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Ganoderma industry in Nepal: current status and future prospects

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Abstract

Ganoderma has long been regarded as one of the most important medicinal mushrooms, particularly in China, Japan, and the Korean Peninsula for millennia to enhance longevity and health. *Ganoderma* and its allied products are a multi-billion-dollar worth industry worldwide. *Ganoderma*, which is considered an important non-timber forest product (NTFP) in Nepal, has entered the industrial market only a decade ago. Besides the global market, the domestic market has grown dramatically in recent years. *Ganoderma* is collected in large quantities (about 4-10 tons per year) from Nepalese forests to meet its rising demand and is mostly sold to China in crude form. Since the authority has poor knowledge of the *Ganoderma* market it is transported with minimal royalty of US$ 0.043/kg under the heading entitled "sadharan chyau". Almost all of Nepal's *Ganoderma* comes from natural stands, with the bulk coming from the Karnali (46%) and Far West (50%) provinces. With the great potential for the *Ganoderma* business, most of the other areas of the country have yet to be fully explored. By establishing processing units and offering locally priced micro-enterprise technologies, there are several opportunities for value addition. However, it looks that sustaining a steady supply of this highly sought mushroom will be tough. Concerns have been expressed about overexploitation of wild *Ganoderma* obtained in an unsustainable way or at an early stage. For the long-term management of *Ganoderma* and its habitat protection, a solid local resource monitoring system and scientific intervention for artificial cultivation are required. This study attempts to summarize the trade dynamics and development of the *Ganoderma* industry in Nepal with reference to the global *Ganoderma* industry.

Keywords – Fungi – Lingzhi – MAPs – Mushroom – NTFPs – Nutraceutical – Trade

Introduction

Ganoderma is a worldwide genus of highly regarded medicinal mushrooms in the Ganodermataceae established by Karsten (1881) with *G. lucidum* (Curtis) P. Karst. as the type species, which is native to Europe (Moncalvo & Ryvarden 1997). *Ganoderma* has long been utilized as a traditional medicine in Asia, particularly in China, Korea, and Japan (Zhou et al. 2012). *Ganoderma* is known as "Lingzhi, Chizhi, or Ruizhi" (auspicious herb) in China, "Reishi, Munnentake, or Sachitake" in Japan and "Youngzhi" in Korea (Wagner et al. 2003, Paterson 2006). In different regions of Nepal, *Ganoderma* is known by various local names such as Dadu Chyau, Rato Chyau, Kanchatak, and Dhi Shyamu (Adhikari 2014).

Ganoderma species are found in both tropical and temperate climates around the world

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(Luangharn et al. 2021). As a facultative parasite, they grow as a saprobe parasite that may flourish on rotting stumps and roots (Pilotti et al. 2004). Basidiocarps grow in the shape of a bracket from a living or, more typically, a dead trunk or branch of a tree (Mawar et al. 2020). Depending on the species, they generate two types of basidiocarps: laccate basidiocarps with a lustrous upper surface and non-laccate basidiocarps with a dull upper surface (Smith & Sivasithamparam 2003, Pilotti et al. 2004). Because of their therapeutic capabilities and pathogenicity, *Ganoderma* species have a high economic value (Dai et al. 2009). They decompose lignin, cellulose, and similar polysaccharides, causing white rot in hardwoods (Adaskaveg et al. 1991, Mawar et al. 2020). The root and stem rots caused by *Ganoderma* species result in loss of forestry service yields worldwide. e.g. *Elaeis guineensis* (oil palm) (Glen et al. 2009, Azuan et al. 2019), *Dalbergia sissoo* (Thapa 1990, Timilsina et al. 2020), *Hevea brasiliensis* (rubber) (Monkai et al. 2016). *Ganoderma* has received very little attention in Nepal, despite its huge economic importance. Over the last two decades, the worldwide *Ganoderma* industry has expanded dramatically, and thousands of products are now available on the market. With reference to the global *Ganoderma* market, this review provides an important insight into the evolution of the *Ganoderma* industry in Nepal.

