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RESEARCH ARTICLE

Potential Role and International Trade of Medicinal and Aromatic Plants in the World

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ABSTRACT

Before the dawn of civilization, humans have hunted and gathered, and the only trustworthy sources of medicine were plants and herbs. The needs for traditional medicine, which are present in both local and international markets, are met in large part by medicinal and aromatic plants (MAPs). Due to the abundance of medicinal plants, people in many tribal and rural parts of Bangladesh, like many other nations, have traditionally relied on nature and natural remedies to heal themselves and avoid ailments. The market is flooded with items made from medicinal and aromatic herbs. Plants can be used to produce specialty materials like biocides, cosmetics, medicines, essential oils, dyes, and colorants. Most of the species of MAPs are produced for such industrial uses, but most of them are still wild collected. The increasing demand in botanicals results in a great trade from local to international level. Identifying the significant role played by MAPs in serving health and well-being security, it is very important for the countries to utilize the need to conserve, sustainably use, and commercialize the MAP biodiversity resources responsibly throughout the world. The total trades in MAPs have increased from 2.4 billion USD in 1996 to 6.2 billion USD in 2013 with annual growth rate of 5.4% in past 18 years, and growth rate of 10.7% is noticed in recent years. By 2023, it will be expected that the market for herbal medicines would develop at a compound annual growth rate (CAGR) of 5.88% and reach USD 1,29,689.3 million. Nowadays, roughly 80% of the world's population gets their healthcare mostly from plants and plant extracts. According to a World Health Organization (WHO) forecast, the worldwide herbal industry would reach $5 trillion by the year 2050. China, India, Hong Kong, USA, Germany, Republic of Korea, Canada and Poland are the top export countries while top destinations include USA, Hong Kong, Japan, Germany, France, Republic of Korea, China and Singapore. The study suggests five major trade centers of MAPs worldwide viz. USA, Hong Kong, Germany, Republic of Korea and China. A number of Non-Governmental Organizations (NGOs), Governmental Organizations (GOs) and International Non-Governmental Organization (INGOs) have been working on improvement and expansion of commodity-wise value chains for selected MAPs throughout the world. For commercial developments of MAPs sub-sector, it is required to gather experiences of technical, socio-economical, institutional and policy inputs.

Keywords: Aromatic plant, medicinal plant, role, trade.

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1. Introduction

For thousands of years, medicinal and aromatic plants (MAPs) have been utilized for celebrations, food preparation and preservation, traditional medicine, cosmetics, and other uses. MAPs go by many different names, such as medical plants, herbs, spices, etc., [1]. MAPs can be gathered from the wild or from cultivation. Wild harvesting refers to the collection of various MAPs that have grown naturally. These components, which may be gathered from a variety of sites, including agricultural land, forest land, gardens, mountains, the side of the road, etc., include leaves, herbs, flowers, fruits, bark, wood, and roots [2]. At present, it's estimated that various MAPs are used by more than three quarters of the world's population

[3]. Today's commercial medications and pharmaceuticals contain active components originating from plants in about 60% of cases. According to [3], the MAPs are important parts of ecosystems, hence the sustainable harvesting practices of wild MAPs should be used to confirm the compromise between sustainable management and commercialization in order to preserve and sustain the biodiversity.

Synthetic chemicals are widely employed practically everywhere in the world's production systems, not just in Bangladesh [4]. People are becoming more concerned of their health, and they are considering using natural, organic items more often in their daily lives. The acceptance of therapeutic plants has taken on various forms, and they greatly extend both the national and worldwide economies [5]. The cultivation of medicinal plants goes back to history; some sources date it to 3500 BC [6]. As a tropical nation, Bangladesh is particularly rich in many natural MAPs that are spread out across the forests, farmlands, plains, gardens, roadside vegetation, and wetlands. MAPs are screaming out for our wealth, much like our cultural and national wealth [7].

FAO estimates that 77 million acres of land were used to produce 330 million tons of MAPs worldwide [8]. The Japan, USA and Europe are the major MAPs consumers of the world, while India and China are the most important MAPs suppliers in Asia; China shipped 358,000 tons of traditional According to information from the China Chamber of Commerce for Export & Import of Medicine & Healthcare Products, the use of Chinese medicine increased by 0.7% in 2016 over the prior year. Export revenue increased by 2.1 percent to $3.6 billion in 2017. Only behind China, India is the world's second-largest exporter of herbal medicines. More than 70% of the demand for herbal medicines worldwide is produced in both countries. In 2017–2018, India exported raw herbs valued USD 330.18 million, an increase of 14.22% over the previous year [9]. The worldwide trade of added-value extracts of medical plants and herbal products reached USD 456.12 million in 2017–2018, a 12.23% rise from the previous year [9]. The most significant MAPs suppliers in Africa are Egypt and Morocco, whereas the most significant MAPs suppliers in Europe are Poland, Albania, and Bulgaria; the two most significant MAPs suppliers in South America are Peru and Chile [10].

MAPs have been the historical cornerstone of conventional healthcare in major civilizations, and 75%–80% of the global population still uses them today for their primary healthcare [11]. In 1999, the global market for MAPs was USD 1.1 billion, and it increased to USD 1.8 billion, USD 3 billion, and USD 4 billion in 2015 [12]. Additionally, it is anticipated to increase at a compound annual growth rate of 6.6% from 2015 to 2025, reaching USD 35.4 billion [13]. India's classical medical systems, such as Siddha and Ayurveda, which use around 7,000 kinds of flowering plants, have strong traditional health care practices. India has been a significant player in the global trade of MAPs. In 2017–2018, India traded raw herbs for USD 330.18 million, up 14.22% from the previous year [14].

The focus of health care is shifting globally from sickness to wellness, from treatment to prevention and early diagnosis, and from a broad approach to individualized therapy. Alternative medicines are steadily gaining ground on the global market. Natural products are driving the expansion of the global market because they are thought to have fewer side effects than contemporary pharmaceuticals and are also less expensive in comparison. According to a World Health Organization (WHO) forecast, the global herbal market would rise from its current level of USD 62 billion to USD 5 trillion by 2050 [15]. In the western world, which is accustomed to natural products with no side effects, alternative medical disciplines including yoga, homeopathy, acupuncture, massage, Traditional Indian System of Medicine (TISM), and Traditional Chinese Medicine (TCM) are currently gaining more appeal. The focus of both the modes of treatment, TISM and TCM, is on the patient's health and the holistic treatment of disorders, with the patient being the focal point rather than the illness [16].

