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STATUS AND ROLE OF MEDICINAL AND AROMATIC PLANTS (MAPs) IN NEPALESE LIVELIHOOD

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Abstract

Medicinal and aromatic plants (MAPs), a principal sub-component of Non-Timber Forest Products (NTFPs), are undoubtedly an important source of revenue and rural employment. This review paper explores the current ecological and prioritized status of MAPs by the Government and the practical significance of MAPs in bodily health, lucrative employment to the Nepalese population, and revenue opportunities to the government based on 72 published articles from 1995 to 2021. The Department of Plant Resources (DPR) reported that the number of medicinal plant species has increased from 701 in 2007 to 819 in 2016 with 285 endemic plant species from 43 families, and 238 chemically tested MAPs species for medicinal significance. MAPs are highly prevalent within the 1000-2500m elevation gradient in Nepal. GoN has categorized 30 species for economic development, 12 species for cultivation and research, 12 species for protection, and 237 species for collecting royalties. Around 100 Nepalese NTFPs/MAPs are traded, but only 20 species accounts for 80% of the total trade in terms of volume and value. Nepal ranks 42nd with a value of $7.4 million and 62nd with a value of $3.3 million in exports of MAPs and essential oils, respectively, in 2017. About 80% of the Nepalese population relies on traditional medicine for basic health needs. The NTFPs/MAPs Business Promotion Strategy specifies 20 species for product promotion across Nepal. As current data are still lacking on different uses of MAPs in Nepalese society, this comprehensive review will facilitate herbal specialists, policymakers, scientific researchers, botanists, and various key stakeholders to assure better research and increase the export of MAPs in Nepal. Therefore, this study recommends public, private, and government- agencies to contribute to the infrastructure development through competitive "field-to-market" incentives and funding for the increment of the export of MAPs that directly improve the socio-economic status of the Nepalese people.

Keywords: COVID-19; Essential oils; Export; Livelihood; Medicinal Plants

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Introduction

Medicinal plants are those with therapeutic potential that have been proven successful in one's well-being (World Bank, 2018). Aromatic plants are those that contain or exude volatile compounds such as essential oils. Medicinal and aromatic plants are among the reliable sources of survival and economic opportunity that provide cash income to rural populations (Pérez and Byron, 1999; Olsen and Larsen, 2003; Shackleton and Shackleton, 2004). MAPs are promising raw materials in the pharmaceutical, nutraceutical, and cosmeceutical industries (Marriott, 2000; Pieroni et al., 2004; Barnes and Prasain, 2005).

Medicinal plants are important components of the pharmacopoeia of allopathic treatments, whereas around 28,187 species have been identified in herbal medicine (Wills, 2017). Between 1940 and 2014, 49 percent of biomolecules approved by the United States Food and Drug Administration were natural or derived products (Newman and Cragg, 2016). Approximately 25% of allopathic drugs are currently made from plant-related substances and compounds extracted from plants (Rao et al., 2004). Approximately 15% of plant species have been researched phytochemically, and only 6% have been tested for their pharmacological potency (Seidel, 2020). Thus, there are still many plant-derived chemicals whose medicinal prospects need to be explored (Atanasov et al., 2015; Beutler, 2009; Thomford et al., 2018).

The country ranked 25th in global biodiversity richness and 11th among Asian countries (Ministry of Forests and Environment, 2018b). Nepal's unique topography and varying climates have resulted in floral species count of 11,971, accounting for 3.2% of the world's total flora (MoFSC, 2014). According to the Medicinal and Aromatic Plants Database of Nepal (MAPDON), there are approximately 1,624 medicinal plant species in Nepal, with approximately 100 species traded annually (SAWTEE, 2015). The Department of Plant Resources (DPR) has reported that the number of medicinal plant species has increased from 701 (DPR, 2007) to 819 (DPR, 2016). Till now, 238 MAPs species have been chemically tested for their medicinal properties (Government of Nepal, 2004). Nepal has 285 endemic plant species from 43 families, which have global biological significance (Rajbhandari and Dhungana, 2011). MAPs are more prevalent in forests and grasslands of hilly and mountainous terrain above 2,000m in Nepal (EPI, 2017).

About 85% of MAPs are harvested from the wild, especially in the Far-West and Mid-West of Nepal (GIZ, 2017). Far west Nepal alone accounts for about one-third of Nepal's entire trade volume (Kunwar et al., 2015),

where only one district, Jajarkot contributes US$13,209.4 from MAPs to the national economy (Lamichhane et al., 2021). About 143-161 NTFP species, including MAPs, are collected for commercial purposes (Bhattarai and Ghimire, 2006; Subedi, 2006). However, 60 MAPs species are classified as endangered (Shrestha and Joshi, 1996; Bhattarai et al., 2002). Approximately 50-60% of MAPs harvest goes unrecorded, as they are either consumed in households or sold on local marketplaces without any official procedures (KC, 2014). Around 100 Nepalese NWFPs are traded, but only 20 species account for 80% of the total trade in terms of volume and value (KC, 2014). According to NTFPs studies presented at a seminar on Herbs, Herbal Products, and Spices held in 2005, the forestry sector contributes approximately 15% to the Nepalese GDP, while NTFPs comprise about 5% of GDP (CECI, 2006). As buyers are becoming more interested in organic and natural goods, the market for MAPs continues to grow around the world (Acharya, 2014).

MAPs are among 19 sectors having a high potential for trade promotion listed by the Nepal Trade Integration Strategy (NTIS) (NTIS, 2010). MAPs can be harvested in a short period than timber, which gives them a competitive advantage in the forest as compared to timber (Paudel and Acharya, 2018; Lawrence, 2003). Nepal's NTFP sector has been the subject of much debate and little action. The Master Plan for Forestry Sector (1989-2010) included MAPs as a priority initiative. Despite MAPs being one of the government's priority sectors under the Tenth five-year plan (2002-2007), sufficient attention has not been given to its cultivation (Bhattarai and Ghimire, 2006). The study aimed to present a comprehensive overview of the current ecological and prioritized status of MAPs by GoN to develop and commercialize them, and the general trend of MAPs export from Nepal.

Methodology

This paper is based on a thorough analysis of online national and international publications, project papers, websites, booklets, government policy documents, and available published materials. Google Scholar, ResearchGate, Scopus, and PubMed were the primary databases used for acquiring the literature including the keyword ‘MAPs’, ‘NTFPs’ ‘Role’, ‘Livelihood’, ‘COVID-19’, ‘Export’, and ‘Nepal’. Seventy-two articles were identified, which was in agreement with our inclusion and exclusion criteria. The literatures sorted were systematically reviewed multiple times, and information about the status of MAPs and their role in Nepalese livelihood were gathered, compiled, and arranged in a logical sequence. The complete process is explained in figure 1 which is based on the PRISMA flow chart.

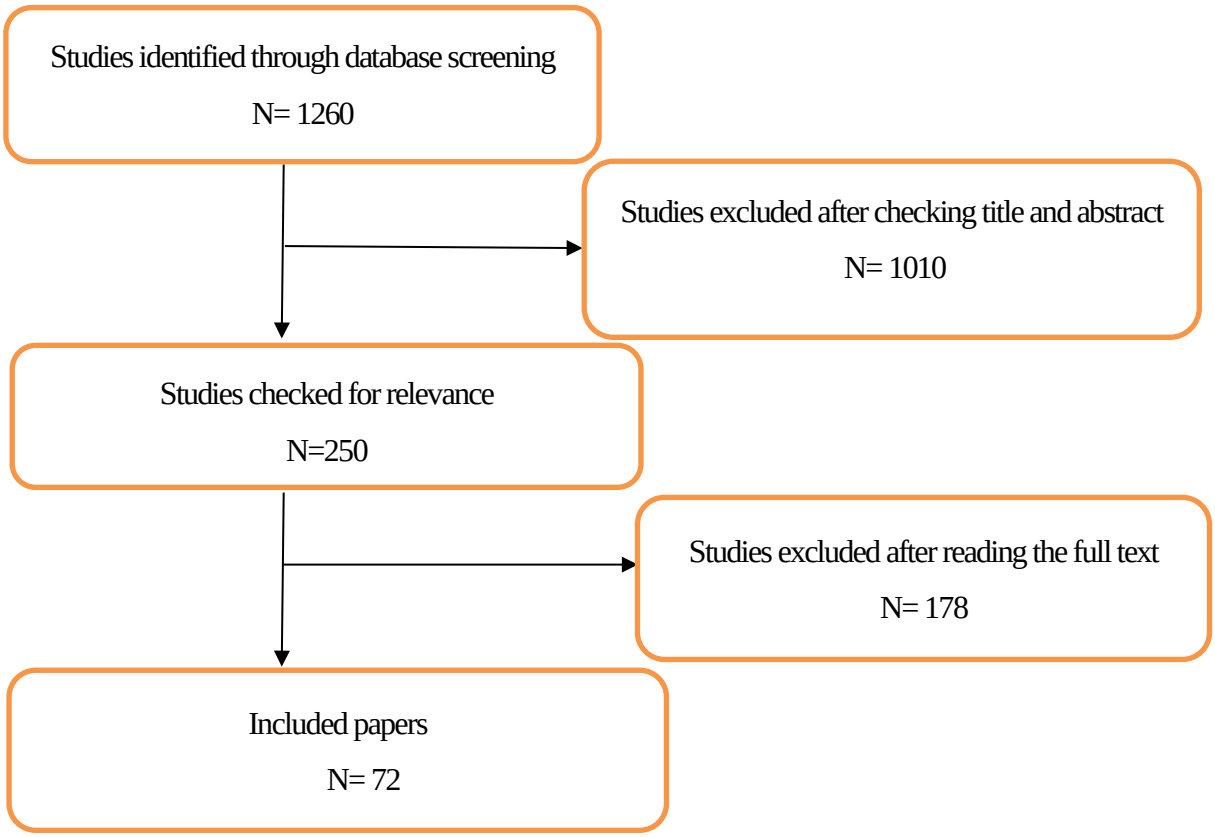

Figure 1: PRISMA flow chart for studies related to status and role of MAPs in Nepalese livelihood