Ganoderma as a medicinal mushroom

Many health products have been manufactured from the *G. lucidum* species complex (Bijalwan et al. 2020). The inclusion of *Ganoderma* in the Chinese Pharmacopoeia, American Herbal Pharmacopoeia, and Therapeutic Compendium attests to its diverse pharmacological actions (Hapuarachchi et al. 2018a). For almost two millennia, the *G. lucidum* species complex (as Lingzhi) has been utilized as a medicinal fungus in Traditional Chinese Medicine (TCM) (Annon 1955, Zhou et al. 2015). *Ganoderma* has long been regarded as a magical herb known as xian-cao, rui-cao, or rui-zhi, symbolizing good fortune and happiness. (Li et al. 2016). The prophylactic and therapeutic properties of *G. lucidum* were first mentioned in Chinese literature Shen Nong Materia Medica. According to the State Pharmacopoeia of the People's Republic of China (2000), *G. lucidum* is used to replenish Qi, calm the mind, and reduce cough and asthma. It is also used to treat dizziness, sleeplessness, palpitation, and shortness of breath (Wachtel-Galor et al. 2011). The most prominent scholar, Li Shi-Zhen, described Lingzhi as a vegetable in his Compendium of Materia Medica with therapeutic benefit for enhancing the spirit and lifespan (Li et al. 2016). According to several studies, *Ganoderma* contains about 400 bioactive components, including polysaccharides, triterpenoids, steroids, fatty acids, amino acids, nucleotides, proteins, and alkaloids (Cör et al. 2018). *Ganoderma lucidum* polysaccharides (GLPs) and *Ganoderma* triterpenoids (GTs), which boost immunity and have anti-ageing properties, are the key contributors to the beneficial medicinal properties of *G. lucidum* (Li et al. 2016). Numerous preclinical (in vitro and in vivo) and clinical research back up TCM's claims about its medicinal and therapeutic advantages (Bishop et al. 2015, Bhardwaj & Misra 2018). Anorexia, arthritis, asthma, bronchitis, cancer, cardiovascular problems, constipation, diabetes, dysmenorrhoea, gastritis, haemorrhoids, hepatitis, hypercholesterolaemia, hypertension, lupus erythematosus, migraine, and nephritis are among the diseases for which the mushroom is used in the prevention or treatment (Hapuarachchi et al. 2016). *Ganoderma lucidum* has recently been proven particularly efficient in the treatment of COVID-19 infections also (Obaid AL-Jumaili et al. 2020, Raut 2020).

Taxonomical ambiguity

The taxonomy of the *G. lucidum* species complex has long been a mess and subjected to debate (Hapuarachchi et al. 2015, Zhou et al. 2015). Traditional Chinese texts divided *Ganoderma* into six species based on the color of the basidiocarps: Sekishi (red), Shishi (violaceous), Kokushi (black), Oushi (yellow), Hakushi (white), and Seishi (blue) (Szedlay 2002). *Ganoderma* is divided into two categories by traditional taxonomy; *G. lucidum* (laccate basidiocarp) and *G. applanatum* complex (non-laccate basidiocarp) which belongs to the subgenera *Ganoderma* and *Elfvingia*, respectively (Hapuarachchi et al. 2015, Kwon et al. 2016, Bhardwaj & Misra 2018).

