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Lichens in Apple Orchards: Are They Harmful? – Social Perspective and Control Measures in Jumla, West Nepal

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Abstract

This study attempts to document lichen species of apple orchards, and the social perspective and control measures on orchard lichens practiced by locals in Jumla, West Nepal. Four apple orchard sites were selected in two rural municipalities (Tatopani and Guthichaur). Field survey and key informant interviews were performed to collect data. Altogether 13 lichen taxa viz. *Canoparmelia* sp., *Flavoparmelia caperata, Flavopunctelia flaventior*, *Heterodermia diademata, Hypotrachyna cirrhata, H. nepalensis, Parmotrema cetratum*, *Parmotrema* sp. *Pertusaria* sp., *Phaeophyscia* sp., *Pyxine* sp., *Usnea* sp., and *Xanthoria ulophyllodes* were recorded. Epiphytic orchard lichens were considered as harmful, and the control measures included manual removal followed by application of limestone powder and blue vitriol solution once a year. Apple orchards supported to diverse lichen species providing suitable habitat, which may harbor pests of various kinds, and they may possibly harm apple plants. Further studies are in demand since the lichenological data is missing from agroecosystems in Nepal.

Keywords: Agroecosystems, Epiphytic lichens, Jumla, Management measures

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Introduction

Lichens are one of the most successful group of organisms growing on a variety of natural habitats viz. rock, soil, tree bark, twigs, leaves, wood, moss (Green et al., 2018; Pinokiyo et al., 2006) and other artificial habitats such as monuments, gravestones, plastic, textiles, and abandoned vehicles (Aptroot et al., 2014; Jagtap et al., 2013; Rai et al., 2020) as well. Lichens cover approximately 8% of the Earth's terrestrial surface (Ahmadjian, 1995; Asplund & Wardle, 2016), recording 19,409 accepted species in the world (Lücking et al., 2017). On the basis of substrates on which lichens grow they are saxicolous (on rock), corticolous (on bark trees, also known as epiphytic), foliicolous (on leaves),

muscicolous (over mosses), lignicolous (on wood), etc.

Lichens are known to exist in a variety of ecosystems, particularly all terrestrial ecosystems, and even the man-made, including agroecosystems. Agroecosystems are of great importance as the agricultural landscapes provide an interesting habitats and substrates for growth of various types of lichens (Matwiejuk, 2016; Zarabska-Bożejewicz, 2016). Many studies have revealed high diversity of lichen biota from agricultural landscapes from various parts of the world. Fruit trees primarily constitute important phorophytes for epiphytic lichens in the agricultural land (Matwiejuk, 2017). Researches from some of the European countries have underlined that apple orchards are good enough to support a rich diversity of lichens (Matwiejuk, 2017; Zarabska et al., 2009).

In Nepal, agricultural land occupies 41,275.5402 km^2 which is 28% of the total area of the country (MoALD, 2025). However, studies on land use and land cover change (LUCC) in Nepal have shown that agricultural land use was 43,880 km^2 in 2010 (Paudel et al., 2018). Among fruits cultivation, apple is one of the major subsectors within agriculture in Nepal. In fiscal year 2023/24, a total area occupied by apple was 12,492 ha with a productive area of 6,285 ha and 54,506 Mt apple production (MoALD, 2025). According to the official data from 2025 (MoALD, 2025) twelve districts of the country – Solukhumbu, Manang, Mustang, Rolpa, Rukum East, Kalikot, Dolpa, Jumla, Mugu, Humla, Bajura, and Darhula are listed as major contributors of apple production. Jumla district is the largest apple producing center of the country (Devkota et al., 2017), with a total 3,285 ha apple cultivated area, and 13,594 Mt apple production (MoALD, 2025).

Jumla is one of the ten districts of Karnali Province, West Nepal. It lies between 28°58' to 29°50' latitude and 80°51' to 82°35' longitude. Its elevation ranges from 2000 m (Nagma village) to 6424 m above sea level (asl), Patarrasi Himal (Palikhey et al., 2016). Temperature ranges from 18 to 30°C in summer and -14 to 8°C in winter, and annual average rainfall is recorded around 1300mm (Khadka & Solberg, 2020).