Results and Discussion

MAPs distribution in Nepal

In Nepal, MAPs can be found at elevations ranging from 100 to 5,500 m above sea level (Bhattarai and Ghimire, 2006). The total MAPs species richness (Herbs, Shrubs, Climbers, and Trees) is found between the elevation gradient of 1000-2500 m. The MAPs of trees and climbers are found to be optimal at 1000 m; shrubs at 2000 m; and herbaceous at 2500 m (Bhattarai and Ghimire, 2006). MAPs species are distributed in different regions of Nepal (Figure 2). West and Eastern regions have the least MAPs at 2% and 3% respectively while East-center west has the highest at 67%, followed by East-center at 12%.

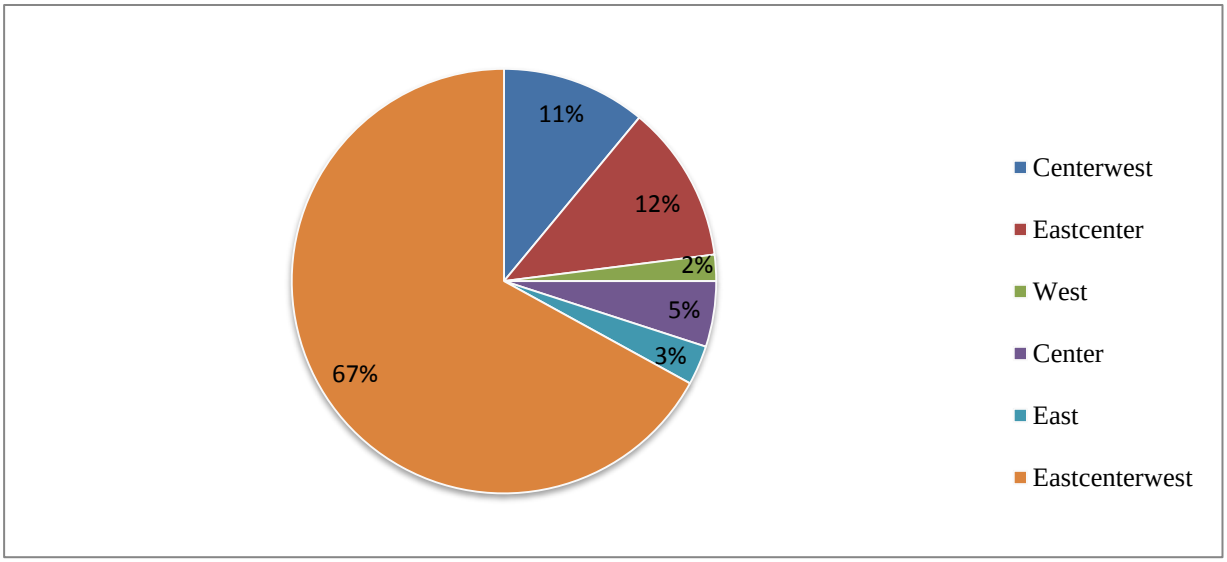

Figure 2: Distribution of medicinal plants in different regions of Nepal [Source: (TEPC, 2018)]

Tropical and sub-tropical regions have the highest proportion of MAPs, followed by temperate, sub-alpine, and alpine zones. Sub-alpine and alpine medicinal plants are treasured both for their medicinal value and export potential. Medicinal plants and herbs provide sufficient income to fulfill the basic needs of poor and marginalized populations in these areas, as well as revenues to the government. Table 1 shows the distribution of MAPs in Physiographic Zones.

Table 1: Distribution of the Medicinal and Aromatic Plants (MAPs) in Physiographic Zones

Region		**% MAPs available**	**Major MAPs**
Alpine region	above 4000 m	7	*Ophiocordyceps Sinensis* (Yarshagumba), *Neopicrorhiza scrophulariflora* (Kutki), *Nardostachys grandiflora* (Jatamansi)
Sub- alpine region	3000-4000 m	18	*Dactylorhiza hatagirea* (Panchaule), *Taxus wallichina* (Lauth Salla), *Rheum austral* (Padamchal), *Swertia chirayita* (Chiraito), *Podophyllum* (Laghupatra), *Paris polyphylla* (Satuwa),
Temperate region	2000-3000 m	36	*Swertia chirayita (Chiraito)*, *Aconitum heterophylloides* (Nirmasi), *Digitalis purpurea* (Tilpushpi), *Berberis asiatica* (Chutro), *Valeriana jatamansii* (Sugandhawal)

Sub-tropical region	1000-2000 m	54	*Gaultheria fragrantissima* (Wintergreen), *Zanthoxylum armatum* (Timur), *Sapindus mukorossi* (Ritha), *Asparagus racemosus* (Kurilo), *Cinnamomum tamala* (Tejpat), *Elaeocarpus sphaericus* (Rudraksha), *Tinospora sinensis* (Gurjo)
Tropical region	below 1000 m	49	*Terminalia chebula* (Harro), *Aegle marmelos* (Bel), *Terminalia belerica* (Barro), *Diospyros melanoxylon* (Tendu), *Azadirachta indica* (Neem), *Haldina cardifolia* (Haldu), *Rauvolfia serpentine* (Sarpagandha), *Phyllanthus emblica* (Amala)

Source: (Malla and Shakya, 1995; Subedi, 2006)

Figure 3 shows the relationship between elevation and species diversity/commercial value. As altitude increases, the diversity of MAPs species declines. On the contrary, the commercial value of MAPs species increases with altitude. Despite having low plant diversity, the commercial values of the NTFPs found in Nepal's mountains (highlands) are the highest. For example, the price of Kurilo (*Asparagus racemosus*) and Sarpagandha (*Rauvolfia serpentina*) in the Terai regions is less than NRs. 500 per kilogram, whereas the price of Yarsagumba (*Ophiocordyceps sinensis*), Wild Morel (*Mochella esculenta*), Jatamansi (*Nardostachys grandiflora*), Panchaule (*Dactylorhiza hatagirea*), etc. are many times higher than lowland species (KC, 2014).

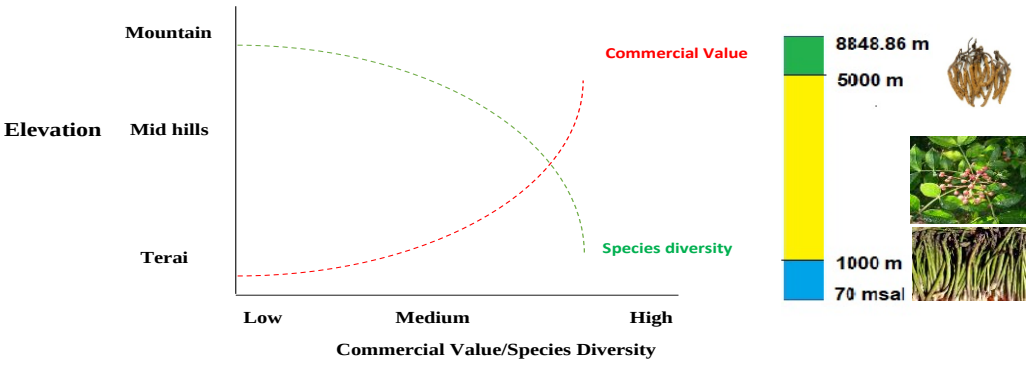

Figure 3**:** General trend of species diversity and commercial importance of NTFPs along the altitudinal gradient in Nepal [Source: (KC, 2014)]

The Government of Nepal (GoN) has established forest policy in 2015 to retain MAPs from exploitation in their natural habitat, as well as to encourage private sectors to domesticate and cultivate MAPs. The goal is to transfer the cultivable MAPs into private land. It has identified (Table 2) 3 major MAPs species of Terai, 16 species of mid-hills, and 11 species of Mountain region that can boost the country's economy.

