Mushroom Diversity Prevailing in the World Peace Biodiversity Garden, Raniban, Pokhara, Nepal

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This study presents the first comprehensive survey of higher fungi, particularly mushrooms, in the World Peace Biodiversity Garden, Raniban, Kaski District, central Nepal. It was carried out during the monsoon seasons in 2022-2024. A total of 44 fungal species, comprising 2 Ascomycetes and 42 Basidiomycetes, were collected. The Ascomycetes were restricted to a single order with two families and two genera, while the Basidiomycetes embraced eight orders with 24 families and 30 genera. Agaricales dominated with 17 species, followed by Polyporales and Russulales (6 species each). The identification was done following relevant literature, and the nomenclature is based on Index Fungorum. The most diverse families were Polyporaceae and Russulaceae, each with 6 species, while other families were represented by 1 to 3 species. Soil was found to be the predominant substrate for 23 species. During discussions with the local collectors and after visual observations, it was found that out of 16 edible species, seven species are locally collected for culinary purposes and *Amanita*-like species are avoided by locals as they are considered poisonous. Further exploration, ethnomycological surveys, and ecological studies are necessary to investigate the fungal diversity of this area.

Keywords: Ascomycetes; Basidiomycetes; Macrofungi; Mushroom; Raniban.

Fungi, particularly mushrooms, play critical roles in ecosystems, contributing to nutrient cycles for plant growth and decomposition processes (Gadd, 2007). Among these, macrofungi, including those from the Ascomycota and Basidiomycota groups, are particularly diverse and widespread, often forming symbiotic relationships with plants, including trees (Hibbett et al., 2007). Nepal is home to a rich variety of mushrooms, with over 1,291 species recorded (Devkota & Aryal, 2020). These include edible, medicinal, and even poisonous varieties. Among these, about 159 species are said to be edible (Devkota & Aryal, 2020), while 100 species are poisonous and 65 species have medicinal value (Adhikari, 2024). Previous studies had documented mushrooms from Pokhara and its adjoining regions; however, none of the studies were confined to the Raniban (Bhandary, 1991; Adhikari et al., 1996; Joshi & Joshi, 1999; Adhikari, 2025). Some notable genera found in central Nepal, including Pokhara, include *Amanita*, *Boletus*, *Cantharellus*, and *Lactarius* (Bhandary, 1991; Adhikari et al., 1996; Devkota & Aryal, 2020; Acharya, 2022).

Investigation and study of the mushroom diversity prevailing in the "World Peace Biodiversity Garden" will hold immense ecological, conservation, and educational value. Understanding their diversity helps uncover their contributions to soil health, forest vitality, and overall ecosystem functioning in the region (Heilmann-Clausen et al., 2015; Fang et al., 2023). Some mushroom species are rare or vulnerable to habitat loss. For example, *Ophiocordyceps sinensis* (Berk.) G.H. Sung. J.M. Sung, Hywel-Jones & Spatafora (locally known as "Yarsagumba"), which is highly valued in traditional medicine and dubbed "Himalayan Viagra", is highly vulnerable to habitat loss, and its wild populations are under serious threat due to over-harvesting and climate change (Yan et al., 2017; Rajbhandari, 2019). Their presence ensures that conservation measures can be tailored to protect these fungi and their habitats, which might face anthropogenic pressures. Cataloguing mushroom

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species adds to the growing knowledge about fungal diversity, highlighting the area's ecological richness and uniqueness. Identifying species can uncover traditional uses, promote sustainable harvesting practices, and even lead to the discovery of compounds beneficial to medicine. Documentation serves as an educational tool, raising awareness about the importance of fungi in the natural world. It also connects local cultural practices to biodiversity conservation, fostering a sense of stewardship (Venturella et al., 2021; Panda & Luyten, 2022; Hamza et al., 2024; Singh et al., 2025).

The World Peace Biodiversity Garden is known for its diverse fungal species, including mushrooms. However, this study attempts to address this gap by carrying out the first comprehensive survey of mushrooms in this garden.