The lichen biota in Nepal is represented by 1,078 species (Baniya et al., 2022) which are found to distributed from the tropical to alpine zone of the country. Until now, lichenological studies are mainly centered on natural forests especially from protected areas (Baniya et al., 2024; Baniya & Gupta, 2002; Baral, 2015; Chongbang et al., 2018; Devkota, 2008), some on community managed forests (Nag et al., 2011; Rai et al., 2016), and a few on urban areas (Karmacharya et al., 2022). Although a limited number of studies have focused on lichen biota of cropland from eastern Nepal (Chongbang et al., 2018). However, our knowledge on species diversity of lichens from the agricultural landscapes is weakly recognized. In this context, present study aims to document the lichen species growing in apple orchards, and additionally, reveal the social perspectives and control measures on orchard lichens practiced by the locals in Jumla, West Nepal.

Materials and Methods

Study area

This study was conducted in two rural municipalities viz. Tatopani Rural Municipality – 4, and Guthichaur Rural Municipality – 3, Jumla district, West Nepal (Figure 1). We selected four apple orchards – two in Gidikhola village and other two in Damdase village of respective municipalities. Both the selected sites lie at the north-facing slope within the temperate mountainous zone.

Gidikhola

Gidikhola village is located along Gidikhola River in Tatopani Rural Municipality – 4 at elevation 2425 m asl. The village is inhabited

by169 households mainly Brahmin, Chhetri, and Schedule castes (SBCFUG, 2020). Tatopani RM – 4 comprises 530 households with a total population of 2091 (NSO, 2021). Gidikhola village is named after a river flowing from Gidi daha (lake) (Palikhey et al., 2016).

Damdase

Damdase village is located in Guthichaur Rural Municipality – 3 at elevation of ca. 3000m asl. The village is inhabited by 25 households of Lama and Rokaya (GCFUG, 2024). Guthichaur RM -3 comprises 357 households with a total population of 1586 (NSO, 2021).