Table 2: List of MAPs species identified for economic development

S.N.	Scientific name of the species	Local name of species	Distributional range(m)	Major parts used	Main uses
1	*Aconitum heterophyllum*	Atis	2400-4100	Rhizome, Roots	Medicine
2	*Aconitum spicatum*	Bisjara	3300-4300	Flower, Leaves	Medicine, scented oil
3	*Acorus calamus*	Bojho	200-2300	Roots	Medicine
4	*Asparagus racemosus*	Kurilo	150-2100	Roots, New shoots	Medicine, food
5	*Azadirachta indica*	Neem	100-900	Whole plant	Medicine
6	*Bergenia ciliate*	Pakhanbed	1600-3600	Rhizome	Medicine
7	*Cinnamomum glaucescens*	Suganda kokila	200-2500	Fruit	Medicine, scented oil
8	*Cinnamomum tamala*	Tejpat	450-2100	Bark, Leaves	Medicine, spice
9	*Dactylorhiza hatagirea*	Panchaunle	2800-4000	Rhizome	Medicine
10	*Dioscorea deltoidea*	Bhyakur	450-3100	Fruit, Roots	Food
11	*Gaultheria fragrantissima*	Dhasingre	1200-2700	Leaves	Scented oil
12	*Juglans regia*	Okhar	1200-3000	Fruit, Bark	Medicine, food
13	*Lichen sps.*	Jhau	2500-3400	Whole plant	Medicine
14	*Morchella esculenta*	Guchi chyau	2000-3500	Whole fungus	Food
15	*Nardostachys grandiflora*	Jatamansi	3600-5000	Rhizome	Medicine, scented oil
16	*Neopicrorhiza scrophulariflora*	Kutki	3600-4000	Rhizome	Medicine
17	*Ophiocordyceps sinensis*	Yarsagumba	4200-5000	Whole fungus. larvae	Medicine
18	*Phyllanthus emblica*	Amala	150-1400	Fruit	Medicine
19	*Piper longum*	Pipla	200-800	Fruit	Spice
20	*Podophyllu hexandrum*	Laghupatra	2400-4000	Roots. Rhizome	Medicine
21	*Rauvolfia serpentina*	Sarpagandha	100-1200	Root	Medicine
22	*Rheum austral*	Padamchal	3000-4200	Stem	Medicine
23	*Rubia majith*	Majitho	1200-2100	Stem. Root	Coloring
24	*Sapindus mukorssi*	Ritha	1000-1400	Fruit, Seed, Bark	Detergent
25	*Swertia chirayita*	Chiraito	1500-3000	Whole plant	Medicine
26	*Tagetes minuta*	Jangali Sayapatri	1200-2500	Whole plant	Scented oil

27	*Taxus wallichina*	Lauth Salla	2400-3400	Leaves	Medicine
28	*Tinospora sinensis*	Gurjo	300-1500	Stem	Medicine
29	*Valeriana jatamansi*	Sugandhawal	1500-3600	Root, Rhizome	Scented oil
30	*Zanthoxylum armatum*	Timur	1100-2500	Fruit	Spice

Source: (GoN, 2010; DPR, 2009; MoFSC, 2012)

Cultivation and domestication of MAPs have been undertaken in Nepal since a few decades. The GoN has prioritized 12 different MAPs species for cultivation and research (DoF, 2015). Tejpat, Rittha, Timur, Chiraito, and Kurilo are the most important domesticated medicinal species exported from Nepal. Similarly, cultivation of essential oil-producing plants such as Mentha, Chamomile, etc., has begun in Nepal's lower regions. There are still additional plants with enormous earning potential. Some of these species include *Asparagus racemosus* (low altitude), *Cinnamomum glaucescens* (low-mid altitude), and *Dactylorhiza hatagirea* (high altitude) (Table 3).

Table 3: Price of NTFP/Medicinal and Aromatic Plants for cultivation and research

S.N.	**Scientific name of the species**	**Local name of the species**	**Price and Current policy arrangement according to Forest Regulation, 2051**
1	*Asparagus racemosus*	Kurilo	Rs 5/kg
2	*Cinnamomum glaucescens*	Sugandha kokila	Rs 7/kg (Banned without processing)
3	*Dactylorhiza hatagirea*	Panchaunle	Rs 1000/kg (Banned without permission for collection, trade)
4	*Nardostachys grandiflora*	Jatamansi	Rs 20/kg (No trade without processing)
5	*Neopicrorhiza scrophulariflora*	Kutki	Rs 15/kg (Protected species, banned for collection)
6	*Piper longum*	Pipla	Rs 10/kg
7	*Rauvolfia serpentine*	Sarpagandha	Rs 20/kg (dry root)
8	*Swertia chirayita*	Chiraito	Rs 15/kg
9	*Taxus wallichina*	Lauth Salla	Rs 25/kg
10	*Tinospora sinensis*	Gurjo	Rs 2/kg (Collected from wild)
11	*Valeriana jatamansi*	Sugandhawal	Rs 15/kg
12	*Zanthoxylum armatum*	Timur	Rs 8/kg

Source: (DoF, 2015)

The GoN has amended the Forest Act 1993 in 2009 and categorized the Non-Timber Forest Products (NTFPs) into eight different categories. The GoN has identified 237 NTFPs under eight categories especially for collecting royalty (Figure 4). The highest number of NTFPs falls under the fruit and seeds category at 27% followed by the other category. The least number of NFTPs are represented by gums, resins, and lac at 3%.

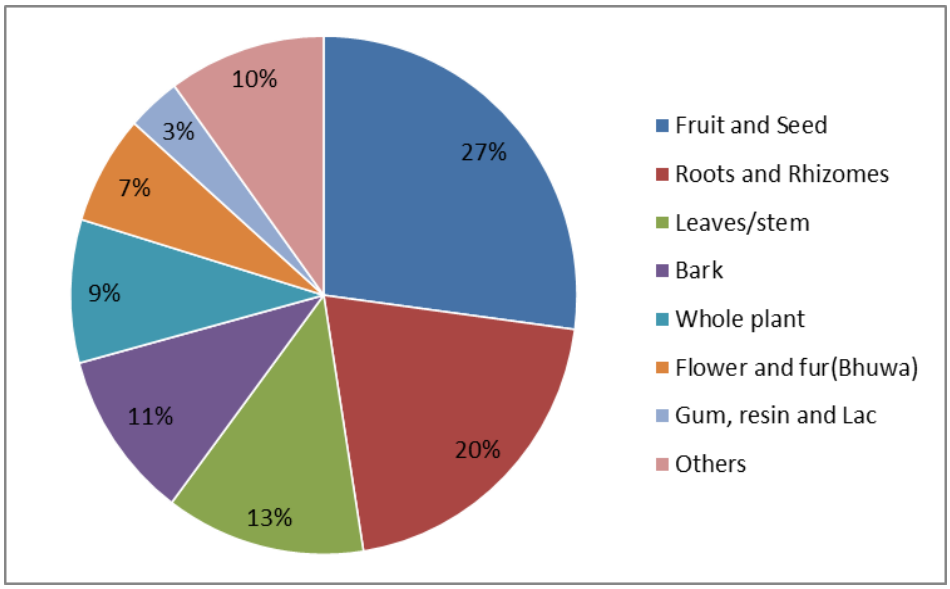

Figure 4: Categories of NTFPs for collecting royalty [Source: (MoFSC, 2012)]

Several wild plant species in Nepal have suffered because of overharvesting and habitat destruction. The GoN has also imposed restrictions on the export of 12 NTFPs species under Section 77 of the Forest Act 2019 specifies two provisions (i) Species banned for collection, use, sale, distribution, transportation, and export (ii) Species banned for export outside the country without processing. According to the Nepal Gazette of December 31, 2001, three species (Panchaule, Okhar bokra, and Kutki) have been banned for collection, use, sale and distribution, movement, and export. Similarly, the nine species (Jatamasi, Sarpagandha, Sugandha kokila, Sugandhawala, Jhyau, Talispatra, Lauth Salla, Silajeet, and Yarshagumba) can be processed in the country for export.

Additionally, Nepal is a member of The World Conservation Union (IUCN) and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1974 and 1975 respectively. The following species have been given various IUCN and CITES status.

