

MEDICINAL AND AROMATIC PLANTS IN NEPAL (A HORTICULTURAL PERSPECTIVE)

Tirtha Bahadur Shrestha, Bhisma Prasad Subedi and
Kuber Jung Malla
(tirthabshrestha@gmail.com)

ABSTRACT

Medicinal and Aromatic plants (MAPs) are important natural resources of Nepal. MAPs are used as medicines since the dawn of human civilization. In recent days the use of these resources is diversified and this situation has created big demand and become sources of income to Nepalese people dwelling in remote areas. Most of the market share of MAPs trade comes from wild collection. Therefore domestication and farming practices are to be done. Nepal is just a beginner in domestication and farming of MAPs. It is therefore timely to look into MAPs from horticultural perspective. MAPs cultivation should be emphasized in harmony with their natural habitats based on agro-ecological zones. Research and development in this aspect is necessary.

INTRODUCTION

Plants have been important sources of food, shelter, and clothes to human beings since the dawn of human civilization. Medicinal use of plants also seems to have been developed currently through observations, experiences and by trial and error.

Domestication and farming of medicinal and aromatic plants (MAPs) do not have a long history as compared to cereals, pulses, and other food crops. People depended upon wild resources for medicinal and aromatic plants due to obvious reasons of easy availability and low consumption. Shrinkage of natural habitats for MAPs and increase in the demand of medicinal and aromatic substances have led people to cultivate them for industrial purposes. In this regard Nepal is just a beginner. It is therefore timely to look into MAPs from horticultural perspective.

Medicinal plants possess useful chemical substances to relieve

ailments of human beings as well as animals. A considerable number of definitions have been proposed for the term ‘medicinal plant’. According to the WHO, “a medicinal plant is any plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes, or which are precursors for chemo-pharmaceutical semi synthesis”.

In spite of tremendous developments in the field of allopathy during the 20th century, herbs still remain one of the major sources of drugs in modern as well as traditional systems of medicine throughout the world. Synthetics and antibiotics show miraculous and often instantaneous results, so these have attained greater prominence in modern medicine but it is also a fact that these synthetics and antibiotics may prove harmful in the long run. That is why plant based drugs are popular these days. This situation has created a big demand of herbal medicines. So medicinal plants have age old tradition of diverse uses, which can be summarized as below:

- Household remedies
- Traditional medicines
- Modern drugs
- Health foods (herbal tea, herbal drink)
- Products for personal hygiene (tooth powder and paste, soaps, herbal aromas, herbal pillows etc)
- Cosmetics (shampoos, skin care, body care etc.)

Aromatic oils are compounds with odiferous nature obtained from leaves, flowers, fruits, seeds, roots, rhizomes. These are also called as essential oil. The term “essential” refers to the presence of an essence or odor and the term “oil” is used because when these compounds are placed on a transparent paper, they leave behind an oily spot. Important uses of these essential oils are put as ingredients in the manufacture of soaps, cosmetics, perfumes, medicines, pharmaceuticals, plastic goods, textiles, leather, confectionary, perfumed tobacco, paan masala, aerated water, syrups, disinfectants, insecticides, fungicides, baby foods, biscuits, paper writing pads, cards etc. Plants, which possess aromatic or essential oil are termed as Aromatic plants.

Aromatherapy is getting popular as a type of alternate medicine

in which healing affects are ascribed to aromatic compounds. Odors influence our sensory functions creating psycho-physiological reactions.

ASPECTS OF MEDICINAL AND AROMATIC PLANTS (MAPS)

There are different aspects of MAPs with their use patterns. These can be summarized as household medicines, traditional medicines, ethno-medicines and modern medicines. Household medicines just plainly cover a mother's household knowledge of curing children's ailments such as cough and cold, whereas medicines practiced and transferred orally from generation to generation are traditional medicines. WHO defines traditional medicine as the sum of total knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness". According to World Health Organization (WHO) 80 % of the people in the developing countries of the world rely on traditional medicines and 85 % of the traditional medicines involve the use of plant materials. WHO has compiled a list of 20, 000 medicinal plants used in different parts of the globe (Gupta and Chadha, 1995), among these over one hundred plants are reported to have consistently large demand and are traded as major drug materials in the world.

In the same way ethno-medicine is the traditional medicine practiced by different ethnic groups especially indigenous groups.

Advances in the field of pharmacology led to the formulation of the synthetic drugs based on natural products in the middle of the 19th century. In 1839, for example, salicylic acid was identified as the active ingredient in a number of plants known for their pain-relieving qualities; salicylic acid was synthesized in 1853, eventually leading to the development of aspirin.