Materials and Methods

Study area

The World Peace Biodiversity Garden (established in 2014 A.D.), at Raniban, Pokhara, lies in Kaski District, Nepal (Figure 1). The name "Raniban" has historical and cultural significance. "Rani" translates to "queen" in Nepali, and "ban" means "forest" or "woodland." The garden is extended in an area of 164.76 hectares, and its altitude varies from 775 to 1078 m asl (DPR, 2025). It is situated on the southwest corner of Fewa Lake, extending from Pardi Fewa Dam to the World Peace Stupa. Raniban forest is a mixed forest of *Schima-Castanopsis* with its associated vegetation, including *Albizia* sp., *Alnus nepalensis*, *Diospyros lanceifolia*, *Magnolia champaca*, *Pinus roxburghii*, and *Prunus cerasoides*, etc. The study area has a subtropical climate, which is cool and humid.

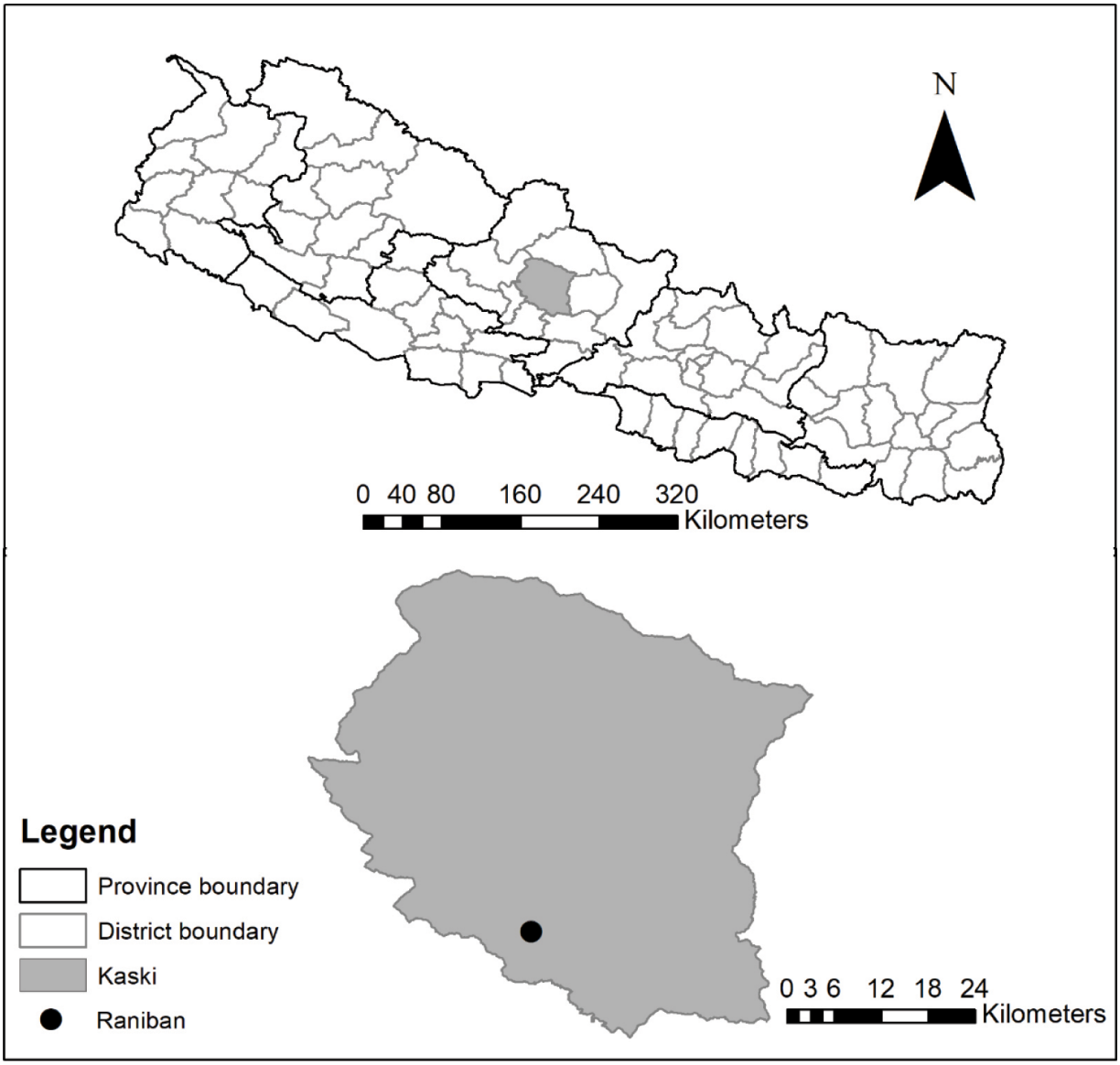

Figure 1: Map of the study area

Collection and identification

The area was surveyed three times in the monsoon season over three consecutive years: August 22, 2022; August 28, 2023; and September 1-2, 2024. A total of 44 fungal species, comprising two Ascomycetes and 42 Basidiomycetes fungi, were gathered from the study area. After thorough drying with a fan heater, the collected specimens were placed in paper envelopes with the appropriate tags and collection numbers. The collected specimens have been deposited at the National Herbarium and Plant Laboratories (KATH), Godawari, Lalitpur.

Some specimens are also preserved in a solution of distilled water, alcohol, and formaldehyde in a ratio of 70:25:5, by following the method described by Purkayastha & Chandra (1985). The specimen identification was carried out using relevant literature (Teng, 1939; Miller, 1972; Walting, 1973; Alexopoulos & Mims, 1979; Dickson & Lucas, 1979; Dennis, 1981; Lincoff, 1982; Svrček, 1983; Adhikari, 2000, 2024). Scientific names for fungi are derived from Index Fungorum (2025).

Results

Altogether 44 fungal species, consisting of 2 Ascomycetes and 42 Basidiomycetes species, were collected from the study area. The Ascomycetes species belonged to a single order, comprising two families and two genera, while the Basidiomycetes species belonged to eight orders, comprising 24 families and 30 genera.