Table 4: MAPs species protected in Nepal

S. N.	Scientific Name	Common Name	Local Name	IUCN Red List Status	CITES Appendix Status
A. Species banned for collection, use, sale, distribution, transportation, and export					
	Dactylorhiza hatagirea	Salep	Panchaunle		II
	Juglans regia	Walnut	Okhar		
	Neopicrorhiza scrophulariflora	Picrorhiza	Kutki	VU	II
B. Species banned for export outside the country without processing					

	Nardostachys grandiflora	Spikenard	Jatamansi	VU	II
	Rauvolfia serpentina	Serpentine	Sarpagandha	ED	II
	Cinnamomum glaucescens	Nepali Sassafras	Sugandha kokila		
	Valeriana jatamansii	Indian Valerian	Sugandhawal		
	Parmelia spp.	Lichen	Jhayau		
	Abies spectabilis	Himalayan Fir	TalisPatra		
	Taxus wallichiana	Himalayan Yew	Lauth Salla		II
	Ophiocordyceps sinensis	Chinese caterpillar fungus	Yarsagumba		
	Rock Exudate	Shilajit	Shilajit		

Source: (DoF, 2018); VU=vulnerable, ED= endangered.

Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled to avoid utilization incompatible with their survival.

Nepal Herbs and Herbal Products Association (NEHHPA) has prepared the identification manual of 69 commercial MAPs along with pictures. The table below provides detailed information on the distribution, harvesting period, traded parts, and traditional usage of 69 commercial medicinal and aromatic plants (Table 5). Among documented commercial species, the mid-hills have more identified commercial species, whereas the mountain region has the fewest. Ranunculaceae, Combretaceae, Rutaceae, Umbelliferae, Compositae, Berberidaceae, Ericaceae, Orchidaceae, Lauraceae, Liliaceae, Leguminosae and Valerianaceae are the common families of MAPs species found in different regions of Nepal. Fruits, leaves, roots, rhizome as well as the whole plant are used commonly for different purposes such as essential oil, coloring, flavoring, and treatment of diseases mostly like anemia, asthma, diabetes, common cold, and stomach related disease.

Table 5: List of some commercial MAPs of Nepal

S.N.	Local name of species	Botanical name of species	Family	Distribution (m)	Harvesting time	Parts used	Traditional Uses
1	Amala	*Phyllanthus emblica*	Phyllanthaceae	150-1600	Sept-Nov	Fruit	Food Preservative, Digestion, Anemia
2	Ashuro	*Justicia adhatoda*	Acanthaceae	600-1600	Jul-Oct	Leaves, Flower	Expectorant, Asthma, Bronchitis
3	Aswagandha	*Withania somnifera*	Solanaceae	Tropical	Sept-Oct	Root	Treatment of Impotency, gout, fever
4	Atis	*Delphinium himalayai*	Ranunculaceae	2000-4000	Oct-Dec	Tuber	Cough and colds
5	Bajradanti	*Potentilla fulgens*	Rosaceae	1800-3500	Oct-Dec	Root	Toothpaste, stomach pain
6	Barro	*Terminalia bellirica*	Combretaceae	3000-1100	Dec-Mar	Fruit, Seed	Digestion, Gum bleeding, Bronchitis
7	Bel	*Aegle marmelos*	Rutaceae	Up to 1100	Aug-Sept	Fruit	Juice, Stomach troubles, diabetes
8	Bojho	*Acorus calamus*	Araceae	500-2300	Sept-Feb	Rhizome	Food preservative, cough, and cold, toothache

9	Bhojpatra Bokra	*Betula utilis*	Betulaceae	2700-4300	Aug-Nov	Bark	Incense, Common cold, Jaundice, Diuretic, Anthelminthic
10	Bhutkesh	*Selinum wallichianum*	Umbelliferae	2500-4500	Oct-Nov	Root	Stomach ache, gastric, fever
11	Bish, Nilo Bish	*Aconitum ferox*	Ranunculaceae	1800-4200	Oct-Nov	Rhizome	Anti-poisonous
12	Bishfej	*Polypodium vulgare*	Polypodiaceae	1300-2700	Sept-Oct	Modified rhizome	Backaches, Stomach troubles
13	Chamomile Flower	*Matricaria chamomilla*	Compositae	500-1800	March onwards	Flower	Essential oil, soaps, cosmetics, tea
14	Chiraito, Tite	*Swertia chirayita*	Gentianaceae	1500-3000	Nov-Dec	Whole plant	Anthelminthic, expectorant, antiperiodic, hypoglycemic, laxative
15	Chiuri	*Diploknema butyracea*	Sapotaceae	300-1500	Jul-Aug	Fruit, Seed, and Ghee	Soap oil, candles, and ghee
16	Chutro	*Berberis asiatica*	Berberidaceae	600-3000	Oct-Dec	Bark, root	Yellow dye, Inflammation of the eye
17	Dalechuk	*Hippophae salicifolia*	Elaeagnaceae	2000-4500	Sept-Nov	Fruit	Skin wrinkling, swelling, antibiotics
18	Dhasingre, Patpate	*Gaultheria fragrantissima*	Ericaceae	1200-2700	October	Leaves	Food flavoring, relieving pain
19	Dhayero	*Woodfordia fruticosa*	Lythraceae	200-1500	Apr-May	Dried flower	Red dye, Digestion, Nose bleeding
20	Dhupi	*Juniperus indica*	Cupressaceae	300-4600	Jul-Aug	Leaf, Fruit, and upper part of the petiole	Appetite cure, Stomach ache, Piles, Asthma
21	Gamdol, Kaladana	*Brachycorythis obcordata*	Orchidaceae	1000-2000	Sept-Nov	Pseudo bulb, Rhizome	Expectorant, astringent, energy tonic
22	Ghodtapre	*Centella asiatica*	Umbelliferae	500-2800	Throughout year	Whole plant	Epilepsy, Neural disease, purification of blood, and fever
23	Githha, Vyakur	*Dioscorea bulbifera*	Dioscoreaceae	150-2000	Dec-Feb	Tuber	Source of Diosgenin
24	Guchi Chyau	*Morchella conica*	Morchellaceae	2000-3500	May-Jul	Whole part above the ground	Vegetable and tonic
25	Gurjo, Guduchi	*Tinospora sinensis*	Menispermaceae	500-1100	Feb-Apr	Stem or petiole	Asthma, Cough, Fever, Diabetes, Acidity, skin and urine related disease, leprosy
26	Harro	*Terminalia chebula*	Combretaceae	150-1100	Dec-Mar	Fruit and seed	Leather, garment, dye, and Ayurvedic medicine industries
27	Jangali sayapatri	*Tagetes minuta*	Asteraceae	1200-2500	Oct-Nov	Whole plant	Flavoring beverage, medicinal tea, and condiment
28	Jatamansi	*Nardostachys grandiflora*	Valerianaceae	3600-5000	Oct-Nov	Rhizome	Stimulant heart and respiratory system, gastric, anemia, urine related disease
29	Jethimandu	*Glycyrrhiza glabra*	Leguminosae	Tropical/subtropical	Oct-Nov	Root	Common cold, sore throat, vomiting, acidity, gout, joint pain
30	Jhayau	*Parmelia nepalensis*	Parmeliaceae	1000-3000	Throughout year	Whole plant	Food poisoning, disturbance in menstrual cycle

31	Jimbu	*Allium hypsistum*	Amaryllidacea e	2500-4000	Oct-Nov	Whole plant	Spice, altitude sickness
32	Kachur	*Curcuma zedoaria*	Zingiberaceae	Up to 1000	Nov-Dec	Rhizome	Essential oil, common cold, and stomach related disease
33	Kakarsingi	*Pistacia chinensis*	Anacardiaceae	300-1500	Nov-Dec	Bark of dry fruit	Dysentery, Asthma, against bites of snake and scorpion and killing worms
34	Kakoli, Ban Lasun	*Fritillaria cirrhosa*	Liliaceae	3000-4500	Sept-Oct	Bulb	Asthma, Bronchitis, and Tuberculosis
35	Kalo Musli	*Curculigo orchioides*	Hypoxidaceae	600-1800	Sept-Oct	Root and Rhizome	Vomiting, Piles, Jaundice, Asthma, Dysentery, Gonorrhea
36	Kaulo	*Persea odoratissima*	Lauraceae	1000-2100	Sept-Nov	Bark of the main stem	Manufacturing Incense
37	Kutki	*Neopicrorhiza scrophulariiflora*	Scrophulariace ae	3600-4800	Nov-Dec	Rhizome and Root	Gastric, Worms, Bile related ailments, Expectorant, Fever and tonic to the heart
38	Laghupatra	*Podophyllum hexandrum*	Berberidaceae	2400-4500	Oct-Nov	Rhizome and Root	Liver wounds, cancer
39	Lalgedi, Ratogedi	*Abrus precatorius*	Leguminosae	Upto 1000	Sept-Oct	Seed	Energetic, sex stimulant, purifying blood, cough, curing eye disease
40	Lauth Salla	*Taxus wallichiana*	Taxaceae	2300-3400	Feb-Apr	Leaves	Breast and ovary cancer
41	Majitho	*Rubia manjith*	Rubiaceae	1200-2700	Oct-Nov	Root and Stem	Heart attack, Ulcer, skin related disease, an antidote to cobra and scorpion bite
42	Nagbeli	*Lycopodium clavatum*	Lycopodiaceae	1200-3500	Oct-Nov	Dust of Lycopod ium (Spores)	Diuretic, Asthma, gout, lungs, and kidney-related disease
43	Neem	*Azadirachta indica*	Meliaceae	100-900	monsoon	Whole plant	Ideal fertilizer for organic culture
44	Nirmansi, Nirbishi, Nilobish	*Delphinium denudatum*	Ranunculaceae	2700-4200	Oct-Nov	Root	Heat production, gastric, acidity, fever, ulcer, and cough
45	Okhar	*Juglans regia*	Juglandaceae	1200-3000	Nov-Dec	Fruit and Bark of stem	Dye, Detergent, Medicine
46	Padamchal	*Rheum austral*	Polygonaceae	3200-4200	Nov-May	Rhizome , Petiole of leaf, Leaves	Diarrhea, Gout, and Epilepsy
47	Pakhanved, Pasanved, Dhungephul	*Bergenia ciliata*	Saxifragaceae	1600-3200	Oct-Nov	Undergr ound stem	Cancer, Dysentery, fever, and kidney disease
48	Panchaunle, Hatajadi	*Dactylorhiza hatagirea*	Orchidaceae	2800-4000		Rhizome	Expectorant, astringent, demulcent
49	Pipla	*Piper longum*	Piperaceae	200-1300	Nov-Jan	Fruit	Condiments, hair tonic, malarial fever, anti-poisonous for snake and wild lizard bites
50	Ritha	*Sapindus mukorossi*	Sapindaceae	600-1400	Nov onwards	Fruit and seed	Natural soap, medicine for cough, anemia, and epilepsy
51	Rudrakshya	*Elaeocarpus sphericus*	Elaeocarpacea e	600-1500	Dec-Feb	Seed	Digestion, whooping cough, controlling pressure, heart, and mental related disease
52	Saldhup	*Shorea robusta*	Dipterocarpace ae	150-1200	Oct-Nov	Resin	Diarrhea, urine burns, burn or toothache

