as healthy food or as functional food (Cheung, 1996). The extractable products from medicinal mushrooms, designed to supplement the human diet not as regular food, but as the enhancement of health and fitness, can be

classified into the category of dietary supplements/ mushroom nutriceuticals (Chang and Miles, 2004).

It has been estimated that over 70,000 species of fungi are found and of which about 2000 species that belong to 31 genera are regarded as prime edible mushrooms (Moore, 2005). Wild edible fungi are collected for food and to earn money in more than 80 countries (Boa, 2004). The number of poisonous mushrooms is relatively small whereby only about 10% that belong to 30 species are lethal (Moore, 2005). There is undoubtedly high diversity of wild mushroom in Africa (Abate, 1998). However, information about wild edible mushroom is scarce in many countries of the continent.

Fresh mushrooms are frequently collected by local people mainly for own consumption while dried mushrooms are sold at market places and along roadsides (Yokabi *et al*., 2004). Domestic use and better marketing of wild mushrooms could contribute to improve the livelihoods and to reduce the poverty of the local communities (Bloesch and Mbago, 2006). Mushrooms can be used as a meat substitutes when meat becomes very scarce or expensive (Osagualekhor and Okhuoya, 2005). The consumption of mushroom can make a valuable addition to the often unbalanced diets of people in developing countries and they are considered to provide a fair substitute for meat with at least a comparable nutritional value to many vegetables (Marshall and Nair, 2009). Edible mushrooms provide high quality protein that can be produced with greater biological efficiency than animal protein, rich in fiber, minerals and vitamins and have low fat content, with high proportion of polyunsaturated fatty acids relative to total content of fatty acids (Marshall and Nair, 2009). Indigenous people in different countries have different eating habits and mushroom dish preparation (Wambua, 2004).

Diversity and distribution of mushroom depends on variety of substrates/hosts, rainfall, temperature. The existing variation in vegetation type and geography makes mushroom diversity to be high in Ethiopia (Abate, 2008). Farmers in Ethiopia have long experience on consumption habit and are able to distinguish between edible and non-edible wild mushrooms (Delelegn *et al*., 2013). Mushroom cultivation is a very recent activity in Ethiopia. Small scale mushroom production presents an opportunity for farmers as an additional work, and is specially an option for farmers with no adequate farm lands (Beetz and Kustudia, 2004).

Mushroom cultivation is seasonal, characterized by the alternation of rainy season, from May/June to September /October part of the year. It mostly grows in the Ethiopian plateau particularly in the southwestern part of the country (Tuno, 2001). In Tigray region particularly in the study area different types of wild mushroom are grown that are not scientifically characterized but known locally as edible and non-edible mushroom with nutritional and medicinal importance (Anonymous, 2013). The study area is characterized by dry climatic conditions and unreliable rainfall. It suffers from chronic food shortages as it lies in a major drought prone area, whose food self-sufficiency prospects are further thwarted by very infertile soils. The study area is one of the 12 chronic food insecure districts of the region. This problem is largely common in low-and middle-income countries which mainly have poor food production system and hence, suffer from serious malnutrition (Olumide, 2007). Such countries must find ways of improving food production so as to feed the ever increasing human population. East African mushrooms are highly treasured by the rural communities as mushrooms start growing soon after the first rains and become very handy and tasty vegetable long before the agricultural crops are ready for harvest (Olila *et al*., 2007). Mushrooms have not given due attention as an important crop that can fetch substantial income to farmers to alleviate poverty (Olumide, 2007). There is lack of mushroom documentation even though the farmers have experiences on picking and consuming of wild mushroom. Therefore, identifying and quantifying of wild mushroom in the study area was important. The objective of this

paper was to study the phenotypic species diversity, nutritional value and farmer's perception on consumption habit of wild mushroom.

## MATERIALS AND METHODS

### Description of the study area

The study was conducted in Enderta district, south eastern Zone of Tigray, Northern Ethiopia located at 13° 09' and, 14° 34' North and 39° 12' and, 40° 28' East (Fig. 1).

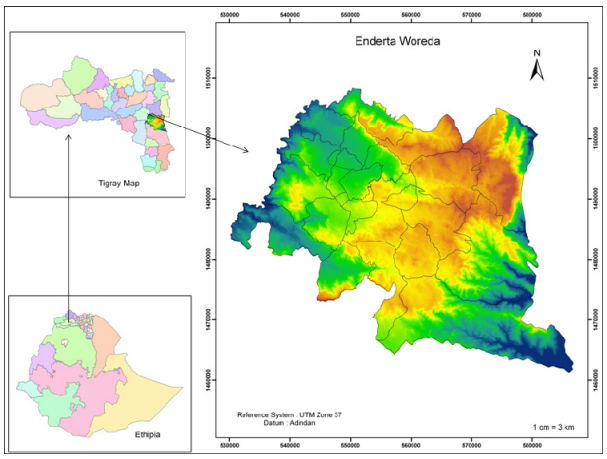


Figure 1. Location maps of the study area.

The area is characterized by erratic rainfall and frequent droughts. The main rainy season lasts from mid-June to first week of September preceded by a less predictable smaller rainy season between March and May (Fig. 2). The minimum and maximum mean annual temperature ranges from 12-15°C to 22-37°C and the average annual rainfall ranges between 390 and 1108.6 mm (Alula-Abanega airport 1959-2012). The subsistence agricultural production is almost entirely dependent on the main rain season (Esteri, 2008). The study area is contained in two major agro climatic zones; where the greater portion (94%) lies in the 'Weyna Dega'(moderate) climatic zone with an elevation range between 1800 m and 2678 m, while a smaller portion (6%) lies in the 'Kolla' (hot) having altitudinal climatic zone ranging between 1500m-1700m (Anonymous, 2010).

The topography comprises several forms from high slope to flat, ragged and deep gorges and gullies. The area was distinguished by cleared forest and now considered as the most degraded and eroded area in the region. The forest cover of the study area accounts for only 1.05% of the regional cover (Anonymous, 2014). The most common soils of the study area are: *Arenosols, Calcisols, Cambisols, Kastanozems, Leptosols, Luvisols, Phaozems, Regosols, Vertisols* and Fluvisols. The Fluvisols are mainly confined to the alluvial deposits along the river valley (Gebrekidan, 2004; Esteri, 2008).

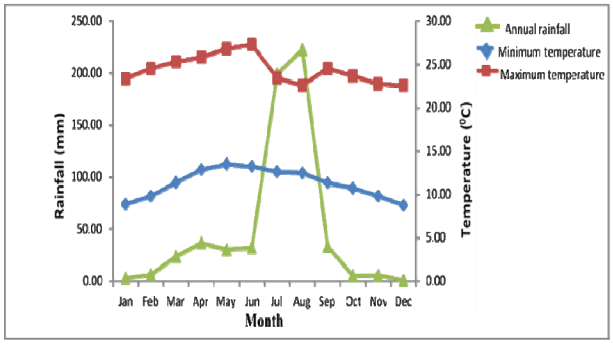


Figure 2. Climatic diagram for the study area.