Furthermore, the Ascomycetes fungal species belonged to the order Xylariales and were represented by the Hypoxylaceae and Xylariaceae families. On the other hand, the majority of the Basidiomycetes fungi belonged to the order Agaricales. With 17 species, the dominant order in the study area was Agaricales. The order Agaricales was equally followed by Polyporales and Russulales with seven species each, followed by Boletales with five species and Hymenochaetales with three species (Figure 2). Similarly, with six species each, the dominating families were determined to be Polyporaceae and Russulaceae. It was followed by Hymenochaetaceae (three species), Agaricaceae, Amanitaceae, Dacrymycetaceae, Hydnaceae, Hydnangiaceae, Marasmiaceae, Physalacriaceae, and Sclerodermataceae (two species), and the rest of the families were represented by only one species (Figure 3).

Enumeration of species

1. *Agaricus cantharellus* Batsch [Agaricales: Agaricaceae]
   On decayed log of *Pinus roxburghii* Sarg., Raniban, 852 m, 2 September 2024; collection no. 20249361, collector- R. Acharya, S. Devkota & D. R. Koirala

2. *Amanita farinosa* cf. Schwein. [Agaricales: Amanitaceae]
   On moist soil, Raniban, 850 m, 22 August 2022, collection no. 20228222, collector- R. Acharya

3. *Amanita vaginata* (Bull.) Lam. [Agaricales: Amanitaceae]
   On moist soil, Raniban, 785 m, 1 September 2024; collection no. 20249213, collector- R. Acharya, S. Devkota & D. R. Koirala

4. *Baorangia bicolor* (Kuntze) G. Wu, Halling & Zhu L. Yang [Boletales: Boletaceae] **Edible**
   On moist soil, Raniban, 782 m, 1 September 2024; collection no. 2024924, collector- R. Acharya, S. Devkota & D. R. Koirala

5. *Calocera cornea* (Batsch) Fr. [Dacrymycetales: Dacrymycetaceae]
   On decayed wood, Raniban, 780 m, 2 September 2024; collection no. 20249350, collector- R. Acharya, S. Devkota & D. R. Koirala

6. *Cantharellus cibarius* Fr. [Cantharellales: Hydnaceae] **Edible**
   On moist soil, Raniban, 785 m, 1 September 2024; collection no. 20249225, collector- R. Acharya, S. Devkota and D. R. Koirala