MAPS IN NEPALESE PERSPECTIVES

Wealth of MAPs

MAP documentation started since the period of Mandev, when the oldest book called Sushruta Nighantu was written on palm leaves

in Devnagari script and Sanskrit verses where 278 MAP were recorded (Malla and Shakya, 1984). It was supposed to be a work of 5th century.

BIR NIGHANTU, a hand written herbal encyclopedia is the work compiled by Pandit Ghana Nath Devkota under the instruction of Chandra Samsher J. B. Rana and Bir Samsher J. B. Rana, the then Prime Ministers of Nepal at the end of 19th and beginning of 20th centuries. This Nighantu (hand written) describes medicinal uses of 750 plants with coloured paints. It is assumed to be the first literature in medicinal plants of Nepal. This work was not published unless the author's son Kosh Nath Devkota completed a concise form named Nepal Nighantu. It was published by Royal Nepal Academy in 1968.

Malla and Shakya (1984) enumerated 690 medicinal plants including 510 wild, 120 cultivated and 60 exotic species. Department of Plant Resources updating Bulletin no. 3 (1970) published in 1970 and Bulletin no. 10 (1997) has described 701 medicinal plants in Bulletin No. 28 (2007) including 177 cultivated, naturalized and exotic plants.

ESON (Ethno-botanical Society of Nepal) has prepared Medicinal and Aromatic Plants Database of Nepal (MAPDON), which includes 1624 plant species. This database also includes some exotic species.

Baral and Kurmi has described 1792 medicinal plants in Compendium of Medicinal Plants of Nepal (2006). This also includes many cultivated, naturalized and exotic species.

Regarding the commercial use, Subedi (2006) has recorded that 161 non-timber forest products (NTFP) species collected for commercial purposes, out of which over 50% are used primarily for medicinal purpose and about 7% used for essential oil.

RESEARCH AND DEVELOPMENT OF MAPS IN NEPAL

a. Mainstreaming with modern science and technology

MAPs were being treated and traded as "Jaributi" meaning crude herbs with healing properties. Government of Nepal initiated a separate section "Banaspati Phant" meaning plant section within the Ministry of Forest. It was upgraded as Banaspati Goswara and ultimately as Banaspati Bibhag during the year 1960 A. D. (2016 B. S.). It was a full fledged department called as the Dept. of Medicinal Plants (DMP).

The challenges to determine scientific identity of herbs, to ascertain their occurrence and distribution (phyto-geography), to identify their chemical constituents and active principles (phyto-chemistry and pharmacognosy), to record their local uses (ethno-botany, ethno-pharmacology, and to bring them under domestication were being addressed through DMP. The Department attempted to farm globally well known species of MAPs such as Belladonna, Pyrethrum, Digitalis and also Kuth (*Saussurea cosrus*). However, domestication of indigenous herbs were not being considered until lately.

The Department was geared to provide scientific services to herbs collecting peasants, and herders, herb dealers, herb processors, herbal drug industries and so on. Horticultural aspects of herbs development should now be viewed as a promising opportunity on the face of declining wild resources and expanding global markets.

Department of Plant Resources (DPR) under the Ministry of Forests and Soil Conservation, Govt. of Nepal is the leading Govt. organization involved in the research and development of MAPs in Nepal from its establishment. It is a multidisciplinary organization with botanists, chemists and pharmacists focused on research and development of plant resources in Nepal.

DPR was established in 1953 (2009 B.S.) as Banaspati Goswara- led by the Senior Botanist Prayag Raj Pandey with the objectives of trade, farming, survey and collection and phyto-chemical studies on plant resources of Nepal.

- The Banaspati Goswara was upgraded to Department of Medicinal Plants (DMP) in 1960 (2016 B. S.).
- Master plan was developed for the development and utilization of herbs and drugs.
- Trade centers as Jaributi Bikri Kendra were established in Nepalganj, Koilabas, Butwal, and Tarahara.
- Outreach research stations were established as herbal farms in Shivapuri and Manichur, where research on cultivation of Belladonna, Digitalis, Pyrethrum etc were started.
- Drug Research Laboratory under DMP was established in 1961 (2017 B.S.).

