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Exploring overlooked farm forest treasures: Unveiling macrofungal diversity of eastern Nepal

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ABSTRACT

Farm forests are the privately-owned forest patches, which forms an integral part of farmer's livelihood. However, study of biodiversity of these forests has been largely neglected, where macrofungi are also one of the important treasures of these forests. The study was aimed to explore macrofungal diversity in the farm forests in Sandakpur-3, Koshi Province, Eastern Nepal. An opportunistic sampling method was used to explore the macrofungal diversity and ecology. Findings revealed fifty-seven macrofungal species, with fifty-one belonging to Basidiomycota and six to Ascomycota. Agaricales (32 species) was the dominant order followed by Polyporales (8 species), Russulales (4 species) while the less diverse orders were Cantharellales, Geastrales, Helotiales, Hypocreales and Thelephorales with single macrofungal species. Physalacriaceae and Polyporaceae were most frequent family representing four species. Macrofungal species were classified based on ecology, with saprophytic fungi (forty-three species) being the most abundant, followed by mycorrhizal (twelve), parasitic (one), and entomophilous (one) species. Edibility assessment revealed twenty-five edible species, eighteen inedible species, two poisonous species and twelve species of undetermined status. These findings emphasize the significant role of privately-owned farm forests in supporting fungal diversity and recommends further research in farm forests for sustainable management of forest products and to promote biodiversity conservation.

Keywords: Macrofungi, mushrooms, mycorrhiza, private forest, wild fungi

In the 1980s, forestry-related terminologies like 'agroforestry,' 'community forestry,' 'social forestry,' and 'farm forestry' emerged, with farm forestry becoming especially prevalent in Asia (Nair, 2005). In Nepal, the distinction between agroforestry and farm forestry is often blurred, and the two terms are used interchangeably within the legal framework. Both practices fall under the category of 'Private Forest' as defined by The Forest Act (2019) of Nepal.

Farm forestry involves the practice of cultivating trees or forests on privately owned agricultural lands, primarily for timber production and/or other forestry-related commodities, with the goal of long-term income generation (Finckh and Wolfe, 1997; Atangana *et al*., 2014; Pande, 2021). Farm forests provide a range of benefits to both farmers and the environment, supporting the concept of sustainable land management (Vize and Creighton, 2001) and carbon sequestration (Singh *et al*., 2000). These farm forest also host diverse biodiversity, including wealth of fungal communities (Wang *et al*., 2019; He *et al*., 2021). The increasing popularity of cultivating forests on private lands, as observed in numerous studies (Warner, 1997; Jodha, 2014) may be attributed to several factors, such as the growing demand for forest

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products and the desire to maximize returns from their land holdings (Kanel, 1995; Das and Oli 2001).

Fungi, often underestimated, are crucial components of ecosystems, which transform seemingly mundane tasks into extraordinary ecological services, such as decaying wood and litter, recycling carbon, minerals, and nutrients into accessible forms for other organisms (Osono, 2006; Ekblad *et al.*, 2013). Beyond nutrient cycling, fungi enhance soil structure by binding soil particles with their mycelial networks, promoting water retention and resilience to environmental stressors (Audet, 2014; Niego *et al.*, 2023). Furthermore, mycorrhizal associations, where fungi exchange nutrients for plant carbohydrates not only boost plant health but also protect them against diseases (Bonfante and Desiro, 2014; Diagne, 2020). The mycorrhizal network serves as an information highway for forest communication, ensuring collective responses to environmental changes (Filotas *et al.*, 2014). About 75% of carbon sequestration can be attributed to belowground fungi having symbiotic relationships between different plant species (Hawkins *et al.*, 2023).

Macrofungal diversity in Nepal has predominantly been studied in community forests and governmental forests (Giri and Rana, 2008; Aryal and Budhathoki, 2013; Bhandari and Jha, 2017; Khadka and Aryal, 2020; Joshi *et al.*, 2022; Adhikari *et al.*, 2024). Farm forests have received relatively little attention in terms of biodiversity studies, particularly macrofungal diversity exploration. Therefore, assessing and documenting macrofungal diversity in farm forests benefits both livelihoods and ecosystems, fostering a harmonious relationship between human needs and forest conservation. Furthermore, it addresses public health concerns, aiming to reduce mushroom poisoning incidents in Nepal (Pandey *et al.*, 2006; Aryal, 2009). Thus, present study aims to explore the macrofungal diversity in farm forest, their ecology and edibility.