According to [4], immediate action is required at the local, regional, national, and international level to halt the depletion of MAPs resources and preserve the history of user-friendly traditional healing. Additionally, this industry offers tremendous potential for economic growth along with export revenues at both the national and international levels. For this reason, there is a high demand for scientific techniques in both local and international markets, including research studies for MAPs cultivation, exploration, conservation, and value addition (through MAPs harvesting, grading, handling, processing, packaging, storage, and marketing). This study will shed light on the importance MAP species and to increase the consciousness of people about importance and potentials of MAPs and also to point out the trade of MAPs and value chain addition for further development of MAPs marketing.

2. Methodology

Only secondary data were employed in this study's analysis. The potential role and commerce of medicinal plants are the topics used in the study.

3. Medicinal and Aromatic Plants (MAPs)

Medicinal herbs are plant species that are used for promoting health and/or curing certain illnesses; they can be used in raw or processed form, alone or in combination with other plants or components, and countries around the world are looking into their usage in both allopathic and traditional systems [17].

On the other hand, Essential oils from aromatic plants are used to make medications, perfumes, and spices. As a result, the two groups frequently interact and act simultaneously, particularly in commercial experiments. MAPs are specially grouped and termed as Jaributi (herbs) in Nepal [17].

Still, one can distinguish between medicinal or therapeutic (pharmacological) and other applications (culinary, cosmetic, food, etc.), in the simplest way [18].

4. Active Ingredients

Chemicals of varied compositions and activities make up MAPs. These compounds are known as active or biologically active substances to denote their impact on living things. These components are essential for the use of plants as MAPs and have a significant ecological and physiological role for the plant itself. Alkaloids, essential oils, glycosides, and other diverse active components are the four commonly recognized groups into which active compounds of various plant species are categorized in scientific literature [19]. These categories are primarily based on practical, diagnostic considerations.

- **Alkaloids** are a class of compounds that primarily react chemically with nitrogenous chemicals. Alkaloids' chemical make-up is quite variable.
- **Glycosides** are substances with variable chemical compositions, physiological effects, and metabolic origins. One or more uniform sugar molecules are linked to a substance (aglycone) that is not typically thought of as a member of the same family of compounds.
- **Essential oils** term refers to a combination of several components, mostly terpenes and terpene derivatives that vaporize at room temperature without leaving any traces. They typically have a strong, distinctive flavor (aroma) and odor. Typically, steam distillation is used to isolate them.
- **Other chemicals** with different chemical structures and physiological benefits, such as carbohydrates, bitter substances, aromatic acids, mucilaginous substances, rubber, sterols, plant pigments, vitamins, and tannins, cannot be categorized under the aforementioned categories. The biogenetic process of inherent substances is based on the major routes of the general metabolism and joined recognized metabolic pathways, such as phenoloids, polyketides, terpenoides, azotoids, sacharides, and terpenoids, in contrast to the classification given above.

5. Potentials of MAPs throughout the World

It is believed that there are 320,000 plant species in the universe that are used as a food source, 25,000 as medical treatments, 5,000 as industrial goals, 15,000 as ornamental plants, and the other species are used for various other purposes. Despite the fact that there are many unused plants, up to 25,000 of them are thought to have medical uses and 10,000 to serve as food sources [20]. On the other hand, it is stated that there are 422,000 blooming plants in the globe, and that 72,000 of those species are thought to have medicinal properties (Table I) [21]. The distribution of plant species across the cosmos is not uniform, and it also differs across geographic regions of the same generation. When it comes to species variety, the tropics are the richest regions of the planet, and as one moves toward the poles, the diversity of species decreases. The richest region in terms of species is the northern section of South America and the Indonesian archipelago [22]–[24].

TABLE I: Number of Total Species and MAPs According to Some Countries

Countries	No. of species	No. of MAPs	Ratio of MAPs (%)
China	32200	4941	15.3
USA	21641	2564	11.8
India	18664	3000	16.1
Malaysia	15500	1200	7.7
Thailand	11625	1800	15.5
Vietnam	10500	1800	17.1
Turkey	10000	3300	33.0
Philippines	8931	850	9.5
Nepal	6973	900	12.9
Pakistan	4950	1500	30.3
France	4630	900	19.4
Bulgaria	3567	750	21.0
Sri Lanka	3314	550	16.6
South Korea	2898	1000	34.5
Hungary	2214	270	12.2
Jordan	2100	363	17.3
World	422000	72000	17.1

Source: Karik and Tuncturk [24].

Due to its health benefit, herbal medicines are becoming more and more important on a global scale. The World Health Organization [24] estimates that 80% of the population of the most developed developing nations, including those in Asia, Latin America, Africa, etc., still rely on traditional natural and herbal remedies for their primary medical requirements [25].

The majority of the world's medicinal plant supply originated in emerging nations. The MAPs' crucial contribution to meeting the health care needs of the three-quarters of the world's population that reside in developing nations [26].

In the Chinese Himalayan region, the State has preserved 116 species of MAPs utilized in TCM and other NTFPs throughout a 434,200 km^2 area. There are 220 botanical gardens there as well as 10 state-run medicinal plant gardens and germplasm banks [27].

According to [28], in India, CAMP (Conservation Assessment and Management Plan) seminars were organized in key regions, including all the Himalayan states, in accordance with IUCN criteria. Additionally, it is providing farmers with 50% government support for the production of 26 selected species. For the cultivation of 18,000 acres under the organic agricultural regime, Sikkim has brought 34,000 farmers.

In order to conserve some of the most popularly traded medicinal plants in the country's wild, the government of Nepal has placed various kinds of limitations on their collection, trading, and export. It has also analyzed 51 commercial MAPs and NTFPs to determine where they should be grown faster [28].

Pakistan confirmed the threat of 52 species of commercial MAPs in 2001 using IUCN standards. The government therefore prioritized 24 commercial MPs in 2010, including 12 endangered and 12 vulnerable species, and created mechanisms to manage and conserve them through various administrative and management entities [28].

Table II lists the nations that are major global producers of MAPs, the geographic locations where they produce, and the variety of plant species they cultivate. The two

TABLE II: Plant Species and Production Areas for Maps in Some Countries

Countries	Area (ha)	No. of species
China	460000	250
India	300000	150
Turkey	90000	50
USA	69200	90
Hungary	40000	40
Canada	34700	60
Poland	30000	30
France	25000	35
Spain	19000	40
Romania	15000	50
Bulgaria	9500	40
Germany	5700	45
Austria	4300	25
Greece	4000	20
Japan	3900	35
Italy	2300	25
United Kingdom	2000	20
Albania	2000	40

Source: Karik and Tuncturk [24].

countries that produce the most goods are China and India. Although MAPs are grown in the majority of European nations, there isn't much production space available. MAPs have been made in China and India for many years. The concurrent consumption in these nations is the main driver behind the creation of MAPs on such a big scale. On the other hand, it is seen that both the number of species grown and the size of the production regions are fairly considerable in these two nations. The high numbers of MAPs in these countries are the source of this situation [21].