53	Salla Simta	*Tsuga dumosa*	Pinaceae	2300-3300	Nov-Dec	Cone	Raw material for handicrafts
54	Sarpagandha, Chandmaruwa	*Rauvolfia serpentine*	Apocynaceae	100-800	Nov-Mar	Root	Veins related disease, sleeplessness, and controlling pressure
55	Satavari, Kurilo	*Asparagus racemosus*	Liliaceae	300-2200	Oct-Dec	Root	Energetic and sex stimulant
56	Satuwa	*Paris polyphylla*	Liliaceae	1900-3100	Oct-Nov	Rhizome	Kill worms and as tincture iodine in cuts or wounds, alternative for diosgenin
57	Seto Musli	*Chllorophytum borivilianum*	Asparagaceae	300-1400	Jan-Mar	Rhizome	Diarrhea, Dysentery, Jaundice and Asthma
58	Sikakai	*Acacia rugata*	Fabaceae	400-800	Mar-May	Pods and Seeds	Stimulant and tonic, insecticides
59	Siltimur	*Lindera neesiana*	Lauraceae	1500-2700	Jul-Sept	Fruit	Spice, medicine for gastric and stomach ache
60	Simal ko ful	*Bombax ceiba*	Bombacaceae	Up to 1200	May-Jul	Cotton like fibrous stuff	Pillows, cushions, quilts, medicine for Dysentery and stomach related disease
61	Somlata	*Ephedra gerardiana*	Ephedraceae	2400-4200	Nov-Dec	Branches	Sinusitis, Asthma, Epilepsy, Diuretic, and Allergy, decrease blood pressure
62	Sugandh kokila	*Cinnamomum glaucescens*	Lauraceae	1000-2500	Oct-Nov	Fruit	Essential oil, stick incense, medicine for cold, worms in stomach, and toothache
63	Sugandhwal, Samayo	*Valeriana jatamansi*	Valerianaceae	1500-3600	Nov-Dec	Rhizome	Relief from pain, heal the wound, stimulant, sleepiness, anemia, gastric, digestive and killing germs
64	Sunpati	*Rhododendron anthopogon*	Ericaceae	3300-5100	Oct-Nov	Leaves and young petiole	Respiratory disease like common cold, Asthma, bronchitis
65	Tejpat, Dalchini	*Cinnamomum tamala*	Lauraceae	450-2000	Oct-Dec	Leaves and Bark	Spice, flavoring, and medicine for digestion, stomachache, dysentery
66	Timur	*Zanthoxylum armatum*	Rutaceae	1000-2500	Oct-Dec	Fruit	Headache, toothache, as spice and pesticide
67	Tukiful	*Taraxacum officinale*	Compositae	1000-4000	Aug-Nov	Root	Potherb, medicine for diuretic, stomachache, and liver-related disease
68	Tulsi	*Ocimum sanctum*	Lamiaceae	400-1800	Oct-Nov	Leaves	Common cold, cough, Toothache and Ear pain, purify blood, digestion, decrease blood sugar level
69	Yarsagumba	*Ophiocordyceps sinensis*	Hypocreaceae	4200-5000		Whole plant	Energetic, sex stimulant, strengthen memory power, medicine for kidney, heart, and blood-related disease

Source: Modified from (Gurung and Pyakurel, 2017)

Role of MAPs in Nepalese Livelihood

Traditional medicine in Nepal

A variety of medicinal plants are used to maintain physical, mental, and spiritual health, and to treat specific ailments (Garg et al., 2021). It is believed that Nepali Vaidhyas used Ayurvedic knowledge as early as 879 (IUCN, 2004). Ayurveda is a Hindu holistic healing system that continues to be the key source of medical knowledge and expertise in many South Asian nations, including Nepal (IUCN, 2000). Nepalese have been using herbalism in the Himalayas for centuries, with positive results and a persuasive story (World Bank, 2018). Ayurveda, Traditional Chinese Medicine, Unani, and Tibetan Amchi are some of the traditional systems of medicine that Nepalese practice over a long period (Shengji, 2001). WHO estimated that 80% of the global population relies on herbal medicines for their basic health security (WHO, 2002). Traditional plant-based medicines are used by 70% of India's population (Gadgil, 1998), 80% of Pakistan's population (Ahmad and Ghafoor, 2000), and 80% of Nepal's population (Kunwar et al., 2006). It is estimated that almost 17% of the population lives in cities and has access to modern medicine, while the rest of the population still relies on traditional medicine for their basic health care requirements in Nepal (Ambu et al., 2020; Adhikari et al., 2019) In the hilly regions of Nepal, about 215 types of plants are used to cure 139 different types of diseases (Miya et al., 2020).

Globally, approximately 50,000 to 70,000 plant species are used as a traditional and modern medicines (Pyakurel and Baniya, 2011). In the absence of any proven medicines/vaccines for COVID-19 cure, possible antiviral and immune booster herbal medicines, extracts, and formulations may be useful in lowering the global mortality rate associated with COVID-19 (Ak et al., 2020). In the current situation, local people are using medicinal herbs as a treatment option for COVID-19 to boost immunity against viral attacks, as there is no specific treatment for COVID-19. The medicinal herbs such as *Tinospora cordifolia* (Gurjo), *Glycyrrhiza glabra* (Jestimadhu), *Swertia chirayita* (Chiraito), *Ocimum sanctum* (Tulsi), *Zingiber officinale* (Aduwa), *Curcuma longa* (Haledo/Besar), *Allium sativum* (Lasun), *Withania somnifera* (Ashwagandha), *Moringa oleifera* (Sheetal Chini), *Zanthoxylum armatum* (Timur), *Cinnamomum zeylanicum* (Dalchini) and *Phyllanthus emblica* (Amala) are used in Nepal for boosting immunity and treatment purposes (Gyawali et al., 2020).

Socio-economic Benefits

MAPs are a key source of government revenue, contributing substantially to rural livelihoods. MAPs and essential oils rank among Nepal's top export commodities. They are important in terms of employment generation and revenue generation, especially in the poorest regions of Nepal (Kalauni and Joshi, 2018).

Cultivating medicinal plants not only offers a means of livelihood to farmers with limited external inputs but also strengthens the economy (Rajak and Singh, 2017). Growing recognition of natural herbal products, which are non-narcotic, have no side effects, and are easily and affordably accessible to the poor has prompted an increase in demand for medicinal plants in both developed and developing countries (Manoharachary and Nagaraju, 2017). The export and trade of medicinal plants and NTFPs affect the local, national and international economy. People in the hilly region of western Nepal mostly collect MAPs for their livelihood upliftment compared to other regions. Thus, MAPs and essential oils, if developed well, can contribute immensely to the raising of the living standard and socioeconomic status of this region (Sharma and Shrestha, 2011).