- Royal Botanical Garden, Godawari under DMP was established in 1963 (2019 B.S.)
- Botanical Survey and Herbarium under DMP was established in 1965 (2021 B.S.).
- Herbal research farms were extended in Daman, Tistung, Hetauda, Tarahara with technical assistance of Mr. P. S. Jamwal from Indian Govt. and started cultivation of Pyrethrum and Saffron in Manichur, Tistung, Daman and Rauvolfia in Tarahara, Hetauda.
- Trade centers were dissolved and converted into Botanical Survey Offices in Nepalganj and Koilabas.
- Later as Govt. policy of not involving in commercial production, Royal Drug Research Laboratory was separated and established Royal Drug Ltd. for commercial drug production as per company rules and mandates.
- Herbs Production and Processing Company Limited (HPPCL) was established for essential oil production and marketing
- At present Department of Plant Resources (former Department of Medicinal Plants) is working in exploring plants, development of agro-technology, phyto-chemical analysis, and certification of MAPs.
- Department of Forests has responsibility on the management of MAPs as Non Timber Forest Products (NTFPs).
- Nepal Agriculture Research Council (NARC) has developed agro-technology of Chiraita (*Swertia chirayita*) after a long research in NARC, ARS Pakhribas, Dhankuta, Nepal.
- The Govt. introduced Herbs and NTFP Development Policy in 2004 to conserve 'herbs' and NTFPs to contribute to the national economy. This policy calls for encouraging the commercial cultivation of valuable herbs and NTFPs; adding value to herbs and NTFPs through processing; improving access to capital in the trade; and developing necessary infrastructure and building technical knowledge and skills.

b. Reviving traditional medicine and strengthening Ayurvedic medicine

Ayurveda, meaning the science of life, is claimed to be the oldest of all medical systems of the world. It is said to have developed during Vedic period (ca 1500 – 900 BC).

Nepal Government's Ministry of Health and Population has a full fledged Department of Ayurveda, which provide medical services through hospitals like the central Ayurvedic Naradevi Hospital, Dang Ayurvedic Hospital, zonal dispensaries, and district health centers. The system is supported by Singh Durbar Vidyakhana as a production unit of Ayurvedic medicines.

Recent revival of Ayurved and other traditional systems like Sowa Rigpa (Tibetan Medicine) has opened up prospects of herbal farming for home remedy as well as marketable industrial products.

An illustrious example of traditional medicine is revival is to be attributed to Yarsagumbu (half plant and half insect). The Himalayan caterpillar-fungus identified as *Cordyceps sinensis*. Currently it fetches over two million Nepalese Rupees per kilogram. Thousands of villagers desert their villages to go to alpine pastures above 3500 m to collect Yarsagumbu. Their two months toil brings income to meet the expenses for the rest of the year. Yarsagumbu collection is almost an annual festival in north-west Nepal (Mugu, Dolpa, Bajhang, and Darchula districts). The caterpillar fungus is the most celebrated medicinal commodity used as an aphrodisiac health food in China, Japan, Korea, Hong kong etc.

It has been realized that this bio-resources has drastically declined in the wild and the need to bring it into cultivation is very obvious. Caterpillar farming for silk production is an age old practice. Yarsagumbu is a fungus growing upon the caterpillar of certain high altitude moth (*Hepialus spp.*), the identity of which is still incomplete (Devkota,S., 2008)

c. Research and development

Research and development on MAPs was initiated by DMP during 1960s. The T. U. Central

Department of Botany as well as Chemistry and the Research center for Applied Science and Technology (RECAST) made significant

contribution on botany, ecology and phyto-chemistry on Nepalese MAPs. Besides the Kathmandu University, Nepal Academy of Science and Technology (NAST) have undertaken applied researches to promote MAPs. The International Center for Integrated Mountain Development (ICIMOD) also promotes studies and researches on MAPs to support mountain development. Other relevant NGOs are Asia Network for Sustainable Agriculture and Bio-resources (ANSAB), Ethno-botanical Society of Nepal (ESON), the world conservation union (IUCN), the World Wildlife Fund for Nature (WWF), Jadibuti Association of Nepal (JABAN), Nepal Herbs and Herbal Products Association (NEHPA) and the like.

At present many Forest Users Groups (FUGs) under the Federation of Community Forest Users, Nepal (FECOFUN) are managing NTFPs of the community forests. FECOFUN is a formal network of Community Forest User Groups (FUGs) from all over Nepal from its inception in July 1995.

Since the mid 1990s, knowledge on biological, social and economic dimensions of MAP resources and enterprises, and the organization of the communities for different stages of MAP value chains has been generated through research, experimentation and continuous monitoring of impacts. Researches backed by experimentation from the organizations have improved understanding of policy provisions vs. implementation, contradictions in intended and actual impacts, and program implantation strategies for the government. As an example of knowledge generation, enterprise-oriented approaches to biodiversity conservation pioneered by ANSAB in Humla district of Nepal from 1995-99 generated information in terms of policy gaps and barriers, feasibility of biological monitoring, and significance of leadership, governance and marketing of NTFP-based enterprises (Subedi and Khanal 2014).