7. *Cantharellus subalbidus* A.H. Sm. & Morse [Cantharellales: Hydnaceae] **Edible**
   On moist soil, Raniban, 850 m, 22 August 2022; collection no.20228228, collector- R. Acharya

8. *Clitocybe fragrans* (With.) P. Kumm. [Agaricales: Clitocybaceae]
   On bark of dead tree, Raniban, 851 m, 22 August 2022; collection no. 20228224, collector- R. Acharya

9. *Coltricia cinnamomea* (Jacq.) Murrill [Hymenochaetales: Hymenochaetaceae]
   On moist soil, Raniban, 876 m, 1 September 2024; collection no. 20249223, collector- R. Acharya, S. Devkota & D. R. Koirala

10. *Coprinellus micaceus* (Bull.) Vilgalys, Hopple & Jacq. Johnson [Agaricales: Psathyrellaceae] **Edible when young**
On stump of *Castanopsis indica* (Roxb.) Miq., Raniban, 960 m, 22 August 2022; collection no. 20238287, collector- R. Acharya

11. *Dacrymyces spathularia* (Schwein.) Alvarenga [Dacrymycetales: Dacrymycetaceae] **Edible**
On decayed wood, Raniban, 890 m, 2 September 2024; collection no. 20249351, collector- R. Acharya, S. Devkota & D. R. Koirala

12. *Daldinia concentrica* (Bolton) Ces. & De Not. [Xylariales: Hypoxylaceae]
On decayed wood, Raniban, 850 m, 2 September 2024; collection no. 20249354, collector- R. Acharya, S. Devkota & D. R. Koirala

13. *Ganoderma applanatum* (Pers.) Pat. [Polyporales: Polyporaceae]
On trunk of living tree of *Melia azedarach* L., Raniban, 880 m, 2 September 2024; collection no. 20249352, collector- R. Acharya, S. Devkota & D. R. Koirala

14. *Geastrum saccatum* Fr. [Geastrales: Geastraceae]
On moist soil, Raniban, 785 m, 1 September 2024; collection no. 20249226, collector- R. Acharya, S. Devkota & D. R. Koirala

15. *Hygrophoropsis aurantiaca* (Wulfen) Maire ex Martin-Sans [Boletales: Hygrophoropsidaceae]
On soil, Raniban, 895 m, 22 August 2022; collection no. 20228221, collector- R. Acharya

16. *Hymenochaete rubiginosa* (Dicks.) Lév. [Hymenochaetales: Hymenochaetaceae]
On stump of *Schima wallichii* Choisy, Raniban, 785 m, 1 September 2024; collection no. 20249221, collector- R. Acharya, S. Devkota & D. R. Koirala

17. *Hymenopellis radicata* (Relhan) R. H. Petersen [Agaricales: Physalacriaceae] **Edible**
On soil, Raniban, 781 m, 1 September 2024; collection no. 2024922, collector- R. Acharya, S. Devkota & D. R. Koirala

18. *Hypholoma fasciculare* (Huds.) P. Kumm. [Agaricales: Strophariaceae] **Poisonous**
On log of *Castanopsis indica* (Roxb.) Miq., Raniban, 891 m, 2 September 2024; collection no. 20249349, collector- R. Acharya, S. Devkota & D. R. Koirala

19. *Inonotus* sp. [Hymenochaetales: Hymenochaetaceae]
On stump of *Castanopsis indica* (Roxb.) Miq., Raniban, 785 m, 1 September 2024; collection no. 20249218, collector- R. Acharya, S. Devkota & D. R. Koirala

20. *Laccaria amethystina* Cooke [Agaricales: Hydnangiaceae] **Edible**
On soil, Raniban, 850 m, 22 August 2022; collection no. 2028229, collector- R. Acharya

21. *Laccaria laccata* (Scop.) Cooke [Agaricales: Hydnangiaceae] **Edible**
On moist soil, Raniban, 852 m, 2 September 2024; collection no. 20249353, collector- R. Acharya, S. Devkota & D. R. Koirala

22. *Lepiota* sp. [Agaricales: Agaricaceae]
On decayed leaf litter, Raniban, 790 m, 1 September 2024; collection no. 20249230, collector- R. Acharya, S. Devkota & D. R. Koirala