The type of land use varies with the topography or landform. Most of the hill tops are occupied by the churches and villages while the flat level areas are used for agriculture and urbanization (Esteri, 2008). Agriculture and livestock are the backbone of the economy in the area. The farming system of the study area is mixed crop with livestock farming system. Agriculture is source of subsistence for the majority of the population.

### Sampling techniques and experimental design

The sampling unit of the study was plot and household. Three villages namely *May-Alem*, *Mesob*o and *Meseret* were randomly selected from the total villages in the district. Using a proportional simple random sampling technique, 150 households were randomly selected from the three villages for interview to conduct the community perception survey. The sampling was done using a list of all households in the villages that was obtained from the village administrations and development agents to systematically identify respondent households. In addition, 11 key informants composed of elders of male and female, mushroom consumers and extension agents were

involved in Focus Group Discussions (FGD) to collect and triangulate the information on edible and non-edible mushrooms.

Reconnaissance survey was undertaken throughout the district in all villages to identify the best possible site where mushroom can grow. Accordingly, 68 mushroom growing areas that comprise four micro habitats namely; cultivated, woody, managed grazing land (with seasonal control) and unmanaged grazing land were identified. Then five sites from each micro habitat were randomly taken by drawing a lottery and replicated three times to minimize possible errors. Therefore, a total of 60 (4x5x3) sample plots were determined from all micro habitats to acquire data for species diversity, characterization and nutritional analysis of the wild mushrooms. From each of the four micro habitat 15 replication in 5 sites were used as a block to minimize possible error. Sample size was determined to be 1000m$^2$ (100m*10m) plots with 50m spacing. Because large sample area and strip plot sizes are needed in order to facilitate the search of wild mushrooms.

**Data collection**

Collection of primary data involved identification of mushroom growing areas and understanding farmers' perception on consumption habit of wild mushrooms. Semi structured questionnaire for individual interview to collect information about; where mushroom grows, factors that influence the growth of mushrooms, current state of mushroom, place of collection, time of growth, consumption pattern, domestication and cultivation of wild mushrooms were involved. Interviews were conducted with the selected farmers under each selected village. The questionnaire was open and closed ended which provide both qualitative and quantitative data. Focus group discussions were conducted to collect data on; the state of wild mushrooms, consumption habit of farmers, the role and variability of edible and inedible wild mushrooms, effect of eating wild mushroom and mitigation measures up on eating poisonous wild mushrooms. Secondary data were collected from district office of Agriculture and Rural Development, to assess the major interventions to promote and conserve wild mushroom.

Canopy cover, fruiting body feature (color, shape, test and size of mushroom) and substrates that potentially host mushrooms were observed and recorded and mushroom species collected from each sample plot. The wild mushrooms found were counted, characterized and collected for nutrient value analysis and species diversity. Slope, coordinate points (using GPS) and soil texture recorded to characterize the habitat where the mushroom grows. The distance where each mushroom grow from the nearby tree recorded to estimate the amount of cover suited for mush room growth. The canopy cover in the plot was estimated as described by Kent and Coker (1996) and categorized as open (0-25%), slightly open (26-50%), slightly closed (51-75%) and closed (76-100%). Mushroom stalk (stem) length, diameter of the cap (pileus) were measured using a graduated ruler and taken for characterization and species diversity. A digital camera was used to capture photograph for each of the identified species. Mushroom specimens and the photographs used to characterize and identify the wild mushroom to a species level using morphological features. Vernacular names of wild mushroom fruit bodies were identified by the local people at the field. Sample species specimens were carefully collected from mushroom growing areas from different locations every morning during the months of July to September. Samples were uprooted by lifting them up holding the stripe gently and firmly very close to the rhizomorph having some soils along with it. This was done to avoid possible damage of tissues. Each specimen was carefully collected and labeled before transporting to town for nutrition analysis and characterization. The specimens were dried in air for 3-14 days. Specimens were stored in transparent polythene bags that were loosely tighten to allow proper aeration. Each of the specimens were properly labeled and sent to Jije Analytical testing service laboratory in Addis Ababa, Ethiopia for nutritional analysis.

### Identification of Specimen

The specimens were identified in Mekelle University at the collage of dry land agriculture using the books of fungus (Peter and Shelly, 2011), internet and mushrooms pictures. Farmer's indigenous knowledge was used to complement the identification process.

### Chemical analysis

Mushrooms from the different micro habitat were first washed thoroughly to free from mud, ferns and other extraneous material, dried on blotting paper, cut into pieces and dried at 80°C for 48 hours. The whole mushrooms (Pileus + stipe) were dried, grounded to a fine powder and stored under vacuum for further analysis. The moisture content, crude fiber, nitrogen and protein, fat and phosphors contents of the mushroom was determined using the Anonymous (1990) procedure. All nutritional analysis was done in triplicates.

### Data Analysis

Phenotypic diversity of wild mushroom was analyzed using conventional method which were matching photograph picture during field observation with world fungus book, diagnostic structures such as visual characteristics, habitat and smell and test of wild mushrooms that were recorded at field, and internet.

Species diversity were analyzed using the fisher's alpha, Simpson's and Shannon's (H,) diversity indices and Evenness or Equitability (E) to determine mushroom species and diversity in the different micro habitat. Total species richness was also estimated using Chao1 estimate. These calculations were done using PASTsoftware. Nutritional value were analyzed using one-way analysis of variance (ANOVA) followed by Tukey's HSD Test with $\alpha = 0.05$. This analysis was carried out using Minitab 16 statistical software. The survey data were analyzed through descriptive statistics and probit model. The probit model was selected for identifying the determinant factors that influence the consumption habit of mushroom. The dependent variable of the study was a binary. One was assigned for those households who consumed mushroom otherwise given zero. Accordingly, the model is given by following formula:

$$E(Y_i = 1/X_i) = \beta_0 + \sum_{i=1}^{n} \beta_i X_i = \int_{-\infty}^{X_i} \Phi(X)dX = \frac{1}{\sqrt{2\Pi}} \int_{-\infty}^{\infty} e^{-\frac{1}{2}X^2} dX$$