6. Determination of Plant Parts to be Collected

Along with understanding the plants, it's crucial to understand which stage of development and where area of the plant the medicine can accumulate in. Typically, the length and/or width of the stem is constrained in the case of herbal medications, when the above-ground plant portions of flowering plants are gathered, with the stem maintaining modest concentrations of active components. The increasing frequency of flower stalks can also degrade the quality of flower medications, which is why these are also prohibited. (e.g.: *Sambuci flos*, *Chamomillae flos*) [29].

Similarly, the drug of roots, stem parts rate should be taken into consideration (e.g.: *Primulae radix, Valerianae radix*). However, in fruit medications, the fruit's color is frequently used as a ripeness detector and is thus a crucial factor to take into account. The relevant drug standards or pharmacopoeia contain this type of knowledge and skill, and MAP collectors must receive the appropriate training and education.

7. Overview of MAPs in Bangladesh

The main sources of MAPs genetic resources have always been the village and the woodland thickets. The core tenet of health and food security is the existence of wild species with a wide range of genetic potentials. The largest tropical rain forest in Bangladesh, which contains an unlimited supply of plant resources, is found in the Chittagong Hill Tracts. Tribal people are reported to treat approximately 302 ailments with a total of about 700 plant species as medication [30]. This region is home to some of the nation's better-off native tribes, which depend on these plant resources for their food, fruit, veggies, fuel, and medicine. Additionally, a large portion of the indigenous population uses several wild plants as folk medicine [30]. This is a complex process that is unique to each ecosystem and ethnic group. Home remedies, weaknesses connected to diet and food, and common ailments are treated with folk medicines. The extensively used medicinal plant species are: Noga Kola (*Alphonsea venticosa*), Thisuru (*Garcinia lanceaefolia*), Ban-jamir (*Acronychia peduculata*), Ban Kamla (*Atalantia monophylla*), Gulul (*Diospyros rammiflora*), Jangli-badam (*Alseodaphne petiolaris*), Ori Gab, Ban Bakul (*Drypetes assamica*), Sumomukhi (*Homalium nepalense*) [31]. In plain land, Sal Forests are consisting of many MAPs of diverse habits spreading from trees and shrubs to herbs and climbers. The medicinal tree species are: Palash (*Butea monosperma*), Bohera (*T. belerica*), Hartaki (*Terminalia chebula*), Chal-mugra (*Hydnocarpus kurzii*), Arjune (*T. arjuna*), Kurchi (*Holarrhena antidysentrica*), Ashok (*Saraca indica*), Parul (*Stereospermum suaveolens*), Sonalu (*Oroxylon indicum*), Muchkundo/Moos (*Pterospermum acerifolium*), Kharajora/Bijal-ghata (*Litsea monopetala*), Rakto-chandan (*Pterocarpus santilinus*), Neem (*Azadirachta indica*), Ganiari (*Premna integrifolia*), Bhela (*Semicarpus anacardium*), Barun (*Crataeva nurvala*), Sonalu (*Cassia fistula*), Chatim (*Alstonia scholaris*), Bael (*Aegel marmelos*). Among the climbers, the species of medicinal importance are: Bhui-kumra (*Ipomea digita*), Shayma-lota (*Ichnocarpus frutescens*), Gulancha (*Tinospora tomentosa*), Shotomuli (*Asparagus recemosus*), Ananta-mool (*Hemidesmus indicus*), Kumari-lata (*Smilax zeylanica*), Gandhabhadulia (*Paederia foetida*), Alkushi (*Mucuna pruriens*), Peepul (*Piper longum*), Makal (*Hodgsonia macrocarpa*), Nata (*Caesalpinia bonduc*) Telakucha (*Coccinea cordifolia*), etc., [32]. In Bangladesh, approximately 109 types of MAPs are grown in the homestead garden and the field area. The initial survey exhibits, Basok (*Justicia adhatoda*), Tulsi (*Ocimum tenuiflorum*), Aloe vera (*Aloe barbadensis*), Kalomegh (*Andrographis paniculate*) and Ashwagandha (*Withania somnifera*) are commercially cultivated. In addition, there are more species that are available but are only occasionally or insignificantly farmed for commercial purposes [4].

8. Type of MAPs Used for Trading

MAPs can be found in the wild or are grown in farms. Aside from being used to extract highly valuable compounds like essential oils, MAPs can be purchased in a variety of forms, including fresh, dried, and teas. Raw MAPs have a short shelf life because of the high moisture content that impairs their physical, chemical, and nutritional properties [31]. The result is that fresh MAPs can be

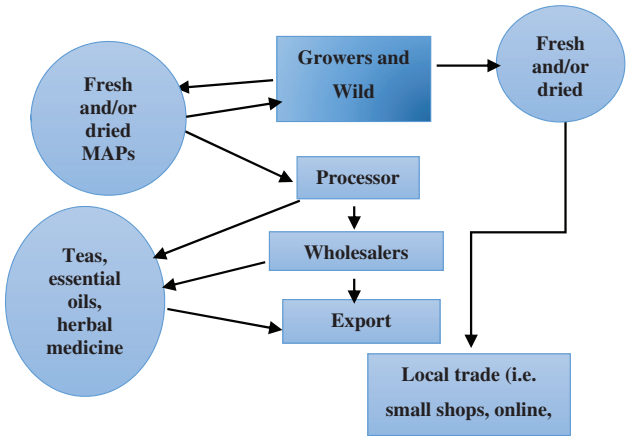

Fig. 1. Steps for using aromatic and medicinal herbs in the supply chain. (Source:https://wildmapsfit.eu/wpcontent/uploads/2022/04/D2-Market-Analysis-of-Wild-MAP.pdf).

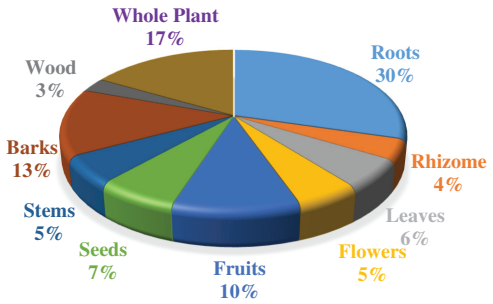

Fig. 2. Assessment of plant parts used in herbal industry. (Source: https://www.rgics.org/wp-content/uploads/Working-Paper-on-Development-and-Trade-of-MAPs-1.pdf).

purchased in small shops or supermarkets but not exported (Fig. 1). Drying is a significant procedure that is frequently applied as the last production stage before packing and selling of MAPs. The farmers or processors often sell the dried MAPs to wholesalers who then distribute them to other stores or industries (such as byproducts, pharmaceuticals, etc.). Due to their low moisture content, dried MAPs can be shipped and stored for a long time. MAPs can also be used to create high-end goods like essential oils and extracts that are utilized for cosmetic or medical purposes [31].

