

ABANT İZZET BAYSAL UNIVERSITY

**THE GRADUATE SCHOOL OF NATURAL AND APPLIED
SCIENCES**



**ETHNOMYCOLOGY OF WESTERN BLACK SEA
MACROFUNGI**

MASTER OF SCIENCE

LEYLA HANDE YILMAZ

BOLU, SEPTEMBER 2015

ABANT İZZET BAYSAL UNIVERSITY
THE GRADUATE SCHOOL OF NATURAL AND APPLIED
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DEPARTMENT OF BIOLOGY



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APPROVAL OF THE THESIS

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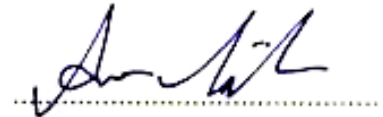
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To My Family

DECLARATION

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Leyla Hande YILMAZ

ABSTRACT

ETHNOMYCOLOGY OF WESTERN BLACK SEA MACROFUNGII MSC THESIS

LEYLA HANDE YILMAZ

**ABANT IZZET BAYSAL UNIVERSITY GRADUATE SCHOOL OF
NATURAL AND APPLIED SCIENCES**

DEPARTMENT OF BIOLOGY

(SUPERVISOR: PROF. DR. NUSRET ZENCİRCİ)

BOLU, SEPTEMBER 2015

Edible macrofungi, which are collected from natural habitats or cultivated in Western Black Sea region are significant products for people from different working groups. These mushrooms are generally consumed and processed in the rural areas and converted to economic, social, and cultural values. The status of edible macrofungi in the Western Black Sea region from identification to marketing was investigated by an ethnomycological approach in this study. Main data were collected between April 2012 and December 2013. It was studied in 6 provinces (Bolu, Düzce, Karabük, Zonguldak, Bartın, and Kastamonu), 6 province centers, 17 counties, and 120 villages where mushroom gathering or production was practiced. A total of 70 field trips were undertaken to different local markets especially during mushroom gathering seasons. The sample of the research was composed of 475 forest villagers who agreed to participate in this research. The total of 2568 from these 475 households participated in the survey questionnaire. Survey questionnaires were prepared by consensus of the project group, and data were collected by a semi structured open-ended questionnaires through face to face interviews. The questionnaires were also applied to 10 randomly selected mushroom producers. Demographic, local, and economic data were evaluated using SPSS (Statistical Package for the Social Sciences) Program Version 16.0. According to the results of the research, 33 species from 14 families marketed in the study area are the following: *Russulaceae* (7), *Morchellaceae* (5), *Agaricaceae* (4), *Cantharellaceae* (3), *Tricholomataceae* (3), *Boletaceae* (2), *Gomphaceae* (2), *Amanitaceae* (1), *Gomphidiaceae* (1), *Hericiaceae* (1), *Hydnaceae* (1), *Lyophyllaceae* (1), *Marasmiaceae* (1), and *Pleurotaceae* (1).

KEYWORDS:

Ethnomycology, Identification, Macrofungi, Systematics, Western Black Sea

ÖZET

**BATI KARADENİZ BÖLGESİ MAKROMANTARLARININ
ETNOMİKOLOJİSİ
YÜKSEK LİSANS TEZİ
LEYLA HANDE YILMAZ
ABANT İZZET BAYSAL ÜNİVERSİTESİ FEN BİLİMLERİ ENSTİTÜSÜ
BIYOLOJİ ANABİLİM DALI
(TEZ DANIŞMANI: PROF. DR. NUSRET ZENCİRCİ)**

BOLU, EYLÜL - 2015

Çeşitli meslek gruplarındaki insanlar tarafından Batı Karadeniz ormanlarının doğal yetiştirme yerlerinden toplanan veya kültürü yapılan yenilebilir makromantarlar önemli ürünler arasındadır. Bu mantarlar, genellikle kırsalda tüketilir, işlenir ve birçok ekonomik, sosyal ve kültürel değerlere dönüştürülürler. Bu çalışmada yenilebilir makromantarların Batı Karadeniz bölgesindeki durumu, tanımlanmalarından pazarlanmalarına kadar etnomikolojik bir yaklaşımla araştırılmıştır. Çalışmanın asıl verileri, Nisan 2012-Aralık 2013 arasında toplanmıştır. Mantar toplayıcılığının veya üretiminin yapıldığı 6 il (Bolu, Düzce, Karabük, Zonguldak, Bartın ve Kastamonu), 6 il merkezi ve 17 ilçeye bağlı 120 köyde çalışılmıştır. Özellikle mantar toplama mevsimlerinde çeşitli yöresel pazarlara toplam 70 saha gezisi yapılmıştır. Araştırmanın örneklemini araştırmaya katılmayı kabul eden 475 orman köyü hanesi oluşturmuştur. Ankete; bu 475 hane halkından toplam 2568 kişi katılmıştır. Anket; proje ekibinin ortak görüşleri doğrultusunda hazırlanmış ve veriler yarı-yapılandırılmış ucu açık sorularla yüz yüze toplanmıştır. Uygulama, ayrıca rastgele seçilen toplam 10 mantar üreticisiyle de yapılmıştır. Demografik, yerel ve ekonomik veriler SPSS (Sosyal Bilimler için İstatistik Paketi) 16.0 programı ile değerlendirilmiştir. Araştırma sonucuna göre, 14 familyadan 33 tür çalışma bölgesinde bulunmaktadır: *Russulaceae* (7), *Morchellaceae* (5), *Agaricaceae* (4), *Cantharellaceae* (3), *Tricholomataceae* (3), *Boletaceae* (2), *Gomphaceae* (2), *Amanitaceae* (1), *Gomphidiaceae* (1), *Hericiaceae* (1), *Hydnaceae* (1), *Lyophyllaceae* (1), *Marasmiaceae* (1) ve *Pleurotaceae* (1).

ANAHTAR KELİMELELER:

Batı Karadeniz, Etnomikoloji, Makromantarlar, Sistematiği, Tanılama

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LIST OF ABBREVIATIONS AND SYMBOLS

CSI	: Cultural Significance Index
FUI	: Frequency of Use Index
HI	: Health Index
KTI	: Knowledge Transmission Index
MFFI	: Multi-Functional Food Index
NWFP	: Non-Wood Forest Product
PAI	: Perceived Abundance Index
SD	: Standard Deviation
SPSS	: Statistical Package for the Social Sciences
TFRK	: Traditional Forest Related Knowledge
TSAI	: Taste Score Appreciation Index
WEMs	: Wild Edible Mushrooms

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1. INTRODUCTION

1.1 What is Macrofungus?

A mushroom is defined as “a macrofungus with a distinctive fruiting body which can be either epigeous or hypogeous. The macrofungi have fruiting bodies large enough to be seen with the naked eye and to be picked up by hand” (Chang and Miles, 1992). In a narrow sense, it is referred to the reproductive structure of fruiting body of a fungus (Berch et al., 2007).

Fungi are eukaryotic, heterotrophic, and osmotrophic. They develop a rather diffuse, branched, and tubular body (radiating hyphae making up mycelia or colonies), and reproduce by means of spores. Mushrooms belong to the kingdom of fungi, a group very distinct from plants, animals, and bacteria. Mushrooms often live in symbiosis with other plants, mostly with the roots of certain trees, both profiting from the relationship (Oseni, 2007).

1.2 Importance to People: Food, Medicine, and Income

1.2.1 Wild or Cultivated Edible Fungi and Livelihoods

Edible fungi were collected from forests in ancient Greek and Roman times, though more by high-ranking people than by peasants (Boa, 2004). They have been highly valued non-wood forest products (NWFP), thus wild edible mushrooms have played an important role in providing new sources of income in the whole World. Commercial mushrooms are either cultivated or harvested from the wild. The species cultivated are all decomposers capable of completing their life cycles on dead organic matter. Most of the forest harvested mushrooms are ectomycorrhizal and can therefore form fruiting bodies only when growing together with living host trees fungus (Berch et al., 2007).

Turkey has very large variety of wild edible mushroom on 21.7 million hectare of forest area (Okan et al., 2013). Particularly, Western Black Sea region has a very rich source of wild edible mushroom. The region has higher rainfall than other regions in Turkey. The high humidity level during almost all season provides ideal atmospheric conditions for the mushrooms. There are several wild mushrooms that grow in the forests of Western Black Sea from where the locals relish them.

1.2.2 Nutrition and Health Benefits

It is known that approximately 14 000 described species of the 1.5 million fungi estimated in the world (Chang, 2006). But, at least 1,154 species of wild fungi are collected for their nutritional and medicinal benefits (Boa, 2004). They have been consumed as food for centuries because of their unique taste. Edible mushrooms are considered as healthy foods because their mineral content is higher than that of meat, fish, and most vegetables. Furthermore, the protein content of fresh mushrooms is about twice of vegetables (Chang, 1981). In most countries, there is a well-established consumer acceptance of cultivated mushrooms (*Agaricus bisporus*, *Auricularia* spp., *Lentinus edodes*, *Pleurotus* spp., *Volveriella volvacea* etc). However, wild edible mushrooms have been traditionally eaten only seasonally by specific groups of people. They are gradually becoming more and more important in our diet for their nutritional value (Diez and Alvarez, 2001), because of their rich vitamins B and D (Oseni, 2007) as well. The rate of consumption of fleshy fungi in many countries has increased in recent years and hence become imperative to explore the treasure of wild or cultivated mushrooms (Kumar et al., 2011). Moreover, recent studies confirm that they are also important source of income beside their nutritive values in both developing and developed countries (Hosford et al., 1997; Boa, 2004). Indigenous people utilize mushroom for the treatment of different type of diseases (Devkota, 2006). *In vitro* and *in vivo* mushroom studies and isolated bioactive constituents from them have purported many pharmacological effects such as anti-tumour, antioxidant, antiviral, hypocholesterolemic, and hypoglycaemic effects. As far as human health is concerned, their daily consumption in our diet may improve the health (Cheung, 2010).

1.2.3 Local Marketing and Income

Forests of Western Black Sea region have commercially important mushroom species and these mushrooms are collected and sold by amateur local people like those in more than 80 countries such as China, Japan, Mexico, several European countries, and in the major areas of Central and Southern Africa. Their estimated value are approximately \$2 billion dollars a year. In rural areas, particularly in non-developed countries, the incomes due to mushrooms selling complete the economy of poor families (Boa, 2004). In addition to this, cultivating mushrooms in North America, Europe, and Asia are an important source of income (Oei, 1996). In several West African countries (Benin, Cameroon), mushroom cultivation generates income, especially for women, thereby contributing to their economic independence.

1.3 Literature Review

The importance of edible fungi has been well established since ancient times. In the last decades, there has been a rising worldwide attention for the use of wild edible fungi. Several recent publications emphasised the importance of wild edible fungi in the rural livelihoods of the developing countries as the collection of wild edible fungi for local markets and as the significant contribution of nutrients into their diet (Boa, 2004; Wang and Hall, 2004).

In this context, mushroom consumption and utilization are integral parts of long-standing traditional and cultural practises. Therefore, various studies called ethnomycological ones have been conducted across the various parts of the world. The following publications were given in a chronological order from recent to past.

- i. An ethnomycological study was performed in San Mateo Huexoyucan, Tlaxcala, Mexico to identify the most important species of wild mushrooms growing in the oak forest and open areas. Thirty-three Mestizo individuals randomly selected in the community were interviewed with various questions. Their significance criteria were established by the Cultural Significance Index (CSI). In addition, Frequency of Use Index (FUI), Health Index (HI), Knowledge Transmission Index (KTI), Multi-Functional Food

Index (MFFI), Perceived Abundance Index (PAI), and Taste Score Appreciation Index (TSAI) were used to determine the relationship between the cultural significance of the mushroom species. As a result of this, six mushroom species were considered with highest CSI values: *Agaricus campestris*, *Amanita* aff. *basii*, *Boletus variipes*, *Ramaria* spp., *Russula* spp., and *Ustilago maydis*. The species with the lowest cultural significance included *Lycoperdon perlatum*, *Russula mexicana*, and *Strobilomyces strobilaceus* (Alonso-Aguilar et al., 2014).

- ii. A survey was conducted to assess mycological knowledge, socio-economic benefits, and the value chain of wild edible mushrooms among *Benna* and *Hehe* ethnic groups in the Southern Highlands of Tanzania. The mushroom hunters, collectors, processors, and retailers from the local communities in Njombe and Iringa regions were interviewed. In this way, the information on indigenous mycological knowledge, collecting and retailing of wild edible mushrooms in *Benna* and *Hehe* communities were gathered. From the survey, it was found that mushroom collection and selling was gender oriented dominated by women at 70% and 93.5% respectively. About 45 species of wild edible mushrooms were collected mainly from *Amanita*, *Cantharellus*, *Lactarius*, and *Russula* species. Rural gatherers were able to collect 1000 to 1500 kilograms earning US \$ 500 to 650 per season (Chelela et al., 2014).
- iii. Regional investigation had shown that the local and indigenous people of the eight districts of the state of West Bengal, India possessed a quite number of traditional knowledge regarding mushroom utilization, which were yet to be fully documented. A 5 years (2008-2012) extensive survey explored 34 macrofungi, among which 31 were used as food and the remaining for medicinal purposes in addition to some species, which were used for both the purposes. Some species of *Amanita*, *Armillaria*, *Astraeus*, *Auricularia*, *Calocybe*, *Coprinus*, *Fistulina*, *Grifola*, *Hericeum*, *Lentinus*, *Meripilus*, *Pholiota*, *Pleurotus*, *Russula*, *Termitomyces*, *Tricholoma*, and *Volvariella* were consumed as food. Species of *Cordyceps*, *Ganoderma*, *Schizophyllum*, *Termitomyces* etc. were used for medicinal purposes with various preparations. Powdered fruit bodies of *Daldinia concentrica* and *Pisolithus arhizus* were applied on to the skin for burning relief, itching, and healing minor skin infections after mixing with coconut oil. The findings could have

served as the foundation for further research on some of the common WEMs of the region (Dutta and Acharya, 2014).

- iv. A paper aimed to record evidence of the knowledge and use of wild potentially edible mushroom species by inhabitants of towns in the Sierra Tarahumara of Chihuahua, Mexico. 197 habitants from seven locations in Urique, Bocoyna, and the Cusarare area were surveyed using a semi-structured technique. Known fungi, their local nomenclature, species consumed, preparation methods, appreciation of taste, forms of preservation, criteria for differentiating toxic and edible fungi, other uses, economic aspects, and traditional teaching were recorded. The studied population reported preference for five species: *Agaricus campestris*, *Amanita caesarea*, *Amanita rubescens*, *Hypomyces lactifluorum*, and *Ustilago maydis*. Fourty nine percent of the respondents said that they do not store their mushrooms, 17% reported that they stored as dry, 18% made syrup out of them; 6% as frozen, and 10% as canned. There were also no apparent differences among Sierra inhabitants in terms of gender, occupation, or language for the recognition and consumption of species (Quiñónez-Martínez et al., 2014).
- v. Another culturally important mushroom was in Wopkola in the Western Highlands Province of Papua New Guinea. Ethnobiological techniques such as free listing and qualitative interview questions were used to obtain information from the residents. Thirty species were identified, among which twenty three were considered edible and two species were considered medicinal while as many as five species were dangerous. In addition to this, seven different species of mushrooms (*Boletus* spp (2), *Boletus edulis*, *Ganoderma* spp., *Polypore* spp., *Trametes* spp., *Tylopilus* spp) were randomly selected based on the indigenous knowledge to investigate of the antimicrobial activity. *Tylopilus* spp. had broad spectrum activity against all microbial isolates used in this research (Kik et al., 2013).
- vi. The rich diversity of mushrooms in Nigeria offered huge socio-economic potential, however it was not well documented for optimum application. This study was therefore, aimed at reducing research gaps on diversity and taxonomic classification of Nigeria's rich fungal diversity. Information was generated and documented by a well-structured questionnaire on local mushroom names nation-wide, edibility determinants, phenology, and

taxonomic classification of common species. Soil debris (24%) and dead woods (22%) were the most common out of 11 substrate types. Mushrooms were generally used as food flavourants (34%) and for income generation (27%). Catalogue and identification of 21 edible species collected from the wild as 4 classes, 4 orders, 10 families, and 13 genera. The most common species found were *Termitomyces* (3 varieties); *Auricularia*, *Chlorophyllum*, *Corprinus*, *Russula*, and *Pleurotus* (2 varieties each). Four species (*Fomes lignosus*, *Lepiota procera*, *Lepista flaccida*, and *Panus fulvus*) and 3 varieties (*Auricularia polytricha*, *Corprinus micaseus*, and *Lactarius deliciosus*) were documented for the first time in Nigeria (Nwordu et al., 2013).