Where, $\Phi(.)$ is the cumulative distribution function of the standard normal distribution. The coefficient of the above model uses to interpret only the direction. For instance, the probability of the farmer to consum mushroom increases with $\beta_i$ exceeding zero. The coefficient of the probit model doesn't use for analysis and interpretation purposes. The study used the marginal probit model to capture the magnitude of the coefficient, which shows by how many units the response variable increases or decreases with a unit change, from the baseline, in one explanatory variable, keeping other independent variables constant using:

$$\frac{\partial P(Y_i = 1/X_i)}{\partial X_i} = \frac{\partial (Y_i / X_i \beta_i)}{\partial X_i} = \frac{\partial (\beta_0 + \sum_{i=1}^{n} \beta_i X_i)}{\partial X_i}$$

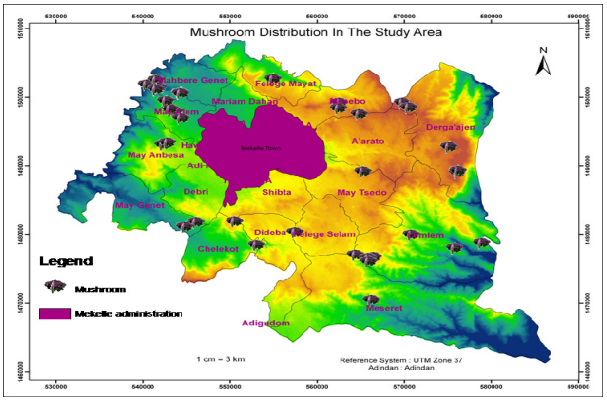


Figure 3: Map of distribution of wild mushroom throughout the study area.

## RESULT AND DISCUSSION

### Ecology of wild mushroom

Majority of the species identified were distributed in all the study area (Fig. 3). The common species

were *Termitomyces rubustus, Clitocybe gibba, Panaeolus papilionaces* and *Leucoagaricus rubrotinctus. Termitomyces clypealus* was exceptionally found in two study sites namely May-alem and Mahberegenet sites.

Eleven different wild mushroom species were found in the four micro habitat sites. Two species were restricted to one micro habitat site and six species appeared in two micro habitats (Table 1). The highest number of species was found on managed grass land and wood land (Table 1). These land uses were moderately disturbed and provided better growing conditions for the mushrooms. Similar observations were made in Uganda by Engola *et al*., (2007) that they found higher species diversity in managed grass land. Unlike to this finding, other studies in Uganda Opige *et al*., 2006 found more species grown on cultivated land and over grazing land. The rainy season appear to provide more and adequate condition for the fruiting bodies more than the drier parts of the year. This could be due to the fact that mushrooms growth depends on the appropriate rainfall conditions.

**Studied mushroms**

**1. *Termitomyces robustus***

Local name (Tigrigna Language): "*Agule*"

Species name: *Termitomyces robustus*

Family: Lyophyllaceae

Order: Agarics

The species has a remarkable association with certain species of termite. The termite activates the fungi inside their mounds using the mycelium to help breakdown and release nutrients from indigestible woody material. In return, the fungus provided with food resource, is protected from competitors, and actively spread from mound to mound. This species fruit bodies appear in the rainy season commonly from August to September and widely collected by local people for food and mostly abundant on cultivated land and managed grass land.

Basic characteristics and features of the species; Cap: form convex at first, flattening when expanded and when becoming old the cap upward from stem. The surface of cap often irregularly ridged or channeled frequently splitting as it expands and old. The color of the surface of the cap /brown yellow/ocher-brown to dark brown and when it dry changes completely brown dark to dark. Gills: are white to pinkish cream and stems have the color of gills. Mycelium: has 25-30 cm long and a blackish root like base. Cap diameter is 12-32 cm, stem height is 10-24c.m. Edible pleasant taste and small, Stem have not ring, easily perishable and easily spoil after collection.

Table 1. Wild mushroom frequency (number) and occurrence (%) in different micro habitat sites.

| Type of species | Frequency (number) and percentage | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Grazing land | | Cultivated land | | Wood land | | Man aged grazing land | |
| | No | % | No | % | No | % | No | % |
| *Clitocybe gibba* | 13 | 37.1 | 0 | 0 | 8 | 22.8 | 14 | 40.0 |
| *Termitomyces robust* | 1 | 9.1 | 6 | 54.5 | 0 | 0 | 4 | 36.4 |
| *Termitomyces clypealus* | 0 | 0 | 9 | 81.8 | 0 | 0 | 2 | 18.2 |
| *Panaeolus papilionaces* | 6 | 46.2 | 0 | 0 | 4 | 30.8 | 3 | 23.0 |
| *Chlorophylluh molybdites* | 4 | 30.7 | 0 | 0 | 4 | 30.7 | 5 | 38.6 |
| *Phyllotopsis nidulans* | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 100.0 |
| *Termitomyces microcarpus* | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 100.0 |
| *Rhizopogon luteolus* | 2 | 66.7 | 0 | 0 | 1 | 33.3 | 0 | 0 |
| *Russula nigricarns* | 0 | 0 | 0 | 0 | 4 | 80.0 | 1 | 20.0 |
| *Panaeolina foenisecii* | 0 | 0 | 0 | 0 | 4 | 66.7 | 2 | 33.3 |
| *Leucoagaricus rubrotinctus* | 0 | 0 | 0 | 0 | 5 | 71.4 | 2 | 28.6 |

**2. *Termitomyces clypealus***

Local name (Tigirgna Language): "Mulkulkay"

Species name: *Termitomyces clypealus*

Family: Lyophyllaceae

Order: Agarics

It is not widespread and is generally uncommon and somewhat less distribution that found in two sites in the study area. The mushroom name implies and derived from the behavior of the mushroom during cooking, which is during making food it is difficult to handle for eating they call it "*Mulkulkay*" or not hold easily. The species are more grow in sandy soil texture and in cultivated and wood land. Normally as compare to other mushroom it has strong and longest mycelium.

Basic characteristics and feature of the species; Cap: form convex at first, flattening when expanded. The color of the surface of the cap /whitish and it has dark color at center of the cap. The caps are cracking from the margin to center of cap and when it dry does not change the color. Gills: are white to pinkish cream and stems are having the color of gills. Mycelium: has 25-45 cm long and do not have a blackish root like base. Cap diameter is 8-12, stem height is 10-13cm. Edible pleasant taste and small. Stem have not ring.

**3. *Clitocybe gibba***

Locally name (Tigirgna language): "Kintishara"

Species name: *Clitocybe gibba,*

Family name: Tricholomataae

Order: Agaricals

It is found widespread in the study area which does not depend on soil fertility and micro habitat. *Clitocybe gibba* is normally similar when young with non-edible poisonous mushroom. It has brittle gill that makes people difficult to eat. The whole body is whitish with shallow mycelium and is the most common species.

Basic characteristics and features of the species; The caps are hemispherical when young and becoming flattens and then depressed to funnel-shaped. The surface is smooth white. The gills are whitish and narrow spaced. Stems are white and short that grow usually as cluster. Cap diameter is 8-12 cm and stem is height 5-8 cm. Edible pleasant test and small. Stem have not ring.