The organizations have also helped to develop a clear process and criteria for fixing and revising royalty rates and implementing the process, and simplifying trade procedures to support small business as well. Some of the policy reforms include the lifting of ban on some tradable NTFPs, rationalization of the royalty rates of over 50 products, prioritization of 30 NTFPs by HNCC for conservation and utilization, and formulation

of NTFP Inventory Guideline 2012 (Subedi and Khanal 2014).

Since last fifteen years, there are some very good examples of successful local community systems of governing forest management and enterprise operation. For example, with ANSAB's facilitation, the communities have initiated systems of NTFP including MAP focused sustainable forestry and are generating biological and socio-economic information required for the management decisions, as reflected in their operation plans (Subedi and Khanal 2014).

TRADE OF MAPS

MAPs address not only the need for access to medicine as a component of health services but also create opportunity of income to collectors and farmers. Trade of medicinal and aromatic plants also creates employment and foreign exchange for developing countries as a significant contribution to the national economy.

The potential of MAPs was recognized by the Government of Nepal in the 'Nepal Trade Integration Strategy' (MoCS, 2010), which identified medicinal herbs and essential oils as having a medium export potential and a high potential for positive socioeconomic impact.

There is a long tradition of trade of MAPs from Nepal to India. It is assumed that 80 % of the collected volume goes to India, 10 % to foreign countries other than India and remaining 10 % is used in national herbal preparations.

Nepal's share in the world market for medicinal herbs is around 0.2 percent (MoCS 2010), and there has been corresponding increase in business volume and value in the country. Although there are variations in estimate of quantity and value of trade, the trend is very clear. The volume of trade for most of the commercial NTFPs including MAPs is increasing and the value is increasing significantly. For example, the government records show that more than 13,000 tons of NTFPs were traded in 2010 (DoF 2011), which was 3,350 tons in 1990 (DoF records). In 2012, the traded volume was about 11,680 tons, which also include large cardamom and essential oils (DoF 2013). Several studies show that the government records include only a portion of NTFPs traded, as informal transactions are common and the record keeping system

is poor. Furthermore, these studies confirm the increasing trend of business. For example, the annual harvesting and trading of NTFPs was 10,000 to 15,000 tons with an export value of US \$8.6 million in early 1990s (Edwards 1996) and 20,000 tons worth of US \$18-20 million in late 1990s (Kanel 1999). Some other estimates show that NTFP trade involved an annual transaction of US \$26 million in 1995 (Subedi 1997) and US \$ 35.7 million in 2002 (Subedi 2006).

The increasing trend of annual value of trade is also demonstrated by the NTFP export value during the past two decades. The NTFP export from Nepal is increased to NRs 515.4 million (about US \$5.9 million) in 2012 from NRs 23 million in 1992, which comes to be more than 2100%. The contribution of NTFPs to the total export from Nepal has also increased from less than 3% in 2003 to above 9% in 2012.

The industry has the potential to grow further, as there is a scope of expanding cultivation and processing of some marketable NTFPs in Nepal. Some prominent examples of successful cultivation in various altitudinal zones during this period include atis, chiraito, satuwa, sugandhwawal, alainchi, timur, ritha, rudraksha, tejpat, chamomile, citronella, lemongrass and mentha (Subedi et al. 2014).

Raw products

Trade of MAPs in Nepal is on practice from the very early as Jaributi. Mostly raw materials are exported. Thus the production of MAPs is the total quantity collected as wild and exported, purchased and used by the herbal companies inside the country. The tentative production data is the quantity licensed by all 75 District Forest Offices (DFOs) for export as raw or semi-processed. The data of the DFOs compiled by the Department of Forest (DoF) is given on the Annex-I.

Processed products

Essential oils are processed in some scale from raw materials of MAPs such as Jatamansi (*Nardostachys grandiflora*), Sugandha Kokila (*Cinnamomum glaucescens*), Sugandhwawal (*Valeriana jatamansi*), but the products are banned for raw material export. Wintergreen oil, Juniper oil and Anthopogon oil are produced from other natural sources, where as

Tagetes, Citronella, Lemongrass, Palmarosa, Chamomile, Basil, Mentha are cultivated species for producing essential oil commercially.

Nepal exports about 55 tons of essential oil, positioning the country 72 in the list of exporters' category. Similarly, Nepal exports about 29 tons of essential oils to India only (Gurung, 2009).

Current trend:

The export of MAPs has now been changing its trend. MAPs are exported to China in high prices. Especially Yarsagumba, Chiraito and Satuwa are in high demand in China. This has hiked the price of these MAPs.