23. *Marasmius* sp. [Agaricales: Marasmiaceae]
On decayed leaf of *Castanopsis indica* (Roxb.) Miq., Raniban, 785 m, 1 September 2024; collection no. 20249224, collector- R. Acharya, S. Devkota & D. R. Koirala

24. *Marasmius oreades* (Bolton) Fr. [Agaricales: Marasmiaceae] **Edible**
On decayed leaf of *Castanopsis indica* (Roxb.) Miq., Raniban, 785 m, 1 September 2024; collection no. 20249224, collector- R. Acharya, S. Devkota & D. R. Koirala

25. *Microporus affinis* (Blume & T. Nees) Kuntze [Polyporales: Polyporaceae]
On fallen branch of *Alnus nepalensis* D. Don, Raniban, 785 m, 1 September 2024; collection no. 20249219, collector- R. Acharya, S. Devkota & D. R. Koirala

26. *Microporus xanthopus* (Fr.) Kuntze [Polyporales: Polyporaceae]
On fallen branch of *Castanopsis indica* (Roxb.) Miq., Raniban, 785 m, 1 September 2024; collection no. 20249217, collector- R. Acharya, S. Devkota & D. R. Koirala

27. *Mycena* sp. [Agaricales: Mycenaceae]
On moist soil, Raniban, 845 m, 2 September 2024; collection no. 20249334 collector- R. Acharya, S. Devkota & D. R. Koirala

28. *Mucidula mucida* (Schrad.) Pat. [Agaricales: Physalacriaceae] **Edible**
On moist soil, Raniban, 781 m, 1 September 2024, collection no. 2024921; collector- R. Acharya, S. Devkota & D. R. Koirala

29. *Picipes badius* (Pers.) Zmitr. & Kovalenko [Polyporales: Polyporaceae]
On fallen branch of *Alnus nepalensis* D. Don, Raniban, 783 m, 1 September 2024; collection no. 2024927, collector- R. Acharya, S. Devkota & D. R. Koirala

30. *Pleurotus ostreatus* (Jacq.) P. Kumm. [Agaricales: Pleurotaceae] **Edible**
On trunk of dead tree, Raniban, 950 m, 28 August 2023; collection no. 20238281, collector- R. Acharya, S. Devkota & D. R. Koirala

31. *Russula chloroides* (Krombh.) Bres. [Russulales: Russulaceae] **Edible**
On soil, Raniban, 852 m, 2 September 2024; collection no. 20249355, collector- R. Acharya, S. Devkota & D. R. Koirala

32. *Russula delica* Fr. [Russulales: Russulaceae] **Edible**
On soil, Raniban, 785 m, 2 September 2024; collection no. 20249216, collector- R. Acharya, S. Devkota, D. R. Koirala & Y. B. Nepali

33. *Russula flavida* Frost ex Peck [Russulales: Russulaceae] **Edible**
On soil, Raniban, 873 m, 22 August 2022; collection no. 20228207, collector- R. Acharya

34. *Russula rosea* Pers. [Russulales: Russulaceae]
On soil, Raniban, 851 m, 2 September 2024; collection no. 20249356, collector- R. Acharya, S. Devkota & D. R. Koirala

35. *Russula sanguinaria* (Schumach.) Rauschert [Russulales: Russulaceae]
On soil, Raniban, 865 m, 2 September 2024; collection no. 20249362, collector- R. Acharya, S. Devkota & D. R. Koirala

36. *Russula virescens* (Schaeff.) Fr. [Russulales: Russulaceae] **Edible**
On soil, Raniban, 785 m, 1 September 2024; collection no. 20249214, collector- R. Acharya, S. Devkota & D. R. Koirala

37. *Schizophyllum commune* Fr. [Agaricales: Schizophyllaceae] **Edible**
On log of wood, Raniban, 845 m, 2 September 2024; collection no. 20249357, collector- R. Acharya, S. Devkota & D. R. Koirala

38. *Scleroderma cepa* Pers. [Boletales: Sclerodermataceae] **Poisonous**
On soil, Raniban, 785 m, 2 September 2024; collection no. 20249227, collector- R. Acharya, S. Devkota, Y. B. Nepali & D. R. Koirala