The Agro Enterprise Centre (AEC- FNCCI) and the Nepal Herbs and Herbal Products Association (NEHHPA) collaborated to launch the NTFPs/MAPs Business Promotion Strategy. The Strategy's long-term vision is to promote NTFPs/MAPs as a national priority sector for Nepal's economic development, which will be supported by lobbying for a favorable policy environment, encouraging private sector investment in identified areas, and diversifying both national and international markets with the highest level of value addition and processing within the country.

The Strategy specifies 20 species for product promotion across Nepal and envisions collaborative efforts of the business sector, government agencies, and development partners, as well as the active participation of local communities/farmers/collectors in the process (Table 6).

Table 6: Products for promotion Identified by the Strategy

S.N.	**Bio-geographic regions**	**Political boundaries-Zones/Districts**	**Species selected/recommended**
1.	Far and mid-western hilly and high regions	Seti: Achham, Bajhang, Bajura, Doti Bheri: Dailekh, Jajarkot, Surkhet Mahakali: Baitadi, Dadeldhura, Darchula	Yarshagumba, Rittha, Lichens
2.	Western mid-hills (Rapti and Lumbini)	Rapti: Pyuthan, Rolpa, Rukum, Salyan Lumbini: Arghakhanchi, Gulmi, Palpa	Chiuri, Rittha, Lichens, Sugandhawal, Sugandha kokila, Timur
3.	Karnali region	Dolpa, Humla, Jumla, Kalikot, Mugu	Jatamansi, Kutki, Yarshagumba
4.	Western Terai and lowlands	Dang, Banke, Bardiya, Kailali, and Kanchanpur	Bael, Chamomile, Mentha, Sarpagandha
5.	Trans Himalayan region	Manang, Mustang	Dhupi, Jatamansi, Seabuckthorn

6.	Western mid hily regions (Kaligandaki corridor)	Kali-Gandaki coridor: Baglung, Myagdi, Parbat, Kaski, Lamjung, Syangja, Tanahu	Allo, Satuwa, Lokta, Lichens, Dalchini
7.	Mid-Terai and lowlands	Chitwan, Parsa, Kapilbastu, Nawalparasi, Rupandehi	Chamomile, Kurilo, Mentha, Lemongrass
8.	Western highlands	Gorkha, Dhading, Sindhupalchowk, Rasuwa and Dolakha	Dhupi, Lokta, Jatamansi
9.	Central mid-hills	Hilly districts of Narayani, Janakpur, and Bagmati zone: Bhaktapur, Kathmandu, Dhading, Lalitpur, Kavrepalanchowk, Rasuwa, Nuwakot, Sindhuli, Makanwanpur, Ramechhap	Lichens, Satuwa, Dhasingre
10.	Eastern mid-hills	Dhankuta, Bhojpur, Panchthar, Terhathum, Ilam, Okhaldunga, Khotang, Udayapur	Lichens, Chiraito
11.	Eastern Himalayas	Sankhuwasabha, Solukhumbu and Taplejung	Chiraito, Dhupi, Kutki
12.	Eastern Terai	Morang, Jhapa, Sunsari, Dolakha, Dhanusa, Sarlahi, Saptari, Mahottari, Bara, Siraha and Rautahat	Mentha, Pipla, Lemongrass

Source: (AEC/NEHHPA, 2012)

The socio-economic benefits pertain mainly to (i) employment generation and (ii) revenue generation

Employment Generation

Karnali Zone has been designated as a "Pocket of Excellence" by the GoN for the development of non-timber forest products (NTFPs), especially high-valued medicinal plants (Poudel, 2015). It is particularly crucial in the Himalayan region, where many rural dwellers depend on MAPs for subsistence (Pyakurel and Baniya, 2011). The FNCCI-AEC/NEHHPA (2012) study found that 10-100% of households in high-altitude areas of Nepal are interested in commercial MAP collections. According to NEHHPA, around 50% of local communities are involved in the collection and trade of MAPs or NTFPs. As many as 300,000 families are interested in MAPs collection in 58 districts of Nepal. Another 100,000 families are ready to join the community if suitable conditions are established (SAWTEE, 2015). Women account for more than 50% of those involved in the collection, cleaning, and grading of MAPs (MoCS, 2010). According to a study conducted by the Environmental Resources Institute (ERI), Nepal's forestry sector employs full-time jobs to 1,658,099 people per annum (SAWTEE, 2015). According to Kunwar et al. (2013), janjati and dalit groups received the highest percentage of income from NTFPs in the far-western region. Several studies have shown that MAPs also have a major impact on the local economy (Edward, 1996; Subedi, 1997; Bhattarai, 1997).

Revenue Generation

The following graph demonstrates the export trend of MAPs from 2012-2017. MAPs export value over two decades (1992-2012) increased continuously (MSFP, 2014) and our study shows the increase of export value over 3 fiscal years (2012-2015) but recent two fiscal years (2015/16 and 2016/17) indicates that export value of MAPs is in decreasing trend (Fig 5).

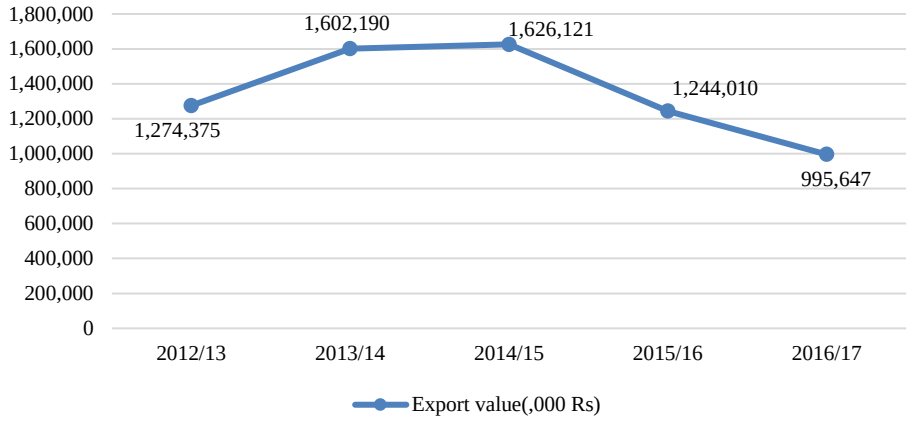

Fig. 5: Export trend of MAPs from 2012-2017

Source: (TEPC, 2017)

According to a WHO study, herbal market demand nearly doubled in Asia during the late 1990s, and the total foreign trade in medicinal plants and their products was US$ 60 billion in 2010 and is projected to cross US$ 5 trillion by 2050 (WHO, 2002). The use of herbal medicine is increasing exponentially worldwide, especially in Asia in the last three decades (Kumar et al., 2014; Huang et al., 2020). Nepal, along with India and China, has been recognized as a major reservoir for the supply of MAPs in Asia (Pyakurel and Oli, 2013). The increase in export value over the last ten years (2005 to 2014) in Nepal suggests increased global demand for MAPs (Ghimire et al., 2016).

Around 90% of MAPs are exported to India in raw form. In 2017, Nepal ranked 42nd among MAPs exporters with a value of $7.4 million. The most exported crude herbs from Nepal are Majitho, Padamchal, Pakhanved, Rittha, Rudrakshya, Kurilo, Satuwa, Tejpat, Yarshagumba, Timur, Chiraito, Jatamansi, Kaulo, and Kutki. Nepal exports 76% of its MAPs production to India and 2.5-3.5 % to Vietnam, France, and China (TEPC, 2018). Only about 10% of the total quantity of MAPs obtained is used to manufacture medicinal products or essential oils in factories and small manufacturing units of Nepal (Tiwari et al., 2004). In 2017, Nepal ranked

62nd for essential oil exports with $3.3 million. The most exported essential oils from Nepal are Juniper oil, lemongrass oil, Mint oil, Wintergreen (Dhasingre) oil, Palmarosa oil, Timur oil, Abies oil, Anthopogon (laliguras) oil, Chamomile oil, Citronella oil, French basil oil, and Jatamansi oil. Nepali essential oil is primarily exported to the United States (34%), followed by Europe (37%), and then Asia (24%) (TEPC, 2018).

Limitations of the study

This review briefly describes the role of MAPs in Nepalese livelihood. Due to the lack of recent studies and databases about MAPs, relevant past data are used in this article.

Conclusion

Although Nepal does not have a significant part of global MAPs markets till now, MAPs have been recognized as one of the Himalayan region's prospective high-value resources with huge economic growth potential. Despite having immense potential to introduce a variety of herbal products, the country still lags far behind in the proper utilization of the available resources. The trade policies tailored to the specific regions of Nepal need to be formulated to produce a conducive environment for MAPs marketing. The promotion and domestication of MAPs, proper harvesting techniques, and employment generation through cultivation are crucial in ensuring food safety, alleviating poverty, and upliftment of livelihood. Research and development of medicinal plants should be carried emphasizing improved equipment, modern technology, standardization, and quality assurance of herbal products to generate high revenue. A clear understanding of the access to herbal plants, conservation of natural resources, sustainable exploitation, protection of indigenous knowledge, and information sharing needs to be at the policy level. We recommend public, private, and government-linked sectors contribute to infrastructure development through competitive "field-to-market" incentives and funding.