Ganoderma lucidum was accepted as the scientific binomial of "Lingzhi" in many reports on Chinese edible and medicinal mushrooms after Liu compiled a monograph of TCM fungi in 1974 (Ying et al. 1987, Mao 1998, Dai et al. 2009). It was recently described as *G. lingzhi* based on strong molecular and morphological evidence (Dai et al. 2017), and presently verified as *G. sichuanense* (Yao et al. 2020). The holotype of *G. sichuanense*, on the other hand, is well-developed with unique morphological attributes and lacks the usual morphological features of Lingzhi (Dai et al. 2017). Many other morphologically similar species to *G. lucidum* have been placed together as part of the *G. lucidum* complex across the world based mostly on their laccate basidiocarp (Zhou et al. 2015). *Ganoderma multipileum* and *G. sichuanense* were regarded as Chinese species; *G. resinaceum* is a European species; while *G. oregonense*, *G. sessile*, *G. tsugae*, and *G. zonatum* are American species (Cao et al. 2012, Zhou et al. 2015). Molecular phylogenetic investigations revealed that *G. lucidum* specimens from East Asia were rarely conspecific with *G. lucidum* from Europe (Moncalvo et al. 1995, Hong & Jung 2004, Yang & Feng 2013). According to recent molecular investigations, the commercially produced *G. lucidum* (Lingzhi) in East Asia is a different species from *G. lucidum*. Later, it was discovered that the *G. lucidum* found in tropical Asia is *G. multipileum* Ding Hou, which is not conspecific with the *G. lucidum sensu stricto* found in Europe, nor with the true "Lingzhi" found in East Asia (Wang et al. 2009). *Ganoderma steyaertanum* B.J. Smith & K. Sivasithamparam was suggested as a new species by Smith & Sivasithamparam (2003) to replace the incorrectly called *G. lucidum* in Australia and Indonesia (Cook 1883, 1892, Mcalpine 1895, Blackford 1944, Hapuarachchi et al. 2015).

Some *Ganoderma* collections around the globe have been recorded incorrectly because of the heterogenicity of the genus that exhibits wide variations due to outcrossing over multiple generations, morphological propensity, and different geographical origins (Miller et al. 1999, Kwon et al. 2016, Luangharn et al. 2020). As a result, most taxonomists consider the current nomenclatural condition of the Ganodermataceae to be chaotic and understudied (Smith & Sivasithamparam 2003, Hapuarachchi et al. 2015, Zhou et al. 2015, Thawthong et al. 2017). The taxonomic position within *Ganoderma* is ambiguous as the notions of species and genera are mixed together (Hapuarachchi et al. 2018b). As a result, it is critical to build a more stable taxonomy using a mixture of morphological, chemotaxonomic, and molecular approaches (Richter et al. 2015, Welti et al. 2015).

In Nepal, the genus *Ganoderma* was firstly reported in the year 1808, then various studies on *Ganoderma* have been published, see Table 1. The majority of *Ganoderma* species described from Nepal, however, have not yet been subjected to comprehensive systematic research, and their exact classification is unknown.

Table 1 *Ganoderma* species records from Nepal.

	Taxa	Districts	References
1	*Ganoderma applanatum*	Sunsari, Kaski, Syangja, Makwanpur, Lalitpur, Gorkha, Bajhang, Jumla, Kathmandu, Solukhumbu, Dolakha	Balfour-Browne (1968), Pandey (1976), Singh & Nisha (1976), Adhikari, (1988a, 1996), Hattori et al. (2002), Giri & Rana (2007), Acharya & Parmar (2016), Adhikari et al. (2019), Acharya (2020a)
2	*G. australe*	Kathmandu, Lalitpur, Mustang	Bang et al. (2014), Tamrakar et al. (2017)
3	*G. carnosum*	Lalitpur, Kathmandu, Chitwan	Adhikari (2011), Bang et al. (2014), Tamrakar et al. (2017)
4	*G. endochrum*	Parsa, Makwanpur	Thapa (1990), Tamrakar et al. (2016, 2017)
5	*G. lingzhi*	Lalitpur, Makwanpur	(Bang et al. (2014), Tamrakar et al. (2016, 2017)
6	*G. lucidum*	Kaski, Solukhumbu, Kathmandu, Lalitpur, Bhaktapur, Rasuwa, Bajhang, Makwanpur, Chitwan, Bara, Parsa, Rauthat, Siraha, Saptari, Dhanusha, Mahotttari, Udaypur,	Balfour-Browne (1968), Singh & Nisha (1976), Ryvarden (1977), Adhikari (1988a, 1988b, 2006), Thapa (1990), Adhikari & Durrieu (1996), Pandey & Budhathoki (2002), Adhikari & Manadhar (2004), Devkota et al. (2005), Adhikari et al. (2006), Pandey et al. (2006), Aryal & Budhathoki (2013), Gurung et al. (2013), Aryal (2015), Poudel et al. (2017), Upadhyaya et al. (2017), Acharya (2020b)

Table 1 Continued.