Depending on their intended application, MAPs materials are traded in a variety of ways. Alcohol can be used to preserve the substance in addition to fresh or dried forms. According to [32], found that a dry form was used in the commerce of 95% of MAPs materials in Germany. Fresh plants or material preserved in alcohol made up the remaining 5%. The active compounds are typically concentrated in a specific area of a Map or may only be found there. As a result, it follows that a plant's entire body or just a few of its sections may be harvested and exchanged [4]. According to [33], the natural regeneration of plant species is declining as a result of rising demand, indiscriminate collecting, and overexploitation of plant species. In India, there is a high demand for MAPs from an expanding number of herbal companies and pharmacies. Of the total raw materials needed plant roots account for 30%, which means that all plants must be completely destroyed (Fig. 2).

TABLE III: Processing Techniques and Finished Medicines

Product type	Stage of processing	Method of processing	Sealable form
Green stuff	Initial	Sanitizing and sorting	Green
	Secondary	Drying	Dry
	Tertiary	Crushing	Dust
Dry product	Tertiary	Crushing	Dust

Source: Palash *et al*. [4].

9. Processing and Value Addition Practices

Long supply chains are expected. Information is conveyed through the chain graphically rather than directly between gatherers, growers, and also end users. For first level semi processing at the village level, there is a limited scope. MAPs go through two rounds of processing:

a. Semi-processing; and

b. Formulation creation (Fig. 3).

Producers sell their green and dry crops after doing primary and secondary processing in the home yard, harvested plot, or temporary yard set up on the side of the road. Initial processing entails separating saleable and valuable product components from the plants, washing saleable parts with water in a pot, and cutting saleable sections of the products into little pieces before drying in sunlight as needed. (Table III) [4].

For business purposes Semi-processing is still in its infancy and little is being done to advance the discipline through the creation of microenterprises. Updated technology is required. GMP (Good Manufacturing Practices) compliance is challenging for small and medium-sized businesses (SMEs) that are involved in the production and processing of the products. It is challenging for gatherers to adhere to GAP (Good Agriculture Practice) norms at the production level since there is a dearth of adequate scientific understanding on sustainable harvesting techniques [8].

10. Stakeholders Involved in MAPs Sector

Growers/collectors, retailers/wholesalers, processors, financing organizations, herbalists, educators, policy officials, and consumers are among the diverse stakeholders involved in the MAPs sector (Fig. 4). MAPs are often grown or collected by small- or large-scale farmers, while wholesalers and retailers market them. Fresh MAPs are processed by the processors either to extend their shelf life (i.e., drying) or to extract the active components in order to prepare high-value goods. For the many parts of the supply chain (such as production, collecting, trading, etc.), policymakers set the rules and directions. Different stakeholders get financial support from funding agencies through different scheme [31].

11. An Overview of SAARC Member Country Situation

According to the [34], as reported in the APAARI/FAO, 2013 publication 2, "Asian botanical trade accounts for 14.505 billion USD in value with 6.634 million tons, or

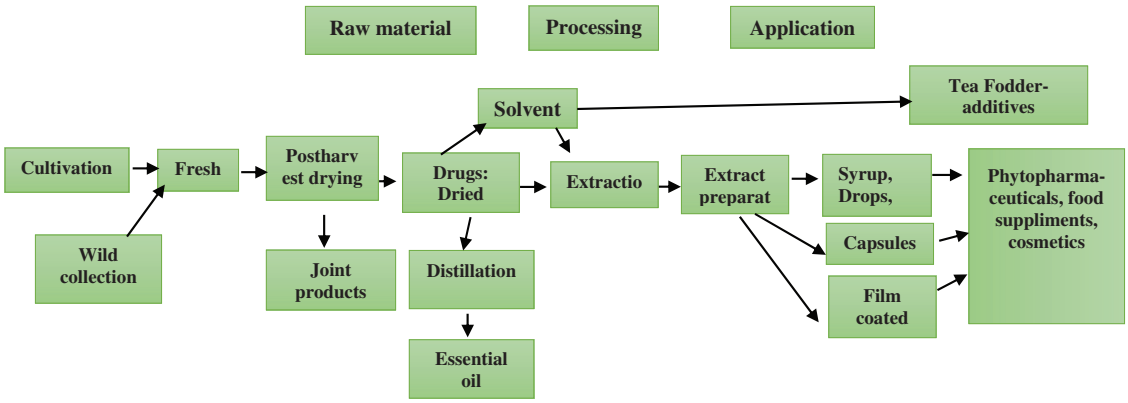

Fig. 3. MAPs value chain: from raw materials to various plant-based medicinal and cosmetic products. Source: [8].

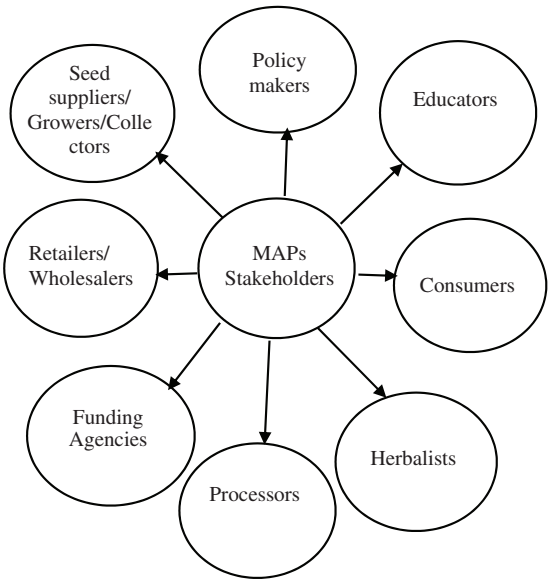

Fig. 4. Stakeholders in the supply chain for medicinal and aromatic plants (MAPs). Source: https://wildmapsfit.eu/wp-content/uploads/2022/04/D2-Market-Analysis-of-Wild-MAP.pdf.