39. *Scleroderma citrinum* Pers. [Boletales: Sclerodermataceae] **Poisonous**
On soil, Raniban, 847 m, 2 September 2024; collection no. 20249358, collector- R. Acharya, S. Devkota & D. R. Koirala

40. *Suillus americanus* (Peck) Snell [Boletales: Suillaceae]
On soil, Raniban, 849 m, 2 September 2024; collection no. 20249359, collector- R. Acharya, S. Devkota & D. R. Koirala

41. *Termitomyces clypeatus* R. Heim [Agaricales: Lyophyllaceae] **Edible**
On soil, Raniban, 879 m, 28 August 2023; collection no. 20238282, collector- R. Acharya, S. Devkota & D. R. Koirala

42. *Trametes apiaria* (Pers.) Zmitr., Wasser & Ezhov [Polyporales: Polyporaceae]
On stump of *Castanopsis indica* (Roxb.) Miq., Raniban, 860 m, 2 September 2024; collection no. 20249338, collector- R. Acharya, S. Devkota & D. R. Koirala

43. *Trametes cinnabarina* (Jacq.) Fr. [Polyporales: Polyporaceae]
On log of wood, Raniban, 851 m, 2 September 2024; collection no. 20249360, collector- R. Acharya, S. Devkota & D. R. Koirala

44. *Xylaria hypoxylon* (L.) Grev. [Xylariales: Xylariaceae]
On decayed fruit of *Schima wallichii* Choisy, Raniban, 790 m, 2 September 2024; collection no. 20249333, collector- R. Acharya, S. Devkota & D. R. Koirala

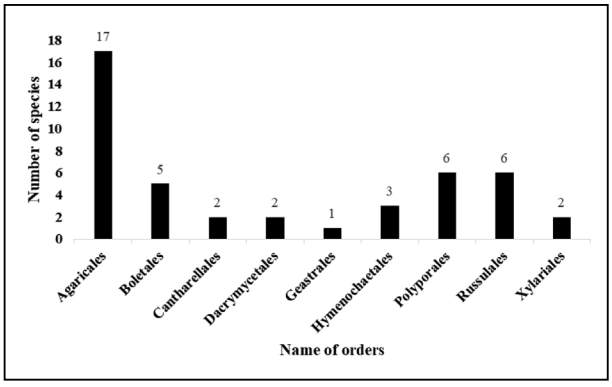

Figure 2: Orders representing the number of species in the study area

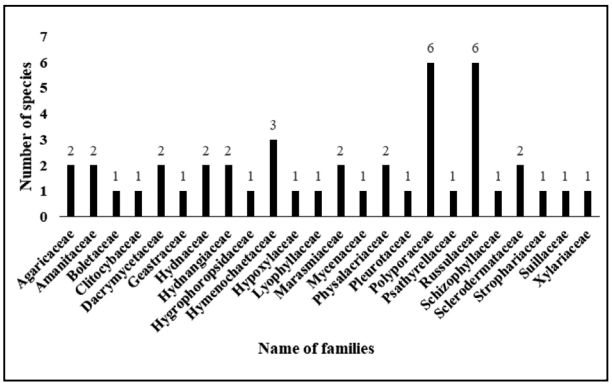

Figure 3: Families representing the number of species in the study area

Discussion

The most prevalent species of basidiomycetes, particularly Agaricales, were found to grow on soil, whereas polypores were primarily observed growing on the fallen branches, stumps, and trunks of living trees. Basidiomycetes species, such as *Microporus xanthopus* and *Microporus affinis*, were discovered to be highly prevalent in the study area out of 44 fungal species. Joshi & Joshi (1999) had reported *Apioperdon pyriforme* (Schaeff.) Vizzini, *Laccaria laccata*, *Termitomyces eurrhizus* (Berk.) R. Heim, *Trametes cinnabarina*, *Schizophyllum commune*, and *Scleroderma citrinum* from Pokhara, Nepal. Amongst them, *L. laccata*, *T. eurrhizus*, *S. commune*, and *S. citrinum* were collected from the Raniban; however, *T. eurrhizus* could not be spotted in this study. Adhikari et al. (1996) reported 19 species of mushrooms from Pokhara, of which seven species (*Coltricia cinnamomea*, *Daldinia concentrica*, *Laccaria laccata*, *Russula delica*, *Schizophyllum commune*, *Scleroderma citrinum*, and *Trametes cinnabarina*) were also found in the Raniban during this study.