**4. *Termitomyces microcarpus***

Local name (Tigrigna Language): "Nieshtey Kintishara"

Species name: *Termitomyces microcarpus*

Family: Lyophyllaceae.

Order: Agarics

Cap conical or bell-shaped when young, with an incurved margin, becoming flattened or concave with the margin split in several places and turned upwards and having a prominent, humped, pointed centre; pure white, or leaden-grey when moist, later becoming dirty white or pale brownish, especially on the hump. Young specimens are slightly silky or striate, older ones are distinctly striate and splitting easily. Gills white, free from the stem or just touching it, Flesh rather thick, waxy white throughout. This mushroom grows in very dense clusters and usually on bare patches of earth thrown up by termites. It develops best in the rainy season. These pellets are composed of fungus threads (hyphae) from which the mushrooms arise, and at first are whitish, later turning yellowish. The mushrooms are edible and of good flavor but so small that a great number are required to provide a meal. The *Termitomyces microcarpus* is small, but makes up for its size by fruiting in vast numbers, typically on or around old stumps grow with termite, individual fruit bodies are not only small, but are also fragile crumbling easily if picked. The respondent of study area were not collected and also do not distinguish whether it is edible or not they said because it is small to collect they do not consider as edible but not also distinguish as non-edible. In other country collected for food by indigenous people in Ghana and other part of Africa (Peter and Shelly, 2011).

Basic characteristics and features of the species; the shape of the cap is convex, very thin-fleshed and fragile, smooth pale whitish color becoming pale gray. The gills are whitish at first, becoming

black. The stem is whitish to pale cap-colored and smooth. The cap diameter is 1.5-2.5 cm and stem height is 4-5 cm. Edible pleasant small and stems have not ring.

**5. *Phyllotopsis nidulans***

Local name (Tigrigna language): "*Kebero Zbei*"
Species name: *Phyllotopsis nidulans*
Family name: Trichoomataceae
Order: Agarics

The Fruit bodies grow as cluster and are laterally attached to wood. It seems to be much less common.

Basic characteristics and features of the species; Fruit bodies are wide, shell shaped, and soft. The caps are weakly convex to flat, orange-buff, becoming pale ocher-yellow, with densely hairy surface. The gills are cap colored and the stem is absent. Habitat: managed grass land and not edible. Cap diameter is 8-10 cm.

**6. *Panaeolus papilionaces***

Local name (Tigirgna Language): "Nieashten Aynihimi"
Species name: *Panaeolus papilionaces*
Family name: Psathyrellaceae
Order: Agarics

This species are charming, but like most panaeolus species it is dung-lover, occurring directly on old herbivore dung or manure ground. It is also small and thin. Habitat grows in elsewhere which were higher abundance.

Basic characteristics and features of the species; The shape of the cap is hemispherical which were smooth and vary in color from ivory or creamy white to cream, buff grayish or radish brown and the gills are mottled black. The stem is smooth color, but often covered in fine whitish particles when fresh. The cap diameter is 1-2 cm and stem height is 4-5 cm. Not edible.

**7. *Russula nigricans***

Local name: "Tslal zbei"
Species name: *Russula nigricans*
Family name: Russulaceae
Order: Agarics

This species is occasionally solid that gradually gets black with age. The old black fruit bodies can persist for weeks. The species sometime considered as edible, but has been implicated in cases of gastroenteritis poisoning.

Basic characteristics and features of the species; the caps are convex, later on becoming flatter and depressed with age. The cap surface is smooth, sordid whitish to cream with smoky, grey-brown patches eventually becoming black. The gills are widely spaced, sordid white, becoming gray brown then black. The stem is cap color and cap diameter is 8-10 cm, stem height is 7-9 cm. Not edible with unpleasant odor. Stem have not ring.

**8. *Chlorophyllum molybdites***

Local name (Tigrigan language): "Abiyi Aynihimi"
Species name: *Chlorophyllum molybdites*
Family name: Agaricaceae
Order: Agarics

*Chlorophyllum molybdites* is number one species responsible for cases of fungal poisoning. It is primarily a tropical sub-tropical agaric particularly common in grass land where it can form impressive rings.

Basic characteristics and features of the species; Caps have form spherical when young, becoming flat to shallowly umbonate, with brown or pinkish brown central patch that is surrounded by small scales of similar color on whitish background. The gills are white, becoming greenish. The stem is smooth, whitish, sometimes browning toward the base, with large, often loose, scaly ring. The cut flesh in the stem base may turn reddish. The cap diameter is 15-24 cm and stem height is 5-7 cm. Not edible. Stem have ring.

**9. *Leucoagaricus rubrotinctus***

Local name (Tigrigna language): "Tslal Aynihimi"
Species name: *Leucoagaricus rubrotinctus*
Family name: Agaricaceae

Order: Agarics

*Leucoagaricus rubrotinctus* is related to Lepiota species, but tend to be larger and more slender with a distinct (not partial) ring on the stem. It is also known as the red eyed parasol, is one of the most widespread and easily recognized species, thanks to attractive color, however this species cannot found in huge quantity.

Basic characteristics and features of the species; has convex cap that becoming flat or weakly umbonate when expanded. The cap center is pinkish red to orange, typically splitting or cracking to ward margin and breaking up in to scale on whitish back ground. The gills are white and the stems are white with white membranous ring. The cap diameter is 8-10 cm and stem height is 9-13 cm. Not edible. Stem have ring.

**10. *Panaeolina foenisecii***

Local name (Tigirgna language): "keyhi Nieshtey Aynihimi"

Species name: *Panaeolina foenisecii*

Family name: Psathyrellaceae

Order: Agarics

Panaeolina Foenisecii are common little agaric to occur in garden lawns. The caps are changing color as they dry out and also small size.

Basic characteristics and features of the species; Caps are convex and smooth, dull yellow-brown. The gills are dark brown and mottled with whitish edge. The stems are fragile whitish color when young then becoming to dark brown. The cap diameter is 2-3 cm stem height is 3-5 cm. Not edible.

**11. *Rhizopogon luteolus***

Local name (Tigirgan language): "Fossikaria"

Species name: *Rhizopogon luteolus*

Family name: rhizopogonaceae

Order: Puffballs

The fruit bodies can be surprisingly conspicuous, partly because of their color and size, because they normally grow half-embedded in the ground and half exposed, rather than hiding deep in litter. In some areas it has deliberately been introduced as beneficial ectomycorrhizal associate, helping the trees establish themselves on poor soils or in reclaimed land such as old spoil heaps.

Basic characteristics and features of the species; The *Panaeolina foenisecii* produces solid, potato-like Fruit bodies that are sordid yellow ocher and may have some darker, finally threadlike mycelia cords attached. The interior is spongy whitish yellow at first, becoming dingy olive-brown on maturity.