MATERIALS & METHODS

Study area

The research was conducted in the various farm forests situated in Sandakpur Rural Municipality-3, located in the Ilam district, Koshi province, Nepal. The study site is located at an elevation of 1610 to 1815 meters above sea level, between 26°59'43"N - 27°00'03"N latitude and 87°56'50"E - 87°56'15"E longitude. The climate at the study site is characterize by humid temperate and heavy rainfall. The annual mean precipitation is 3194 mm, whereas the average maximum temperature and average minimum temperature range from 17.2 to 25.9°C and 6.7 to 20.7°C respectively (https://en.climate-data.org/). These farm forests harbor a diverse range of tree species, contributing to the unique ecological landscape of the region. Trees species, such as *Alnus nepalensis*, *Schima wallichii*, *Macaranga* sp, *Ficus auriculata*, *Ficus bengalensis*, *Engelhardia*

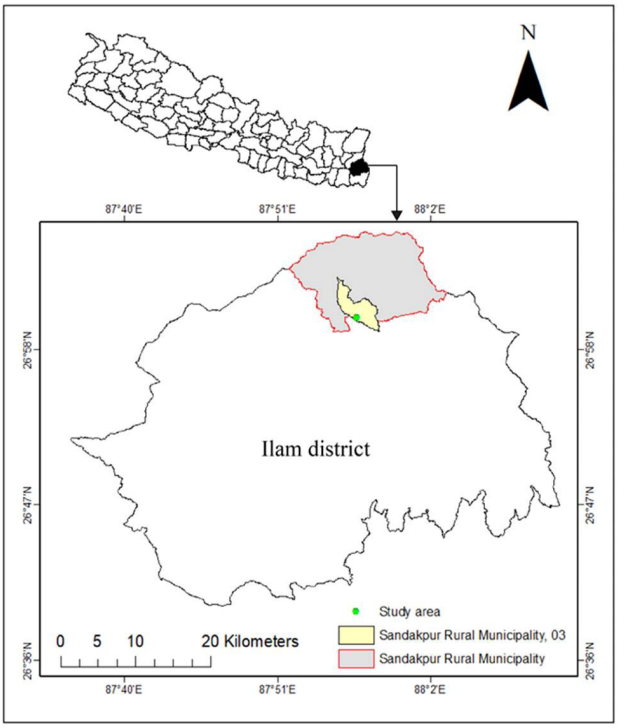

Fig. 1. Map showing study site (farm forest) in Sandakpur-03, Ilam, Koshi province, Eastern Nepal

spicata, *Prunus cerasoides*, *Rhododendron arboreum*, *Fraxinus floribunda*, *Pinus roxburghii*, *Ficus semicordata*, *Ficus lacor*, *Symplocos pyrifolia*, *Eurya acuminata*, *Lyonia ovalifolia*, *Semecarpus anacardium* along with other associated plant species like *Dendrocalamus* sp, *Thysanolaena latifolia* and *Amomum subulatum* were planted inside the farm forest.

Collection of macrofungal samples

Opportunistic sampling method was used to document and collect the specimens of macrofungal species during the months of May to October 2023 from the various farm forests within the study area. The ecological parameters of sampled plots, and morphological features of the fruiting body were recorded on-site. Additionally, photographs of fresh specimens were taken before collection (Appendix II). The specimens were then placed in a container, labelled and kept for further study. The use-value of different macrofungal species were drawn with the help of national and international available literatures (Kharel and Rajbhandary, 2005; Giri and Rana, 2008; Aryal and Budhathoki, 2013; Dutta and Acharya, 2014; Kaul *et al*., 2019; Khadka and Aryal, 2020; Shah *et al*., 2020; Dar *et al*., 2023).

Identification and preservation of the specimens

Identification was done by studying the morphological features of the sporocarps, with the help of field guides and available taxonomic literature (Ostry *et al*., 2010; Phillips, 2013; Adhikari, 2014; McKnight *et al*., 2021). The nomenclature of the identified species was based on The Index Fungorum (https://www.indexfungorum.org/Names/Names.asp). All collected specimens were dried and stored in the zip-lock polyethene bag containing naphthalene balls to prevent microbial deterioration. The preserved specimens are stored in the herbarium section of Department of Botany, Mechi Multiple Campus, Jhapa, Nepal.