Dacrymyces spathularia, *Termitomyces clypeatus*, *Trametes cinnabarina*, and *Scleroderma citrinum* are reported in the present study area and were also reported by Aryal & Budhathoki (2013) at Sankarnagar community forest, Rupandehi District, in central Nepal. Acharya (2020a) had also reported *Daldinia concentrica*, *Ganoderma applanatum*, *Microporus xanthopus*, *Schizophyllum commune*, *and Scleroderma citrinum* in Dhikura village and the nearby Rotepakho community forest in Arghakhanchi District, central Nepal. Similarly, *Daldinia concentrica*, *Inonotus* sp., *Microporus xanthopus*, *Trametes cinnabarina*, and *Schizophyllum commune*, which are reported in the present study area, were also reported by Acharya (2020b) in Lumbini Collaborative Forest, Rupandehi District, in central Nepal. Moreover, *Hymenochaete* sp., *Microporus xanthopus*, *Trametes cinnabarina*, and *Schizophyllum commune*, reported in the present study area, were also reported by Acharya (2022) on the way to the Daunne Devi temple in the Nawalparasi (Bardaghat Susta East) District, in central Nepal.

Hypholoma fasciculare, *Scleroderma cepa*, and *S. citrinum* found in this garden are poisonous according to various literature (Arora 1986; Benjamin 1995; Adhikari 2024). *Baorangia bicolor*, *Cantharellus cibarius*, *C. subalbidus*, *Coprinellus micaceus*, *Dacrymyces spathularia*, *Hymenopellis radicata*, *Laccaria amethystina*, *L. laccata*, *Marasmius oreades*, *Pleurotus ostreatus*, *Russula chloroides*, *R. delica*, *R. flavida*, *R. virescens*, *Schizophyllum commune*, and *Termitomyces clypeatus* found in this garden are reported as edible in various literature (Orr & Orr, 1979; Arora, 1986; Joshi & Joshi, 1999; Boa, 2004; Zhao et al., 2004; Miller & Miller, 2006; Phillips, 2006, 2010; Russell, 2006; Christensen et al., 2008; Schunko & Vogl, 2010; Elekes & Busuioc, 2013; Aryal & Budathoki, 2016; Meuninck, 2017; Adhikari, 2024). However, only *Cantharellus cibarius*, *Laccaria amethystina*, *L. laccata*, *Pleurotus ostreatus*, *Russula delica*, *R. virescens*, and *Termitomyces clypeatus* are used by local people for their culinary purposes. These fungi are seasonally harvested from the forest and are either consumed fresh or preserved for later use. Local knowledge systems often guide their identification, collection, and preparation, reflecting deep ecological knowledge passed through generations. Species like *C. cibarius* and *T. clypeatus* are particularly prized for their taste, texture, and digestibility (Boa, 2004; Chang & Miles, 2004). Furthermore, several of these mushrooms, such as *P. ostreatus* and *R. virescens*, have been documented to contain significant levels of protein, fibre, and bioactive compounds with antioxidant and antimicrobial properties (Wasser, 2010; Valverde et al., 2015). The use of mushrooms not only contributes to household nutrition but also plays a vital role in cultural identity and local food sovereignty. These ethnomycological practices underscore the importance of conserving forest habitats and maintaining access to traditional harvesting areas for sustaining local livelihoods.

Conclusion

The present investigation highlights a wide diversity of commonly available wild mushrooms and locally used species for their food value. Further

ethnomycological surveys, biochemical screening, and detailed ecological studies are recommended to provide more insights, and such interventions should be included in future work. The gardens' authority should play a proactive role by bringing further explorations, creating new catalogues or flyers about mushroom diversity and edibility, raising awareness among locals about mushroom poisoning, and educating them on the ecological roles of mushrooms.

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Author contribution statement

R. Acharya: Field visit, draft writing, manuscript revision. **G. Parmar**: Conception, draft writing, manuscript revision. **S. Devkota**: Field visit, identification, manuscript revision.

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