**Wild mushroom growth substrate**

Different mushroom species require certain growing media in the wild (Table 2). Different substrates enabled different species to grow in different proportions. Soil, termite mound, animal dung and log grew seven species (69.8%), three species (21.6%), two species (13.3%) and one species (0.9%) respectively. Mushroom species adapt to a specific substrate to grow and develop (Engola *et al*., 2007). Most mushroom species grew in soil substrate.

Most mushroom species preferred open canopy followed by slightly open canopy cover but none in the closed canopy cover (Table 3). The difference could have been brought about by the fact that under open canopy the moisture from the rain would easily reach the mushroom and aid their growth than in closed canopy, the dense cover expected to trap moisture is less preferred and they may not grow at all. Mushrooms preferred open canopy (Opige *et al*., 2006).

Figure 4. *Termitomyces Robustus.*

Figure 5. *Termitomyces clypealus.*

Figure 6. *Clitocybe gibba.*

Figure 7. *Termitomyces microcarpus* at field level.

Figure 8. *Phyllotopsis nidulans.*

Figure 9. *Panaeolus papilionaces* top and inside view.

Figure 10. *Russula nigricans* top &inside cap view.

Figure 11: *Chlorophyllum molybdites* at different growth stage on the field.

Figure 12. *Leucoagaricus rubrotinctus* upper and lower view.

Figure 13. *Panaeolina foenisecii* upper view.

Figure 14. *Rhizopogon luteolus.*

**Species diversity**

According to Abate, (2008a) mushrooms can be classified based on order as gill, bracket (pore), and puffballs, morels and truffles fungus. In this study 11 species were morphologically characterized (appendix 1) and identified (Table 4). *Termitomyces robust*, *Clitocybe gibba*, *Termitomyces clypealus* and *Termitomyces microcarpus* known as edible mushrooms. *Phyllotopsis nidulans*, *Panaeolus papilionaces*; *Russula nigricarns*, *Chlorophyllum molybdites*, *Leucoagaricus rubrotinctus*, *Panaeolina foenisecii* and *Rhizopogon luteolus* are known as non-edible wild mushrooms. A total of 1189 individual mushrooms were characterized and recorded comprising 11 species of which four of them were edible and seven were non edible categorized in two genera (Table 4). The abundant species in the study area was *Clitocybe gibba* and the least abundant species was *Termitomyces microcarpus* and orange nock oyster (Table 5). The highest richness, Shannon's, equitability-J, and Simpsons diversity indices of mushroom occurred in grass land. The woodland had the highest Fishers alpha and the cultivated land had the lowest values for all the species diversity and richness (Table 6). In agreement with this study, Engola *et al*. (2007) found the highest species diversity in grass land with quite high species abundance of about 4650 individuals of which 15 of them were edible species. The difference in the abundance of the species could be related to the high level of disturbance and difference in mushroom growing conditions such as amount of rain fall and soil fertility.

Table 2. Mushroom occurrence in different natural substrate.

| Type of species | Type of substrate | | | |
|---|---|---|---|---|
| | Soil | Decayed log | Manure | Termite mounds |
| *Clitocybe gibba* | 35 | 0 | 0 | 0 |
| *Termitomyces robust* | 0 | 0 | 0 | 1 |
| *Termitomyces clypealus* | 0 | 0 | 0 | 1 |
| *Panaeolus papilionaces* | 5 | 0 | 8 | 0 |
| *Chlorophylluh molybdites* | 13 | 0 | 0 | 0 |
| *Phyllotopsis nidulans* | 0 | 1 | 0 | 0 |
| *Termitomyces microcarpus* | 0 | 0 | 0 | 1 |
| *Rhizopogon luteolus* | 3 | 0 | 0 | 0 |
| *Russula nigricarns* | 5 | 0 | 0 | 0 |
| *Panaeolina foenisecii* | 6 | 0 | 0 | 0 |
| *Leucoagaricus rubrotinctus* | 7 | 0 | 0 | 0 |
| Total | 74 | 1 | 8 | 3 |

Table 3. Mushroom occurrence under different canopy cover.

| Type of species | Canopy cover (%) | | |
|---|---|---|---|
| | Occurrence | 0-25 | 26-50 |
| *Clitocybe gibba* | 16 | 43.2 | 56.8 |
| *Termitomyces robust* | 6 | 0 | 100.0 |
| *Termitomyces clypealus* | 9 | 81.8 | 18.2 |
| *Panaeolus papilionaces* | 8 | 61.5 | 38.5 |
| *Chlorophylluh molybdites* | 6 | 46.0 | 54.0 |
| *Phyllotopsis nidulans* | 1 | 100.0 | 0 |
| *Termitomyces microcarpus* | 0 | 0 | 100 |
| *Rhizopogon luteolus* | 1 | 33.3 | 66.7 |
| *Russula nigricarns* | 3 | 60.0 | 40.0 |
| *Panaeolina foenisecii* | 2 | 33.3 | 66.7 |
| *Leucoagaricus rubrotinctus* | 4 | 57.0 | 53.0 |

Table 4. Identified species and local name of wild mushrooms.

| SN | Species | Common name | Local name | Order | Edibility |
|---|---|---|---|---|---|
| 1 | *Termitomyces robust* | Robust Termite | Aigulle | Agarics | Edible |
| 2 | *Termitomyces clypealus* | | Mulkulkay | Agarics | Edible |
| 3 | *Clitocybe gibba* | | Kintishara | Agarics | Edible |
| 4 | *Termitomyces microcarpus* | | Nieashten Kintishara | Agarics | Edible |
| 5 | *Phyllotopsis nidulans* | Orange nock oyster | Kebero Zbei | Agarics | Not Edible |
| 6 | *Panaeolus papilionaces* | Petticoat Mottle gill | Nieashten Aynihimi | Agarics | Not Edible |
| 7 | *Russula nigricarns* | Blacking brittle gill | Mrkus zibiea | Agarics | Not Edible |
| 8 | *Chlorophylluh molybdites* | False parasol | Abiyi Ayni himi | Agarics | Not Edible |
| 9 | *Leucoagaricus rubrotinctus* | Ruby dapperling | Tslal Aynihimi | Agarics | Not Edible |
| 10 | *Panaeolina foenisecii* | Brown Mottlegill | Betsa Nieashten Aynihimi | Agarics | Not Edible |
| 11 | *Rhizopogon luteolus* | Yellow False Truffle | Fossikaria | Agarics | Not Edible |

Table 5. Presence and absence of wild mushrooms in different micro habitats.

| Species | Grazing land | Cultivated land | Wood land | Managed grazing land |
|---|---|---|---|---|
| *Clitocybe gibba* | √ | × | √ | √ |
| *Termitomyces robust* | × | √ | × | √ |
| *Termitomyces clypealus* | × | √ | × | √ |
| *Panaeolus papilionaces* | √ | × | √ | √ |
| *Chlorophylluh molybdites* | √ | × | √ | √ |
| *Phyllotopsis nidulans* | × | × | × | √ |
| *Termitomyces microcarpus* | × | × | × | √ |
| *Rhizopogon luteolus* | √ | × | √ | × |
| *Russula nigricarns* | × | × | √ | √ |
| *Panaeolina foenisecii* | × | × | √ | √ |
| *Leucoagaricus rubrotinctus* | × | × | √ | √ |

(√ indicate presence) and (× indicate that absent) of different types of mushroom species.