44.35 percent and 53.13 percent, respectively, of global trade in botanicals, which totals 32.702 billion USD in value." It is estimated that the SAARC area exports more than 100 MAPs to global markets [27]. Of them, MAPs products alone are calculated to command a market of more than 1 billion USD [28]. The individual country status is given as below:

Through rural collecting, approximately 12,000 tons of MAPs materials worth 4.5 million USD were sold in Bangladesh [6]. Bangladesh also imports materials totaling more than 5000 tons, valued at USD $8 million. Bangladesh's domestic herbal drug market is worth 60 million USD. The primary challenge in Bangladesh is the extinction of native MAP species from their natural habitats, as well as a lack of traditional knowledge that has been valued and documented, a lack of understanding of its usage and conservation, a lack of investment in R&D assistance, and inadequate knowledge of its marketing and infrastructure [14].

In Bhutan, major MAPs valued at 479 Nu. million was produced during 2012 [34]. Also created are the agrotechnology's for growing turmeric, artemisia, and lemongrass. The government is making every effort to increase the commercialization of MAPs, but it is up against a number of obstacles, such as limited technical capacity, a lack of high-quality processing facilities, the production of subpar seed and planting materials, and ignorance of sustainable harvest and value addition [35].

According to [36], Nepal grows fragrant plants (including menthe, lemongrass, chamomile, citronella, palmarosa, and French basil) on an area of around 968 ha, yielding about 2,752 MT of essential oil. 2011–2012 saw a cumulative 2550 MT production of medicinal plants. From MAPs, more than 400 different preparations are produced, distributed locally, and even abroad. Nepal has outlawed collecting, transporting, and trading of about 20 MAP species in order to protect and sustainably use their natural populations. It is estimated that Nepal earns between 13 and 26 million USD annually from the sale of more than 33,000 tons of MAPs. The majority of the goods are traded in raw or partially processed form with India. However, over the past few years, China and SAARC nations have been the main destinations for processed or semi-processed MAP exports. Among processed herbs that are derived from more than 18 aromatic plants, essential oils are the most widely traded products [38]. Many of the oils are sold to numerous nations, including Japan, Germany, the US, Belgium, and others. Therefore, MAP is Nepal's main export good. However, Nepal is also among the largest importers and users of processed MAP products, with a majority coming from India and increasing at a pace of 20% annually [37].

According to [39], in basic healthcare, roughly 20 species of MAPs are heavily utilized. Sole involvement of private sector in processing, value addition and marketing and over 125 commercial enterprises are associated Pharmaceutical Manufacturing Association (PTPMA). Prime constraint to commercialization is the lack of awareness building among stakeholders, especially policy makers on all aspects of MAPs.

12. Global Markets for MAPs

The national, regional, and global markets for MAPs have been increasing, as mentioned above. According to the [2], the greatest markets for herbal medicines are found in China, Japan, Germany, Italy, the USA, the UK, France

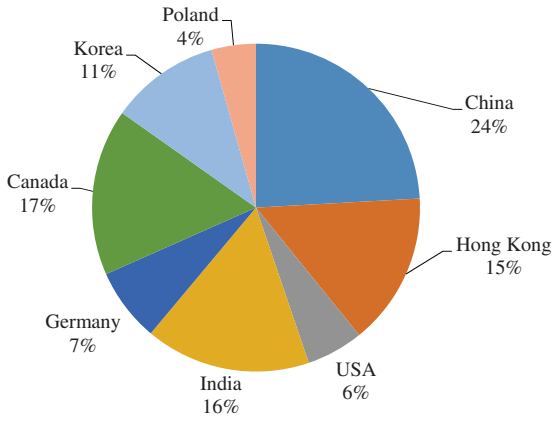

Fig. 5. Top exporting countries with annual growth rate from 2010 to 2013 [40].

and Spain. The prime importing markets are the USA and EU. Since the majority of developing nations, including China and India, export cosmetics, perfumes, herbal tonics, and other products like these, there are promising prospects for export development from LDCs in this sector. According to estimates, sales of herbal medicine alone exceeded 12.5 billion USD in 1994 and 30 billion USD in 2000, with regional variations in average annual growth rates of 7.5%. Between 1990 and 1997, the market for herbal supplements grew at a faster average annual rate of 25% [39].

With an average annual growth rate of 5.4% during the previous 18 years and a growth rate of 10.7% recently, the total value of trades in MAPs climbed from 2.4 billion USD in 1996 to 6.2 billion USD in 2013 (Fig. 5). By 2050, it was anticipated that global trade in MAPs and their products, which was 60 billion USD in 2000 and growing at an average annual rate of 7%, would reach 5 trillion USD [42].

12.1. Export

According to the study of [40], over half of MAPs overall exports are made in terms of trade value. About 20 species of MAPs are heavily used in basic healthcare. In the last 18 years, Ps (54.2%) has been attributed to five nations: China (27.1%), Hong Kong (7.6%), the USA (7%), India (6.5%), and Germany (6.1%) (Table IV and Fig. 5). Other important exporters are Canada (4.9%), South Korea (4.1%), and Poland (2.7%). Since past 18 years, Poland (8.1%) has bound greatest annual growth rate followed by Canada (7.5%), China (7.5%), and India (6.5%). But China (17.6%), Canada (12%), India (11.9%) and Hong Kong (11%) are the rapidly progressive exporters of MAPs in past four years. Overall exportation of MAPs from China since 1996, though far ahead from other main export countries, has increased by 22.3%, from 165,023t, to 201,788t in 2013. However, resembling trade value of the exported plant materials increased by 265%, from 328 million USD to 1,197 million USD for the same period. In contrast to, Hong Kong's exportation has reduced profoundly, from 66105 ton in 1996 to 9,175 ton in 2012; exported volume for 2013 was not available. In case of USA, quantity of export is almost constant with annual average of 14,459 ton, but despite of perturbation, trade value has improved by 40%, reaching 168 million USD in 2013, highest in past 18 years. On the other hand, in Germany, MAPs exportation has upgraded by 37.8%, from 15,460 ton worth 77 million USD to 21,301 ton worth 148 million USD, in 1996 to 2013. Similarly, outflow of MAPs from India has waived by 145%, from 35,817 ton worth 67 million USD to 87,745 ton worth 208 million USD for the same period. Acute decline observed in Republic of Korea's exportation, from 2,508 ton worth 82 million USD in 1996 to 742 ton worth 109 million USD in 2013. Likewise, India, Canada's export has also aggravated about threefold, from 1299 ton worth 50 million USD to 3715 ton worth 185 million USD, and Poland's exportation is doubled (from 7,403 ton worth 16 million USD to 15,603 ton worth 66 million USD) in the same period. Considerably, in comparison to China and other western countries, however, India couldn't couple with increased dividend with upgraded export in volume. Most reliable reason seems to be export of unprocessed, raw plant materials.