RESULTS & DISCUSSION

Diversity of macrofungal species

Altogether, fifty-seven species were identified, with fifty-one belonging to Basidomycota and six to Ascomycota (Fig. 2). Agaricales was the dominant order, comprising 32 species. Physalacriaceae and Polyporaceae families were dominant, each representing four species (Fig. 2). Several studies have reported diverse macrofungal communities across different forests types in Nepal, which includes, community-managed Sal (*Shorea robusta*) forest

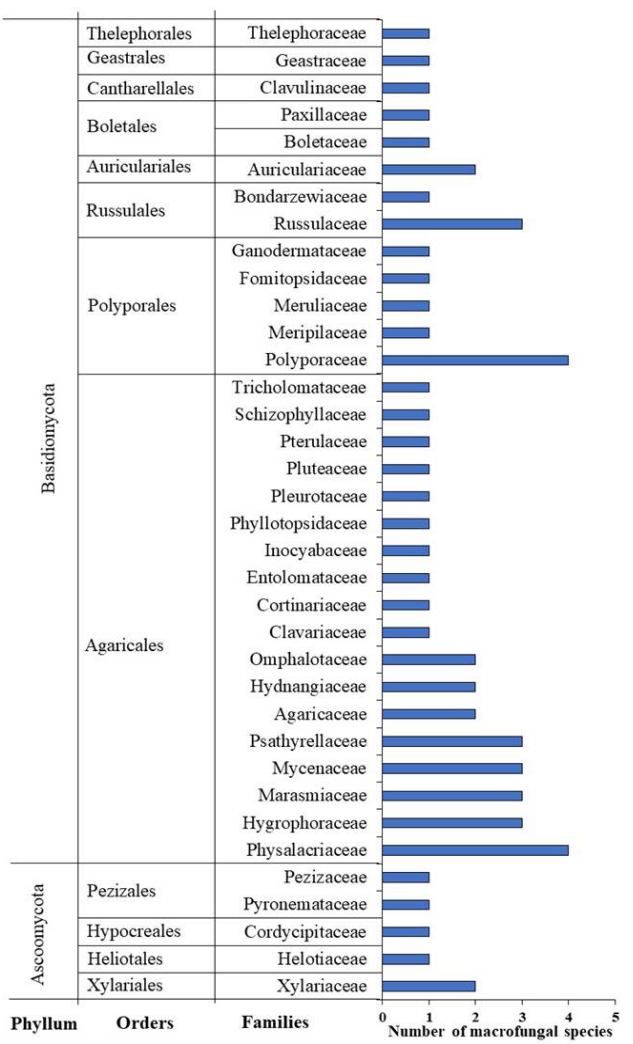

Fig. 2. Diversity of macrofungal species reported in private farm forest, Sandakpur-03, Ilam, Koshi province, Eastern Nepal

from terai region (Baral *et al*., 2015), Oak dominated and Pine dominated forest from hilly area of central Nepal (Khadka and Aryal, 2020), subalpine and temperate forest from high mountain (Giri and Rana, 2008) and different vegetation compositions (Joshi *et al*., 2022). Documentation of fifty-seven species of mushrooms in this study shows the potentiality of farm forest in harboring macrofungal community within a small area with fragmented ecosystem (Table 1, Fig 3).

Ecology of macrofungal species

Various activities by the forest owners such as harvesting timber, fuel woods, fodder, litter, wild fruits and mushrooms reduced the macrofungal diversity as compared to the older, untouched and natural forests (Kranabetter *et al*., 2018; Belay *et al*., 2020). Timber harvesting likely plays an important role in decreasing the diversity and may diminish potential habitat of macrofungal species (Dahlberg *et al*., 2010). Among the documented species, the majority (75.43%) of species fall into the saprophytic fungi (43 species) followed by mycorrhizal fungi (12 species). Parasitic and entomophilous fungi were represented by single macrofungal species (Fig. 4). The tree canopy cover, litter composition, and decomposing various organic matter may have favored saprophytic fungus, resulting in a larger diversity in the study area (Baral *et al*., 2015; Bhandari and Jha, 2017; Joshi *et al*., 2022; Thapa *et al*., 2022). Additionally, farm forests harbor a significant diversity of trees, which eventually contribute to the production of dead wood, which favors the richness of saprophytic fungi (Olou *et al*., 2019). Another important disturbance factor in these farm forests is continuous thinning of trees, which can lower the diversity of mycorrhizal fungi as reported by Zhou *et al*. (2020). Moreover, the presence of higher saprophytic species is also related with the early-stage fungal communities, which depend on dead and decaying organic matter compared to later-stage mycorrhizal fungi, which need to develop complex network for the mobilization of nutrients from organic matter (Kyaschenko *et al*., 2017). These finding seems to be valid in farm forests, as these forests are subjected to continuous disturbance and never reach to the mature climax condition.