- vii. An interview schedule with structured questionnaires was carried out in some rural communities of Zaria and its environments. The survey in this study assessed the edibility, trading, and livelihood improvement of Zaria local community. The age range for consumers of edible mushrooms in Zaria and its environments increased with age. Only few traders of edible mushrooms and few of cultivators of edible mushrooms for commercial purposes were observed. The most common species consumed by the communities were *Lentinus edodes*, *Pleurotus ostreatus*, and *Termitomyces globulus*. *Pleurotus ostreatus* was commonly cultivated mushrooms by city dwellers, but both urban and local folks preferred *Termitomyces* spp. Most individuals have not had any interest in eating mushrooms for the fear of collecting possibility of poisonous mushrooms. *Pleurotus* spp. was also believed to have a medicinal value including lowering of blood pressure in hypertensive patients (Musa et al., 2013).
- viii. This research documented the use of WEMs in Tanzania rural areas and assessed its significance as source of healthy food and income for disadvantaged rural dwellers. The data were collected through surveys to identify different common taxa using a semi-structured interview which involved 160 people. The collected data were comprised of the information where, how, when and who was the principal transmitter of the mycological knowledge learned and general information on their market and values. Results showed that mushroom gathering was gender oriented, dominated by women (76.25%) while men for 23.75%. Seventy five WEMs belonged to 14 families with the commonly sold species belonging to the family

Cantharellaceae (19) followed by *Russulaceae* (16) and *Lyophyllaceae* (13) respectively. The least sold species were from families represented by *Pluteaceae*, *Schizophyllaceae*, *Suillaceae*, and *Tremellaceae*. A person earned about \$400-900 annually (Tibuhwa, 2013).

- ix. The farmers' willingness of cultivating edible fungus was analysed based on 213 farmers surveyed in Hubei province. The results suggested that the factors of market of edible fungus, economic profitability, the responsibility for quality and safety, and farmers' self-efficacy were positive while farmer's age, technical trade barriers of edible fungus were negative for the cultivating willingness (Ni and Qin, 2012).
- x. A preliminary checklist of the macrofungi was assembled in the various ecological regions of Guatemala in order to contribute to the knowledge of the mycoflora of Guatemala, and in the hope that, what is reported here, would stimulate other researchers to study the Guatemalan mycological diversity. Generally, mushrooms were gathered and sold by women, often in family groups spanning three generations. The use of macrofungi in Guatemala for human consumption was limited. The relevant information on the traditional knowledge about mushrooms and their uses with notes on edibility were recorded among native Maya people. *Amanita caesarea* and *Cantharellus cibarius* were the most appreciated edible mushrooms. Sporocarps of *Geastrum* and *Lycoperdon* were used as cicatrizing substances to treat burns in children. Similarly, dried specimens of *Lycoperdon marginatum* were used to heal and disinfect wounds, and to cure bee stings. The religious role played by *Amanita muscaria* and *Psilocybe mexicana* were also mentioned (Flores et al., 2012).
- xi. One ethnomycological research was carried and documented for the utilization of macrofungi by six Aeta communities in three selected provinces of Central Luzon, Northern Philippines. Recorded fungal species were used for food, medicine, house decoration, societal ritual material, and beliefs. Twelve macrofungi species were utilized as food (*Auricularia auricula*, *A. polytricha*, *Calvatia* spp., *Lentinus sajor-caju*, *L. tigrinus*, *Pleurotus* spp., *Schizophyllum commune*, *Termitomyces clypeatus*, *T. robustus*, two species of *Termitomyces*, and *Volvariella volvacea*) while *Ganoderma lucidum* and *Mycena* spp. were used as house decoration and medicine, respectively. One

large mushroom species identified only as belonging to the genus *Termitomyces* was believed to be guarded by supernatural beings. The Aeta communities performed their rituals prior to the collection of the mushroom, including tribal dancing, praying, and kissing the ground (Am et al., 2012).

- xii. In another research, folk taxonomy and mushroom use were investigated by the Kurya and Maasai communities around Ngorongoro and Serengeti National Park, Tanzania. Information was collected by face to face interviews with 150 people in 6 selected villages. Based on the data presented in this research, the Kurya was mycophilic with 94% of the respondents recognizing utilization of the wild mushroom either as foodstuff or as tonics while the Maasai was mycophobic with 99% being unaware of the edibility of mushroom although 28% recognized mushrooms as tonic. Mushroom cultivation was widely welcomed (94.7%) as an alternative crop. For both communities, the knowledge of mushroom utilization and folk taxonomy increased with age of the respondents while it decreased with formal education level of the respondents (Tibuhwa, 2012).
- xiii. The information on the species of wild mushrooms from Jammu and Kashmir (India) was limited. In this backdrop, a systematic study of wild mushroom diversity from various locations of Jammu and Kashmir was undertaken in different seasons. Data were collected by the regular semi - structured interviews over an extended period. A total of 66 taxa of wild mushrooms belonging to 33 genera, 22 families, 10 orders, and 3 classes were identified. The identified species and varieties in following genera; *Agaricus* (1), *Amanita* (1), *Astraeus* (1), *Auricularia* (1), *Boletus* (4), *Bovista* (2), *Cantharellus* (2), *Chalciporus* (1), *Clavaria* (1), *Clavulina* (2), *Coprinus* (1), *Flammulina* (1), *Geopora* (2), *Gyromitra* (2), *Helvella* (3), *Lactarius* (1), *Lentinus* (1), *Leucopaxillus* (1), *Lycoperdon* (4), *Macrolepiota* (1), *Morchella* (5), *Otidea* (1), *Peziza* (2), *Pleurotus* (2), *Ramaria* (6), *Rhizopogon* (4), *Russula* (3), *Schizophyllum* (1), *Scleroderma* (1), *Sepultaria* (1), *Sparassis* (2), *Termitomyces* (4), and *Verpa* (1) (Kumar and Sharma, 2011).
- xiv. Another ethnomycological study was in three villages -Czudec, Pstragowa, and Nova Wies- in the southeast Poland. Edible fungi were collected and identified in the region by the locals; also age and gender differences were researched. The gathering of 17 folk taxa of edible fungi (most commonly

Armillaria spp., *Boletus edulis*, *Boletus erythropus*, *Cantharellus cibarius*, *Lactarius salmonicolor*, *Leccinum* spp., *Macrolepiota procera*, *Russula* spp., *Suillus* spp., and *Xerocomus* spp) was recorded. Gender and age differences were small. Collecting mushrooms was mainly for their own use, sometimes for sale (Łuczaj and Nieroda, 2011).

- xv. A study in the forest areas of Gorakhpur was carried out for the distribution, collection and utilization of species of *Termitomyces*. In this way, the traditional knowledge was collected from tribal people and forest dwellers of the area. The survey revealed that species of *Termitomyces* were safe natural source of nutritional food and medicine to overcome the problem of scarcity of healthy and nutraceutical food. Collectors got huge income from sale of *Termitomyces* (Srivastava et al., 2011).
- xvi. Although surveys of macrofungi were reported by different researchers in many other countries, very little information existed about the macrofungi in Qatar (Moubasher, 1993). This determined and provided more data on the hyper off macrofungi and desert truffle species in the harsh environments of Qatar. Fourteen macrofungal genera belonging to 11 families and 7 orders were identified. The lists of the macrofungi in this study provided the baseline data needed for ongoing assessment of changes in biological diversity in Qatar (Al-Thani, 2010).
- xvii. The collection of wild edible Nepalese fungi, which species were used, what were the specific characteristics of the collectors, and the collection itself were investigated in this study. Data were collected using 282 structured questionnaires, interviews and, forest walks in 17 districts, environmental household accounts from 413 households in two communities, and the literature was reviewed. Given the limited local trade and occurrence of globally marketed species, the scope for increasing contributions to rural livelihoods from collection of mushrooms, and risks in relation to this were briefly discussed. Some potential risks in relation to increased commercialization of wild edible mushrooms in Nepal were overexploitation of the resource and the exclusion of the already disadvantaged groups. Avoiding these risks would require, formal strengthening of local rights to the resource and strenghtening or establishment of local level marketing channels (Christensen et al., 2008).

- xviii. More than 200 species of wild edible mushrooms were consumed in Mexico, and over 100 were sold in local, regional, and wholesale markets. This research analyzed general trends in the commercialization of wild edible mushrooms at twelve markets in Central Mexico. It also focused its analysis on the traditional market at Ozumba. More than 100 local names were registered. The greatest diversity of species was recorded in July and August. More than 90% of the wild mushroom vendors were women, and 64% were 40 to 60 years old. The economic value of wild mushrooms in some regions of Mexico appeared to contribute to the maintenance of traditional ethnobiological knowledge (Pérez-Moreno et al., 2008).
- xix. In 2003, ninety five questionnaires were applied to a randomly selected respondents. The cultural significance of wild edible resources was analyzed using as a model which was the Edible Mushroom Cultural Significance to obtain the traditional mycological knowledge of Zapotecs from Oaxaca, Mexico. This index included eight variables: frequency of mention, perceived abundance, use frequency, taste, multifunctional food use, knowledge transmission, health, and economy. In each variable the species had different conducts. *Cantharellus cibarius* was the species with most frequency of mention. *Pleurotus* spp. had the highest perceived abundance. *C. cibarius* was the most frequently consumed species. *Gomphus clavatus* was the most palatable species and with the highest multifunctional food index. *Tricholoma magnivelare* was identified as a health enhancer. According to the compound index, *A. caesarea*, *C. cibarius*, *Neolentinus lepideus*, and *Ramaria* spp. were the mushrooms with highest cultural significance (Garibay-Orijel et al., 2007).
- xx. Edible ectomycorrhizal mushrooms were the most economically important groups among mushroom species and had an important market rate as well. Approximately, half of the total edible mushroom species were belong to ectomycorrhizal groups. However, there was a very limited number of studies on the cultivation of ectomycorrhizal mushrooms and also only a few of them were cultivated succesfully. In this review, methods used in the cultivation of ectomycorrhizal mushrooms and related studies on their cultivation were presented (Pekşen and Kibar, 2007).

- xxi. This study also examined the economics of mushroom marketing as a coping strategy for reducing poverty in Ondo State of Nigeria. Primary data were collected from one hundred randomly selected mushroom marketers. Majority of the marketers (72%) were feminine. There was more awareness among the highly educated about mushroom marketing as many of them engage in selling mushroom as a part-time business venture. Mushroom marketing was profitable with a margin of N73, 459.00 per marketer per mushroom season. This would go a long way to alleviate poverty among the populace. Those who would otherwise remain jobless and in absolute poverty can use it as coping strategy (Oseni, 2007).
- xxii. The results of this ethnomycological research in the markets of a wide area of the Mexican tropics were reported based on by 291 non-structured and semi-structured interviews. The dynamics related to the traditional selling process of wild mushrooms were described and the tendencies of respondents toward mushrooms as mycophily vs. mycophobia were determined. Among their respondents, urban Mestizo people were mycophobic, rural Mestizo people were non-mycophilic, and indigenous people were true mycophilic. In Oaxaca, economic dynamics were not based on capitalism; such as exchange, reciprocity, and barter (Ruan-Soto et al., 2006).
- xxiii. The information on the amounts of *Lactarius deliciosus* collected and sold in Buenavista of Northern Spain was summarized by interviewing all the stakeholders involved in their market chain. Nearly every inhabitant collected saffron milk caps, for which they received an average of 2 €/kg. Average annual income per family in the area was 18.727 €. Collectors sold the gathered mushrooms either to a local middlemen or directly to the buyer (De Román et al., 2006).
- xxiv. A similar study was in the Hindu-Kush Mountains of Swat, Pakistan. Morel collection and marketing were recorded by a questionnaire method. It was found that seven species of genus *Morchella* (*Morchella conica*, *Morchella crassipes*, *Morchella deliciosa*, *Morchella elata*, *Morchella esculenta*, *Morchella rotunda*, and *Morchella semilibera*) were collected in Swat for marketing purposes but sometimes, used as traditional medicine and flavoring agent (Hamayun et al., 2006).

- xxv.** In order to document the indigenous uses of mushrooms among the Bini-speaking people residing in southern Nigeria near Benin City, Aihuobabekun Community was used as a case study. The study showed that 90% of the respondents consumed mushrooms as food, while 21.6% used mushrooms for medicinal purposes. 93% consumed mushrooms because of taste, 90.5% used mushrooms as substitute for meat, 79% used them as soup thickener, 21.6% because of their nutritional qualities. Two fungi species also used in ethnomedicine in the study area were: *Calvatia* spp. for curing barrenness in women and stopping chronic hiccups. *Daldinia concentrica* for curing stomach upset or ulcer, skin diseases, whooping cough and prevention of excessive growth of the foetus for easy delivery (Okhuoya et al., 2005).
- xxvi.** Mushroom picking has been as common among Finns and also been a traditional outdoor activity that brought people close to nature. In this study; participation, the frequency of participation, and the factors that explain who had mushroom picking skills were searched among Finnish people. Age and level of education seemed to have a role in mushroom picking participation. 50% participation rate was found for those aged 45-64 compared to 18% among those aged 15-24. Higher education also was positively related to mushroom picking skills (Sievänen et al., 2004).
- xxvii.** Ethnomycological studies were made on wild mushrooms in Cameroon, Central Africa. Macrofungal biodiversity was rich and mushrooms played important social, economic, and ecological roles in this region but it was poorly explored. Several species, belonging to the genera *Agaricus*, *Auricularia*, *Flammulina*, *Ganoderma*, *Pleurotus*, *Termitomyces*, and *Volvariella* were used as food or in traditional medicine by the indigenous people. *Ganoderma lucidium* was dried and mixed with palm oil to be used as ointment for the treatment of skin diseases in Baligham (Yongabi et al., 2004).
- xxviii.** Major efforts in mushroom cultivation have been focused on technological developments and yields. However, its future would also depend on a thorough understanding of consumer trends worldwide. This was the case of developing countries where the importance of edible mushrooms within consumer preferences and perceptions has not clearly studied yet. Therefore, a study was carried out in order to understand the patterns of mushroom

consumption in Central Mexico, where most wild/cultivated mushrooms were produced and/or marketed. About half (49.4%) of urban consumers bought mushrooms, independently of their social level (fresh or canned: *Agaricus*, *Lentinula*, and *Pleurotus*). There were different factors affecting mushroom quality and price through long channels of distribution. Preferences and perceptions from Mexican consumers depended on the social level (Martinez-Carrera et al., 2004).

- xxix.** Traditional forest related knowledge (TFRK) was an important aspect in sustainable forest management and in understanding the ecology of forest ecosystems. It provided invaluable information on the diversity of organisms within this ecosystem. Of Malaysia's neighbouring countries, Thailand, had relatively more information on the utilization of macrofungi (Chamratpan, 2003) than Indonesia and the Philippines, and little information was available for Malaysia itself. Hence, some of observations on the utilization of macrofungi were discussed in Malaysia. Species of local macrofungi were utilized not only for food, but also as medicine and for spiritual purposes, including discouraging certain undesirable behaviour in children. The observations indicated that some species of *Auricularia*, *Cookeina*, *Cyathus*, *Favolus*, *Lentinus*, *Pleurocybella*, *Schizophyllum*, and *Termitomyces* were consumed as food. Species of *Daldinia*, *Lentinus*, *Lignosus*, and *Pycnoporus* were used to treat various ailments or health related conditions. Whereas a species of *Amauroderma* was used to prevent fits, a species of *Xylaria* was used to stop bed-wetting in children (Chang and Lee, 2004).
- xxx.** This paper described the traditional mycological knowledge in the Nahua community which was the most numerous and widely distributed ethnic group of San Isidro Buensuceso, in the state of Tlaxcala, Mexico. The results described in this paper were obtained through 226 semistructured interviews with villagers selected at random; a free listing technique was used to determine the cultural significance of the mushrooms of the region. A total of 48 species which had 65 Náhuatl names (izquilo, xelhuas etc) and 40 names in Spanish were identified. From a cultural perspective, *Boletus* spp., *Gomphus flocossus*, and *Ramaria* spp. were the most important species of the region (Montoya et al., 2003).