Table 6. Wild mushroom diversity indices on four micro habitats.

| Land use | Diversity indices | | | | | | |
|---|---|---|---|---|---|---|---|
| | S | No/plot | D | 1-D | H | F_A | C-1 |
| Grazing land | 5.00 | 194.00 | 0.75 | 0.25 | 0.38 | 0.56 | 1.73 |
| Cultivated land | 2.00 | 352.00 | 0.97 | 0.03 | 0.05 | 0.23 | 1.07 |
| Wood land | 7.00 | 162.00 | 0.67 | 0.33 | 0.52 | 0.75 | 2.00 |
| Managed grazing land | 10.00 | 516.00 | 0.61 | 0.39 | 0.61 | 0.59 | 2.27 |

Where: S=Taxa (s), no/plot=individuals, D=dominance (D), 1-D=Simpson 1-D, H=Shannon-H), F-A=Fisher alpha and C-1=Chao-1.

## Nutritional values of wild Mushroom

**Moisture content:** All the specimens had high moisture content (Table 7). Mushrooms generally have high moisture content which enables them to have shorter shelf life, which makes most mushrooms to be highly perishable and deteriorate easily after harvest if preservative measures are not employed (Kadiri and Fasidi, 1990). The moisture content of the collected mushroom samples ranged from 81.83% to 87.96% (Table 7). The highest moisture was recorded from *Termitomyces robust* (87.9%) and the lowest moisture content was obtained from *Clitocybe gibba* (81.83%). Significant difference was observed between species in moisture content of *Termitomyces Robust* (Table 7) from *Chlorophyllum Molybdites* and *Clitocybe Gibba* mushroom. The variation might be due to species and natural substrate. This is similar to the result obtained in Nigeria by Gyar and Owaku, (2011) recorded a moisture content ranged 80.53-89.94% of dry weight and lower with the results from India by Manjunathan and Kaviyarasan, (2011) observed that the moisture content of the collected mushroom samples ranged from 87.13% to 95.17% of dry weight.

**Crude Protein:** Mushroom is considered to be a good source of digestible protein content above most vegetables and somewhat less than most meats and milk reported by Krishnendu *et al*., (2013). In the present study the protein content of

the collected mushroom samples ranged from 23.46% to 37.21%. The highest protein was obtained from *Chlorophyllum molybdites* (37.21%) and the lowest protein content was from *Clitocybe gibba* (23.46%). Significant difference was observed protein content between species of *Chlorophyllum molybdites* (Table 7), *Termitomyces robust, Termitomyces clypealus* and *Clitocybe gibba* mushrooms. The variation might be due to the species and the natural substrate where the species grow. According to Kaviyarasan *et al*. (2011) protein contents of mushrooms were reported to vary according to the genetic structure of species. This is similar to the result obtained in Brazil by Chang (2007), the protein content ranged from 10-40% on a dry weight basis, in India by Krishnendu *et al*. (2013) protein content 16.7 - 24.7 %, in India by Kaviyarasan *et al*. (2011) protein content 30.27-39.11% and by Aglarirmak *et al*. (2002) protein content ranged 26-31% and higher with results found in Iran by Ogbe and Obeka (2013) observed that the protein content 16.79%, and in India by Longvah and Deosthale (1998) with a protein content 15.9-22.8 % of the collected mushroom samples on dry weight basis.

**Total Carbohydrate**: Edible mushrooms are highly valued for the carbohydrate constitutes. A considerable portion of the carbohydrate compounds occurs in the form of polysaccharides of different sizes. Fungal polysaccharides are represented by glycogen and some indigestible form as dietary fiber of cellulose, chitin, mannose and glucans (Krishnendu *et al*., 2013). In the present study the highest carbohydrates content ranged from 32.41% to 43.93%. The highest carbohydrate was obtained from *Clitocybe gibba* (43.93%) and the lowest carbohydrate content was obtained from *Termitomyces robust* (32.41%). Significant difference was observed in carbohydrate content between *Clitocybe gibba*, *Termitomyces robust* and *Chlorophyllum* species (Table 7). The variation might be due to species and the natural substrate.This is similar to the result obtained in India by Kaviyarasan *et al*. (2011) carbohydrate content 33.23% to 47.83% and was lower than that reported by Ogbe and Obeka (2013) and in Europe by Pavel (2012) carbohydrate content 63.27% and 50-60% respectively.

**Total Fat:** The highest fat content ranged from 1.99 to 4.47%. The highest fat was obtained on *Termitomyces robust* 4.4667% and the lowest fat content was obtained on *Chlorophyllum molybdites* 1.99 %. Significant difference was observed between species in fat content of *Termitomyces robust* (Table 7) from *Chlorophyllum molybdites* mushroom. The variation might be due to species and natural substrate. This is similar to the result obtained in Turkey by Aglarirmak *et al*. (2002) fat content ranging from 1.1 - 8.3%, fat content range from 1.8-17% of dry weight.

**Total Ash:** The ash content of wild mushroom was high (Table 7) which means higher composition of minerals that are indispensible to human health and a reflection of the high content of organic matter present in the sample (Gyar, 2011). In the present study the highest ash content ranges from 14.92% to 19.60%. The highest ash was obtained on *Termitomyces clypealus* 19.60%, and the lowest ash content was obtained on *Termitomyces robust* 14.92%. Significant difference was not observed between the species. This is similar to the result obtained in India by Kaviyarasan *et al*. (2011), ash content ranging from 5.1-16.8%, reported in Turkey by Aglarirmak *et al*. (2002) ash content of ranging from 8.1-17.7%, and obtained by Ogbe and Obeka (2013) the ash content were 8.42% of dry weight.