Edible, poisonous and medicinal fungi

Global and local literatures regarding the macrofungal edibility shows twenty-five edible species, eighteen species were found to be inedible, two species were poisonous, and twelve species without any status (Fig. 5). Farm forest harbors several edible species like *Auricularia auricula-judae, Flammulina velutipes, Russula vesca, Russula delica, Pleurotus pulmonarius* and *Bondarzewia berkeleyi, Laccaria lacata*, which were reported edible in several previous literatures (Devkota, 2008; Singdevsachan *et al*., 2014; Raut and Adhikari, 2021). Some of the species reported in this study such as *Fomitopsis pinicola* and *Hygrocybe coccinea*, are inedible due to their hard texture and small size, respectively. These species are used in decorative, spiritual and cultural purposes by Sherpa community in eastern Nepal (Kharel and Rajbhandary, 2005; Khadka and Aryal, 2020). Additionally, it was crucial to document two poisonous mushroom species i.e., *Omphalotus japonicus* and *Inosperma erubescens* from the study area. The local people lack specific knowledge about poisonous mushroom and generally do not collect mushroom for any purpose. They instead favor commercially available ones from the market. Nevertheless, few people in the study area collect *Russula vesca* for edible purpose.

Mushroom species from inedible and unknown categories were also being widely researched for their medicinal properties (Zhang *et al*., 2023). Some of the inedible species reported in this study, such as *Xylaria hypoxylon, Xylaria polymorpha, Fomitopsis pinicola, Trametes hirsuta* and *Trametes gibbosa*


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Fig. 3. Some fruit bodies of macrofungal species from the farm forest areas of Sandakpur-3, Ilam District, Koshi Province, Nepal. (1. *Aleuria aurantia*, 2. *Ascocoryne sarcoides*, 3. *Auricularia cornea*, 4. *Pterula* sp, 5. *Coprinellus disseminates*, 6. *Coprinopsis lagopus*, 7. *Xylaria polymorpha*, 8. *Delicatula integrella*, 9. *Entoloma hochstetteri*, 10. *Favolaschia pustulosa*, 11. *Flammulina velutipes*, 12. *Fomitopsis pinicola* 13. *Ganoderma lucidum*, 14. *Geastrum lageniforme*, 15. *Hygrophorus eburneus*, 16. *Hydropus floccipes*, 17. *Hygrocybe ceracea*, 18. *Hygrocybe coccinea*, 19. *Hymenopellis radicata*, 20. *Inosperma erubescens*, 21. *Lycoperdon molle*, 22. *Laccaria amethystina*, 23. *Lactifluus piperatus*, 24. *Lentinus crinitus*, 25. *Marasmius oreades*, 26. *Mycena haematopus*, 27. *Mycena galericulata*, 28. *Paxillus involutus*, 29. *Phlebia acerina*, 30. *Phyllotopsis nidulans*, 31. *Rigidoporus sanguinolentus,* 32. *Pleurotus pulmonarius*, 33. *Pluteus cervinus*, 34. *Laccaria laccata*, 35. *Thelephora palmata*, 36. *Strobilurus albipilatus*, 37. *Russula delica*, 38. *Russula vesca*, 39. *Schizophyllum commune*, 40. *Strobilomyces strobilaceus*, 41. *Thaxterogaster purpurascens*, 42. *Trametes gibbosa*, 43. *Trametes hirsuta*, 44. *Xylaria hypoxylon*, 45. *Auricularia auricula-judae*, 46. *Calvatia cyathiformis*, 47. *Clavulina coralloides*, 48. *Clavulinopsis aurantiocinnabarina*, 49. *Grifola frondosa*, 50. *Hymenopellis raphanipes*, 51. *Cordyceps tenuipes*, 52. *Lentinus arcularius*, 53. *Marasmiellus* sp, 54. *Marasmius rotula*, 55. *Omphalotus japonicus*, 56. *Peziza atrovinosa*, 57. *Candolleomyces candolleanus)*

Table 1. Mushroom taxa collected and identified from farm forest of eastern Nepal