- xxx. In the rain forest of Southern Cameroon, the indigenous knowledge of edible fungi by local populations, related folk taxonomy to scientific nomenclature, assessed mushroom utilization type and rate, harvesting patterns, and factors that affected mushroom usage were investigated. Some 100 participants from the major ethnic groups, comprising Bantu farmers and Bagyeli hunter-gatherers, were interviewed. Mushroom knowledge among both groups was extensive. Over 50 folk names (Abominlo, kulowo, mbondè, ngumbè, sewo, etc) were recorded by respondents. Mushroom usage by 30 families (319 people) was monitored daily for over a year. In their daily meals, mushrooms were prepared in soups of peanut butter, bush mango almonds (*Irvingia gabonensis*), and oil palm fruits (*Elaeis guineensis*). Some mushrooms like Kôndô and Babe (*Termitomyces* spp) and the Biyaé (jelly fungi) were wrapped in leaves of banana trees (*Musa* spp.) before cooking. Collected mushrooms were dried in sunshine such as most *Cantharellus* spp. However, these preservation techniques were seldom used because collected ones were generally prepared fresh for the daily meal. Moreover, some fungi species were used in traditional medicine by Bantu communities. To illustrate, Bikôkô biyôkô (*Lentinus squarrosulus*) was used to heal the newborn baby's navel. Dunda (*Pleurotus tuber-regium*) was used to improve lactation of breast feeding women; its sclerotium may heal heart palpitations. In mushroom harvesting activity; while women and children were the most involved in the Bantu communities, women and men participated equally in Bagyeli communities. Average annual mushroom consumption was low for both groups; 1.4 kg for Bantu and 1.1 kg of fresh mushrooms for Bagyeli, a rate was much lower than in Central and Eastern Africa. During the research, there was little difference in edible fungi consumed by Bantu and Bagyeli people. Most households (more than 90%) consume less than 3 kg of fresh mushrooms per season per year (Dijk et al., 2003).
- xxxii. In this study, commercialization of wild mushrooms was shown during market days of Tlaxcala, Mexico. Three "tianguis" (popular market days) were visited in the study area in order to monitor wild edible fungi being sold, their prices, and seasonal availability, as well as to interview mushroom sellers. A total of 52 species with their 91 popular names were recorded. Their prices varied seasonally in the market of Tlaxcala city. *Agaricus*

campestris, *Amanita caesarea*, and *Boletus pinophilus* showed the highest prices and demand by consumers. *Calvatia cyathiformis* and *Russula delica* were sold at the lowest price (Montoya-Esquivel et al., 2001).

2. AIMS AND SCOPE OF THE STUDY

Reported surveys by different researchers in different communities showed that the mushroom played vital ecological, social, or economical roles. Taking into consideration of likely richness of the macrofungal diversity in the Western Black Sea region of Turkey, and too limited number of ethnomycological studies, a research was considered to be necessary to carry out.

Therefore, the present research aimed to:

- i.** emphasize the importance of mycology in the studied area,
- ii.** investigate the indigenous knowledge of edible mushrooms by local populations,
- iii.** explore the present status of the folk taxonomy knowledge with scientific classification,
- iv.** assess the type of ethnomycological utilizations (dietary, income or therapeutic),
- v.** investigate the trade importance of some naturally grown macrofungi in the Western Black Sea region,
- vi.** provide evidence for the collection and marketing profitably of mushrooms, on local and national scale,
- vii.** describe main marketing channels for wild and cultivated mushrooms,
- viii.** determine the potential income costs associated with mushroom marketing,
- ix.** examine socio-economic characteristics of mushroom marketers,
- x.** introduce mushroom cultivation in the region as an alternative crop,
- xi.** create awareness on mushroom cultivation and marketing,
- xii.** encourage small scale farming in the production of mushrooms,
- xiii.** gain better understanding of the relationship between the fungi, local people and their economy, and
- xiv.** develop baseline data for the present fellow mycologists, biologists and other scientists.

3.2 Ethical Aspects of Research

Though no written or oral permit for ethical issues was needed since no harm on human or animal was anticipated. The official ethics permissions were still searched and obtained orally from the relevant institutions such as municipalities in each province: Bolu, Düzce, Karabük, Zonguldak, Bartın, and Kastamonu before data collection. A meeting was then held with the interviewers, who were a team of ten students selected from Abant İzzet Baysal University, Biology Department in Bolu. After purpose of the study, confidentiality of responses, and descriptive information about the questionnaire etc. were explained to the students, the confirmation was obtained for their participation in the study. Afterwards, the questionnaire was given to each student by the researcher. Totally 550 copies of the questionnaires were handed out to the team, 505 copies returned, of which 475 of them were valid. The ratio of valid questionnaire was 86.36%. The questionnaires were collected after the required time (6 months) ended to have forms to be filled out.

3.3 Materials

3.3.1 Data Collection

The research data were collected based upon both primary and secondary sources between early April of 2012 and late December of 2013.

3.3.1.1 Primary Data Collection

Primary data consisted of both qualitative and quantitative data. All relevant data were collected via such as:

- i.** Semi-structured open ended questionnaires and
- ii.** In depth-interviews.

3.3.1.1.1 Survey Questionnaire and Interviews

Extensive field trips -a total of 70 times- were taken to different local markets particularly during the mushroom gathering seasons from early April of 2012 to late December of 2013 in order to monitor economically significant wild or cultivated edible fungi. Exact market location and names are given with their established days below (Table 3.1).

Table 3.1. Field research in Western Black Sea region

Market Number	Established Day	Market Name	Market Address
1	Monday	<i>Bolu Market</i> <i>Bolu Public Market</i> <i>Grand Market</i> <i>Monday Market</i>	İhsaniye District, Stadium Avenue, Çeşmeli Street, Number 55, CENTRE/BOLU
2	Saturday	<i>Bahçelievler Local Market</i>	Bahçelievler District, Şemsi Ahmet Paşa Avenue, CENTRE /BOLU
3	Thursday	<i>Beşkavaklar Local Market</i>	Beşkavaklar District, İskender Street, CENTRE / BOLU
4	Friday	<i>Karaçayır Market</i>	Karaçayır District, Murat Canbaş Avenue, CENTRE / BOLU
5	Friday	<i>Sağlık District Market</i>	Sağlık District, Yelki Street, CENTRE / BOLU
6	Thursday	<i>Köroğlu Market</i>	Köroğlu District, Aydınlar Street, CENTRE / BOLU

Table 3.1 Field research in Western Black Sea region (cont'd)

7	Saturday	<i>Sümer Covered Local Market</i>	Sümer District, Ayhan Street, CENTRE / BOLU
8	Thursday	<i>Kahıcıkönutlar Local Market</i>	Yaşamkent District, Canip Baysal Street, CENTRE / BOLU
9	Every day	<i>Kadı Mosque Local Products Market</i>	Karaçayır District, CENTRE / BOLU
10	Friday	<i>Cumayeri Market Dörtdivan Municipality's Covered Marketplace</i>	Kadılar District, Hal Street, Number 3, DÖRTDİVAN / BOLU
11	Saturday	<i>Gerede Covered Marketplace</i>	Seviller District, Yeni Hal Street, GEREDE / BOLU
12	Wednesday	<i>Wednesday Market</i>	Mimar Sinan Avenue, New District, GEREDE / BOLU
13	Wednesday	<i>Old Mengen Market Pazarköy Market</i>	Kültür District, Pazarköy Avenue, MENGEN / BOLU
14	Saturday	<i>New Mengen Market Türkbeşli / Türkbeyli Covered Marketplace</i>	Türkbeyli District, Pazarköy Avenue, MENGEN / BOLU
15	Tuesday	<i>Gökçesu Market Tuesday Market</i>	Hürriyet District, Open Market Place Area, MENGEN / BOLU

Table 3.1 Field research in Western Black Sea region (cont'd)

16	Saturday	<i>Mudurnu Local Market</i>	Marketplace Area, MUDURNU / BOLU
17	Thursday	<i>Yeniçağa Market</i>	Sultan Reşat Avenue, Camiatik and Atılbey District, YENİÇAĞA / BOLU
18	Monday Thursday	<i>Düzce Manufacturer's Market</i>	Aziziye District, Öztürk Site, Fixed Market Place, CENTRE / DÜZCE
19	Saturday Sunday	<i>Azmimilli Market</i>	Azmimilli District, CENTRE / DÜZCE
20	Tuesday	<i>Hamidiye Market</i>	Hamidiye District, CENTRE / DÜZCE
21	Saturday Sunday	<i>Kalıcıkönutlar Market</i>	Kalıcıkönutlar, CENTRE / DÜZCE
22	Friday	<i>Friday Market</i>	Osmaniye District, Çuvallı Bazaar, AKÇAKOCA / DÜZCE
23	Tuesday	<i>Hüseyin Yanmaz Covered Marketplace</i>	Osmaniye District, Hüseyin Yanmaz Avenue, AKÇAKOCA / DÜZCE
24	Wednesday Saturday	<i>Soğuksu Covered Marketplace</i>	Cumhuriyet Avenue, CENTRE / ZONGULDAK

Table 3.1 Field research in Western Black Sea region (cont'd)

25	Monday	<i>Devrek Food Market</i>	New District, Halıcı Street, DEVREK / ZONGULDAK
26	Tuesday Friday	<i>Bartın Ladies' Bazaar</i> <i>Friday Market</i> <i>Galla Bazaar</i> <i>Tuesday Market</i>	Kemerköprü District, Davut Fırıncıoğlu Avenue, CENTRE / BARTIN
27	Every day	<i>Hal Blokları Market</i>	Kemerköprü District, Hürriyet Avenue, CENTRE / BARTIN
28	Tuesday Friday	<i>Hendekyanı Local Market</i>	Hendekyanı Avenue, Demirciler District, CENTRE / BARTIN
29	Sunday Thursday	<i>Hürriyet District Local Market</i>	Hürriyet District, CENTRE / BARTIN
30	Tuesday Friday	<i>Kavaklı Avenue Local Market</i>	Kavaklı Avenue, CENTRE / BARTIN
31	Monday	<i>Kemerköprü Local Market</i>	Kemerköprü District, Yukarı Street, CENTRE / BARTIN
32	Saturday	<i>Kaynarca Local Market</i>	Kaynarca Avenue, Orduyeri District, CENTRE/BARTIN
33	Tuesday Friday	<i>Orduyeri District Local Market</i>	Orduyeri District, CENTRE / BARTIN

Table 3.1 Field research in Western Black Sea region (cont'd)

34	Friday	<i>TOKI Local Market</i>	Orduyeri District, CENTRE / BARTIN
35	Tuesday Friday	<i>Amasra Municipality's Covered Marketplace</i>	Kum District, Küçükliman Avenue, AMASRA / BARTIN
36	Friday	<i>Friday Market</i>	Kaldırım District, Old Marketplace Street, ULUS / BARTIN
37	Tuesday	<i>Esentepe Tuesday Market</i>	Esentepe District, Şehit Mehmet Esen Street, CENTRE / KARABÜK
38	Friday	<i>Friday Market</i>	Hürriyet District, Aktaş Avenue, CENTRE / KARABÜK
39	Thursday	<i>Thursday Market</i>	Beşbinevler District, Avenue 36, CENTRE / KARABÜK
40	Sunday	<i>Sunday Local Market</i>	Beşbinevler District, Avenue 33, CENTRE / KARABÜK
41	Tuesday	<i>Şirinevler Tuesday Market</i>	Şirinevler District, Göktürk Avenue, CENTRE / KARABÜK
42	Tuesday	<i>Wednesday Market Yenimahalle Tuesday Market</i>	Etiler Avenue, CENTRE / KARABÜK

Table 3.1 Field research in Western Black Sea region (cont'd)

43	Saturday	<i>Yüzüncü Yıl Market</i>	Yüzüncü Yıl District, Avenue 1003, CENTRE / KARABÜK
44	Monday	<i>Eflani Peasant Market</i>	Candaroğulları District, Şehit Yaşar Semerci Avenue, EFLANI / KARABÜK
45	Tuesday	<i>Tuesday Market</i>	Harmanlar Site, SAFRANBOLU / KARABÜK
46	Thursday	<i>Grand Market</i> <i>New Thursday Market</i>	New District, Ata Street, SAFRANBOLU / KARABÜK
47	Saturday	<i>Old Bazaar Market</i> <i>Old Safranbolu Market</i>	Hanarkası Street, SAFRANBOLU / KARABÜK
48	Saturday	<i>Old Thursday Market</i>	Cumhuriyet Avenue, SAFRANBOLU / KARABÜK
49	Sunday	<i>Sunday Market</i>	Emek District, In front of Yunus Emre Mosque, SAFRANBOLU / KARABÜK

Table 3.1 Field research in Western Black Sea region (cont'd)

50	Tuesday	<i>Tuesday Market</i>	Faruk Nuhoglu Street, Mehmet Akif Ersoy District, CENTRE / KASTAMONU
51	Wednesday Saturday	<i>Centre Covered Marketplace</i>	Topçuoğlu District, CENTRE / KASTAMONU
52	Friday	<i>Olukbaşı Market</i>	Saraçlar District, Behind Stadium, CENTRE / KASTAMONU
53	Sunday	<i>Kuzeykent Covered Marketplace</i>	Kuzeykent District, CENTRE / KASTAMONU
54	Wednesday	<i>Azdavay Public Market</i>	Azdavay Centre District, Industry Bazaar, Tume Homes Area, Covered and Open Market Area, AZDAVAY / KASTAMONU
55	Monday Friday	<i>Cide Covered Marketplace</i>	Marketplace Street, CİDE / KASTAMONU
56	Every evening only for summer days	<i>Beach Marketplace</i>	Coast Square, CİDE / KASTAMONU

Table 3.1 Field research in Western Black Sea region (cont'd)

57	Monday	<i>Küre District Market</i>	Kebir Mosque District, Büyükbahçe Street, KÜRE / KASTAMONU
58	Friday	<i>Friday Market</i>	Centre District, Republic Area, Market Street, ŞENPAZAR / KASTAMONU
59	Tuesday	<i>Tuesday Market</i>	Bahçelievler District, Tuesday Market Site, TAŞKÖPRÜ / KASTAMONU
60	Friday	<i>Covered Friday Market</i>	Karasait District, TAŞKÖPRÜ / KASTAMONU
61	Monday	<i>Tosya Market</i>	Cumhuriyet District, Atatürk Avenue, TOSYA / KASTAMONU
62	Every day	<i>MantarhaneCom - Gökhan KANDEMİR</i>	Yakuplar Village, Ortaköy Locality, CENTRE / BOLU
63	Every day	<i>MantarhaneCom - Gürkan İYİSEVER</i>	Yakuplar Village, Ortaköy Locality, CENTRE / BOLU
64	Every day	<i>In the basement of his house Zeki BOZOĞLU</i>	Çıkınlar District, CENTRE / BOLU

Table 3.1 Field research in Western Black Sea region (cont'd)

65	Every day	<i>In the basement of his house</i> <i>Hasan AYTEKİN</i>	Alpagut District, CENTRE / BOLU
66	Every day	<i>VELİOĞLU - Mushroom</i> <i>Production Facility</i> <i>Şerif Ali VELİOĞLU</i>	Gündolaması Village, CENTRE / DÜZCE
67	Every day	<i>VELİOĞLU's middleman</i> <i>Nail GÜNER</i>	Fevzi Çakmak District, Old Bolu Avenue, Against the prison, CENTRE / DÜZCE
68	Every day	<i>SAFGÜL - Mushroom</i> <i>Production Facility</i> <i>İsmail ÖZTÜRK</i>	Cemaller Village Location, CENTRE / KARABÜK
69	Every day	<i>In Mushroom Production</i> <i>Facility</i> <i>Mustafa KANAT</i>	Emirler Village, CENTRE / KASTAMONU
70	Every day	<i>In Mushroom Production</i> <i>Facility</i> <i>Hasan KARAOSMANOĞLU</i>	Musallar Village, CENTRE / KASTAMONU

The sample size (n) was determined as 475 people assuming sampling error 5% and confidence interval 95%. The participants were interviewed in order to obtain mycological data in 6 provinces (Bolu, Düzce, Karabük, Zonguldak, Bartın, Kastamonu), 6 centers, 17 counties and, 120 villages (

Table 3.3).