12.2. Import

According to the study of [40], as per value of trade, USA and Hong Kong are the greatest importers accounting 13.5% and 13.3%, respectively, followed by Japan and Germany (9.1% each) in past 18 years (Fig. 6). In total, annual growth rate of MAPs importation to China, in term of value of trade, is 9.4% (greatest among majority importing countries) and 31.5% is recorded in past-four years. Like, Singapore has bound 18% and 7.5% for past-four and 18 years, respectively. From 1996 to 2013, importation to Hong Kong, Japan, Republic of Korea, and France has decreased by 37.1% (from 70,382 ton worth 312 million USD to 44,248 ton worth 393 million USD), 69.7% (from 96,140 ton worth 191 million USD to 29,085 ton worth 269 million USD), 45.2% (from 49,667 ton worth 73 million USD to 27,228 ton worth 94 million USD) and 15.5% (from 20,310 ton worth 48 million USD to 17,158 ton worth 96 million USD), respectively. In contrast to, importation to USA, Germany, Singapore and China have increased by 29% (56,407 ton worth 138 million USD to 72,775 ton worth 378 million USD), 9% (52,211 ton worth 130 million USD to 56,924 ton worth 236 million USD), 140% (5,648 ton worth 49 million USD to 13,555 ton worth 170 million USD) and 584.5% (14,488 ton worth 42 million USD to 99,175 ton worth 212 million USD), respectively for the same period.

Mexico exports 37,600 tons of pharmaceutical plants annually, for a low price of 14.3 million USD. The exports only fluctuated between 4,700 and 17,600 tons in the 1990s, but they went from 42,550 tons in 2000 to 1, 47,300 tons in 2003. The exports increased 16 times in total. Up to 99% of exports went to the United States [41].

Chile is the second-largest exporter of pharmaceutical manufacturing facilities to the United States, with an annual average export value of 26.4 million USD of 9,850 tons. Only 320 tons were imported annually on average. At least 35 nations received the export of the good, although in 2003 Germany accounted for 38% of all exports. Additional 35% stayed in South America, 14% went to Brazil, and 13% went to Argentina [41].

TABLE IV: Leading Export-Import Countries by Percentage of Trade over the Previous 18 Years

Commodity	Export/import	Country	Trade in year (million USD)		Total trade (1996–2013)	
			1996	2013	Million USD	%
Plants, plant parts, perfumery, pharmacy etc.	Export	China	328	1197	7573	27.1
		Hong Kong	249	120	2118	7.6
		USA	120	168	1969	76.4
		India	67	208	1803	6.1
		Germany	77	148	1701	4.9
		Canada	50	185	1360	4.1
		Korea	82	109	1148	2.7
		Poland	16	66	744	13.5
	Import	USA	138	378	3884	13.3
		Hong Kong	312	393	3815	9.1
		Japan	191	269	2624	9.1
		Germany	130	236	2609	4.3
		France	48	96	1239	4
		Singapore	49	170	1138	3.8
		China	42	212	1101	3.6
		Korea	73	94	1033	3.0
Ginseng roots	Export	Canada	49	176	1258	24.4
		China	49	135	1068	20.7
		Korea	70	107	1066	20.7
		USA	66	91	801	15.5
		Hong Kong	84	42	759	14.7
		Italy		8	26	.5
	Import	Hong Kong	183	287	2533	56.3
		China	35	47	477	10.6
		Japan	32	42	365	8.1
		USA	12	32	332	7.4
		Singapore	15	15	151	3.3
		Canada	4	14	133	2.9
		Italy	3	15	114	2.5
Plants and parts, pharmacy, perfume, insecticide Use	Export	China	271	1062	6428	28.5
		India	61	208	1768	7.8
		Germany	75	147	1662	7.4
		Hong Kong	162	77	1342	6.0
		USA	53	78	1160	5.1
		France	34	59	877	3.9
		Singapore	60	93	800	3.5
		Poland	16	66	735	3.3
		Egypt	59	110	537	2.4
	Import	USA	115	345	3470	14.6
		Germany	127	224	2525	10.6
		Japan	153	227	2211	9.3
		Hong Kong	129	107	1277	5.4
		France	43	94	1171	4.9
		Korea	67	93	967	4.1
		Singapore	34	155	978	4.1
		UK	30	84	826	3.5
		China	7	166	620	2.6

Source: Tripathi *et al*. [40].

The country that exports the most pharmaceutical plants to the global market is Egypt, according to the COMTRADE database, which is located in Africa. Between 1991 and 2003, Egypt exported goods worth 13.5 million USD per year, or an average of 11,800 tons, to at least 66 nations, primarily the USA (20%) and Germany (26%). Poland, the Netherlands, the UK, Italy, and France were the top purchasing nations for Egyptian botanicals. Approximately 3,520 tons worth of goods are imported. Morocco, another African country, exported 8,500 ton valued 13.7 million USD, the exports increased from 6,700 ton in 1991 to 10,750 ton in 2003. Last but not least, Bulgaria and Albania are significant supplier nations for pharmaceutical factories. During the time under investigation, Bulgaria exported 10,300 tons of goods annually on average, the majority of which went to Germany (at

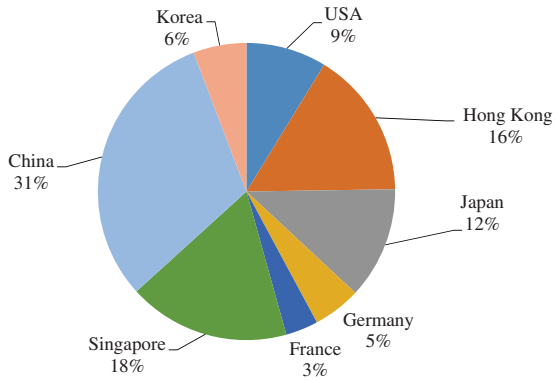

Fig. 6. Top importing countries with annual growth rate from 2010 to 2013 [40].

least 60% in 2003), 12% to Spain, and 4%-5% to each of France and Italy. Nevertheless, 97% of Bulgaria's exports stayed within the borders of Europe, going to 37 different nations. Average annual exports from Albania were 8,050 tons valued at 11.7 USD [41].

13. Challenges for Sustainable Commercialization

MAPs sub-sector in South Asia ensures good economic potentials, health and environmental benefits and above all critical livelihood support to marginalized and poor communities, no doubt. However, today's unregulated use and unsustainable harvesting; the status of many MAP is acutely threatened, with future availability and quality risk. While production is now a larger part of the supply of MAPs, in the near future the majority will come from wild collection due to consumer demand for organic and natural products, making the issue of sustainable management of wild MAPs the biggest barrier to commercialization. In addition, there is no 'Golden Rule' that can be used universally to ensure the conservation and sustainable management of MAPs because the conservation and sustainable usage will vary depending on the species of plant, location, component used, and other factors, as well as the techniques and site and season of extraction [28].