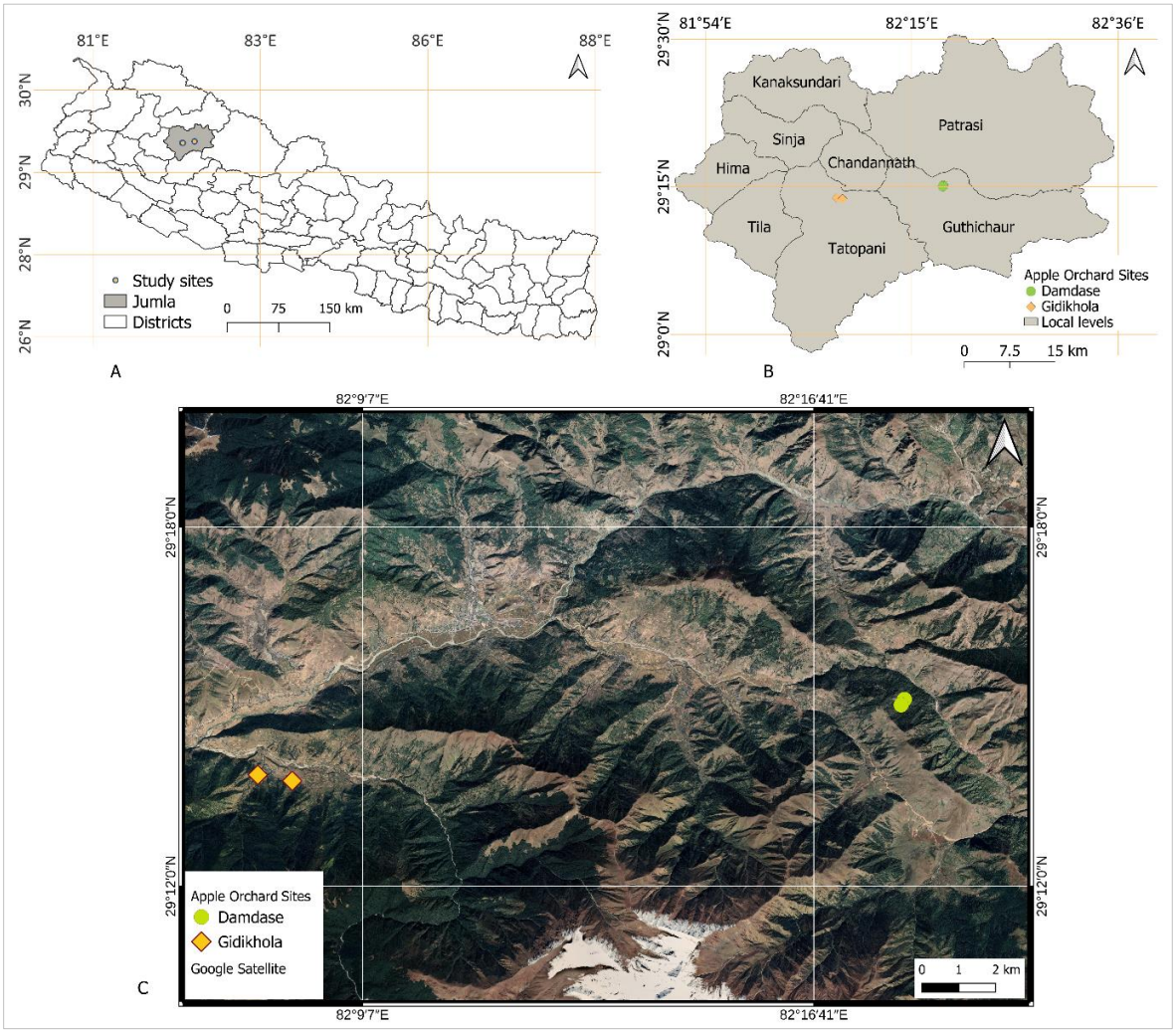

Figure 1. Map of study area. **A**. Jumla district in Nepal. **B**. Local levels of Jumla. **C**. Google Satellite image (Image © 2026 CNES/Airbus) showing the study sites in Tatopani RM and Guthichaur RM, Jumla

Field work and data collection

Field work was carried out on April and October, 2025. Key Informant Interview (KII), informal meetings with locals, and field observations were carried out to collect the primary data. Altogether four apple orchard owners were selected for KIIs (Table 1), and semi-structured questionnaires (Table 2) were asked to respondents to understand their perspective regarding the epiphytic lichens growing in their apple orchards and the

controlling measures to the lichens practiced by them.

Verbally consent was taken from the owners before collecting lichen specimens from apple orchards. Lichen specimens were removed from the bark of plant using Swiss-knife, and collected on paper envelopes. Lichen species which were identified in field were listed and unidentified species were brought to the laboratory of Central Department of Botany, Tribhuvan University, Kirtipur, Kathmandu for the identification. Geographic coordinates and elevation were recorded using Garmin *etrex30x.* Photographs of lichens were taken with a camera (*Canon PowerShotSX60 HS*).

Table 1. Details of informants participating in KIIs

SN	Respondents	Age (Years)	Address	Area of Apple orchard (m^2)
1.	Kaurav Pandey	34	Gidikhola, Tatopani RM – 4	1875
2.	Krishna Prasad Chaulagain	48	Gidikhola, Tatopani RM – 4	1200
3.	Torchi Rokaya	54	Damdase, Guthichaur RM – 3	1500
4.	Nurbu Lama	64	Damdase, Guthichaur RM – 3	3500

Table 2. Questionnaire used for informants

1.	How do you take the "*Jhyau*" (lichens) that grow on your apple orchards?
2.	How do you remove these "*Jhyau*" (lichens) from the plant?
3.	Which months do you remove these "*Jhyau*" (lichens)?
4.	What kind of measures do you adopt to remove them?
5.	Which materials do you use to remove them?