These data were collected face to face by means of a semi-structured open ended questionnaire (Giuliani et al., 2009). The original form was tested in a pilot study and modified for the research.

The survey questionnaires were applied to randomly selected (aged 15 and above) people from study sites (Table 3.2). These volunteer respondents assured non-biased answers. The interviewees also informed that the people interviewed were aware that the information they provided would be published.

Table 3.2. The respondents filled the questionnaire

Respondents	No. of Questionnaires (n)	Percentage (%)
BOLU	109	23.0
DÜZCE	80	16.8
KARABÜK	86	18.1
ZONGULDAK	52	10.9
BARTIN	56	11.8
KASTAMONU	92	19.4
TOTAL	475	100.0

Table 3.3. The sites from where data obtained about macrofungi through survey questionnaires during field trips

Number	Province	County	Village
1	BOLU	Centre	Kozlu
2	BOLU	Centre	Mesciler
3	BOLU	Centre	Ömerler
4	BOLU	Centre	Pirahmetler
5	BOLU	Centre	Rüzgârlar
6	BOLU	Centre	Ulumescit
7	BOLU	Centre	Vakıfgeçitveren
8	BOLU	Centre	Yakuplar
9	BOLU	Centre	Yenigeçitveren
10	BOLU	Centre	Yumrukaya
11	BOLU	Dörtdivan	Bünüş
12	BOLU	Dörtdivan	Cemaller
13	BOLU	Dörtdivan	Çalköy
14	BOLU	Dörtdivan	Seyitaliler
15	BOLU	Gerede	Aydınlr
16	BOLU	Gerede	Demirler

17	BOLU	Gerede	İmamlar
18	BOLU	Gerede	Sipahiler
19	BOLU	Gerede	Yukarıovacık
20	BOLU	Mengen	Çubukköy

Table 3.4 The sites from where data obtained about macrofungi through survey questionnaires during field trips (cont'd)

21	BOLU	Mengen	Hacıahmetler
22	BOLU	Mengen	İlyaslar
23	BOLU	Mengen	Kuzgöl
24	BOLU	Mengen	Teberikler
25	BOLU	Mudurnu	Dodurga
26	BOLU	Mudurnu	Gelinözü
27	BOLU	Mudurnu	Hacımusalar
28	BOLU	Mudurnu	Ilıca
29	BOLU	Mudurnu	Örencik
30	BOLU	Mudurnu	Pelitözü
31	BOLU	Mudurnu	Taşcılar
32	BOLU	Yeniçağa	Akıncılar
33	BOLU	Yeniçağa	Çamlık
34	BOLU	Yeniçağa	Eskiçağa
35	BOLU	Yeniçağa	Hamzabey
36	BOLU	Yeniçağa	Sarayköy
37	DÜZCE	Centre	Bahçeköy
38	DÜZCE	Centre	Fındıklıaksu
39	DÜZCE	Centre	Gümüşpınar
40	DÜZCE	Centre	Gündolaması
41	DÜZCE	Centre	Pınarlar
42	DÜZCE	Centre	Samandere
43	DÜZCE	Centre	Taşköprü
44	DÜZCE	Akçakoca	Çayağzı
45	DÜZCE	Akçakoca	Kurugöl
46	DÜZCE	Akçakoca	Yenice
47	DÜZCE	Akçakoca	Yeşilköy
48	KARABÜK	Centre	Aşağıkızılcaören
49	KARABÜK	Centre	Belen
50	KARABÜK	Centre	Cumayanı
51	KARABÜK	Centre	Çerçiler
52	KARABÜK	Centre	Saitler
53	KARABÜK	Centre	Salmanlar
54	KARABÜK	Centre	Ödemiş
55	KARABÜK	Centre	Yukarıkızılcaören
56	KARABÜK	Eflani	Çukurören
57	KARABÜK	Eflani	Güngören
58	KARABÜK	Eflani	Halkevleri
59	KARABÜK	Eflani	Karacapınar
60	KARABÜK	Eflani	Saraycık

61	KARABÜK	Safranbolu	Aşağıçiftlik
62	KARABÜK	Safranbolu	Değirmencik
63	KARABÜK	Safranbolu	Harmancık
64	KARABÜK	Safranbolu	İncekaya
65	KARABÜK	Safranbolu	Karacatepe

Table 3.5 The sites from where data obtained about macrofungi through survey questionnaires during field trips (cont'd)

66	KARABÜK	Safranbolu	Nebioğlu
67	KARABÜK	Safranbolu	Pelitören
68	KARABÜK	Safranbolu	Yukarıçiftlikköy
69	ZONGULDAK	Centre	Alancık
70	ZONGULDAK	Centre	Aşağıçayır
71	ZONGULDAK	Centre	Dereköy
72	ZONGULDAK	Centre	Ebegümeci
73	ZONGULDAK	Devrek	Bakırcılar
74	ZONGULDAK	Devrek	Pelitli
75	ZONGULDAK	Devrek	Pınarönü
76	ZONGULDAK	Devrek	Sipahiler
77	ZONGULDAK	Devrek	Sofular
78	BARTIN	Centre	Akıncılar
79	BARTIN	Centre	Darıören
80	BARTIN	Centre	Gürgenpınarı
81	BARTIN	Centre	Hacıosmanoğlu
82	BARTIN	Centre	Hanyeri
83	BARTIN	Centre	Söğütlü
84	BARTIN	Centre	Uluköy
85	BARTIN	Centre	Uzunöz
86	BARTIN	Amasra	Çakrazşeyhler
87	BARTIN	Amasra	Çanakçılar
88	BARTIN	Amasra	Kazpınarı
89	BARTIN	Amasra	Saraydüzü
90	BARTIN	Ulus	Çubuklu
91	BARTIN	Ulus	Kirazcık
92	BARTIN	Ulus	Uluköy
93	BARTIN	Ulus	Yukarıdere
94	KASTAMONU	Centre	Hamitköy
95	KASTAMONU	Centre	Hatipli
96	KASTAMONU	Centre	İbişler
97	KASTAMONU	Centre	Mescitköy
98	KASTAMONU	Centre	Musallar
99	KASTAMONU	Azdavay	Hıdırlar
100	KASTAMONU	Azdavay	Kozluören
101	KASTAMONU	Azdavay	Söğütpınarı
102	KASTAMONU	Cide	Çataloluk
103	KASTAMONU	Cide	İlyasbey
104	KASTAMONU	Cide	Nanepınarı
105	KASTAMONU	Cide	Öveçler

106	KASTAMONU	Küre	Ersizlerdere
107	KASTAMONU	Küre	Kozköy
108	KASTAMONU	Küre	Topçu
109	KASTAMONU	Şenpazar	Alancık
110	KASTAMONU	Şenpazar	Dereköy

Table 3.6 The sites from where data obtained about macrofungi through survey questionnaires during field trips (cont'd)

111	KASTAMONU	Şenpazar	Gürpelit
112	KASTAMONU	Şenpazar	Salman
113	KASTAMONU	Şenpazar	Uzunyol
114	KASTAMONU	Taşköprü	Akseki
115	KASTAMONU	Taşköprü	Pirahmetli
116	KASTAMONU	Taşköprü	Uzunkavak
117	KASTAMONU	Tosya	Çakırlar
118	KASTAMONU	Tosya	Çukurköy
119	KASTAMONU	Tosya	Ekincik
120	KASTAMONU	Tosya	Zincirlikuyu

These questionnaires (Appendix Table 1) focused on:

- i. Who sells mushrooms, women or men?
- ii. Age of the vendors (Five age groups): Younger than 30, 31 to 40, 41 to 50, 51 to 60, and over 60.
- iii. Household population of the respondents (≤ 2 , 3, 4, 5, ≥ 6)
- iv. The level of education (No formal, primary, adult, secondary or college education)
- v. Employment status of the respondents (civil servant, employed, engineer, entrepreneur, farmer / pastoralist, housewife, and retired)
- vi. Types of wild or cultivated edible mushroom species locals know
- vii. Which edible mushrooms have you collected?
- viii. Which mushroom species have you sold?
- ix. Which mushroom species used but not sold?
- x. The folk name of each mushroom species being sold

- xi.** The habitat of gathered mushrooms
- xii.** Time of occurrence (phenology) of mushrooms
- xiii.** Days picked per season (d)
- xiv.** Duration of typical collection trip (h)
- xv.** Mushroom collected per season (kg)
- xvi.** Number of mushrooms collected by different communities in the studied area
- xvii.** How mushrooms gathered (alone or at least two people)
- xviii.** Usage of gathered mushrooms (food, income or medicine)
- xix.** Learning ways of traditional knowledge about macrofungi
- xx.** Collecting and marketing experience of the respondents in the Western Black Sea region
- xxi.** Field observations for cultivated edible mushrooms
- xxii.** Number of people who mention each species being sold
- xxiii.** Basic marketing channels of wild and cultivated edible mushrooms in the Western Black Sea region - To whom do you sell mushrooms? (Middlemen, local consumers in / outside the community, restaurants or abroad)
- xxiv.** Economic aspects of wild and cultivated edible mushrooms in the studied area
- xxv.** Methods of processing and preservation of mushrooms (freezing, sun drying or salting)
- xxvi.** Therapeutic uses of mushrooms in the traditional pharmacopoeia of the region

3.3.1.1.2 In Depth-Interviews

Only 10 respondents, including 4 men and 6 women (ages 32 to 55 years) from the Western Black Sea region having different working groups (entrepreneurs and farmers) were randomly selected for deep interview. We let them talk freely about their life story related to mushroom production and trading development in their households.

3.3.1.2 Secondary Data Collection

After primary data were collected, they were also evaluated and supported by the following secondary data sources:

- i.** Literature (Review),
- ii.** Newspapers, and
- iii.** Television news.

3.3.1.3 Pilot Study

A pilot study was a fundamental phase of the research process. This preliminary investigation during two months (from early April 2012 to late May 2012) was carried out to pre-test the questionnaire prepared for the study. Therefore, a pilot-community (50 respondents) was chosen in Bolu's grand local markets from where the most wild and cultivated mushroom species reached. Face to face interviews were preferred because this preliminary survey needed to be improved for time use and question clearness. Some interviewees were so old and/or illiterate

respond only to oral questions. In this way, the questionnaire was improved for comprehensibility and applicability of the questions and reorganized accordingly.



Figure 3.2. A team member recording different folk taxa from a respondent during the pilot study

Kadı Mosque Local Products Market, Centre, BOLU, May, 2012

3.4 Methods

3.4.1 Collection, Characterization, and Identification

All fruit bodies of the macrofungal species utilized by Western Black Sea communities collected from their natural habitats (undisturbed forests, meadows, damp places of public gardens, parks, bush fallow, on decayed roots of the dead trees, and under trees) during the rainy seasons for a period of more than one year

(From April 2012 to December 2013) and taken to the local markets in baskets or buckets for selling, were obtained from rural gatherers and recorded in field book. At last, the samples were bought and taken to the laboratory for detailed taxonomic and identification studies.

In the first stage; Watling's method was the most appropriate ones to obtain spore prints. This method was applied as follows: A cap of mature mushroom was cut. A slide or petri dish was put under hymenium layers and spore prints were obtained after waiting one night. In this way, a color catalog (Watling, 1973) were used to determine the color of the spore prints for identification of a family or genus of the mushrooms. This process was done in the laboratory as soon as we had returned from fieldwork.

While chemical reagents were used as aniline blue, concentrated sulfuric acid, Melzer's reagent, and ammonium hydroxide in the microscopic studies; sodium hydroxide, potassium hydroxide, nitric acid, aniline, and sulfovanilin for the macroscopic studies. When these reagents were applied to samples, it was determined whether entered into a reaction or a color change. While aniline, nitric acid, and concentrated sulfuric acid were directly used, methods used in the preparation of other reagents were taken from Largent (1986). It has been summarized below.

NaOH: 10 grams of sodium hydroxide were prepared by dissolving in 90 ml distilled water.

KOH: 3 grams of potassium hydroxide were prepared by dissolving in 97 ml distilled water.

Sulfo-vanilin: This reagent was obtained by 5 grams of pure vaniline, 2 ml of distilled water, and 4 ml of concentrated sulfuric acid mixtures. It was used to distinguish *Russula* spp.

NH₄OH: 10 grams of ammonium hydroxide were obtained by dissolving in 90 ml distilled water. This solution had been used to examine mushroom sections and spores under a microscope.

Melzer's Reagent: 1.5 grams of iodine, 5 g of potassium iodide, and 100 g of chloral hydrate were dissolved in 100 ml distilled water. The resulting mixture was prepared by slightly heating. This reagent was applied to basidiospores. Moreover, it was used to distinguish family, genus, and species each other. If the reaction is positive; it is called "amyloid spore" and spores were stained to bluish-black. If the spores were stained reddish-brown, it is called as "deksrinoid (pseudo-amyloid) spores". If there is no color change, reaction is a negative and it is called "inamyloid spores".

Aniline Blue: First, 0.5 grams of aniline blue were dissolved in 49 ml of distilled water. This solution was prepared with 100 grams of lactic acid, 100 g of phenol, and 150 ml glycerine by mixing in 50 ml distilled water.

This reagent was applied to basidiospores. It was not observed any change in some spores and some changed to blue. Whereas blue spores were referred to "syanoofilik", others were "nonsyanoofilik".

Aniline and Nitric Acid: It was used to distinguish between *Agaricus* spp. Aniline was applied in line to cap and nitric acid was applied as (+) sign. According to Capelli (1984), this reaction was known as "Schaeffer Reaction". If the orange color was formed, it would be SR(+); if it was not formed, it would be SR(-).

That is to say, macroscopic, microscopic investigations, and also micro-chemical reactions were applied on the samples collected.

Unknown mushroom material was also identified by comparison with properly pre-identified herbarium specimens and with the appropriate related taxonomic literature (Bas et al., 1988-1999; Breitenbach and Kranzlin, 1984-2000; Calogne, 1998; Canon and Kirk, 2007; Ellis and Ellis, 1990; Hansen and Knudsen, 1992-2000; Heilmann-Clausen et al., 1998; Index Fungorum (www.speciesfungorum.org: accessed 20 April 2014), Kirk et al., 2008; Kranzlin, 2005; Moser, 1983).

Fifty grams of crystal thymol were placed to whole dried mushroom samples in order to protect the internal and external parasites attack which may occurs in the future and they were waited at 50 °C for 3 hours. Thus, evaporating thymol provided

protection from pests by entering into the mushroom tissue. Voucher specimens were deposited at the Herbarium of Ankara University with accession numbers and some duplicates were preserved in Abant Izzet Baysal University, Biology Department, Plant Genetics Laboratory, Bolu, TURKEY.

3.4.2 Data Analysis

3.4.2.1 Qualitative Analysis

The materials gained from the investigations and semi-structured interviews were used for qualitative study. After collecting these data, the information was synthesized immediately for checking and controlling the data. All results were arranged into files. In this way, all data from each tool could be listed. Additionally, all information was interpreted regarding to our research questions and preliminary conclusion could be drawn.

3.4.2.2 Quantitative Analysis (SPSS and Excel)

Analysis of data was conducted using a Statistical Package for the Social Sciences (SPSS) Software Program Version 16.0. Each question in the questionnaire was coded and loaded into the files immediately after interviews. After that all variables were also loaded into the spreadsheet table of SPSS for analyzing. The data for socio-demographic profiles of the respondents in the Western Black Sea region and knowledge on the actual use were analysed descriptively by frequency, percentage, mean, and standard error. The charts for some results were constructed in the Excel spreadsheet program.

4. RESULTS AND DISCUSSIONS

4.1 Wild Edible Mushroom Collection and Folk Taxonomy in the Western Black Sea

People, who collect and sell macrofungi species are called "mushroomers (mantarcı)" in the area. These mushroomers usually use simple tools such as basket or bucket and a knife for mushroom collecting activity.