Cute shortages of suitable land, a lack of cultivation techniques and high-quality planting materials, a lack of government and policy support, a marketing system that is poorly influenced by intermediaries, a lack of processing technology, a lack of infrastructure and capacity building, financial incentives in the form of microcredit, and poor coordination between various organizations [41].

14. Area for Improvement: Value Chain Development

According to FAO, organic trade is growing at a rate of 15 to 20 percent annually, and more than 100 countries already export products that are certified organic. However, a plethora of standards, rules, and conformity assessment processes have effectively shut down the international commerce in organic products.

The two current international standards for organic agriculture are the FAO/World Health Organization (WHO) Codex Alimentarius Commission Guidelines-based standards and the global Federation of Organic Agriculture Movements (IFOAM) core standards. Because of this, goods with an organic label in one system might not be recognized as such in another, which would cause problems and increase expenses [43].

TABLE V: Institutional Liability for MAPs Sector Development

Type	Duty to be played
NGOs	Farmers and institutions networking
	Encouragement of microcredit with low interest rates
	Public education and community involvement
	Training and ability building
	Extension officers
Research institution	Quality material development
	Management technology
	Detailed inventory resource
	Active research
Department of forestry and other government organizations	Buildings
	Detailed data base and resource inventory preparation
	Evaluation and monitoring
	Market promotion of NTFP

Source: Rashid [42].

When harvesters participate in value-added activities related to the packaging of goods or the production of secondary products, tiny and other marginal community groups have the ability to diversify and accelerate their means of subsistence. The development of economic enterprises strives to improve the activities and way of life of entire communities. For better marketing, there is a need for capable groups, like cooperatives or other farm associations, that can help make decisions of common interest and collective action, as well as have the revenue and bargaining power with dealers and middlemen to lower producers' risk [44].

Small-scale farmers could gain from the specific knowledge even though they already have some marketing skills. For small farmers to learn about marketing, extension specialists, nongovernmental organizations (NGOs), and community leaders can be useful intermediaries [39]. For chosen MAPs around the world, a variety of NGOs, GOs, and INGOs have been working to expand and improve commodity-based value chains (Table V).

15. Conclusion

It is obvious that there is increasing economic value of MAPs that the developing countries need to grasp in order to enhance their economic and health care delivery systems. The importance of MAPs sector can be estimated from the fact that natural herbal medicines provide the healthcare needs of about 80% population of the world. The World Health Organization (WHO) asserts that herbal and natural remedies are essential to achieving the aim of "Health for all". Recognizing the crucial role that MAPs play in ensuring the security of health and well-being, it is

crucial that nations utilize the need to conserve, sustainably utilize, and responsibly market the MAP biodiversity resources worldwide. China, India, Canada, Hong Kong, Germany, USA, Republic of Korea and Poland are the top export countries while top destinations include USA, Japan, Germany, Hong Kong, France, China, Rep. of Korea and Singapore. According to the survey, the United States, Hong Kong, Germany, the Republic of Korea, and China are the five main trade hubs for MAPs worldwide.

Sustainable MAP production, commercialization and marketing engage working in transparent business dealing and partnerships models of strategic in which MAPs processing and value addition is done as close to the in-situ areas as possible. MAP species play a vital role in serving primary healthcare for small farmers and forest dependent communities and also support forest conservation. In order to find novel ways to maintain and use plants for the benefit of entire communities as well as the accomplishment of larger development goals, local knowledge about MAPs and the system of creativity of individuals and communities are helpful.

16. Suggestions

1. To enhance availability and production of medicinal plants, the export subsidy for certain plants needs to be raised.

2. Every year, the cultivators should be included in the awareness campaign.

3. Allocate funds for research and development that aims to improve a variety of medicinal plants, increase their accessibility, and determine the usefulness of those plants in a range of clinical situations.

4. To ensure that unfinished medicines may be sold, there should be a connection between growers and pharmaceutical firms.

5. The government should create commercialization facilities for these plants.

References

[1] Giannenas I, Sidiropoulou E, Bonos E, Christaki E, Florou-Paneri P. The history of herbs, medicinal and aromatic plants, and their extracts: past, current situation and future perspectives. In Feed Additives Aromatic Plants and Herbs in Animal Nutrition and Health by (eds) Panagiota Florou-Paneri, Efterpi Christaki, Ilias Giannenas [Elsevier], [2020] pp. 1–18. doi: 10.1016/B978-0-12-814700-9.00001-7.

[2] Food FF. *Agriculture Organization of the United Nations*. Rome, 2005.

[3] Chandra P. The medicinal and aromatic plants business of Uttarakhand: a mini review of challenges and directions for future research. In *Natural Resources Forum*. vol. 44. Oxford, UK: Blackwell Publishing Ltd, 2020, August. pp. 274–285.

[4] Palash MS, Amin MR, Ali MY, Sabur SA. Medicinal plant business in Bangladesh: exploring the performance of supply chain actors. *J Agric Food Res*. 2021;6:100230.

[5] Ekor M. The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. *Front Pharmacol*. 2014;4:177.

[6] Chowdhury MSH, Koike M, Muhammed N, Halim MA, Saha N, Kobayashi H. Use of plants in healthcare: a traditional ethnomedicinal practice in rural areas of southeastern Bangladesh. *Int J Biodivers Sci Manage*. 2009;5(1):41–51.

[7] Rahman H, Rahman M, Islam M, Reza S. The importance of forests to protect medicinal plants: a case study of Khadimnagar National Park, Bangladesh. *Int J Biodivers Sci Ecosyst Serv Manage*. 2011;7(4):283–94.

[8] Karasinski C. EIP-AGRI focus group-plant-based medicinal and cosmetic products-DISCUSSION PAPER. 2019. https://ec.europa.eu/eip/agriculture/sites/default/files/fg35_starting_paper_2019_en.pdf

[9] Kumar MR, Janagam D. Export and import pattern of medicinal plants in India. *Indian J Sci Technol*. 2011;4(3):245–8.

[10] Vasisht K, Sharma N, Karan M. Current perspective in the international trade of medicinal plants material: an update. *Curr Pharm Design*. 2016;22(27):4288–4336.

[11] Latif A, Ashiq K, Qayyum M, Ashiq S, Ali E, Anwer I. Phytochemical and pharmacological profile of the medicinal herb: bryophyllum pinnatum. *JAPS: J Anim Plant Sci*. 2019;29(6):1528–1534.

[12] Muruganandam C, Kalidasan T, Kousika S, Sajiv G. Effect of integrated nutrient management on growth of senna (Cassia angustifoliaVahl.). *Int J Sci Res Arch*. 2022;7(2):555–8.