Mushroom Taxa	Classification	Ecology	Edibility	Habitat	Common name
Ascocoryne cylichnium (Tul.) Korf	Phylum: Ascomycota; Order: Helotiales; Family: Helotiaceae	Saprophytic	Inedible	Forest floor on soil under high canopy	
Cordyceps tenuipes (Peck) Kepler, B. Shrestha & Spatafora	Phylum: Ascomycota; Order: Hypocreales; Family: Cordycipitaceae	Entemophilous	Edible	Dead insect	
Peziza atrovinosa Cooke & W.R. Gerard	Phylum: Ascomycota; Order: Pezizales; Family: Pezizaceae	Saprophytic	Unknown	Dead tree stump	Cup fungus
Aleuria aurantia (Pers.) Fuckel	Phylum: Ascomycota; Order: Pezizales; Family: Pyronemataceae	Saprophytic	Edible	Forest floor on soil under high canopy	Orange Peel Fungus
Xylaria hypoxylon (L.) Grev.	Phylum: Ascomycota; Order: Xylariales; Family: Xylariaceae	Saprophytic	Inedible	Dead trunk of *Prunus cerasoides*	Candlestick fungus
Xylaria polymorpha (Pers.) Grev.	Phylum: Ascomycota; Order: Xylariales; Family: Xylariaceae	Saprophytic	Inedible	Dead bamboo stump (moist)	Dead man's fingers
Calvatia cyathiformis (Bosc) Morgan	Phylum: Basidiomycota; Order: Agaricales; Family: Agaricaceae	Saprophytic	Edible	Forest floor	Purple-spored puffball
Lycoperdon molle Pers.	Phylum: Basidiomycota; Order: Agaricales; Family: Agaricaceae	Saprophytic	Inedible	Dead tree stumps in moist place (High canopy)	The soft puffball
Clavulinopsis aurantiocinnabarina (Schwein.) Corner	Phylum: Basidiomycota; Order: Agaricales; Family: Clavariaceae	Saprophytic	Unknown	Forest floor (High canopy)	Orange spindle coral
Thaxterogaster purpurascens (Fr.) Niskanen & Liimat.	Phylum: Basidiomycota; Order: Agaricales; Family: Cortinariaceae	Mycorrhizal	Edible	Forest floor under the canopy of *Alnus nepalensis, Macaranga sp, Engelhardia sp, Dendrocalamus* sp	Bruising Webcap
Entoloma hochstetteri (Reichardt) G.Stev.	Phylum: Basidiomycota; Order: Agaricales; Family: Entolomataceae	Saprophytic	Unknown	Forest floor under the canopy of *Alnus nepalensis, Macaranga sp, Engelhardia sp, Dendrocalamus sp*	Blue pinkgill
Laccaria amethystina Cooke	Phylum: Basidiomycota; Order: Agaricales; Family: Hydnangiaceae	Mycorrhizal	Edible	Forest floor/litter rich under the canopy of *Alnus sp, Macaranga sp, Engelhardia sp, Dendrocalamus sp*	The amethyst deceiver
Laccaria laccata (Scop.) Cooke	Phylum: Basidiomycota; Order: Agaricales; Family: Hydnangiaceae	Mycorrhizal	Edible	Forest floor/litter rich under the canopy of *Alnus sp, Macaranga sp, Engelhardia sp,, Dendrocalamus*	Deceiver
Hygrocybe ceracea (Sowerby) P.Kumm.	Phylum: Basidiomycota; Order: Agaricales; Family: Hygrophoraceae	Mycorrhizal	Edible	Forest floor with litter and branches	Butter Waxcap