The survey of ours revealed that 97.89% of the respondents collected mushrooms in fresh form directly from field or close by home forests. The collecting started early in the morning and lasts until the afternoon. Gatherers, one or at least two, walked 5-10 km for their favorite sites (55.4%), but 44.6%, on the other hand, paid fares to travel in private vehicles in order to reach more farther forested areas where a better collection was perceived ($p < 0.05$).

During mushroom collection, levels of activity could differ from one collector to another. The amount of time ranged from 4 to 10 hours per day with an average of 5.45 ± 1.29 in the forest. In a season, a family could gather 120.55 ± 23.50 (kg) of mushrooms. A recent investigation (Montoya et al., 2008) concurred with this information. Our study indicated that Western Black Sea community appreciated greatly collecting wild mushrooms. Extra income appeared to be main motivation. Characteristics of mushroom collection activity were analysed (Table 4.1).

Table 4.1. Characteristics of mushroom collection activity (Mean $\pm$ SD)

Mushroom Collection Activity (n = 465)		
	Mean	SD
Days picked per season (d)	29.44	7.02
Duration of typical collection trip (h)	5.45	1.29
Mushroom collected per season (kg)	120.55	23.50

Mushrooms were highly valued by all respondents for several reasons. The results demonstrated that the respondents collected different types of mushrooms mainly for food (55.4%), income (43.8%) and rarely for medicine (0.8%) (1.45±0.52) (Figure 4.1). Similar kinds of studies have been conducted by some other researchers from other countries yet (Quiñónez-Martínez et al., 2014; Musa et al., 2013; Hamayun et al., 2006).

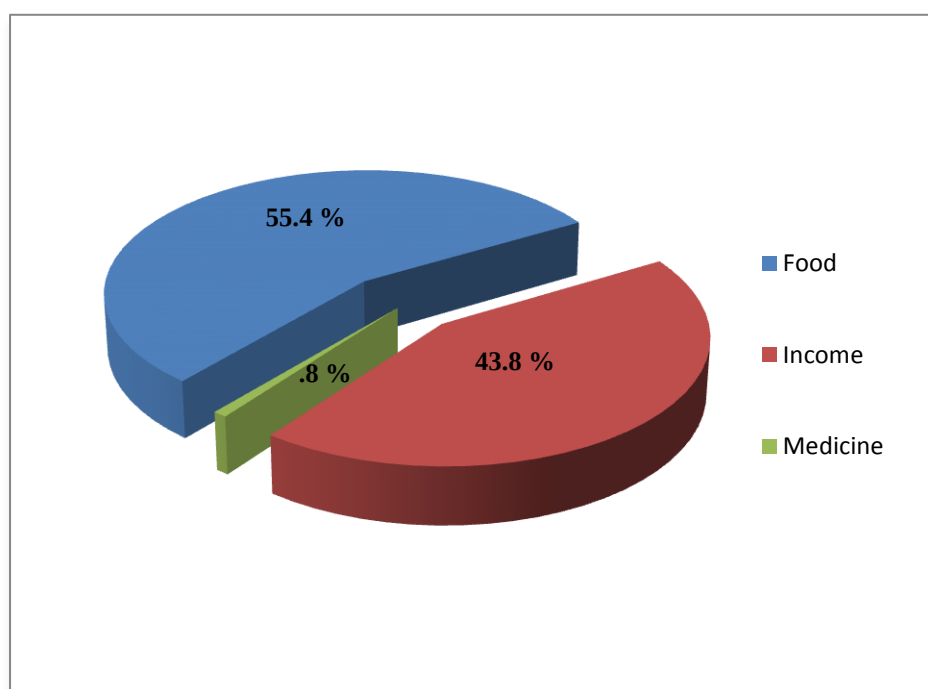


Figure 4.1. Categories of mushroom utilization in Western Black Sea

The rural gatherers from Western Black Sea successfully collected wild edible mushrooms for several reasons. These were:

- i. Unrestricted access to the Western Black Sea forests and grasslands,
- ii. No expenditure for mushroom collection,
- iii. Direct economic benefits generated from the sale of collected mushrooms, and
- iv. Several social and cultural benefits between families and market place.

The challenges mushroom collectors faced during the collection forced them. Rough field conditions (58.2%) and wild animals (41.8%) were also serious threat to the most of women, men, and children during mushroom collection.

Based on the study's findings, majority of the wild mushroom collectors interviewed (73.5%) possessed over 20 years of experience. 20.2% of the respondents had a period of 15-20 years. 5.2% between 10 and 15 years while just 1.1% had 5 to 10 years (25.4 ± 1.55 ; $n=465$), (Table 4.2). It seemed that they had a long tradition for the collecting and consuming mushrooms. The findings here were supported by other studies, too (Quiñónez-Martínez et al., 2014; De Román and Boa, 2006).

Table 4.2. Mushroom collecting experience in Western Black Sea (years)

Years of Experience	Frequency (n)	Percentage (%)
5 - 10	4	1.1
10 - 15	19	5.2
15 - 20	97	20.2
> 20	345	73.5
TOTAL	465	100.0

Sixty-seven percent of those respondents obtained traditional knowledge of macrofungi from their grandparents, 16.0% from their parents, 8.2% from their neighbours, 6.9% from their friends and 1.7% with their own experience (1.60 ± 1.01 ; $n=475$), (Figure 4.2). As seen, learning began at earlier ages. A large part of the knowledge was transmitted from generation to generation via families. This observation was in concordance with a study by Łuczaj and Nieroda, (2011) who demonstrated that "fathers were the most frequently mentioned first teachers in teaching children about mushrooms" (p.319).

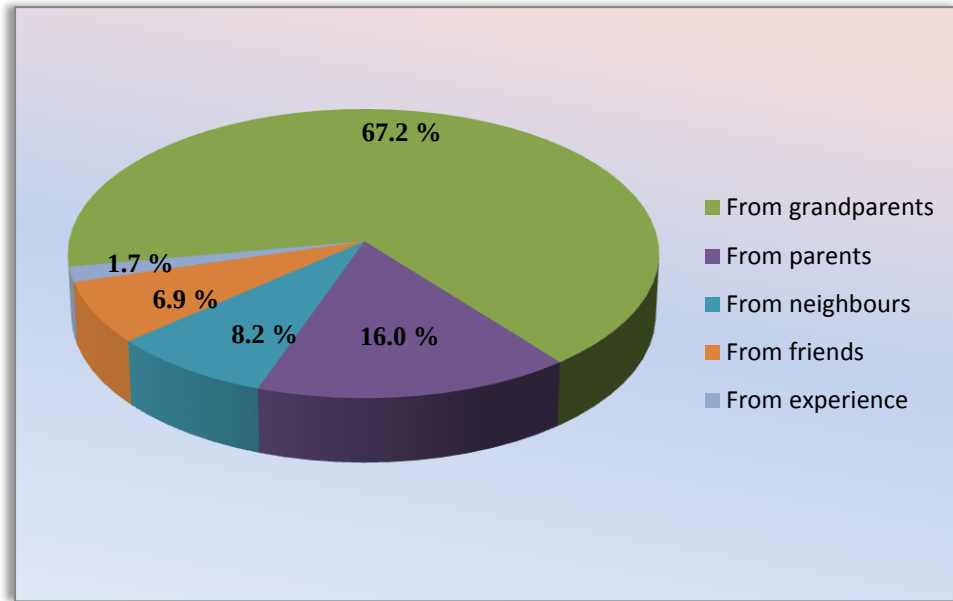


Figure 4.2. Learning ways of traditional knowledge about macrofungi in Western Black Sea region

The survey also indicated that Bolu, Düzce, Karabük, and Kastamonu collected a wider range of mushrooms. Some field observations about wild edible mushroom collection were shown (Figure 4.3). Gathering was common in these communities because of the total number of species collected (Table 4.3). Bartın and Zonguldak were generally less interested in the collecting activity. A similar research (Christensen et al., 2008) concurred with this information.

Table 4.3. Number of mushrooms collected in different provinces in the Western Black Sea region

Provinces	n	1-2 species (%)	3-5 species (%)	More than 6 species (%)
BOLU	109	8	41	51
DÜZCE	80	31	54	15
KARABÜK	86	16	54	30
ZONGULDAK	52	58	27	15
BARTIN	56	61	32	7
KASTAMONU	92	7	38	55
TOTAL	475			



Figure 4.3. Field observations of wild edible mushroom collection

A) Baskets in their hands. Mushroom gathering time now! (Mudurnu, Bolu; April, 2012)

B) Foraging for wild mushrooms is seasonal and part time activity (Küre, Kastamonu; May, 2013).

C) Collectors ready to return homes after rich mushroom gathering from the forests (Ilgaz, Kastamonu; September, 2012).

D) Fresh mixed species of "Ayı mantarı" *Boletus edulis* and "Borazan mantarı" *Craterellus cornucopioides* (Ilgaz, Kastamonu; September, 2012).

To date, a comparison of the few ethnomycological studies have showed that each had its own focus, but there were also some commonality; they all addressed both folk taxonomy, where and when mushrooms grow (Nwordu et al., 2013; Dijk et al., 2003). It was apparent from our results that extensive folk nomenclature for mushrooms was in practiced in the study area. Overall, thirty three edible fungi species (2 cultivated, 31 wild) with their Turkish folk names (169) and common names (58) were obtained within 2 years (Table 4.4). Commonly used folk names of the species referred mostly to their similarity with common objects "Civciv Bacağı", "Mıh Başı", "Saçaklı", and "Şemsiye" (Figure 4.4), to particular places or substrates where fungal species grow "Çayır Mantarı", "Fındık Kırmiti", and "Küner Kanlıcası", or to their colour "Mavi Cincile" (Figure 4.5) and "Fesleğen" (Figure 4.6).

In addition, most of the species existed in the same family were named by a single folk name in the Western Black Sea region. To illustrate, "*Kuzu Göbeği*" described mushrooms in family of *Morchellaceae* like *Morchella conica*, *Morchella deliciosa*, *Morchella elata*, and *Morchella esculenta* (Table 4.5). Many such significant contributions for folk classification of the macrofungi have been reported for the first time in the studied area.



Figure 4.4. *Macrolepiota procera*

A) Mushrooming - Indeed, it was look like an *umbrella* so much!

B) Surprised, cute little girl gathering *Macrolepiota procera* with her mother in Bolu Mountains, Turkey (September, 2013).



Figure 4.5. The basket full of "Mavi cincile" or "Mor cincile", popular Turkish folk names for *Lepista nuda* in the Western Black Sea region (Abant, Bolu, September, 2013)



Figure 4.6. *Boletus edulis*- called "fesleğen" because of its color in some villages of Western Black Sea region (Gerede, Bolu; June, 2012)

Table 4.4. Common macrofungal species reported, consumed, produced and sold in various local markets in the Western Black Sea Region

No	Type	Turkish Folk name	Common name	Scientific name
1	Cultivated	Beyaz Şapkalı Kültür Mantarı	Button Mushroom Champignon Common Mushroom Table Mushroom White Mushroom	<i>Agaricus bisporus</i> (J.E. Lange) Imbach
2	Wild	Ak mantar Çayır Çimen İçi kızıl	Ghost Ears Field Mushroom Meadow Mushroom	<i>Agaricus campestris</i> L.
3	Wild	Döbelen Mürekkep Söbelek Söbelem Söbelen Pösteki	Lawyer's Wig Shaggy Ink Cap Shaggy Man	<i>Coprinus comatus</i> (O.F. Müll.) Pers.
4	Wild	Dede Dedebelik Dedebölkü Dedebölük Dedebör Dedebört Dedebörtü Dedebörük Dede Guli Dedemen Kadın Memesi Şalvarlı Şemsiye Turna Bacağı	Parasol Mushroom	<i>Macrolepiota procera</i> (Scop.) Singer

Table 4.4 Common macrofungal species reported, consumed, produced and sold in various local markets in the Western Black Sea Region (cont'd)

5	Wild	Altın Yumurta Duvaklıca Gelin Gelincik Geyik Göbeği İmparator Padişah Sarı Göbelek Yumurta Mantarı Yumurta Sarısı	Caesar's Mushroom	<i>Amanita caesarea</i> (Scop.)
6	Wild	Ayıca	Bay bolete	<i>Boletus badius</i> (Fr.) Fr.
7	Wild	Ayı Ayıboku Ayköşkü Bolet Çörek Fesleğen Feslek Feslik Pestik	Cep King Bolete Penny Bun Porcini Porcino	<i>Boletus edulis</i> Bull.
8	Wild	Balkadın Cüce Kız Hakiki Horoz Horoz İbiği Horoz Mantarı Kaz Ayağı Meşe Kızılı Meşe Mantarı Sarı Kız Tavuk Ayağı Tavuk Bacağı Tavuk Kirmiti Tavuk Mantarı	Girolle Golden Chanterelle	<i>Cantharellus cibarius</i> Fr.

Table 4.4 Common macrofungal species reported, consumed, produced and sold in various local markets in the Western Black Sea Region (cont'd)

9	Wild	Borazan	Black Trumpet	<i>Craterellus</i>
		Huni	Horn of Plenty	<i>cornucopioides</i>
		Hunihoroz		(L.) Pers.
10	Wild	Civciv Ayağı	Trumpet Chanterelle	<i>Craterellus</i>
		Civciv Bacağı	Yellowlegs	<i>tubaeformis</i> (Fr.) Quél.
11	Wild	Enişte	Cauliflower Coral	<i>Ramaria botrytis</i>
		Erişte		(Pers.) Ricken
		Gelin Teli		
		Gelin Tırnağı		
		Halı Saçağı		
		Keçi Sakalı		
		Kedi Tırnağı		
		Saçaklı Mantar		
		Sakallı Saçak		
		Tellice		
		Teltel		
		Telteli		
		Tiltıl		
12	Wild	Tellice	Coral Fungi	<i>Ramaria flava</i>
		Hanımeli		(Schaeff.) Quél
13	Wild	Çam Kabara	Brown Slimecap	<i>Chroogomphus rutilus</i>
		Geyik Mantarı	Copper Spike	(Schaeff.) O.K. Mill.
		Geyiksütü		
14	Wild	Dede Sakalı	Coral Tooth	<i>Hericium coralloides</i>
		Mercan Mantarı		(Scop.) Pers.
		Sakal Mantarı		
		Tellice		
15	Wild	Sığır Dili	Hedgehog Mushroom	<i>Hydnum repandum</i> L.
			Sweet Tooth	
			Wood Hedgehog	
16	Wild	Cincile	St. George's Mushroom	<i>Calocybe gambosa</i>
		Kokarca		(Fr.) Donk

Table 4.4 Common macrofungal species reported, consumed, produced and sold in various local markets in the Western Black Sea Region (cont'd)

17	Wild	Cincile	Fairy Ring Champignon	<i>Marasmius oreades</i> (Bolton) Fr.
		Mih Başı	Fairy Ring Mushroom	
		Mihdepesi		
		Mihlıca		
		Mih Mantarı		
		Mih Tepesi		
		Mık Tepe		
18	Wild	Kuzu Göbeği	Black Morel	<i>Morchella conica</i> Krombh.
		Kuzu Kulağı		
		Kuzu Mantarı		
19	Wild	Kuzu Göbeği	White Morel	<i>Morchella deliciosa</i> Fr.
20	Wild	Kuzu Göbeği	Black Morel	<i>Morchella elata</i> Fr.
			Fire Morel	
			Morel	
21	Wild	Göbelek	Common Morel	<i>Morchella esculenta</i> (L.) Pers.
		Göbelen	Sponge Morel	
		Höbelen	True Morel	
		Kuzu Göbeği	Yellow Morel	
22	Wild	Kuzu Göbeği	Morel	<i>Morchella esculenta</i> var. rotunda
23	Cultivated	İstiridye	Oyster Mushroom	<i>Pleurotus ostreatus</i> (Jacq.) P. Kumm.
		Karakulak		
		Kavak		
		Kaya		
		Kayın		
		Kültür Mantarı		
		Kütük Mantarı		
		Midye		
		Yaprak		

Table 4.4 Common macrofungal species reported, consumed, produced and sold in various local markets in the Western Black Sea Region (cont'd)