Lichen identification

Lichen specimens were identified by studying morphology and anatomy under a dissecting microscope (BS-3040T). The chemical constituents were identified through spot test reactions using three chemical reagents: Potassium hydroxide solution (K), Calcium hypochlorite solution (C), and *para*-Phenylenediamine (P). Relevant keys of Divakar (2005) and Awasthi (2007) were followed to identify the specimens. Six specimens of lichens were identified only up to genus level, since very less materials were collected during the field work. Voucher specimens were deposited at the Tribhuvan University Central Herbarium (TUCH), Kirtipur, Kathmandu, Nepal.

Results

Lichen richness

In the present study 13 lichen taxa belonging to 11 genera and five families were recorded from apple orchards in Jumla, West Nepal (Table 3). These lichen species belonged to three growth forms viz. foliose comprising 11 species, whereas crustose and fruticose with a single species each (Table 3).

Social perspective on epiphytic lichens

The apple growers and other local villagers understood the epiphytic lichens in apple orchards as harmful for plants. Respondents had a common understanding that these epiphytic lichens cause drying of apple plants. The lichens that belonged to foliose and fruticose growth forms were remarked as harmful while very negligible attention was given to crustose type lichens. During trainings organized by district Agriculture Development Office (ADO), the officials advised orchard owners to remove lichens from trees, treating them as a disease.

Control measures of epiphytic lichens

The apple growers used to remove epiphytic lichens from the bark of apple plants once a

year during the month of February and March. The sandpapers or jute sacks were used to scrub off the lichens. After removing the lichens, a solution of limestone powder (Calcium carbonate) and blue vitriol (Copper Sulfate Pentahydrate) was applied over the trunk of plants (Fig. 2F) by the help of paint brush. The coating solution was prepared by mixing about 300 gm of Copper Sulfate Pentahydrate ($CuSO_4.5H_2O$) and 1200 gm of Calcium carbonate ($CaCO_3$) in 7 liters of water. This kind of coating action would control growth of lichens and prevent pest insects as well.

Pest management measures

For pest control, the apple growers used to spray insecticide – Malathion 50% prepared by mixing one capful ca. 5 – 10 ml of chemical in 5 liters of water. The respondents used to spray insecticide (Fig. 2G) on trunk and branches of apple plants during the month of June and July. Additionally, Bordeaux mixture, neem oil, cow urine, beer (small amount mixed in solution of limestone powder and blue vitriol), were applied as pesticides.

Table 3. List of lichen taxa found growing in apple orchards of Gidikhola, Tatopani RM – 4, and Damdase, Guthichaur RM – 3, Jumla

Families	Lichen taxa	Growth form
Caliciaceae	*Pyxine* sp.	Foliose
Parmeliaceae	*Canoparmelia* sp.	Foliose
	Flavoparmelia caperata (L.) Hale	Foliose
	Flavopunctelia flaventior (Stirt.) Hale	Foliose
	Hypotrachyna cirrhata (Fr.) Divakar, A. Crespo, Sipman, Elix & Lumbsch	Foliose
	Hypotrachyna nepalensis (Taylor) Divakar, A. Crespo, Sipman, Elix & Lumbsch	Foliose
	Parmotrema cetratum (Ach.) Hale	Foliose
	Parmotrema sp.	Foliose
	Usnea sp.	Fruticose
Pertusariaceae	*Pertusaria* sp.	Crustose
Physciaceae	*Heterodermia diademata* (Taylor) D.D. Awasthi	Foliose
	Phaeophyscia sp.	Foliose
Teloschistaceae	*Xanthoria ulophyllodes* Räsänen	Foliose

Discussion

The present study documented 13 taxa of epiphytic lichens from apple orchards of two rural municipalities of the Jumla district, which is the first for the country so far. In Nepal, previously many researchers (Baniya et al., 2024; Baniya & Gupta, 2002; Baral, 2015; Nag et al., 2011; Rai et al., 2016) have documented the lichen biota from natural forests including community forests, and recently Karmacharya et al. (2022) have documented corticolous lichens from urban area. Moreover, Chongbang et al. (2018) have listed 30 species of lichens from cropland, with six corticolous (epiphytic) species from Ghunsa valley, Kanchenjunga Conservation Area, eastern Nepal. However, there is knowledge gap on species richness of epiphytic lichens from different kinds of agroecosystems in Nepal.