Mushroom Taxa	Classification	Ecology	Edibility	Habitat	Common name
Hygrocybe coccinea (Schaeff.) P.Kumm.	Phylum: Basidiomycota; Order: Agaricales; Family: Hygrophoraceae	Mycorrhizal	Inedible	Under the canopy of bamboo in the moist area	Scarlet waxcap
Hygrophorus eburneus (Bull.) Fr.	Phylum: Basidiomycota; Order: Agaricales; Family: Hygrophoraceae	Mycorrhizal	Edible	Forest floor/litter rich under the canopy of *Alnus sp, Macaranga sp, Exbucklandia sp*, *Dendrocalamus* sp	Ivory waxy cap
Inosperma erubescens (A.Blytt) Matheny & Esteve-Rav.	Phylum: Basidiomycota; Order: Agaricales; Family: Inocyabaceae	Mycorrhizal	Poisonous	Litter rich forest floor	Deadly Fibrecap
Hydropus floccipes (Fr.) Singer	Phylum: Basidiomycota; Order: Agaricales; Family: Marasmiaceae	Saprophytic	Unknown	Forest floor with litter and branches	Toadstool
Marasmius oreades (Bolton) Fr.	Phylum: Basidiomycota; Order: Agaricales; Family: Marasmiaceae	Saprophytic	Inedible	Forest floor	The fairy ring mushroom
Marasmius rotula (Scop.) Fr.	Phylum: Basidiomycota; Order: Agaricales; Family: Marasmiaceae	Saprophytic	Inedible	Small dead branches of trees	The pinwheel mushroom
Favolaschia pustulosa (Jungh.) Kuntze	Phylum: Basidiomycota; Order: Agaricales; Family: Mycenaceae	Saprophytic	Unknown	Dead bamboo stumps/ low canopy	White Porecap
Mycena galericulata (Scop.) Gray	Phylum: Basidiomycota; Order: Agaricales; Family: Mycenaceae	Saprophytic	Inedible	Dead tree stumps in moist place	The common bonnet
Mycena haematopus (Pers.) P.Kumm.	Phylum: Basidiomycota; Order: Agaricales; Family: Mycenaceae	Saprophytic	Inedible	Forest floor/litter rich under the canopy of *Alnus sp, Macaranga sp*, *Engelhardia sp, Dendrocalamus sp*	The blood-foot mushroom
Marasmiellus sp	Phylum: Basidiomycota; Order: Agaricales; Family: Omphalotaceae	Saprophytic	Unknown	Small dead branches of trees	
Omphalotus japonicus (Kawam.) Kirchm. & O.K.Mill.	Phylum: Basidiomycota; Order: Agaricales; Family: Omphalotaceae	Saprophytic	Poisonous	Dead tree stump	
Phyllotopsis nidulans (Pers.) Singer	Phylum: Basidiomycota; Order: Agaricales; Family: Phyllotopsidaceae	Saprophytic	Unknown	Dead tree stump	Orange mock oyster
Flammulina velutipes (Curtis) Singer	Phylum: Basidiomycota; Order: Agaricales; Family: Physalacriaceae	Parasitic	Edible	Dead tree stumps/ low canopy	Velvet foot
Hymenopellis raphanipes (Berk.) R.H.Petersen	Phylum: Basidiomycota; Order: Agaricales; Family: Physalacriaceae	Saprophytic	Unknown	Litter rich forest floor	
Hymenopellis radicata (Relhan) R.H.Petersen	Phylum: Basidiomycota; Order: Agaricales; Family: Physalacriaceae	Saprophytic	Edible	Large cardamom farm under canopy of *Alnus nepaulensis*, *Macaranga nepalensis*	The rooting shank

Mushroom Taxa	Classification	Ecology	Edibility	Habitat	Common name
Strobilurus albipilatus (Peck) V.L.Wells & Kempton	Phylum: Basidiomycota; Order: Agaricales; Family: Physalacriaceae	Saprophytic	Unknown	Litter rich forest floor	
Pleurotus pulmonarius (Fr.) Quél.	Phylum: Basidiomycota; Order: Agaricales; Family: Pleurotaceae	Saprophytic	Edible	Dead trunk of *Ficus nerrifolia*	Indian Oyster
Pluteus cervinus (Schaeff.) P.Kumm.	Phylum: Basidiomycota; Order: Agaricales; Family: Pluteaceae	Saprophytic	Edible	Forest floor	Deer mushroom
Candolleomyces candolleanus (Fr.) D.Wächt. & A.Melzer	Phylum: Basidiomycota; Order: Agaricales; Family: Psathyrellaceae	Saprophytic	Unknown	Forest floor	Crumble Cap
Coprinellus disseminatus (Pers.) J.E.Lange	Phylum: Basidiomycota; Order: Agaricales; Family: Psathyrellaceae	Saprophytic	Edible	Forest floor and dead tree stumps	Fairy inkcap
Coprinopsis lagopus (Fr.) Redhead, Vilgalys & Moncalvo	Phylum: Basidiomycota; Order: Agaricales; Family: Psathyrellaceae	Saprophytic	Unknown	Forest floor and dead tree stumps	Hare'sfoot Inkcap
Pterula sp	Phylum: Basidiomycota; Order: Agaricales; Family: Pterulaceae	Saprophytic	Unknown	Bamboo base	Angel hair coral.
Schizophyllum commune Fr.	Phylum: Basidiomycota; Order: Agaricales; Family: Schizophyllaceae	Saprophytic	Edible	Dead bamboo stump (Dry)	Common split gill
Delicatula integrella (Pers.) Fayod	Phylum: Basidiomycota; Order: Agaricales; Family: Tricholomataceae	Saprophytic	Inedible	Forest floor and dead tree branches	
Auricularia auricula-judae (Bull.) Quél.	Phylum: Basidiomycota; Order: Auriculariales; Family: Auriculariaceae	Saprophytic	Edible	Dead *Alnus nepalensis* tree stump	Jelly ear
Auricularia cornea Ehrenb.	Phylum: Basidiomycota; Order: Auriculariales; Family: Auriculariaceae	Saprophytic	Edible	Dead tree stumps and branches	Hairy Jew's Ear, Wood Ear
Strobilomyces strobilaceus (Scop.) Berk.	Phylum: Basidiomycota; Order: Boletales; Family: Boletaceae	Mycorrhizal	Edible	Under canopy of *Rhododendron* sp.	Old man of the woods
Paxillus involutus (Batsch) Fr.	Phylum: Basidiomycota; Order: Boletales; Family: Paxillaceae	Mycorrhizal	Edible	Forest floor/litter rich under the canopy of *Alnus sp, Macaranga sp, Engelhardia sp, Dendrocalamus sp*	The brown roll-rim
Clavulina cristata (Holmsk.) J.Schröt.	Phylum: Basidiomycota; Order: Cantharellales; Family: Clavulinaceae	Saprophytic	Edible	Forest floor	The crested coral fungus
Geastrum lageniforme Vittad.	Phylum: Basidiomycota; Order: Geastrales; Family: Geastraceae	Saprophytic	Inedible	Humus rich forest floor	Flask earthstar