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Author contribution statements

All the authors were involved in concept development, defining intellectual content, and literature research. V.T. Chhetri, S. Shrestha, and S. Thapa reviewed the literature and prepared a draft manuscript. S. Timilsina edited and reviewed the manuscript for finalization. The published version of the manuscript has been read and approved by all authors. V.T. Chhetri, as a corresponding author, is the guarantor for this article.

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References

Acharya, K.R., 2014. Value chain development. International Journal of Operations and Production Management, 16(10), 23–36. https://doi.org/10.1108/01443579610130673

Adhikari, B., Marasini, B.P., Rayamajhee, B., Bhattarai, B.R., Lamichhane, G., Khadayat, K., Adhikari, A., Khanal, S. and Parajuli, N., 2021. Potential roles of medicinal plants for the treatment of viral diseases focusing on COVID-19: A review. Phytotherapy Research, 35(3), 1298–1312. https://doi.org/10.1002/ptr.6893

Ahmad, Z. and Ghafoor, A., 2002. Resource Base and Conservation Strategies of MAPs in Pakistan. In: Sharing Local and National Experience in Conservation of Medicinal and Aromatic Plants in South Asia Edited by: Bhattarai N., Karki M., HMGN, IDRC and MAPPA, 105-109.

Ak, S., Jp, C., Khan, R., Dhand, C. and Verma S., 2020. Role of Medicinal Plants of Traditional Use in Recuperating Devastating Role of Medicinal Plants of Traditional Use in Recuperating Devastating COVID-19 Situation. Medicinal and Aromatic Plants, 9(5), 1–16. https://doi.org/10.35248/2167-0412.20.9.359.Copyright

Ambu, G., Chaudhary, R.P., Mariotti, M. and Cornara, L., 2020. Traditional Uses of Medicinal Plants by Ethnic People in the Kavrepalanchok District, Central Nepal. Plants, 9(6), 759. http://dx.doi.org/10.3390/plants9060759

Atanasov, A.G., Waltenberger, B., Pferschy-Wenzig, E.M., Linder, T., Wawrosch, C., Uhrin, P., Temml, V., Wang, L., Schwaiger, S., Heiss, E.H., Rollinger, J.M., Schuster, D., Breuss, J. M., Bochkov, V., Mihovilovic, M.D., Kopp, B., Bauer, R., Dirsch, V.M. and Stuppner, H., 2015. Discovery and resupply of pharmacologically active plant-derived natural products: A review. Biotechnology Advances, 33(8), 1582–1614. https://doi.org/10.1016/j.biotechadv.2015.08.001

Barnes, S. and Prasain, J., 2005. Current progress in the use of traditional medicines and nutraceuticals. Current opinion in plant biology, 8(3), 324–328. https://doi.org/10.1016/j.pbi.2005.03.010

Beutler, J.A., 2009. Natural products as a foundation for drug discovery. Current Protocols in Pharmacology, SUPPL. 46, 1–21. https://doi.org/10.1002/0471141755.ph0911s46

Bhattarai, K.R. and Ghimire, M., 2006. Commercially important medicinal and aromatic plants of Nepal and their distribution pattern and conservation measure along the elevation gradient of the Himalayas. Banko Janakari, 16(1), 3–13. https://doi.org/10.3126/banko.v16i1.357

Bhattarai, N.K., Tandon, V. and Ved, D.K., 2002. Highlights and outcomes of the Conservation Assessment and Management Planning (CAMP) Workshop, Pokhara, Nepal. In: Sharing local and national experiences in Conservation of Medicinal and aromatic plants in South Asia (Edited by Bhattarai, N.K. and Karki, M.). IDRC South Asia Regional Office, New Delhi, India, 46-53.

Bhattarai, N., 1997. Biodiversity-People Interface in Nepal, Medicinal Plants for Forest Conservation and Health Care. Rome: FAO and UN.

CECI, 2006. Synthesis of seminar presentation and discussions. First national trade show and seminar on Herbs, Herbal Products and Spices, 12-14 November 2005. Published by CECI in March 2006.

DoF, 2018. Hamro Ban. Annual Report of Department of Forest. Government of Nepal, Ministry of Forests and Soil Conservation (MoFSC), Kathmandu. Available online: https://www.dofsc.gov.np//public/uploads/files/1593881065Hamro%20ban%20Report-20751.pdf.

DPR, 2007. Medicinal plants of Nepal (revised), Adhikari, M.K., Shakya. D.M., Kayastha, M., Baral, S.R. and Subedi, M.N. (eds). Department of Plant Resources, Thapathali, Kathmandu, Nepal.

DPR, 2016. Medicinal Plants of Nepal (Revised),Department of Plant Resources (DPR),Thapathali, Kathmandu, Nepal.

DPR, 2009. Prioritized NTFPs for Economic Development of Nepal. Ministry of Forests and Soil Conservation, Department of Plant Resources, Thapathali, Kathmandu.

Edward, D., 1996. Non-Timber Forest Products from Nepal: Aspect of the trade in medicinal and aromatic plants. FORESC monograph, Ministry of Forests and Soil Conservation, 1-96.

EPI, 2017. Political Economy Analysis of MAPs Sector in Nepal. Mimeo, Kathmandu: Economic Policy Incubator - Nepal.

FNCCI-AEC/NEHHPA, 2012. NTFPs/MAPs Business Promotion Strategy (2012-2016) - From Private Sector Perspective. Kathmandu: FNCCI.

Gadgil, M. and Seshagiri Rao, P.R., 1998. Nurturing Biodiversity: An Indian Agenda. Center for Environment Education, Ahmadabad, India.

Garg, A.K., Faheem, M. and Singh, S., 2021. Role of Medicinal Plant in Human Health Disease. Asian Journal of Plant Science and Research, 11(1), 19–21.

Ghimire, S.K., Awasthi, B., Rana, S., Rana, H.K., Bhattarai, R. and Pyakurel, D., 2016. Export of medicinal and aromatic plant materials from Nepal. Botanica Orientalis: Journal of Plant Science, 10, 24–32. https://doi.org/10.3126/botor.v10i0.21020

GIZ, 2017. MAPs and Essential Oils from Nepal: Market Analysis And Market Entry Strategies in Five Selected Markets. Bonn:Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

GoN, 2004. Herbs and NTFPs Development Policy. Government of Nepal, Ministry of Forest and Soil Conservation, Kathmandu Nepal. Available online: https://www.mofe.gov.np/downloadfile/11_NTFPPolicy_1526466471.pdf [Accessed on 29 December 2020].

Gurung, K. and Pyakurel, D., 2017. Identification Manual of Commercial Medicinal and Aromatic Plants of Nepal. Nepal Herbs and Herbal Products Association (NEHHPA). Teku, Kathmandu, Nepal. http://www.nepalherbs.org.np/assets/downloads/171115021205NTFP Book_english.pdf

Gyawali, R., Paudel, P.N., Basyal, D., Setzer, W.N., Lamichhane, S., Paudel, M.K., Gyawali, S. and Khanal, P., 2020. A Review on Ayurvedic Medicinal Herbs as Remedial Perspective for COVID-19. Journal of Karnali Academy of Health Sciences, 3(Special Issue). https://doi.org/10.3126/jkahs.v3i0.29116

Huang, J., Tao, G., Liu, J., Cai, J., Huang, Z. and Chen, J.X., 2020. Current Prevention of COVID-19: Natural Products and Herbal Medicine. Frontiers in Pharmacology, 11, 1–18. https://doi.org/10.3389/fphar.2020.588508

IUCN, 2000. National Register of Medicinal and Aromatic Plants. IUCN-The World Conservation Union, Kathmandu, Nepal.

IUCN, 2004. National Register of Medicinal and Aromatic Plants (Revised and updated). In IUCN-The World Conservation Union, Kathmandu, Nepal (Vol. 13, p. 202).

Kalauni, D. and Joshi, A., 2018. Status of Medicinal and Aromatic Plant (MAPs) and Socio-Economic Influence in Nepalese Livelihood-A Review Research. Acta Scientific Agriculture, 2(9), 123–130.

KC, R., 2014. Prominent Non-Wood Forest Products of Terai and Siwalik Regions in Nepal Prominent Non-Wood Forest Products of Terai and Siwalik Regions in Nepal (Issue November). Sustainable Management and Development of NWFPs in Terai and Siwalik Regions of Nepal.

Kumar, V., Banu, RF., Begum, S., Kumar, M.S. and Mangilal T., 2015. Evaluation of antimicrobial activity of ethanolic extract of Dactylocteniumaegyptium. International Journal of Pharmacological Research, 5(12), 338-344.