24	Wild	Çam Kanlıcası	Red Pine Mushroom	<i>Lactarius deliciosus</i> (L.) Gray
		Çam Mantarı	Saffron Milk Cap	
		Çıntar	Spruce Milk Cap	
		Kanlıca		
		Kara Kanlıca		
25	Wild	Melki		<i>Lactarius glyciosmus</i> (Fr.) Fr.
		Ebişek	Coconut Scented Milk	
		Eliceek	Cap	
		Fındık Kırmiti		
26	Wild	Fındık Mantarı		<i>Lactarius piperatus</i> (L.) Pers.
		Acı	Peppery Milk Cap	
		Acılı		
		Ak Kanlıca		
		Ak Mantar		
		Ak Melki		
		Beyaz Dağ		
		Kırmiti		
		Beyaz Mantar		
		Biberli		
		Biberlice		
		Deliibram		
		Hacı Mantar		
		Kıtirik		
		Kırmit		
		Koç		
		Koçak		
		Sütlüce		
		Sütlü koç		

Table 4.4 Common macrofungal species reported, consumed, produced and sold in various local markets in the Western Black Sea Region (cont'd)

27	Wild	Al Kanlıca	Saffron Milk Cap	<i>Lactarius</i>
		Çıntar		<i>salmonicolor</i>
		Kanlıca		R. Heim & Leclair
		Köknar Mantarı		
		Küner Kanlıcası		
28	Wild	Melki		
		Geyik Kiriti	Weeping Milk Cap-	<i>Lactarius volemus</i>
		Geyik Mantarı	voluminous - latex	(Fr.) Fr.
		Geyiksırası	milky	
		Geyik Sütü		
		Kiriti		
		Sütliyen		
		Timrit		
29	Wild	Tirit		
		Kayışkırın	Blue Band Brittle-gill	<i>Russula chloroides</i>
30	Wild			(Krombh.) Bres.
		Akçıntar	Milk - White Brittle-gill	<i>Russula delica</i> Fr.
		Ak Mantar		
		Güz Kiriti		
		Sütsüz Mantar		
33	Wild	Karaböcü	Dirty Tricholoma	<i>Tricholoma terreum</i>
		Karaca	Grey Knight	(Schaeff.) P. Kumm.
		Karacakulak		
		Karacaoğlan		
		Karagöce		
		Karagörece		
		Karakız		
		Karakulak		
		Karaoğlan		
		Kız		

4.2 Overview of Sample Profile

Out of those respondents eagerly answered the survey questions, 63.6% was female (n=302) and 36.4% was male (n=173), (Table 4.5). As seen, the woman was mostly interested in mushroom marketing than man. This finding concurs with the other researchers (Chelela et al., 2014; Garibay-Orijel et al., 2012; Pérez-Moreno et al., 2008; Oseni, 2007). In many parts of the world, we can conclude that every stage of mushroom activities from collection to processing and to marketing are by woman.

The most of the respondents, about 50.9%, were between 31 and 50 years old (51.54 ± 0.48); (Table 4.5). It was followed by 51 to 60 (29.5%), and by 60 and over group (16.2%). The age of 3.4% was below 30. The respondents' ages ranged from 13 to 84 years old. From this point, it was clear that wild or cultivated mushroom resources provided likely labor force for all age groups especially for middle and/or old people in the Western Black Sea region. This was parallel with the report of Sievänen et al., (2004) in Finland. The older and experienced people collected more mushrooms than younger people.

As to the household population, of the frequency a family with four members was 33.7% and a family with five members was 31.2% (Table 4.5). Similarly, the families with six and above members were 18.1%, three were 14.5%, and two and below were 2.5%. The total number of households in the survey was 2568. It might have indicated that macrofungi business were good source of income for crowded families.

The 60.2% of people in the study had an education degree of primary school. 14.5% completed middle schools and 10.1% secondary or high schools (Table 4.5). Whereas 2.1% of the respondents attained colleges, and 13.1% was illiterate. Consistently with the finding of a study (Çelik and Peker, 2009), mushroom collection or cultivation were managed by people who were less lucky in the rural areas. 13.1% of illiterate people got their mycological knowledge through practice over the years from older generations.

As employment status, of the 475 respondents, 36.2% were farmers, 27.6% were housewives, 25.5% employed, 9.3% retired, and the rest 1.4% was professionals such as agricultural engineers or entrepreneurs (Table 4.5). Based on these results, it was crystal that this macrofungi business provided an additional income for all people involved.

Table 4.5. Demographic characteristics of the surveyed sample living in the Western Black Sea (n=475)

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	173	36.4
Female	302	63.6
1.62±0.36		
Age		
< 30	16	3.4
31-40	76	16.0
41-50	166	34.9
51-60	140	29.5
> 60	77	16.2
51.54±0.48		
Household Population		
≤ 2	12	2.5
3	69	14.5
4	160	33.7
5	148	31.2
≥ 6	86	18.1
4.78±0.21		
Level of Education		
No formal education	62	13.1
Primary education	286	60.2
Middle education	69	14.5
Secondary education	48	10.1
College education	10	2.1
Employment Status		
Employed	121	25.5
Engineer	3	0.6
Entrepreneur	4	0.8
Farmer/pastoralist	172	36.2
Housewife	131	27.6
Retired	44	9.3
TOTAL	475	100.0

4.3 Identification and Classification of Macrofungi Species

Based on survey questionnaires, interviews, and laboratory studies, from early April of 2012 to late November of 2013, a total of 33 taxa belonging to 4 classes (Agaricomycetes, Basidiomycetes, Homobasidiomycetes, and Pezizomycetes), 6 orders (Agaricales, Boletales, Cantharellales, Gomphales, Pezizales, and Russulales), 14 families (Agaricaceae, Amanitaceae, Boletaceae, Cantharellaceae, Gomphaceae, Gomphidiaceae, Hericiaceae, Hydnaceae, Lyophyllaceae, Marasmiaceae, Morchellaceae, Pleurotaceae, Russulaceae, and Tricholomataceae) and 20 genera; comprising *Lactarius* (5), *Morchella* (5), *Agaricus* (2), *Boletus* (2), *Craterellus* (2), *Ramaria* (2), *Russula* (2), *Amanita* (1), *Calocybe* (1), *Cantharellus* (1), *Chroogomphus* (1), *Clitocybe* (1), *Coprinus* (1), *Hericium* (1), *Hydnum* (1), *Lepista* (1), *Macrolepiota* (1), *Marasmius* (1), *Pleurotus* (1), and *Tricholoma* (1) were identified, respectively. Five taxa belong to *Ascomycota* and 28 to *Basidiomycota*. They were systematically listed below in alphabetical order.

Domain: Eukarya

Kingdom: Fungi

Division: *Ascomycota* Caval.-Sm.

Ordo: *Pezizales* J. Schröt.

Family: *Morchellaceae* Rchb.

Morchella conica Krombh.

Morchella deliciosa Fr.

Morchella elata Fr.

Morchella esculenta (L.) Pers.

Morchella esculenta var. *rotunda*

Division: *Basidiomycota* Whittaker ex Moore

Ordo: *Agaricales* Underw.

Family: *Agaricaceae* Chevall.

Agaricus bisporus (J.E. Lange) Imbach

Agaricus campestris L.

Coprinus comatus (O.F. Müll.) Pers.

Macrolepiota procera (Scop.) Singer

Family: *Amanitaceae* R. Heim ex Pouzar

Amanita caesarea (Scop.) Pers.

Family: *Lyophyllaceae* Jülich

Calocybe gambosa (Fr.) Donk

Family: *Marasmiaceae* Roze ex Kühner

Marasmius oreades (Bolton) Fr.

Family: *Pleurotaceae* Kühner

Pleurotus ostreatus (Jacq.) P. Kumm.

Family: *Tricholomataceae* R. Heim ex Pouzar

Clitocybe geotropa (Bull.:Fr.) Quel.

Lepista nuda (Bull.) Cooke

Tricholoma terreum (Schaeff.) P. Kumm.

Ordo: *Boletales* E.-J. Gilbert

Family: *Boletaceae* Chevall.

Boletus badius (Fr.) Fr.

Boletus edulis Bull.

Family: *Gomphidiaceae* Maire ex Jülich

Chroogomphus rutilus (Schaeff.) O.K.Mill.

Ordo: *Cantharellales* Gäum.

Family: *Cantharellaceae* J. Schröt.

Cantharellus cibarius Fr.

Craterellus cornucopioides (L.) Pers.

Craterellus tubaeformis (Fr.) Quél.

Ordo: *Gomphales* Jülich

Family: *Gomphaceae* Donk

Ramaria botrytis (Pers.) Ricken

Ramaria flava (Schaeff.) Quél.

Family: *Hericiaceae* Donk

Heridium coralloides (Scop.) Pers.

Family: *Hydnaceae* Chevall.

Hydnum repandum L.

Ordo: *Russulales* Kreisel ex P.M. Kirk, P.F. Cannon and J.C. David

Family: *Russulaceae* Lotsy

Lactarius deliciosus (L.) Gray

Lactarius glyciosmus (Fr.) Fr.

Lactarius piperatus (L.) Pers.

Lactarius salmonicolor R. Heim and Leclair

Lactarius volemus (Fr.) Fr.

Russula chloroides (Krombh.) Bres.

Russula delica Fr.

4.4 Mushroom Cultivation Technology in the Area

Out of the respondents 2.11% produced their mushrooms in own small scale places, basements, or modern production facilities (Figure 4.7). Velioğlu Facility, on the other hand, produced 80.0% of the market of Western Black Sea. In depth-interviews, Şerif Ali Velioğlu, the founder of Velioğlu Mushroom Production Facility named two basic categories of cultivated mushrooms in the region.

- i. *Agaricus bisporus* (Button mushroom), which preferred composted materials and
- ii. *Pleurotus ostreatus* (Oyster mushroom), which preferred straw or sawdust.

Agaricus spp. and *Pleurotus* spp. efficiently utilized their substrates. They were able to fruit on a single component substrate rapidly while tolerating high carbon dioxide levels and producing abundant crops within a short time period. Hence, they were usually ideal for small scale cultivation in the area.



Figure 4.7. Overview of Indoor Trays of Technology

- A)** Mushroom production tents (MantarhaneCom, Centre, Bolu; March, 2013)
- B)** Velioğlu's middleman - Bag production system - *Agaricus bisporus* cultivation cottage (Centre, Düzce, October; 2012).
- C)** Special production rooms for cultivating mushrooms (Safgül Mushroom Production Facility, Centre, Karabük; November, 2012).
- D)** *Pleurotus* spp., the Oyster mushroom growing in cultivation (MantarhaneCom, Centre, Bolu; February, 2013).
- E)** Safgül Mushroom Production Facility (Centre, Karabük; November, 2012).

There were six steps to mushroom cultivation in the area studied. They were composting, spawning, casing, pinning, cropping, and packaging (Figure 4.8 and Figure 4.9).



Figure 4.8. Overview of *Agaricus* spp. Production System - Velioğlu Mushroom Production Facility - I

Centre, Düzce; November, 2012

A) After composting, the stage of spawning

B) Casing for *Agaricus bisporus*

C) Pinning - Mushrooms farming and maturing on the casing

D) Pinning - Both pins and young mushrooms are visible.



Figure 4.9. Overview of *Agaricus* spp. Production System - Velioğlu Mushroom Production Facility - II

Centre, Düzce; November, 2012

E. Cropping of mushrooms - Each mushroom was hand harvested, the base of the mushroom was trimmed by the worker.

F. Clean, mature *Agaricus* spp. were placed in baskets for packaging.

G. Mushrooms were placed on foam plates and weighed by balance as 400 grams.

H. Post-crop mushroom compost being loaded onto a tractor as it was removed from Velioğlu Production Facility.

Moreover, most mushroom producers harvested their mushrooms for 40 to 45 days. This cycle can repeat a few times.

Not all mushroom producers received any training for cultivation techniques. They learned the business by trial and error following routine cultivation methods on the internet. 60.0% of the respondents had 2 years and less experience in mushroom cultivation, 30.0% had 3-5 years experience in marketing of mushroom, 10.0% between 6 and 8 years of experience. By comparison with collection process, mushroom production system in the region was apparently too recent and still at its infancy. Marketing experience of the respondents was shown in Table 4.6, in detail. Entrepreneurs (40.0%) and farmers (60.0%) were also actively involved in mushroom production for extra income.

Table 4.6. Marketing experience of respondents

Experience	Frequency (n)	Percentage (%)
0 - 2	6	60.0
3 - 5	3	30.0
6 - 8	1	10.0
TOTAL	10	100.0

4.5 Economic Aspects of Cultivated Mushrooms in the Western Black Sea Region

Cultivated *Agaricus* spp. (deep-frozen) and *Pleurotus* spp. (fresh and deep-frozen) were usually available in public markets or supermarkets. Soups, pizzas and, salads were prepared with these mushrooms.

Consumer prices of *Agaricus* spp. were generally higher than *Pleurotus* spp (Table 4.10).

Average yearly harvests of *Agaricus* spp. were 10 - 15 tons. The observed market price ranged from 10 - 15 ₺ per a kg. As a result, a producer could earn about 100.000 - 150.000 ₺ per a year. The average harvests of *Pleurotus* spp., on the other hand, were 750 to 800 kg per a year. The total income generated range from 6.000 - 8.000 ₺ for a year with the average market price of 8 - 10 ₺ per a kg.

In general, cultivated mushroom yields decreased during autumn and spring, when wild mushrooms appeared. In addition to this, mushroom's cultivation was new and limited in the region but it still made more profit to mushroom producers.

4.6 Habitats of Macrofungi Collected in the Western Black Sea

Peasants knew the exact places where mushrooms grow. The survey responses indicated that habitats of the macrofungi collected were classified into 3 main groups: 78.8% in the forest [pine (63.6%), fir (6.1%), oak (6.1%), and birch (3.0%)], 15.1% outside of the forest [plains and meadows (9.1%) and road sides (6.0%)], and 6.1% in the compost heaps or manure (Table 4.7).

These results showed that *Abies*, *Pinus*, and *Quercus* forests produced the greatest wild mushroom diversity and the most valued commercial species (Figure 4.10). Previous studies confirmed this information as well (Kumar and Sharma, 2011; Montoya et al., 2003).

Table 4.7. Places where mushrooms grow

<u>In the forest</u>	
<u>In pine forest (<i>Pinus</i> spp.)</u>	<i>Amanita caesarea</i>
	<i>Boletus</i> spp.
	<i>Cantharellus cibarius</i>
	<i>Clitocybe geotropa</i>
	<i>Chroogomphus rutilus</i>
	<i>Craterellus tubaeformis</i>
	<i>Hericium coralloides</i>
	<i>Hydnum repandum</i>
	<i>Lactarius deliciosus</i>
	<i>Lactarius piperatus</i>
	<i>Lactarius volemus</i>
	<i>Morchella</i> spp.
	<i>Ramaria</i> spp.
	<i>Russula delica</i>
	<i>Tricholoma terreum</i>

Table 4.7 Places where mushrooms grow (cont'd)

In fir forest (<i>Abies</i> spp.)	<i>Lactarius salmonicolor</i> <i>Lepista nuda</i>
In oak forest (<i>Quercus</i> spp.)	<i>Craterellus cornucopioides</i> <i>Russula chloroides</i>
Under birch (<i>Betula</i> spp.)	<i>Lactarius glyciosmus</i>

Outside the forest

Plains and meadows	<i>Agaricus campestris</i> <i>Coprinus comatus</i> <i>Macrolepiota procera</i>
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Road sides	<i>Calocybe gambosa</i> <i>Marasmius oreades</i>
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<u>Compost heaps or manure</u>	<i>Agaricus bisporus</i> <i>Pleurotus ostreatus</i>
---------------------------------------	--



Figure 4.10. Some places where mushrooms grow in the Western Black Sea region

- A)** Mixed (Eflani, KARABÜK),
- B)** *Pinus-Quercus* (Ilgaz Mountains, KASTAMONU),
- C)** *Coniferous* (Çakmaklar Pine Grove Locality, BOLU) forests

4.7 Time of Occurrence (Phenology)

Mushrooms appeared to be collected and consumed during rainy seasons. Data from the survey revealed that mushroom season began in the beginning of April and ended in December for the Western Black Sea region. When we asked about the best weather conditions for a good mushroom season, all collectors agreed that August rains were important (87.9%); ($p < 0.05$). While the highest number of wild edible species were recorded in the months of August to November (60.6%), ($p < 0.05$), the smallest number of species occurred in December (9.1%), ($p < 0.05$). Peak mushroom season in the region of Western Black Sea was September (81.8%), ($p < 0.05$). 33.3% of the samples were collected in June and July; and 27.3% in April

and May, ($p < 0.05$). Cultivated ones (*A. bisporus* and *P. ostreatus*) may be found in each month (100.0%), ($p < 0.05$) (Table 4.8).