Mushroom Taxa	Classification	Ecology	Edibility	Habitat	Common name
Fomitopsis pinicola (Sw.) P.Karst.	Phylum: Basidiomycota; Order: Polyporales; Family: Fomitopsidaceae	Saprophytic	Inedible	Forest floor/litter rich under the canopy of *Alnus sp*, *Macaranga sp*, *Exbucklandia sp*, *Ficus sp*	Red-belted conk
Ganoderma lucidum (Curtis) P.Karst.	Phylum: Basidiomycota; Order: Cantharellales; Family: Ganodermataceae	Saprophytic	Edible	Dead tree stumps	
Rigidoporus sanguinolentus (Alb. & Schwein.) Donk	Phylum: Basidiomycota; Order: Cantharellales; Family: Meripilaceae	Saprophytic	Inedible	Dead tree stump	
Phlebia acerina Peck Family: Meripilaceae	Phylum: Basidiomycota; Order: Cantharellales;	Saprophytic	Inedible	Dead tree stump of *Leucospectrum canum*	
Lentinus arcularius (Batsch) Zmitr.	Phylum: Basidiomycota; Order: Cantharellales; Family: Polyporaceae	Saprophytic	Inedible	Forest floor/litter rich under the canopy of *Alnus sp, Engelhardia sp, Exbucklandia sp*, *Dendrocalamus sp*	Spring polypore
Lentinus crinitus (L.) Fr.	Phylum: Basidiomycota; Order: Cantharellales; Family: Polyporaceae	Saprophytic	Edible	Forest floor/litter rich under the canopy of *Alnus sp, Macaranga sp, Exbucklandia sp*, *Dendrocalamus sp*	Fringed sawgill
Trametes gibbosa (Pers.) Fr.	Phylum: Basidiomycota; Order: Cantharellales; Family: Polyporaceae	Saprophytic	Inedible	Dead tree stumps	The lumpy bracket
Trametes hirsuta (Wulfen) Lloyd	Phylum: Basidiomycota; Order: Cantharellales; Family: Polyporaceae	Saprophytic	Inedible	Dead tree stumps	Hairy bracket
Bondarzewia berkeleyi (Fr.) Bondartsev & Singer	Phylum: Basidiomycota; Order: Russulales; Family: Russulaceae	Saprophytic	Edible	Dead tree stump	Berkeley's polypore
Lactifluus piperatus (L.) Roussel	Phylum: Basidiomycota; Order: Russulales; Family: Russulaceae	Mycorrhizal	Edible	Litter rich forest floor	The Peppery Milkcap
Russula delica Fr.	Phylum: Basidiomycota; Order: Russulales; Family: Russulaceae	Saprophytic	Edible	Under the canopy of *Schima wallichii, Alnus nepalensis, Dendrocalamus* sp	Milk-white brittlegill
Russula vesca Fr.	Phylum: Basidiomycota; Order: Russulales; Family: Russulaceae	Mycorrhizal	Edible	Under canopy of trees/humus rich soil	Bare Toothed Brittlegill
Thelephora palmata (Scop.) Fr.	Phylum: Basidiomycota; Order: Thelephorales; Family: Thelephoraceae	Mycorrhizal	Inedible	Litter-rich forest floor	The stinking earthfan