	Taxa	Districts	References
7	*G. multipileum*	Rupandehi	Tamrakar et al. (2016, 2017)
8	*G. tsugae*	Rasuwa, Makwanpur	Pandey & Budhathoki (2007), Khadka & Aryal (2020)

Ganoderma as an important non-timber forest product (NTFPs)

In Nepal, the gathering of non-timber forest products (NTFPs), Medicinal and Aromatic Plants (MAPs) generates major commerce and revenue (Shrestha et al. 2020). Plants and mushrooms sold as pharmaceuticals, nutritional supplement items, natural health products, cosmetics, other personal care items, and culinary goods have recently been categorized as MAPs (Medicinal Plant Specialist group 2007, He et al. 2018). MAPs are the largest and most important sub-sectors of NTFPs, contributing significantly more to the rural economy, livelihoods, and healthcare than other NTFP sub-sectors (Pyakurel & Baniya 2011). For example, in the Nanda Devi Biosphere Reserve of the western Himalaya, NTFP (Yarsagumba) harvesting generates approximately 74% of household income (Yadav et al. 2019), while wild, collected medicinal plant products contribute an average of 58% of total annual household income, and 78% of cash income in the Jumla district of Nepal (Timmermann & Smith-Hall 2019). The global MAPs market was valued at over US$ 3.6 billion in 2014, with a total production of over 0.7 million tons, up roughly 2.4 % year on year (Vasisht et al. 2016). Around 90% of NTFPs/MAPs are harvested from the wild, and over 72,000 plant and fungus species are employed as traditional medicine in both domestic and commercial trade on a local, regional, national, and worldwide scale (Schippmann et al. 2006). Nepal sold over 300 species (Pyakurel et al. 2019), and the yearly export is expected to be between 7,000 and 27,000 tones, with a value ranging from USD 11 to 48 million (in 2020 value, inflation-adjusted values obtained from (Olsen 2005b). Due to their long history and tradition of MAPs used, China and India have been the major consumers of MAPs in Asia (Vasisht et al. 2016). Hundreds of thousands of tons of over 30 distinct species are collected and sold to these two countries each year (Olsen 2005a, He et al. 2018). Royalties are levied by the Government of Nepal (GoN) on 217 taxa of medicinal plants, fungi, and lichens (GON 2015, 2018, Pyakurel et al. 2019). This contains a collection of mushrooms that may contain two or more different species, such as *Morchella* spp., *Ganoderma* spp., and *Ophiocordyceps* spp. (Raut et al. 2019). Mushrooms have long been a popular commodity (CDB 2010), and *G. lucidum* is a key non-timber forest product (NTFP) used to make pharmaceuticals, dietary supplements, natural health products, cosmetics, and other personal care items (Wang et al. 2020) even though its trade started only a decade ago in Nepal. Royalty generated from the trading of *Ophiocordyceps sinensis* is highest among NTFPs. In recent years, *Ophiocordyceps* has become a major source of income. Though *Ganoderma* is also collected in huge amounts (Fig. 1), it is poorly known by the authority and traded under the “sadharan chyau” with minimal royalty of US$ 0.043/kg (Panta et al. 2005, Chhetri & Lodhiyal 2009, DFO 2013, 2015, 2017) while local authority/Government in some places has increased it up to US$ 0.43/kg recently.