Kunwar, R.M., Mahat, L., Acharya, R.P. and Bussmann, R.W., 2013. Medicinal plants, traditional medicine, markets and management in far-west Nepal. Journal of Ethnobiology and Ethnomedicine, 9(1), 1–10. https://doi.org/10.1186/1746-4269-9-24

Kunwar, R.M., Nepal, B.K., Kshhetri, H.B., Rai, S.K. and Bussmann, R.W., 2006. Ethnomedicine in Himalaya: A case study from Dolpa, Humla, Jumla and Mustang districts of Nepal. Journal of Ethnobiology and Ethnomedicine, 2(27), 1–6. https://doi.org/10.1186/1746-4269-2-27

Lamichhane, R., Gautam, D., Miya, M.S, Chhetri, H.B. and Timilsina, S., 2021. Role of Non-Timber Forest Products in National Economy: A Case of Jajarkot District, Nepal. Grassroots Journal of Natural Resources, 4(1), 94-105. https://doi.org/10.33002/nr2581.6853.040107

Lawrence, A., 2003. No forest without timber? International Forestry Review, 5(2), 87–96. https://doi.org/10.1505/IFOR.5.2.87.17411

Malla, S.B. and Shakya, P.R., 1995. Medicinal Plants. In: Mapuria, T.C and Kumar, R. (eds.), Nepal Nature's Paradise, New Edition 1999. Gwalior, India: M. Devi Publisher, 261-297.

Manoharachary, C. and Nagaraju, D., 2017. Medicinal plants for human health and welfare. Annals of Phytomedicine, 5(1), 24–34. www.ukaazpublications.com

Marriott, B.M., 2000. Functional foods: An ecologic perspective. American Journal of Clinical Nutrition, 71(6), 1728S–1734S. https://doi.org/10.1093/ajcn/71.6.1728s

Miya, M.S., Timilsina, S. and Chhetri, A., 2020. Ethnomedicinal uses of plants by major ethnic groups of Hilly Districts in Nepal: A review. Journal of Medicinal Botany, 4, 24-37. doi: 10.25081/jmb. 2020.v4.6389

MoCS, 2010. Nepal Trade Integration Strategy. Kathmandu: Government of Nepal.

MoFE, 2018. Nepal's Sixth National Report to the Convention on Biological Diversity. Ministry of Forest and Environment, Nepal. Available online: https://www.mofe.gov.np/downloadfile/6th%20NR_Bio_Diver_1576649610.pdf.

MoFSC, 2012. Non-Timber Forest Product Resource Inventory Guideline. Ministry of Forests and Soil Conservation (MoFSC), Department of Forest, Kathmandu.Available online: https://dofsc.gov.np//public/uploads/files/1593847620NTFP%20Guidline_Last%20Final_SGOP_Le aout_new.pdf.

MoFSC, 2014. Nepal Biodiversity Strategy and Action Plan 2014- 2020. Government of Nepal, Ministry of Forest and Soil Conservation.

MSFP, 2014. Private Sector Involvement and Investment in Nepal's Forestry: Status, Prospects and Ways Forward. March, 170. https://ansab.org.np/storage/product/private-sector-involvement-and-investment-in-nepals-forestry-20141022034611-1579165165.pdf

Newman, D.J. and Cragg, G.M., 2016. Natural Products as Sources of New Drugs from 1981 to 2014. Journal of Natural Products, 79(3), 629–661. https://doi.org/10.1021/acs.jnatprod.5b01055

NTIS, 2010. Nepal Trade Integration Strategy. Nepal Trade and Export Promotion Center, Kathmandu, Nepal.

Olsen, C.S. and Larsen, H.O., 2003. Alpine medicinal plant trade and Himalayan mountain livelihood strategies. The Geographical Journal, 169(3), 243–254. https://doi.org/10.1111/1475-4959.00088

Paudel, G. and Acharya, R., 2018. Higher estimation, lower harvesting: case of NTFPs from Dhaulagiri region, Nepal. Banko Janakari, 28(2), 45–51. https://doi.org/10.3126/banko.v28i2.24187

Pérez, M.R. and Byron, N., 1999. A methodology to analyze divergent case studies of non-timber forest products and their development potential. Forest Science, 45(1), 1–14. https://doi.org/10.1093/forestscience/45.1.1

Pieroni, A., Quave, C.L., Villanelli, M.L., Mangino, P., Sabbatini, G., Santini, L., Boccetti, T., Profili, M., Ciccioli, T., Rampa, L.G., Antonini, G., Girolamini, C., Cecchi, M. and Tomasi, M., 2004. Ethnopharmacognostic survey on the natural ingredients used in folk cosmetics, cosmeceuticals and remedies for healing skin diseases in the inland Marches, Central-Eastern Italy. Journal of Ethnopharmacology, 91(2–3), 331–344. https://doi.org/10.1016/j.jep.2004.01.015

Poudel, K.L., 2015. Trade Potentility and Ecological Analysis of NTFPs in Himalayan Kingdom of Nepal. Himalayan College of Agricultural Sciences and Technology (HICAST).

Pyakurel, D. and Oli, B.R., 2013. Market Study of Tradeable and Economically Important Medicinal and Aromatic Plants of Eastern Nepal (Using Value Chain Approach). Department of Plant Resource and BARDAN, Kathmandu, Nepal.

Rajak, A. and Singh, R., 2017. Contribution of Medicinal Plants in Economic Growth. World Journal of Pharmacy and Pharmaceutical Sciences, 6(11), 367–372. https://doi.org/10.20959/wjpps201711-10370

Rajbhandari, K. and Dhungana, S.K., 2011. Endemic flowering plants of Nepal Part III. Department of Plant Resources, Kathmandu, Nepal.

Rao, M.R., Palada, M.C. and Becker, B.N., 2004. Medicinal and aromatic plants in agro-forestry systems. Agroforestry Systems, 61, 107-122.

SAWTEE, 2015. Realising the Export Potential of MAPs and Essential Oils. i: www.giz.de/nepal / www.nepaltrade.org

Seidel, V., 2020. Plant-derived chemicals: A source of inspiration for new drugs. Plants, 9(11), 1–3. https://doi.org/10.3390/plants9111562

Shackleton, C. and Shackleton, S., 2004. The importance of non-timber forest products in rural livelihood security and as safety nets: A review of evidence from South Africa. South African Journal of Science, 100(11), 658–664.

Sharma, P. and Shrestha, N., 2011. Promoting Exports Of Medicinal And Aromatic Plants (MAPs) And Essential Oils From Nepal. South Asia Watch on Trade, Economics and Environment (SAWTEE), 1–41.

Shengji, P., 2001. Ethnobotanical approaches of traditional medicine studies: some experience from Asia. Pharmaceutical Botany, 39(sup1), 74-79. https://doi.org/10.1076/phbi.39.s1.74.0005

Shrestha, P.M. and Dhillion, S.S., 2003. Medicinal plant diversity and use in the highlands of Dolakha district, Nepal. Journal of ethnopharmacology, 86(1), 81–96. https://doi.org/10.1016/S0378-8741(03)00051-5

Shrestha, T.B. and Joshi, R.M., 1996. Rare, Endemic and Endangered plants of Nepal, 244p.

Subedi, B.P., 2006. Linking Plant-Based Enterprises and Local Communities to Biodiversity Conservation in Nepal Himalaya. Adroit Publishers, New Delhi, India. 244p.

Subedi, B., 1997. Utilization of Non-Timber Forest Products: Issue and strategies for environmental conservation and economic development. Kathmandu: Asia Network for Sustainable Agriculture and Bio resources.

TEPC, 2017. A Glimpse of Nepal ' s Foreign Trade. Government of Nepal Ministry of Commerce. Trade & Export Promotion Centre, October 2017.

TEPC, 2018. Trade and Export Promotion. Australian Journal of Public Administration, 49(3), 343–348. https://doi.org/10.1111/j.1467-8500.1990.tb01977.x

Thomford, N.E., Senthebane, D.A., Rowe, A., Munro, D., Seele, P., Maroyi, A. and Dzobo, K., 2018. Natural products for drug discovery in the 21st century: Innovations for novel drug discovery. International Journal of Molecular Sciences, 19(6), 1578. https://doi.org/10.3390/ijms19061578

Tiwari, N.N., Poudel, R.C. and Uprety, Y., 2004. Study on Domestic Market of Medicinal and Aromatic Plants (MAPs) in Kathmandu Valley. Kathmandu and Winrock International. https://doi.org/10.13140/RG.2.1.5166.0243

WHO, 2002. Programme on Traditional Medicine. WHO Traditional Medicine Strategy 2002–2005. World Health Organization Geneva.

World Bank, 2018. Strategic Segmentation Analysis - Nepal Medicinal and Aromatic Plants. Pharmaceutisch Weekblad, 1–61.

Willis, K.J., 2017. State of the World's Plants 2017. Report. Royal Botanic Gardens, Kew.https://stateoftheworldsplants.org/2017/report/SOTWP_2017.pdf