**Crude Fiber**: This species of mushroom is a very rich source of plant fiber (Table 7). According to Gordon (2002) there is a "dietary fibre hypothesis" which suggests that the main role of the insoluble fibre found in fresh mushrooms is to ensure the peristaltic regularity and good bowel health. It also helps slow digestion and adds satiety or staying power to foods. In the present study the highest fiber content ranges from 12.32% to 18.07%. The highest fiber was obtained on *Termitomyces Robust* 18.07% and the lowest fiber content was obtained on *Clitocybe gibba* 12.32%. Significant

difference was not observed between the species. This similar reported in Nigeria by Etang *et al*., (2006) fiber content 11.2-18.4%. And higher than the result reported by Krishnendu *et al* (2013) the fiber content were 8.71-12.5% in dry weight base.

**Phosphors:** Phosphors are one of the prevailing mineral in wild mushroom with substantial amount (Table 7). In the present study the highest phosphors content ranges from 0.55% to 0.91%. The highest phosphors was obtained on *Termitomyces clypealus* 0.91% and the lowest phosphors content was obtained on *Clitocybe gibba* 0.55%. Significant difference was not observed between the species. This is similar to the result obtained by Pavel (2012), phosphors content of ranging from 0.5-1.0 and higher than the result reported by Longvah and Deosthale (1998) Phosphorus content 0.40 - 0.49% in dry weight base.

Generally the above result shows that considerable amount of nutrient content of wild mushroom were observed and essentially may be taken regularly as part of the human diet or be treated as healthy food or as functional food to study area and other area community. But the nutritional content among edible and non-edible mushrooms was almost comparable except on protein content. The behaviour of edible and inedible which was poisons of wild mushroom may be contributing other mineral which cannot cover this study. And also comparing along with edible mushrooms there were differ in their nutritional content due to the fact that different genetically structure of the species and natural substrate of the wild mushrooms grown.

**Farmers perception habit on wild mushroom**

The descriptive result of the study shows that about 79% of the respondents were male. The average age was about 47 years. About 38% of the respondents were literate in different levels, ranged from religious to college level.

The study used the regional livelihood threshold (18000 Birr per household per year) as a benchmark to investigate the percentage of food secure and food insecure households in the study areas. Accordingly, about 63% of the respondents were food secure, which meant that they on average earned more than 18000 ETB (Table 8).

Table 7. Nutrient content of three edible and one inedible wild mushroom in (DW %).

| Composition | *Termitomyces robust* | | *Chlorophylluh molybdites* | | *Clitocybe gibba* | | *Termitomyces clypealus* | |
|---|---|---|---|---|---|---|---|---|
| Moisture content | 87.96±2.200 | a | 82.82±2.171 | b | 81.83±1.210 | b | 83.34±1.525 | ab |
| Protein | 30.14±3.520 | b | 37.21±3.586 | a | 23.46±0.762 | b | 26.48±0.936 | b |
| Fat | 4.47±0.518 | a | 1.99±0.421 | b | 3.59±1.510 | ab | 2.61±0.045 | ab |
| Carbohydrate | 32.41±4.278 | b | 32.94±3.169 | b | 43.93±6.134 | a | 35.81±1.759 | ab |
| Ash | 14.92±3.104 | a | 15.44±3.554 | a | 16.69±4.377 | a | 19.60±0.272 | a |
| Fibre | 18.07±2.139 | a | 12.42±1.973 | a | 12.32±6.378 | a | 15.50±1.127 | a |
| Phosphorus | 0.91±0.223 | a | 0.82±0.162 | a | 0.55±0.079 | a | 0.91±0.107 | a |

Data are mean values ± standard deviation (SD) of Triplicate results and Means that do not share a letter are significantly different.

Table 8. Socio-demographic characteristics of the study population**.**

| Variable | Observation | Mean value |
|---|---|---|
| Male headed households (%) | 150 | 80 |
| Average age of the head (year) | 150 | 47 |
| Married proportion (%) | 150 | 78 |
| Literate household heads | 150 | 37 |
| Primary occupation proportion agriculture (%) | 150 | 94 |
| Average livestock resources (TLU) | 150 | 9 |
| Average annual income (Birr) | 150 | 25843 |
| Proportion of food secure people (%) | 150 | 63 |
| Average land size of head (hectare) | 150 | 0.9 |
| Mushroom consumed (%) | 150 | 90 |
| Mushroom not consumed (%) | 150 | 10 |

The respondents recognized that mushroom grows in their local areas, mainly managed grassland, cultivated land, unmanaged grass land and wood land. Mushroom grows mainly in rainy season especially from the first week of June to late September though some mushroom like *Termitomyces robust* and *Termitomyces clypealus* grows starting mid of July to the last week of September. The participants in the household survey and focus group discussion explained the factors that influence the growing condition of wild mushroom are heavy storm, lighting, thunder and organic matter. Similar reports and folklore were reported in others. For example, the issues of lighting, thunder and storm were common in Japan. Anonymous (2008) studied the determinant factors of mushroom using static electricity and found that it depends on the species of the mushroom. For example, artificial lightening can therefore be very beneficial for the mushroom business in Japan (Adey, 1993). Islam and Ohga (2012) explained why lightning trigger mushroom growth was that heavy rain and lightning trigger the germination of dormant spores in the soil. Furthermore, lightning causes the precipitation of atmospheric nitrogen to nitrate which enhances mushroom growth and fruiting body formation.

Though mushroom in the study area has a long history, it has gradually declined. About 95% of the respondents realized not only the reduction but also disappearing of mushroom from some land uses mainly due to anthropogenic effects such as deforestation, expansion of cultivated areas, increasing settlement and other factors. Similarly, alarming decline in wild edible mushroom populations has been reported from central part of Burkina Faso which was closely linked to disappearing forest habitats (Guissou *et al*., 2008). In Wacha kebele, south Ethiopia there is a sharp decline in wild mushroom population (Delelegn *et al*., 2013). In contrary, in countries like Japan, the Republic of Korea, China, and the Russian Federation, the tradition of eating wild edible mushroom is much stronger and appears to have withstood the changes experienced elsewhere as stated by Boa (2004). Hence, the population of wild edible mushroom is increasing in some of the developed countries probably due to better management of natural forests in contrast to the trend seen in developing countries.

Several studies conducted on the abundance, edibility and endanger species of mushroom (Guissou *et al*., 2008). The respondents easily identified endangered and non-endangered species of wild mushroom. They also easily distinguished the edible and inedible species of the mushrooms. In this study the respondent identified the highest abundant species as *Clitocybe gibba* and the endangered species was *Termitomyces robust.* The reason for this condition could be the difference in resistance of species to anthropogenic factors.