Numerous species are sold from Nepal to China. Nepalese customs report that more than 17 species are commonly traded annually with China (He et al. 2018). According to Tibet's Commercial Bureau, only seven commonly traded species account for almost 90 % of MAPs traded from Nepal to China in terms of both volume and value. In terms of both volume and values, the *G. lucidum* species complex ranks second after *Fritillaria cirrhosa* D. Don., among the seven (He et al. 2018). Nepal-China MAPs trade surged ninefold from US$ 1.9 million in 2010 to US$ 17 million in 2013, owing to the rapid rise of the herbal medicine market in central China. There has been a growth in the number of species traded as well as the volume and value of MAPs sold. The data records of both countries' customs offices show a significant variance. In 2013, China recorded a trade value of US$ 17 million, but Nepal only recorded US$ 7.7 million (He et al. 2018). This suggests that huge quantities of MAPs are being traded illegally, that is, without Nepalese customs clearance, and that their worth is being underestimated.

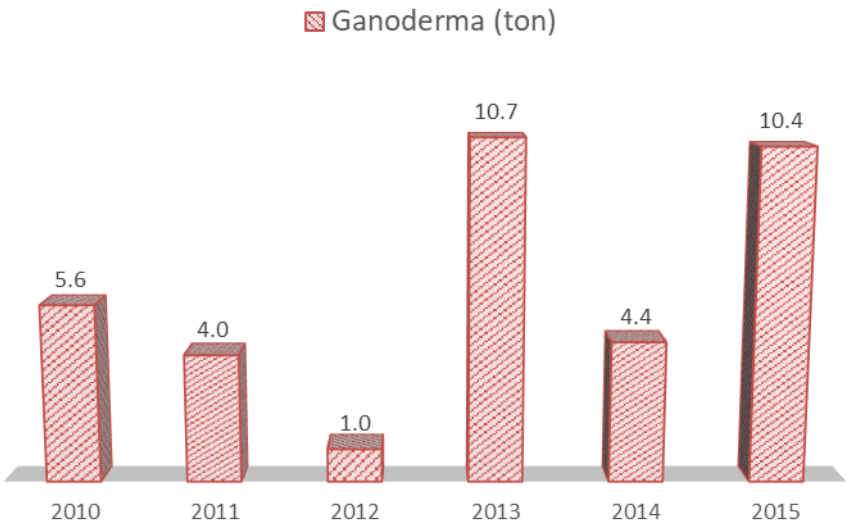

Fig. 1 – Extraction of wild *Ganoderma* for the international trade in Nepal (Source: Hamro Ban; Annual report (2010–2015), Department of Forest, Babarmahal, Kathmandu, Nepal).

Ganoderma is harvested from national forests, protected areas, and community forests. Although it is rarely mentioned in community forestry operational plans, any collection that occurs is not governed by official rules. Concerns have been raised regarding the overexploitation of wild *Ganoderma* in the region. They are gathered in an unsustainable or premature manner. The long-term viability of these high-value mushrooms appears to be a challenge. According to the rules of the Nepal Constitution (CoN 2015), and following the country's restructuring in 2017, the federal Ministry of Forests and Environment, with its Environment and Biodiversity Division, is responsible for all environmental and biodiversity concerns. The majority of *Ganoderma* is currently collected and traded in Nepal's Karnali and Far West Provinces (Fig. 2). With the tremendous potential for *Ganoderma* trade, most of the other regions have yet to be adequately explored.

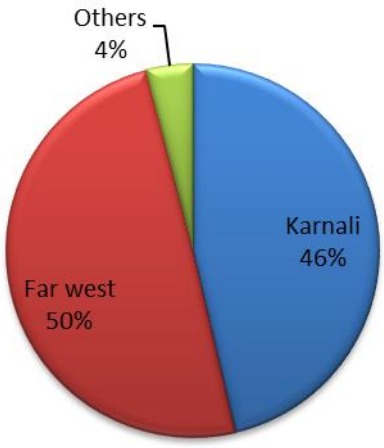

Fig. 2 – Collection and trade of wild *Ganoderma* from different Provinces of Nepal in 2015.

Trade routes of *Ganoderma* from Nepal

The majority of *Ganoderma* is being traded to China (He et al. 2018). Poor locals who live near the forest collect the mushroom as part-time work in addition to their normal agricultural and

animal husbandry affairs. They collect *Ganoderma* during the summer-autumn seasons and sell it at a nearby market as a supplement to their income (Fig. 3).