Table 2. Bioactive compounds and medicinal prospects of selected edible species found in farm forest, Sandakpur-03, Ilam, Koshi province, Eastern Nepal

Macrofungal species	Bioactive Compounds	Medicinal values	References
Auricularia auricula-judae (Bull.) Quél	2-Nonenoic acid, 2(3H)-Furanone, Acetyl cyanide, 6-Nitro-8-methoxy-2H-chromene, N-Desmethyltapentadol	Anti-microbial, anti-oxidant, anti-inflammatory, anti-fungal, immune-modulatory, anti-coagulant, anti-diabetic, radio-protective, anti-cancer, cytotoxic	Oli *et al*., 2020; Jamtsho and Wangchuk, 2023
Ganoderma lucidum (Curtis) P.Karst.	Polysaccharides, Glycoproteins (lectins), Ganoderic acid, Lucidenic acid, Ganoderiol, Lucidumol, Ganodermatriol, Ganodermanontriol, β-Glucans	Anti-inflammatory, Anti-cancer, Anti-viral (including HIV), Anti-microbial, Hypotensive, Cardio-tonic, Immuno-modulating, Nephrotonic, Hepatoprotective, Neurotonic, Anti-asthmatic	Ekiz *et al*., 2023; £ysakowska *et al*., 2023
Cordyceps tenuipes (Peck) Kepler, B. Shrestha & Spatafora	Cordycepin, Tenuipyrone, Cephalosporolide C, 4-b-Acetoxyscirpendiol, Tenuipesine, Paecilomycine, Isariotin, 3'-Deo-xyhanasanagin, Adenosine, Spiro-tenuipesine, Phenol	Antioxidant, antiproliferative, anti-inflammatory, insecticidal activities, antifungal, Cytotoxic	Pitiwittayakul *et al*., 2023; Chhetri *et al*., 2020
Lactifluus piperatus (L.) Roussel	Hexanal, Benzaldehyde, Octanal, Nonanal, Decanal, Heptanone, Acetophenone, β-Pinene, D-Limonene, Dimethyl trisulfide, n-Decanoic acid, Catechin	Antioxidant, Antimicrobial, genoprotective, anticancer, neuroprotective, antithrombotic, antimutagenic	Shamtsyan, 2016; Kosanic *et al*., 2020; Jamtsho and Wangchuk, 2023
Schizophyllum commune Fr.	Schizoplyllan, β-carotene, flavonoids, lycopene, phenols, tocopherol, Ascorbic acid, β-glucans, hetero-β-glucans	Cytotoxic, antioxidant, anti-fungal, antibiotic, anti-inflamm-atory, immunomodulating, anti-cancer, antiparasitic, antiviral, apoptogenic, hepatoprotective, cardioprotective	Emsen *et al*., 2017; Berikashvili *et al*., 2023

are recently widely researched for their anti-proliferative, anti-spasmodic anti-inflammatory and anti-microbial properties (Begum *et al*., 2023; Sresuksai *et al*., 2024). However, this study specifically highlighted only six edible species describing their bioactive compounds and medicinal values based on reviewed published literatures (Table. 2).

Research on macrofungal populations in present study area with moderate rainfall revealed a diverse macrofungal species. However, the therapeutic and edible benefits of maximum mushrooms remain unknown to the local population. Long-term observations are needed to improve our understanding of regional macrofungal assemblies and species diversity. More research is needed to understand macrofungi in this type of environment.

CONCLUSION

This study shed light on the diversity of macrofungal species within a small range of disturbed, fragmented and privately-owned farm forest. Fifty-seven macrofungal species were identified with their ecological significance through associative saprophytic and mycorrhizal relationships. However, the list of macrofungal species in this study provides baseline information needed for assessing changes in the macrofungal diversity. We strongly recommend

further researches in such farm forest to benefit farmers in managing these forests, which can maximize the outcome and sustain forest products while preserving biodiversity.

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