Table 4.8. Fungal species and their availability at the markets for sale along the rainy season of the year (2012-2013)

Species	Ap	M	Jn	Jl	A	S	O	N	D
<i>A.bisporus</i>	*	*	*	*	*	*	*	*	*
<i>A.campestris</i>			*	*	*	*	*	*	
<i>A.caesarea</i>					*	*	*	*	
<i>B.badius</i>				*	*	*	*	*	
<i>B.edulis</i>			*	*	*	*	*	*	
<i>C.gambosa</i>	*	*	*						
<i>C.cibarius</i>		*	*	*	*	*	*	*	
<i>C.rutilus</i>				*	*	*	*	*	
<i>C.geotropa</i>				*	*	*	*	*	
<i>C.comatus</i>		*	*	*	*	*	*	*	
<i>C.cornucopioides</i>					*	*	*	*	
<i>C.tubaeformis</i>			*	*	*	*	*	*	
<i>H.coralloides</i>			*	*	*	*	*	*	
<i>H.repandum</i>				*	*	*	*	*	
<i>L.deliciosus</i>					*	*	*	*	
<i>L.glyciosmus</i>					*	*	*	*	
<i>L.piperatus</i>			*	*					
<i>L.salmonicolor</i>	*	*			*	*	*	*	
<i>L.volemus</i>			*	*	*	*			
<i>L.nuda</i>						*	*	*	*
<i>M.procera</i>				*	*	*	*		
<i>M.oreades</i>	*	*				*	*	*	
<i>Morchella spp.</i>	*	*							
<i>P.ostreatus</i>	*	*	*	*	*	*	*	*	*
<i>Ramaria spp.</i>			*	*	*	*	*	*	
<i>R.chloroides</i>						*	*	*	
<i>R.delica</i>				*	*	*	*	*	
<i>T.terreum</i>					*	*	*	*	

*Mushroom species recorded during each month;

Ap: April **M:** May **Jn:** June **Jl:** July **A:** August **S:** September **O:** October

N: November **D:** December

Table 4.9. Frequency of mushrooms mentioned in the survey using a semi structured open-ended questionnaire

Scientific name	Number of people mentioned		
	Women (n=302)	Men (n=173)	TOTAL
<i>Lactarius deliciosus</i> (L.) Gray	302	173	475
<i>Lactarius salmonicolor</i> R. Heim & Leclair	300	170	470
<i>Agaricus campestris</i> L.	283	170	453
<i>Agaricus bisporus</i> (J.E. Lange) Imbach	288	162	450
<i>Pleurotus ostreatus</i> (Jacq.) P. Kumm.	276	165	441
<i>Marasmius oreades</i> (Bolton) Fr.	284	153	437
<i>Ramaria</i> spp.	281	150	431
<i>Boletus</i> spp.	274	144	418
<i>Cantharellus cibarius</i> Fr.	258	142	400
<i>Coprinus comatus</i> (O.F. Müll.) Pers.	264	135	399
<i>Tricholoma terreum</i> (Schaeff.) P. Kumm.	251	131	382
<i>Morchella</i> spp.	247	126	373
<i>Amanita caesarea</i> (Scop.) Pers.	239	114	353
<i>Chroogomphus rutilus</i> (Schaeff.) O.K. Mill.	226	105	331
<i>Lactarius piperatus</i> (L.) Pers.	215	102	317
<i>Clitocybe geotropa</i> (Bull.:Fr.) Quel.	217	98	315
<i>Russula chloroides</i> (Krombh.) Bres.	194	84	278
<i>Lactarius glyciosmus</i> (Fr.) Fr.	182	79	261
<i>Lactarius volemus</i> (Fr.) Fr.	173	56	229
<i>Russula delica</i> Fr.	142	40	182
<i>Craterellus cornucopioides</i> (L.) Pers.	131	29	160
<i>Hericium coralloides</i> (Scop.) Pers.	117	25	142
<i>Macrolepiota procera</i> (Scop.) Singer	103	30	133
<i>Calocybe gambosa</i> (Fr.) Donk	84	23	107
<i>Hydnum repandum</i> L.	81	10	91
<i>Craterellus tubaeformis</i> (Fr.) Quél.	74	11	85
<i>Lepista nuda</i> (Bull.) Cooke	54	25	79

According to the findings, more than 90.0% of those interviewed mentioned and widely appreciated the following mushrooms: *Lactarius deliciosus*, *Lactarius salmonicolor*, *Agaricus campestris*, *Agaricus bisporus*, *Pleurotus ostreatus*, *Marasmius oreades*, and *Ramaria* spp., respectively. Other mushrooms consumed and mentioned by more than 50.0% of the respondents were: *Boletus* spp., *Cantharellus cibarius*, *Coprinus comatus*, *Tricholoma terreum*, *Morchella* spp., *Amanita caesarea*, *Chroogomphus rutilus*, *Lactarius piperatus*, *Clitocybe geotropa*, *Russula chloroides*, and *Lactarius glyciosmus*. The mushrooms mentioned by more than 20.0% but fewer than 50.0% by respondents were: *Lactarius volemus*, *Russula delica*, *Craterellus cornucopioides*, *Hericium coralloides*, *Macrolepiota procera*, and *Calocybe gambosa*. The mushrooms mentioned by less than 20.0% were: *Hydnum repandum*, *Craterellus tubaeformis*, and *Lepista nuda*. In other words, residents had a selective preference despite of the wide diversity of edible mushrooms in the region. Our results concurred with the report of Christensen et al. (2008) and Garibay-Orijel et al. (2007). To compare, Garibay-Orijel et al. (2007) suggested that *Cantharellus cibarius* was the species with most frequency of mention by the Zapotecs from Oaxaca, Mexico, but the complex of *Amanita caesarea* was the most important economically. Similarly, when our figures the compared, *Lactarius deliciosus* was the species most frequently mentioned in the Western Black Sea region, but *Morchella* spp. were the most economic one (Table 4.9).

4.8 Current Mushroom Marketing

Mushrooms were also important for economical aspects. Even though Western Black Sea had a long tradition for wild or cultivated edible species, relatively few of them were traded. In described earlier, 208 (43.8%) of the respondents sold their mushrooms for income in the local markets of the region. These markets are held on a fixed day or some days during each week (Figure 4.11). Thirty three different edible mushroom species were found to be sold, either in fresh or dried at the roadsides or weekly markets.



Figure 4.11. Gerede Covered Marketplace

Gerede, Bolu; April, 2013

4.9 Basic Marketing Channels of Wild and Cultivated Mushrooms

Wild or cultivated edible mushrooms needed efficient marketing systems for high quality and better price.

Five marketing channels were identified and described in the studied area: Three for cultivated and two for wild mushrooms. Gatherers or producers sold their mushrooms either to a middlemen or directly to a public market. All channels from suppliers reached to consumers.

The three channels of distribution for cultivated mushrooms were:

- i. Cultivated *Agaricus bisporus* and *Pleurotus ostreatus* were sold by middlemen to local consumers in public markets (15.5%).
- ii. Cultivated species were sold by middlemen to restaurants for traditional meals (5.6%).
- iii. Cultivated species were sold by middlemen to supermarkets (11.3%) like ADESE and MİGROS in the studied area.

The simplest two channels of distribution for wild mushrooms were given below.

- i. The wild mushrooms were sold by rural gatherers directly to consumers in public markets (67.4%) (Figure 4.13).
- ii. Selected species of wild mushrooms, such as *Morchella* spp. in rural communities were also bought by middlemen from exporting companies, in order to be processed for the international market (0.2%).

Even though mushroom collection and cultivation were increased in many developing countries and/or our region, the marketing systems were poorly understood and investigated, except two researches (Yaman and Akyıldız, 2008; Martinez-Carrera et al., 2005). Present investigations confirmed that all operations were by cash in the markets. Basic channels of distribution studied were shown in Figure 4.12.

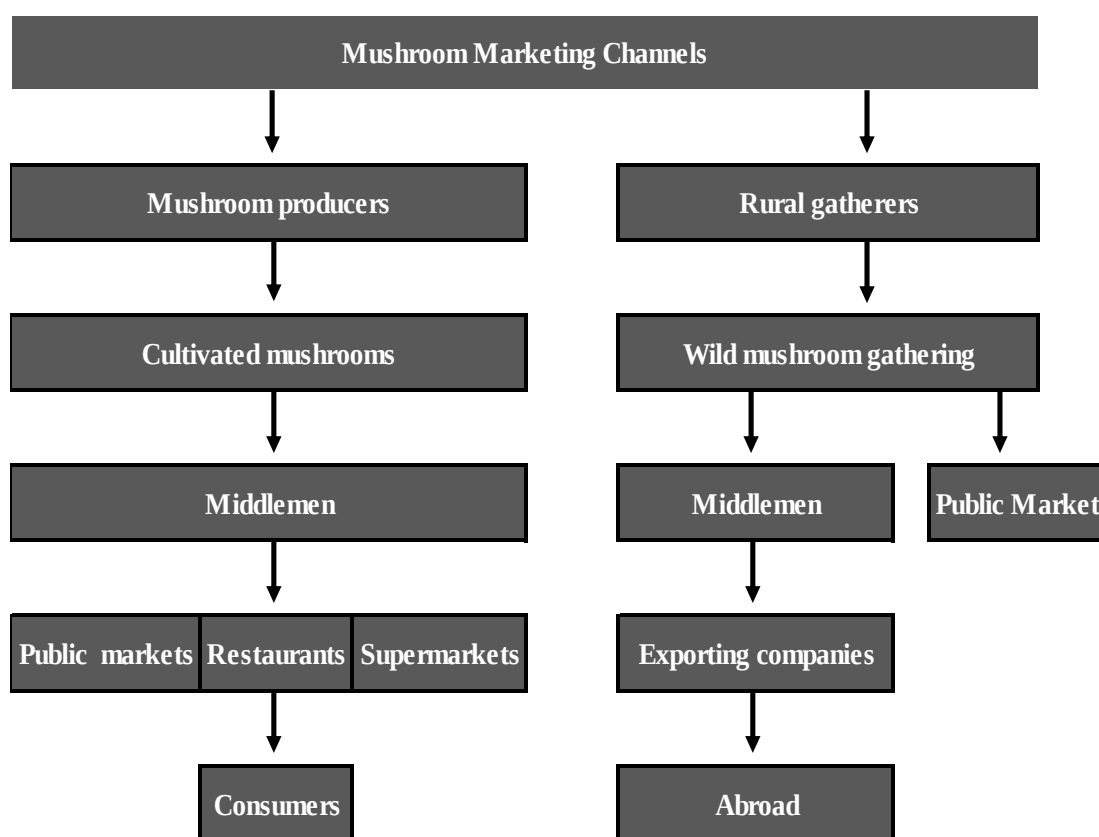


Figure 4.12. Main marketing channels for wild and cultivated (fresh and processed: *Agaricus* spp., *Pleurotus* spp.) edible mushrooms of the Western Black Sea region



Figure 4.13. A peasant selling *Lactarius deliciosus* on the left and *Clitocybe geotropa* on the right in Old Thursday Market

Safranbolu, Karabük, November, 2013

4.10 Economic Aspects of Wild Edible Mushrooms in the Western Black Sea Region

According to the information from interviews and direct observations, mushroom prices varied seasonally. The most appreciated and economically important species were *Lactarius deliciosus* and *Lactarius salmonicolor* (Figure 4.14) in the Western Black Sea region. *Morchella* spp., and *Amanita caesarea* had the highest prices (Table 4.10) but preferred moderately in the local community. The cheapest and the least appreciated was *Tricholoma terreum* (Figure 4.21). The local markets' prices were generally in the price of 1 kg of fresh mushrooms (Figure 4.15, 4.16, 4.17, 4.18, 4.19, 4.20, 4.21 and 4.22). However, these prices varied from species to species. At the beginning of the fruiting period, prices were higher. The prices of mushrooms depended on freshness and storage type. There was also competition between sellers (Figure 4.23 and Figure 4.25). Then, prices went down towards the end of the fruiting period. The sellers themselves' consumed or processed mushrooms if they were not sold,

During this research, it was also noted that a few mushroom species were especially collected for home consumption. Obviously, there was little or no market for them or sellers preferred them. These species were *Lepista nuda* and *Macrolepiota procera*.

In the most stands where the mushroom were sold, there was also commercialization of other local products. Some of these were chestnut, milk, domestic bird eggs, garlic, spinach etc (Figure 4.24).

Few mushroom species were sold in dried form. Dried mushrooms were sold in the public markets at relatively higher prices than fresh ones (Table 4.10). For instance, one kilogram of dried *Morchella* spp. fetched to 60.00 ₺. The prices of morels were also same for all species in the Western Black Sea region. However, Hamayun et al. (2006) suggested that the prices of *Morchella* spp. varied in the markets of Swat depending on the species. To exemplify, the price of *Morchella conica* was always higher than other species.

More important, the results indicated that the international market for wild or cultivated edible fungi was scant (0.2%). Only species with potential were *Morchella* spp. in the region. They were exported to Europe, particularly France, but also Germany and Belgium, in dried form at very high prices (Table 4.10). Also, the prices in local markets of the region were lower than international markets.

The final results showed that a family could collect 120 kilograms (kgs) of wild mushrooms per season. The collector could sell an average of 80 kgs per season. An average income of about 320.00 ₺ - 36.000 ₺ can be generated by a collector per season. That is to say, the WEMs positively contributed to income generation of Western Black Sea region. This very recent research for the region was also in concordance with a study by Montoya et al., (2008). Selected mushroom species of commercial importance in the studied area and their prices were given in Table 4.10.

Table 4.10. Mushroom species of commercial importance in the Western Black Sea, and their prices in 5 selected popular markets in 2013

Scientific name	<u>Markets</u>				
	*14	81	78	74	37
<i>A. bisporus</i>	10.0-15.0	10.0-12.0	12.0-15.0	10.0-15.0	10.0-15.0
<i>A. campestris</i>	8.0-10.0	8.0-9.0	8.0-9.0	7.0-8.0	8.0-10.0
<i>A. caesarea</i>	-	-	-	-	30.0-40.0
<i>Boletus spp.</i>	15.0-20.0	10.0-15.0	10.0-12.0	10.0-15.0	15.0-20.0
<i>C. gambosa</i>	20.0-25.0	15.0-20.0	10.0-15.0	12.0-15.0	10.0-15.0
<i>C. cibarius</i>	12.0-15.0	10.0-12.0	8.0-12.0	8.0-12.0	12.0-15.0
<i>C. rutilus</i>	8.0-10.0	8.0-10.0	10.0-12.0	-	8.0-12.0
<i>C. geotropa</i>	-	-	15.0-25.0	-	-
<i>C. comatus</i>	5.0-6.0	5.0-7.0	5.0-6.0	-	5.0-7.0
<i>C. cornucopioides</i>	-	-	-	-	8.0-10.0
<i>C. tubaeformis</i>	-	-	-	-	8.0-9.0
<i>H. coralloides</i>	-	-	-	8.0-15.0	10.0-15.0
<i>H. repandum</i>	-	-	10.0-12.0	-	8.0-10.0
<i>L. deliciosus</i>	15.0-20.0	15.0-25.0	20.0-25.0	15.0-20.0	15.0-20.0
<i>L. glyciosmus</i>	10.0-15.0	10.0-15.0	12.0-15.0	12.0-15.0	15.0-20.0

Table 4.10 Mushroom species of commercial importance in the Western Black Sea, and their prices in 5 selected popular markets in 2013 (cont'd)

<i>L. piperatus</i>	5.0-7.0	5.0-6.0	5.0-7.0	5.0-7.0	5.0-8.0
<i>L. salmonicolor</i>	15.0-20.0	15.0-20.0	20.0-25.0	15.0-20.0	15.0-20.0
<i>L. volemus</i>	-	-	-	-	15.0-20.0
<i>L. nuda</i>	4.0-5.0	-	-	-	-
<i>M. procera</i>	4.0-5.0	-	-	-	-
<i>M. oreades</i>	10.0-12.0	8.0-10.0	8.0-10.0	8.0-10.0	8.0-10.0
<i>Morchella</i> spp. (fresh)	-	-	30.0-40.0	30.0-35.0	35.0-40.0
<i>Morchella</i> spp. (dry)	-	-	50.0-60.0	45.0-55.0	50.0-60.0
<i>Morchella</i> spp. (abroad)	-	-	350.0-400.0	300.0-450.0	350.0- 450.0
<i>P. ostreatus</i>	10.0	8.5-10.0	8.0-10.0	8.0-10.0	8.0-10.0
<i>Ramaria</i> spp.	4.0-7.0	4.0-5.0	4.0-7.0	4.0-7.0	4.0-7.0
<i>R. chloroides</i>	8.0-10.0	7.0-8.0	8.0-12.0	-	7.0-12.0
<i>R. delica</i>	10.0-15.0	10.0-12.0	10.0-15.0	10.0-15.0	12.0-15.0
<i>T. terreum</i>	4.0-5.0	4.0-4.5	4.0-5.0	4.0-4.5	4.0-5.0

*14, Bolu Public Market; 81, Düzce Manufacturer's Market; 78, Karabük's Old Thursday Market; 74, Bartın's Ladies Bazaar; 37, Kastamonu's Azdavay Public Market.