Fig. 3 – *Ganoderma* mushroom from Nepal. a. Fruiting body of *Ganoderma*; b. Dried *Ganoderma* fruit bodies products in a general store in district market in West Nepal.

District or regional traders are the most common carriers of *Ganoderma* to Kathmandu. Exporters or central wholesalers in Kathmandu gather *Ganoderma* and ship it to regional wholesale depots in Shigatse and Lhasa of China via official Chinese border ports (He et al. 2018). *Ganoderma* was brought from these regional wholesale depots to four of China's main central wholesale markets by regional dealers (Xining in Qinghai, Bozhou in Anhui, Lanzhou in Gangshu, and Chengdu in Sichuan Provinces) (He et al. 2018). From these major wholesale marketplaces, *Ganoderma* is marketed to local stores, pharmacies, and processors in other parts of China (He et al. 2018). Even, manufacturers of *Ganoderma*-based products in Nepal import raw *Ganoderma* powder from China and sell it in America, Australia, Europe, Nepal, and other regions in the world (Fig. 4).

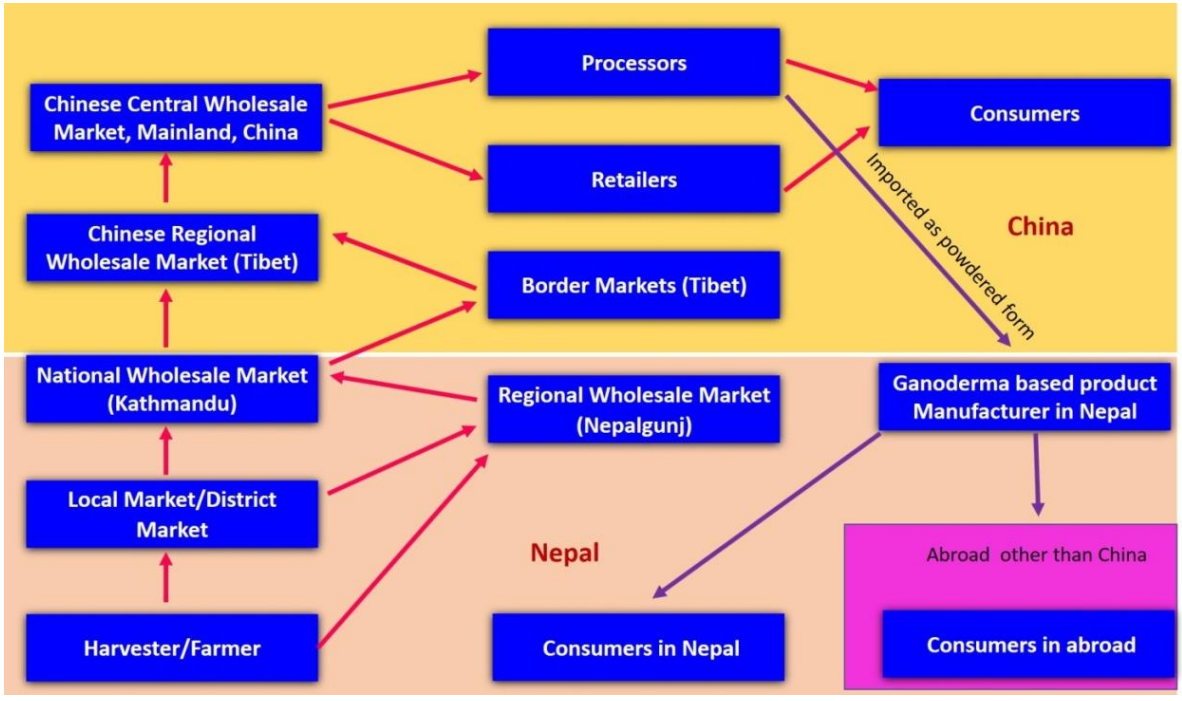

Fig. 4 – Trade network of *Ganoderma* mushroom from Nepal to China.