Another important issue about mushroom is that who consume the mushroom and whether the local communities are aware of the consumption habit of the wild mushroom. Because of the knowledge transfer from local elders, about 96% of the respondents had information and knowledge on consumption habit of mushroom. The respondents consumed wild mushroom regardless of economic status because of its good taste, sometime solving food shortage, and substituting meat. In other words, some of the respondents (57%) ate wild mushroom simply by chance when they found wild mushroom, and some (33%) consumed it during shortage of food at home while others (10%) consumed at any time due to good aroma of the wild mushroom. According to the participants in the household survey and focus group discussion, the farmers ate the wild mushroom in fresh (raw), by cooked or roasted depending upon the preference of the farmers. *Termitomyces robust and Termitomyces clypealus* were consumed as raw while *Clitocybe gibba* required caution as it was similar with other poisonous mushroom like *Leucoagaricus rubrotinctus and Chlorophyllum molybdites* species during young stage. The appetite to eat different mushroom species was

determined by its taste. *Termitomyces robust* was preferred all consumers, the second choice was *Termitomyces clypealus*, preferred by 80 % of the consumers and the third choice of consumers' was *Clitocybe gibba*. The result of consumers preference indicates that mushroom flavors has no relationship with its nutrient content, this was in conformity with Chang, (2007) who, reported that the desirability of a food product does not necessarily bear any relationship to its nutritional value. Instead, its appearance, taste and aroma sometimes can stimulate one's appetite.

Pertaining to the taste quality from accessible edible wild mushroom in the area of the total respondent responded that *Termitomyces robust* the first 81.3%, *Termitomyces clypealus* 9.3% and *Clitocybe gibba* 8.7%. Besides annual consumption per household in kilogram of edible wild mushroom of the respondent was those consume from 0.25-5kg respond 76%, 5-10kg consume respond 12% ,10-20 kg consume respond 6.7% and those consumed 20-30 kg respond 2%. The annual mean consumption per household of the respondents was 3.5 kg/HH. In agreement with other study in Czech Republic obtained by Gyar (2011) consumed wild mushroom about 70% of the population with a statistical mean of 5.6 kg of fresh mushrooms per household yearly. Nevertheless, some individuals consume over 10 kg yearly. UK household consumption of mushrooms was 36 g/week mushroom Pavel (2012).

As regards the current status of edible wild mushroom consuming at study area, most of 95.3% of the respondents indicated that there were a sharp decrease in mushroom consumption. As compared to previous consumers currently they reduce consumption of respondents by 40% were responded. The most important reasons for decreasing mushroom consumption in the current study were attributed reduce growing of mushroom 53.3%, followed farmers understand mushroom as poor food 30%, farmers got other better options 12.7% and the rest 4% they said there were no reduction as responded by the respondent.

The other wonderful point about the 94% respondents of study area were they clearly able to distinguish between edible and non-edible wild mushrooms and they have different ability to distinguish among edible and non-edible wild mushroom by which using color, size, smell, and ring of mushrooms. They gave different reasons that were not consume inedible mushrooms such as could be not eat by people, it is poisonous, bad smell, and attack by insects as 61.3%, 24.7%, 9.3% and 2% respectively.

Besides part of the respondent have did different treatment for those who encounter chance to eat non-edible mushrooms which got illness in a way that treated by drinking milk products such as fresh milk, sour milk and lentil. This is very interesting that coupling such traditional knowledge with scientific description and identification of the edible fungi could have paramount advantage in sustainable utilization of the resource for various obvious purposes in the area as well as elsewhere in the region. Furthermore, such local knowledge could be even more important for people who are not familiar to the area as one should eat mushrooms only if one knows their names and their properties with considerable precision.

Finally, domestication of mushroom was not practiced as indicated by the participants in the questionnaire survey and focus group discussion because the local farmers didn't know whether or not the mushroom has seed or spore for reproduction. However few of respondent have experience in the form of client on their farm or communal land locally they called it "*fekur*" (mean an area that used for collection of mushroom at private level year to year regularly). Market condtion of wild mushrooms in the study area were respond 100% has did not practiced due to the fact that farmers did not consider and lack knowledge as cash crop wild mushrooms. In addition 100% have not cultivated mushroom due to lack of awareness and knowledge. But 84% portion of the respondent has interest to cultivate if they got, counseling, support on training and spawn.

**Factors influence consumption of wild mushroom**

The study used probit model to identify the major factors that influence consumption habit of wild mushroom in the study area. The overall fitness of the model was statistically (Pseudo $R^2$ = 0.5610). Of the stated independent variables of the model, age of the households had a positive and statistically significant influence on the consumption habit of the households for wild mushroom.

Age variables appeared to influence the level of consumption of mushroom of the households studied and their signs are complete agreement with a priori expectations because as age increase the consumption of mushroom by farmers increases due to the fact that elders have experience and knowledge about wild mushroom consumption. However the other important independent variables such as educational level, income and farm size have not influence and statically not significantly difference the consumption of mushrooms. The above result was also similar with results found practically during different field survey techniques conducted in this research. The magnitude effect of the independent variables, age of the household heads was the only statistically significant variable that explains the consumption habit of mushrooms. The result (Table 9) explained that as the age of the respondent increased by one year, the probability of consuming mushroom increased by about less than 1 percent.

## CONCLUSION

Four wild edible and seven non-edible wild mushrooms categorized in to two genera were identified. The species composition of the identified wild mush rooms were few compared to other similar areas. Species diversity was high in managed grassland. Type of substrate, level of canopy cover and heavy rain fall were some of the determinant environmental factors that affect the distribution of mushroom. Wild mushrooms were rich in carbohydrate and protein content and were low in fat content. According to the respondents there were a decline in abundance and distribution wild edible mushroom species; particularly *Termitomyces robust* was endangered. The traditional culture of hunting and consuming wild mushrooms is declining in the study area.

Table 9. Probit regression estimation of mushroom consumption.

| Attributes | Coef. | dF/dx | Std. err | Z | P>\|z\| | 95% Conf. |
|---|---|---|---|---|---|---|
| Family number | 0.09 | 0.00 | 0.18 | 0.49 | 0.62 | 0.27 |
| Age | 0.17 | 0.00 | 0.05 | 3.54 | 0.001 | 0.07 |
| Farm Size | 1.14 | 0.002 | 0.86 | 1.33 | 0.18 | 0.54 |
| Female | 0.95 | 0.001 | 0.77 | 1.23 | 0.22 | 0.56 |
| Illiterate | 0.70 | -0.001 | 0.89 | 0.79 | 0.43 | 2.44 |
| Read & writing | 0.70 | 0.001 | 1.39 | 0.50 | 0.62 | 2.03 |
| One-six grade | 1.40 | -0.015 | 1.04 | 1.35 | 0.18 | 3.44 |
| Married | 1.38 | 0.015 | 1.31 | 1.05 | 0.29 | 1.19 |
| Separated | 0.09 | 0.000 | 1.32 | 0.07 | 0.94 | 2.50 |
| Food secure | 0.10 | 0.000202 | 0.60 | 0.16 | 0.87 | 1.07 |
| LR $Chi^2(10)$ = 54.47 | | | | Pseudo $R^2$ = 0.561 | | |

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