[13] Roosta RA, Moghaddasi R, Hosseini SS. Export target markets of medicinal and aromatic plants. *J Appl Res Med Aromat Plants*. 2017;7:84–8.

[14] Merry MS, Shahjahan M. Cultivation of MAPs: a potential health care resource. *Proceedings of Workshop on Medicinal Plants of Bangladesh*, 2014.

[15] Sharma R, Kaur S, Uniyal SK. Population and vulnerability assessment of high value medicinal plants in the Alpine regions of western Himalaya. *J Appl Res Med Aromat Plants*. 2022;26:100353.

[16] Patwardhan B. Bridging Ayurveda with evidence-based scientific approaches in medicine. *EPMA J*. 2014;5:1–7.

[17] Sharma UR, Malla KJ, Uprety RK. Conservation and management efforts of medicinal and aromatic plants in Nepal. *Banko Janakari*. 2004;14(2):3–11.

[18] Wani NA, Tantray YR, Wani MS, Malik NA. The conservation and utilization of medicinal plant resources. *J Biosci and Med*. 2022, July 7;10(7): 691–715.

[19] Sage C, Kenny T. Connecting agri-export productivism, sustainability, and domestic food security via the metabolic rift: the case of the Republic of Ireland. In *Advances in Food Security and Sustainability*. vol. 2, Elsevier, 2017. pp. 41–67. doi: 10.1016/bs.af2s.2017.09.006

[20] der Bundesregierung GlobaleUmweltveränderungen WB. *Erhaltung und nachhaltige Nutzung der Biosphäre*. Berlin Heidelberg: Springer; 2000.

[21] Schippmann UWE, Leaman D, Cunningham AB. A comparison of cultivation and wild collection of medicinal and aromatic plants under sustainability aspects. *Frontis*. 2006;chapter 6:75–95.

[22] Arslan N. Cultivation of natural plants. *Turk Agric Mag*. 2004;155:26–31.

[23] Arslan N. Our endemic medicinal plants. 2. Medical aromatic plants symposium. *Invited Pap*. 2014;23(25):2014, September.

[24] Karik Ü, Tunçtürk M. Production, trade and future perspective of medicinal and aromatic plants in Turkey. 2019. Available from: https://www.researchgate.net/publication/338080721_Production_Trade_and_Future_Perspective_of_Medicinal_and_Aromatic_Plants_ in_Turkey.

[25] Ismail CA, Baraka AM, Abdallah RM, El-Dien OG, Mostafa DK. Spergularia marina: a potential source of a novel calcium channel blocker with antihypertensive and diuretic activities. *Eur Rev Med Pharmacol Sci*. 2022;26:506–17.

[26] Brandt FS, Cazzaniga A, Hann M. Cosmeceuticals: current trends and market analysis. In *Seminars in Cutaneous Medicine and Surgery*. vol. 30, Elsevier, WB Saunders, 2011, September. pp. 141–143.

[27] Hamilton AC, Radford EA. *Identification and Conservation of Important Plant Areas for Medicinal Plants in the Himalaya*. Salisbury: Plantlife International; 2016.

[28] Karki MB. Harnessing the potential of medicinal, aromatic and non-timber forest products for improving the livelihoods of pastoralists and farmers in Himalayan mountains. In *Conservation and Utilization of Threatened Medicinal Plants*. Springer Nature Switzerland AG 2020, 2020. pp. 93–106.

[29] Canter PH, Thomas H, Ernst E. Bringing medicinal plants into cultivation: opportunities and challenges for biotechnology. *Trends Biotechnol*. 2005;23(4):180–5.

[30] Uddin SN. *Traditional Uses of Ethnomedicinal Plants of the Chittagong Hill Tracts*. China: Bangladesh National Herbarium, 2006.

[31] Kala CP. Medicinal and aromatic plants: boon for enterprise development. *J Appl Res Med Aromat Plants*. 2015;2(4):134–9.

[32] Timothy J. Trade survey of medicinal plants in Germany: a contribution to international plant species conservation. *Econ Bot*. 1998;52(2):206.

[33] Bhattacharya R, Reddy KRC, Mishra AK. Export strategy of Ayurvedic products from India. *Int J Ayurvedic Med*. 2014;5(1):125–8.
[34] Pareek R, Dasgupta S. Region: Proceedings, Bangkok. In *Expert Consultation on Promotion of Medicinal and Aromatic Plants in the Asia-Pacific Region: Proceedings*. Mal B, Ghosh SP, Pareek SK, APAARI, Region: Proceedings, Bangkok, Thailand, 2-3 December, 2013. pp. 259.
[35] Wangchuk P, Tobgay T. Contributions of medicinal plants to the gross national happiness and biodiscovery in Bhutan. *J Ethnobiol Ethnomed*. 2015;11:1–13.
[36] Bhattarai N, Karki M. Medicinal and other useful plants and sustainable development in the Asia Pacific region: present scenario, challenges and way forward. *Asia-Pacific Mountain Courier*. 2010;11(1):1–6.
[37] Karki MB. Challenges, opportunities and trade-offs in commercialization of medicinal and aromatic plants in South Asia Region. In *Invited Paper Presented at the Workshop on Current Challenges and Recommendations*. New Delhi: Government of India, 2017.
[38] Shrestha S, Shrestha J, Shah KK. Non-timber forest products and their role in the livelihoods of people of Nepal: a critical review. *Grassroots J Nat Resour*. 2020;3(2):42–56.
[39] Choudhary D, Pandit BH, Kinhal G, Kollmair M. Pro-poor value chain development for high value products in mountain regions: Indian Bay Leaf. 2011. https://www.cabdirect.org/cabdirect/abstract/20113325606.
[40] Tripathi H, Suresh R, Kumar S, Khan F. International trade in medicinal and aromatics plants: a case study of past 18 years. *J Med Aromat Plant Sci*. 2017;39:1–17.
[41] Lange D. International trade in medicinal and aromatic plants: actors. *Frontis*. Printed in the Netherlands: Springer, 2006;Chapter 11:155–70.
[42] Rashid AZMM. Management of medicinal plants in Bangladesh: issues and challenges of sustainability. *CBM Master's Thesis*, (66).
[43] Karki MB, Chowdhary CL. Non-timber forest products (NTFP) and Agro-forestry subsectors: potential for growth and contribution in agriculture development. In *Agricultural Transformation in Nepal: Trends, Prospects, and Policy Options*. Springer Nature Singapore Pte Ltd., 2019. pp. 385–419.
[44] Singh KM. Scope of medicinal and aromatic plants farming in Eastern India. In *Engineering Practices for Agricultural Production and Water Conservation*. Apple Academic Press, 2017. pp. 261–288.