All the wild harvests are traded in crude form. They are dried and graded based on basidiome size and color. Also, the price of mushrooms varies based on their size and color. The local collectors get US$ 9-22 /kg for lower grade (basidiome size < 3 inches) and US$ 26-43/kg for higher grade (basidiome size > 3 inches). Its price range is US$ 71-79/kg in the regional wholesale market in mainland China (He et al. 2018). Processing and value addition practices are absent, so the potentials of *Ganoderma* with ample opportunities for value addition seems encouraging that can generate huge revenue in the country.

Artificial cultivation

The artificial cultivation of *Ganoderma* began in 1937 because of the varied quality of *Ganoderma* in the wild and the ever-growing demand for food service, pharmaceutical, cosmetics, and health product sectors (Bijalwan et al. 2020). In China, however, *Ganoderma* was successfully farmed on a large scale for the first time in 1969 (Yu & Shen 2003). Since then, *Ganoderma* farming has become widespread in China and other Asian countries, such as Japan and Korea (Li et al. 2016). However, it began in Nepal in 2001 with an exotic strain of *G. lucidum* from the Philippines (Poudel & Bajracharya 2011). The artificial cultivation of *Ganoderma* in Nepal was pioneered by the Nepal Agriculture Research Council (NARC) and the Centre for Agriculture Technology (CAT). Dr. Keshari Laxmi Manandhar, a pioneering Nepalese scientist, made significant contributions to *Ganoderma* commercialization (Raut 2013). However, in the last two decades, its artificial production on a commercial scale has been unable to acquire attraction (Raut 2019). Almost all of Nepal's *Ganoderma* collections comes from natural sources. Scientists from the Nepal Academy of Science and Technology (NAST) and Mushroom Seed Nepal and Research Center (MSNRC) have recently launched numerous *Ganoderma* research projects, including the domestication of indigenous *G. lucidum* complex strains and product diversification. The company has put *Ganoderma* powder on the market with the technical support of NAST, based on its production of 1,000 kg of fruit body on sawdust synthetic log (Fig. 5). In 2021, the company plans to produce 10,000 kg of fresh *Ganoderma* fruit body (Pers. Commun.). Another *Ganoderma* cultivation enterprise in Nepal is Bhairav Chyau Udyog Pvt. Ltd. with the technical assistance of Himalayan mushroom farm, the company has been producing *Ganoderma* in modest quantities on the natural log, sawdust synthetic log, and straw. The company is planning to build a sophisticated production unit with a capacity of 1,000 kg per day very soon (Pers. Commun.). Apart from them, other companies in Nepal import a large amount of raw *Ganoderma* powder, mainly from China, for their numerous *Ganoderma*-based products.

Fig. 5 – Commercial scale artificial farming of *Ganoderma* at Mushroom Seed Nepal & Research Center farm and its own product of *Ganoderma* sporocarp powder.

Diverse sorts of substrates such as grain, sawdust, wood logs (Chang & Buswell 1999, Boh et al. 2007), tea squander (Peksen & Yakupoglu 2009), cotton seed husk, or farm crop residues

(Zhang & Wang 2010), cork residues (Riu et al. 1997), sunflower seed hull (González–Matute et al. 2002), corn cobs (Ueitele et al. 2014), olive oil press cakes (Gregori & Pohleven 2014), and wheat straw (Khajuria & Batra 2014) have been utilized for the *Ganoderma* mushroom cultivation around the world. In addition, *G. applanatum*, *G. lucidum*, *G. neojaponicum*, *G. sinense*, and *G. tsugae* are cultivated commercially worldwide (Hapuarachchi et al. 2018a). Because artificial cultivation of *Ganoderma* fruiting bodies takes a long time and the quality isn't always consistent, mycelia-based and culture broth-based products made with fermentation technology are seen as a promising alternative for a faster production cycle, higher product yield, consistent quality, and lower costs (Sanodiya et al. 2009, Zhou et al. 2012, Li et al. 2016).