Many researches from European countries (Matwiejuk, 2016, 2017; Zarabska et al., 2009; Zarabska-Bożejewicz, 2016) have documented the species richness of lichen biota from agricultural landscape including apple orchards. Zarabska et al. (2009) have recorded a total of 74 lichen taxa from apple orchards of three countries viz. Poland, Slovakia, and Italy. Similarly, Matwiejuk (2016) has documented 72 taxa of epiphytic lichens from agricultural landscape of North East Poland, of which 25 species were recorded from apple trees alone. Ginszt et al. (2022) have described apple tree to be additional phorophytes to lungwort lichen *Lobaria pulmonaria,* which grows mainly in old and undisturbed forests. The high diversity and abundance of epiphytic lichens are primarily driven by the tree species itself (Spier et al., 2010), and the bark chemistry (Paukov et al., 2022).

Most of the lichen taxa recorded in our study like *Flavoparmelia caperata, Pertusaria* sp., *Phaeophyscia* sp., *Usnea* sp., *Xanthoria ulophyllodes* were also recorded on the bark of *Malus* sp. in the apple orchards from Poland, Slovakia, and Italy (Zarabska et al., 2009). The lower species richness of lichens found in our study area compared to the findings of other European countries is closely associated with the direct anthropogenic disturbance and agricultural management practices adopted by farmers. Lichen species richness has been found to decrease with the increasing anthropogenic disturbance (Boggess et al., 2024). The yearly removal of lichens from bark certainly destroys the habitat of lichens that dwelling on bark of apple plant. This kind of mechanical control followed by farmers might have caused the decrease in number of lichen species in apple orchards.

Despite social perspectives of apple growers, the epiphytic lichens use trees as growth substrate, usually do not cause any disease or damage. However, Favero-Longo and Piervittori (2010) have discussed negative relationships, including lichen parasitism and allelopathic interferences. Recent study conducted by Adhikari and Acharya (2026) have documented five major pests viz. wooly apple aphid, San Jose scale, stem borer, root borer, and tent caterpillar as severe pest infestation in Jumla. All the mentioned pests have also been discussed as major pests of apple in India (Khan et al., 2018; Sherwani et al., 2016). Although, these pests primarily feed on the living tissues of apple plant, but do not feed on lichens growing over the apple plant. However, epiphytic lichen thalli serve as shelters and/ or oviposition sites for a variety of insects primarily aphid species (Martinez et al., 2013, 2014). Additionally, our findings regarding to the control of pests and diseases practiced by local apple growers which included use of Bordeaux mixture, animal urine, and botanical pesticides, closely coincided with the previous findings of Adhikari & Acharya (2026). Moreover, spraying of malathion pesticide to control growth of epiphytic lichens including pests of apple plant was also discussed previously in other studies (Adhikari, 2022).

Conclusion

Our work revealed the social perspective on orchard lichens, and their management practices in Jumla, West Nepal. Apple trees are important phorophyte for growth of epiphytic lichens, but their studies are generally ignored in context of Nepal. There

are no evidences to support the existing social perspective of apple growers regarding that orchard lichens kill their trees. The agricultural management measures practiced by locals directly influence the colonization and growth of lichen group in agroecosystems. Knowledge of lichen biota of agroecosystems is crucial for accurate estimation of the country flora. So, further studies on diversity of epiphytic lichen species in other types of agroecosystems are vital to enrich the lichen flora of the country.

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Figure 2. A. Apple orchard in Damdase, Guthichaur, Jumla. **B** – **E**. Epiphytic lichens growing on apple trees. **F**. Apple trees (on trunk) coated by a solution of limestone powder and blue vitriol. **G**. Malathion (50%). **H**. Bordeaux mixture (Photo from Internet).

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