Prices were given by minimum and maximum values as Turkish Liras (₺).

All measures were for 1 kg of fresh weight by using following unit equivalent based on own observation: 1 g dried fungi: 10 g fresh fungi.



Figure 4.14. Some mushroom species sold and/ or consumed in the Western Black Sea region - I

A) *Lactarius deliciosus* (Centre, Bolu, Bolu Public Market; September, 2012)

B) *Lactarius salmonicolor* (Centre, Bolu, Bolu Public Market; September, 2012)



Figure 4.15. Some mushroom species sold and/ or consumed in the Western Black Sea region - II

A) *Marasmius oreades* (Eflani, Karabük, Eflani Peasant Market; April, 2013)

B) *Agaricus bisporus* (Centre, Karabük, SAFGÜL - Mushroom Production Facility; May, 2013)

C) *Cantharellus cibarius* (Centre, Bolu, Bolu Public Market; May, 2013)



Figure 4.16. Some mushroom species sold and/ or consumed in the Western Black Sea region - III

A) *Amanita caesarea* (Cide, Kastamonu, Beach Marketplace; October, 2013)

B) *Lepista nuda* (Centre, Bolu; October, 2012)

C) *Boletus edulis* (Amasra, Bartın, Amasra Municipality's Covered Marketplace; June, 2012)

D) *Ramaria spp.* (Devrek, Zonguldak, Devrek Food Market; September, 2013)



Figure 4.17. Some mushroom species sold and/ or consumed in the Western Black Sea region - IV

A) *Macrolepiota procera* (Centre, Bolu; September, 2012)

B) *Hydnum repandum* (Taşköprü, Kastamonu, Tuesday Market; August, 2013)

C) *Calocybe gambosa* (Centre, Bolu, Bahçelievler Local Market; May, 2013)



Figure 4.18. Some mushroom species sold and/ or consumed in the Western Black Sea region - V

A) *Lactarius piperatus* (Safranbolu, Karabük; New Thursday Market; July, 2012)

B) *Lactarius volemus* (Küre, Kastamonu; July, 2012)

C) *Russula delica* (Mengen, Bolu; September, 2012)



Figure 4.19. Some mushroom species sold and/ or consumed in the Western Black Sea region - VI

Agaricus campestris (Mudurnu, Bolu, Mudurnu Local Market; October, 2012)



Figure 4.20. Some mushroom species sold and/ or consumed in the Western Black Sea region - VII

A) *Lactarius glyciosmus* (Centre, Düzce, Kalıcıkönutlar Market; September, 2013)

B) *Russula chloroides* (Centre, Karabük, Esentepe Tuesday Market; October, 2013)

C) *Morchella* spp. (Azdavay, Kastamonu; April, 2013)



Figure 4.21. Some mushroom species sold and/ or consumed in the Western Black Sea region - VIII

A) *Clitocybe geotropa* (Safranbolu, Karabük, Tuesday Market; November, 2013)

B) *Pleurotus ostreatus* (Centre, Düzce, VELİOĞLU Mushroom Production Facility; September, 2012)

C) *Tricholoma terreum* (Dörtdivan, Bolu, Cumayeri Market; October, 2012)



Figure 4.22. Some mushroom species sold and/ or consumed in the Western Black Sea region - IX

A) *Coprinus comatus* (Mengen, Bolu, Türkbeyli Covered Market Place; September, 2012)

B) *Hericium coralloides* (Ulus, Bartın, Friday Market; November, 2012)

C) *Craterellus tubaeformis* (Azdavay, Kastamonu, Azdavay Public Market; September, 2013)



Figure 4.23. The *Kara Kanlıca* for sale- Folk name of *Lactarius deliciosus*

Old Safranbolu Market, Safranbolu, Karabük; November, 2012



Figure 4.24. A little boy selling *Marasmius oreades* and *Clitocybe geotropa* along the roadside of Düzce Manufacturer's Market in the month of October, 2012.



Figure 4.25. A typical collector and seller in Kadı Mosque Market

Giant *İcikızıl* were surprised to people!

Centre, Bolu; September, 2012

4.11 Processing and Preservation for Long-Time Utilization

Out of respondents, ninety one percent did not store their mushrooms. In general, they immediately consumed after collected or bought. If they did not sell all they collected in a day, they preserved mushrooms through different storage methods: freezing (4.6%), sun drying (2.5%), and salting (1.9%), respectively (Figures 4.26 and 4.27). As seen, preservation techniques were seldom in the Western Black Sea region, even though there were many studies about the preservation techniques in the world (Chelela et al., 2014; Tibuhwa, 2013; Garibay-Orijel et al., 2012). Processing and preservation were practised mainly by female (97.3%) for home consumption (95.5%) and little for selling (4.5%).



Figure 4.26. Wild Edible Mushrooms: Traditional Drying and Storage Methods - I

Azdavay, Kastamonu, September, 2013

A) Dried form of *Craterellus* spp.

B) Dried chick feet grinding in mortar - It is used as spice after drying.

C) Fruiting bodies of *Craterellus tubaeformis* collected in baskets



Figure 4.27. Wild Edible Mushrooms: Traditional Drying and Storage Methods - II

Cide, Kastamonu; May, 2013

A) Sun drying of morels in open

B) Hanged dried *Morchella* spp. with dried peppers to wall for sale

C) Dried morels in airtight jar can stay for over one year in good condition.

4.12 Medicinal Mushrooms

The traditional usage of medicinal mushrooms in the region was limited (0.8%). Most of the respondents (98.4%) agreed that there were medicinal mushrooms available in their environments. However, there were inadequate data to identify and understand medicinal purposes of wild mushrooms. Only few people used mushrooms for traditional medical practices. One interesting result was that watery part of *Morchella* spp. was practiced to cure eye infections (Figure 4.28). There was such similar information in the literature. According to Sher and Shah (2014), “all the named *Morchella* spp. was found to be an edible source as well as a part of the local healing system to cure different disease states. Morels were established antioxidants having curative properties such as anti-inflammatory, liver tonic, blood purifiers, anti-tumor, and a remedy for digestive disorders, cold, fertility issue, and diabetes”. Additionally, *Morchella* spp. were used against scorpion sting in Muğla and Aydın, Turkey (Sarı et al., 2010).



Figure 4.28. Only *Morchella* spp. has been practiced in traditional medicine of Western Black Sea

Tosya, Kastamonu, Tosya Market; April, 2013

5. CONCLUSIONS AND RECOMMENDATIONS

Economic activities of Western Black Sea region largely depended on agriculture, livestock keeping, mining, and tourism. A small but active markets existed for wild and/or cultivated edible fungi in the area.

This research pinned down the importance of ethnomycology in Western Black Sea region by collecting the indigenous knowledge of the people together with marketing channels of wild or cultivated mushrooms. Wild or cultivated mushroom harvesting not only provided nutritious food for low-income households, but also an alternative employment opportunities by improving their socioeconomic status. Women actively participated in every stage of utilization of mushrooms. In the studied area, the marketing systems for wild edible mushrooms were simpler than cultivated ones. During the rainy seasons, WEMs were selected and prepared by rural gatherers for marketing, while the rest was kept for their own consumption. Wild mushroom was directly marketed to consumers, either locally or abroad. The widely appreciated edible mushrooms by the respondents were *Lactarius deliciosus*, *Lactarius salmonicolor*, and *Agaricus campestris*. *Morchella* spp. were believed to have some medicinal values i.e. treatment of eye infections. There was a clear need to explore and use this knowledge in medical science. Their usage was not only useful for conservation of cultural traditions and biodiversity but also for community health care and possible drug development for now and future. In addition to this, morels make top of the list and contribute most to the local economy; they fetch high prices in the international markets. But, there is a huge gap in despite of the diversity of mushrooms in the studied area. Mushroom production farms were scarce and inadequate in spite of the growing demands by mycophobic city settlers. For this purpose, edible mushrooms' domestication in the region requires an integrative government support and policies. Besides, workshop training programs must be run particularly on cultivation technology. Social media should also organized special programmes in order to avoid mushroom poisoning. In this way, more edible species and varieties of fungi would be entered into the local markets with new technologies and information, therefore, our knowledge about fungal utilization would increase.

The traditional knowledge of these valuable resources described here will create awareness for the encouragement of more research publications. It could be attracted fellow mycologists, biologists and other scientists for the exploration of scientific, economic, and biological prospects. Furthermore, more ethnomycological, biodiversity, medicinal, chemical, and ecological researches are required to move the region of Western Black Sea to a place of global recognition for edible mushrooms.

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APPENDICES

7. APPENDICES

Appendix Table 1. The questionnaire applied in the study in order to obtain data.

STRICTLY CONFIDENTIAL

Questionnaire number:

QUESTIONNAIRE FARMER (and PROCESSOR)

MODULE A: SURVEY INFORMATION

1. Date of interview: (Day/Month/Year)				
2. Interviewer:				
3. Folk name (Species name)				

MODULE B: HOUSEHOLD INFORMATION

IDENTIFICATION

1. Gender of the acting head of household		Male : ☐ Female: ☐
2. Location of household(<i>name of province, county and village</i>)		
3. Age of the respondent		
4. Number of household population		
5. Highest level of education of the head of household?	☐ No formal ☐ Primary ☐ Adult ☐ Secondary ☐ College	
6. Main source of income of the household?		

MODULE C: TECHNOLOGY

1	Which equipment/technology do you use?
	Basket
	Bucket
	Penknife or knife
	Brush
	Any other equipment

2. Do you have the possibility to store the target species?	Yes: ☐ No: ☐
3. What type of structure does your household have for storage ?	

MODULE D: ECONOMY

MODULE D-1: Rank in terms of income

List the mushroom mentioned in order of economic importance

	1. Mushroom	Rank in terms of income
1		
2		
3		
4		

MODULE D-2: Production of the target species

Variety name	1. Variety name (write the folk name in order of importance)	Location	Is it cultivated in: Irrigated (I) Rain fed (R) land?	Do you collect it from the wild?	
				Natural	Cultured
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

2. From the table above, indicate the 3 varieties you would mostly like to work on market related activities (*processing, selling, etc.*) and indicate why (*easier to process, more consumers' request, higher income, etc.*).

	Variety 1	Variety 2	Variety 3
Variety name			
Reason why			

MODULE D-3: Cultivation (and collection) of the target species

1	Where do you get spore materials? <i>(Please indicate if there are multiple sources and differences in varieties, please write the variety number)</i>	Own	From relatives	From the wild	From farmers in the village	From farmers outside the village	From shop	From institutions / government
2	If you collect this species also from the wild, which are the main differences and what are the main problems?							

MODULE D-4: HARVEST/COLLECTING ACTIVITY

Please report answers related to (Variety 1), (Variety 2) (Variety 3) as in question D2

		Variety 1	Variety 2	Variety 3
1	When is the harvesting date/season?			
2	How long is the typical collection trip? (h)			
3	How much is mushroom collected per season? (kg)			
4	How much is the total income per season? (□)			

MODULE D-5 How do you maintain after you collected mushrooms?

Name the variety	Freezing	Drying	Brine	Other

MODULE E -SOCIAL / LABOUR

Please report answers related to (Variety1), (Variety 2) (Variety 3) as given in question D2

MODULE E-1: SOCIAL

1	Which is the main reason for growing/collecting this target species?	local customs / imitation of neighbours	income	others (please indicate other reason):
	Variety 1:			
	Variety 2:			
	Variety 3:			
2	Collecting experience of respondents?	:		
3	Cultivation experience of respondents?			

Please report answers related to (Variety1), (Variety 2) (Variety 3) as in question D2

Variety 4 and Variety 5 can be other important varieties.

4	Which purposes are you using mushrooms?					
	Variety:	Food	Health remedies	Cultural / religious	Fodder	Other
	1.					
	2.					
	3.					
	4.					
	5.					

5	If you are using mushrooms for therapeutic purposes, for which disease you use? [According to the table above, if the mushroom is used for the treatment, ask this question in this section].
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MODULE E– 2: PROCESSING

1	Is the target species processed? In which products according to which variety?	Type of final products	Is there any middlemen? (Yes or no)	Where is it processed? (House/community/other)
	Variety 1:			
	Variety 2:			

	Variety 3:			
2	Variety	Which kind of technology is used for processing?		
	Variety 1:			
	Variety 2:			
	Variety 3:			
3	Are the products packaged?	Yes: ☐ No: ☐		
Fill in the following table if the products are packaged.				
Type of packaging		Where is it packaging done? (House/community/other)		
Paper and cardboard ☐				
Cardboard box ☐				
Foam ☐				
Bags and handbags ☐				
Plastic (Including cellulose and rubber) ☐				
Other: ☐				

MODULE E-3: LABOUR in cultivating/collecting for the target species

1	Number of people involved in cultivating and harvesting (<i>family members + external workers</i>)	Tot. no :	No. of women	No. of children <12 year old:	Estimate average age
		family members:	family members:	family members:	
2	Number of people involved in collecting from the wild (<i>family members + external workers</i>)	Tot. no :	No. of women	No. of children <12 year old:	Estimate average age
		family members:	family members:	family members:	
3	Number of people involved in the processing (<i>family members + external workers</i>)	Tot. no :	No. of women	No. of children <12 year old:	Estimate average age
		family members:	family members:	family members:	
4	Number of people involved in the packaging (<i>family members + external workers</i>)	Tot. no :	No. of women	No. of children <12 year old:	Estimate average age
		family members:	family members:	family members:	
5	Who is involved in this activity?	Household members (<i>mother, father, sons, daughters, grandparents</i>)			

MODULE E-4: TRAINING

1	Are farmers trained to cultivate/collect this species?	Women		Men	
	By whom? <i>tick</i>	Household members	Community farmers	Farmers from other communities	Government, institutions Agencies, extension (<i>please indicate</i>)
2	Are farmers trained to process this species?				

MODULE F – MARKET

MODULE F-1: MARKET PLACE

- The names, established day(s) and addresses of the markets?

No	Market name	Established day	Market Address
1			
2			
3			
4			
5			
6			
7			
8			

MODULE F-2: MARKET CHANNELS

1	To whom do you sell the mushrooms? (please tick)	Variety 1	Variety 2	Variety 3
	nobody			
	middlemen			
	Local consumers in the community			
	Local consumers outside the community			
	Restaurant			
	Abroad			
2	How do you get to the market place?	Own transport: ☐ Paid transport: ☐		

MODULE F-3: PRICES

1		2012-2013
	Price (per kg) (specify the price as □)	
2	What is the total income coming from the sale of mushrooms?	

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2) Hande Yılmaz, Nusret Zencirci, 9-11 September 2015, Ethnomycological Conspectus of Western Black Sea Macrofungi: Identification to Marketing, 2nd National Mycology Days (Symposium), Yeditepe University, ISTANBUL/ TURKEY (Poster Presentation)

3) Hande Yılmaz, Nusret Zencirci, 20-23 October 2015,
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