Ganoderma products and market

Ganoderma products include coffee, dental pastes, dietary supplements, drinks, lotions, powder, spore products, soaps, syrups, and tea (Hapuarachchi et al. 2018a). In the early 1980s, there were only a few *Ganoderma* products on the international market, such as decoction, syrup, pill, and injection liquid (Zhou et al. 2012). In the early 1990s, about 90 *Ganoderma* product brands were registered and marketed worldwide (Lin 2000). The China Food and Drug Administration (CFDA) has 572 *Ganoderma* products in its database (Li et al. 2016). The CFDA has officially confirmed several healthcare activities of these drugs, including anti-ageing, anti-fatigue, blood sugar and blood fat regulation, immunoregulation, liver protection, sleep promotion, and tumor suppression (Li et al. 2016). However, it is believed that at least 100 brands and over 780 products, ranging from nutritional supplements to pharmaceuticals, health liquors, and cosmetics, are produced and marketed on the world market today (Lai et al. 2004, Li et al. 2016). *Ganoderma* fruit body, spore powder, mycelia, and culture broth are used to make *Ganoderma* products (Li et al. 2016). Approximately 80-85% of all products are based on fruit bodies that have been either professionally cultivated or gathered from the wild, with only 15-20% based on mycelia of *Ganoderma* (Zhou et al. 2012).

The products based on *Ganoderma* have been increasingly popular in Europe, Malaysia, North America, and Singapore in recent years. China, Japan, and Korea are the leading producers and suppliers of the products, with the United States having the largest market (Hapuarachchi et al. 2018a). With a capacity of about 110,000 MT/year of fruiting bodies, slices, and spore powders as the most popular items, China is the top producer and exporter (Li et al. 2016). In China, there are more than 100 research institutes dedicated to the studies of *Ganoderma* as well as more than 200 enterprises producing pharmaceuticals and nutraceuticals based on *Ganoderma* (Li et al. 2016, Hapuarachchi et al. 2018a). In some Asian countries, *Ganoderma* preparations are sold as prescribed medications, however, they are generally used as dietary supplements around the world (Lai et al. 2004). The global market for *Ganoderma* products was valued at US$ 2.5 billion (Li et al. 2016, Hapuarachchi et al. 2018a). As it is rapidly increasing, global use is estimated at several thousand tons (Wachtel-Galor et al. 2011).

A variety of aforementioned *Ganoderma*-based products is available in Nepalese markets from a variety of enterprises (Fig. 6), and their demand is growing by the day. According to figures from the Department of Customs, dietary supplement imports are increasing by 20% per year. In 2018, imports of dietary supplements totaled NRs. 1.54 billion (US$ 1.3 million). The majority of dietary supplements (95%) are imported from India, with the remainder coming from Australia, China, Germany, Japan, Korea, Malaysia, Taiwan, Thailand, the United Kingdom, the United States, and other nations (DoC 2018, Lamichhane & Pandeya 2020). Systematics and taxonomy of *Ganoderma* species, efficacy, safety and, homogeneity of products, absence of high value-added products, poor quality, and high costs are a few challenges of the *Ganoderma* industry (Li et al. 2016, Hapuarachchi et al. 2018a).

Fig. 6 – Various marketed *Ganoderma* products in Nepal.

Conclusion

Despite a few challenges, the prospects for *Ganoderma* and its products are promising. People involved in collecting and sale are reaping considerable financial rewards with ever-rising demand. *Ganoderma* collection and trade has also become a key source of income for the majority of Nepalese people who live in rural hills and mountainous areas. It can be summed up that the *Ganoderma* sector in Nepal is gradually increasing every day through artificial production, product formulation, and consumption. The production, value addition, and commercialization of *Ganoderma*-based products offer a great opportunity for local farmers, growers, and entrepreneurs. The *Ganoderma* trade can have a significant impact on the local economy as well as the country's national economy. Furthermore, there is a need to investigate and address the taxonomic ambiguity of *Ganoderma* species. The development of the local *Ganoderma* industry should be aided by researches on many aspects of *Ganoderma*. Cultivation technology should be improved by utilizing locally available input resources to meet market demand.

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