The recent trend of export presented in a recent study (Subedi et al.2014) is given below:

Medicinal herbs: The Nepal's export value of medicinal herbs in fiscal year 2012/013 was about NRs 1.2 billion. The export trend over the past decades shows that India is an established market for low value high volume products, whereas overseas countries buy the high value low volume products. More than 90% of the crude herbs are exported to India, with the remaining sent to other countries, such as the United States, Europe, Middle East and China. The supply trend, during the past few years, shows that the export of some high value crude herbs to China is increasing through both legal and illegal channels. For example, the export of some NTFPs including chiraito, ritha, satuwa, and rudrakshya to China has been initiated recently.

Essential oils: Since the past few years the production and export of essential oils has been increasing. Nepal produces about 70 tons of 16 different essential oils annually, out of which 64.2 tons was exported in 2012/13, which was 37.4 tons in 2011/12. The export value of essential oils in fiscal year 2012/013 was NRs 87.03 million, which is 13.3% higher than that in 2011/12. These essential oils are mainly exported to the EU (71%), India (11%) and USA (10%). Besides, Singapore and Australia are the most potential and attractive markets for essential oils. Available data shows that Nepal is in the 64th position for exporting essential oils at global level (Sharma and Shrestha 2011).

CULTIVATION OF MAPS

Nepal has a great potential for producing MAPs as horticultural crops as has already been evident with the cultivation of aromatic plants like menthe, lemongrass, citronella, palmarosa and the like. Agro-forestry of big cardamom has proved very promising along east Nepal hills. Attempts made for domestication and cultivation of chiretta (*Swertia chirayita*) have proved fruitful during last 10 – 15 years (Barakoti, 2004). Promising results of cultivation are also evident in the case of seabuckthorn (*Hippophae salicifolia*), taxus (*Taxus wallichiana*), soap-nut tree (*Sapindus mukorossi*), timur (*Zanthoxylum armatum*) and cinnamon (*Cinnamomum tamala*). Ginger and turmeric cultivation has an age-old tradition in Nepal.

The Master Plan for Horticulture Development (HMG/ADB, 1991) emphasizes on the agro-ecological approach to horticulture. MAPs cultivation without agro-ecological consideration may prove futile because MAP cropping is not aimed for primary metabolites (carbohydrates, proteins etc.) but for secondary metabolites (phenols, alkaloids etc.) synthesized by plants in order to cope with harsh climatic conditions, destructive pathogens as well as animal or birds invasion. MAPs therefore require inputs of ecological stresses in the process of farming/cultivation. As well nourished Ginseng farm may produce vegetable ginseng (carrot ginseng) while potent ginseng may require near-wild ecological habitat subjected to ecological stresses of nature. Three key aspects to be considered for horticultural development as regards to MAPs are (i) genology (ii) phenology and (iii) ecology of the crop.

Integration of medicinal plants with farm crop cultivation in eastern Nepal has been proved to be profitable to farmers (Pandit et al, 2008). However, existing rules and regulations on marketing and export do not favor domestication and cropping of native species occurring in the wild. Govt. rules and regulation are based upon wild resources of plants being collected from Govt. land (forest). Pandit et al, 2008 consider the lack of favorable institutional environment and has been the major factor constraining the MAP species integration into farmland.

MAPs are marketed on the basis of chemical constituents they contain. Therefore phyto-chemical determination and monitoring of

constituents should be an integral part of cropping system.

- The research and development on cultivation of MAPs was started since 1960 after the establishment of DPR starting with Belladonna, Digitalis and Pyrethrum. Later in the consequence of its work plan of the Department, research to develop agro-technology of MAPs (including indigenous and exotic) were continued and at present agro-technology of following MAPs have been developed by DPR.

S. No.	Botanical name	Common name	Nepali name
1	<i>Asparagus racemosus</i> Willd.	Wild asparagus	Satawari
2	<i>Atropa belladonna</i> L.	Belladonna	Belladonna
3	<i>Catharanthus roseus</i> (L.) G. Don	Periwinkle	Sadabahar
4	<i>Chrysanthemum cinerariaefolium</i> Vis.	Pyrethrum	Pyrethrum
5	<i>Cinnamomum tamala</i> (Buch.-Ham.) Nees and Eberm	Cinnamon	Tejpat, Nepali dalchini
6	<i>Crocus sativus</i> L.	Saffron	Keshar
7	<i>Cymbopogon flexuosus</i> Nees	Lemon grass	Lemon grass
8	<i>Cymbopogon martini</i> Stapf.	Palmarosa	Palmarosa
9	<i>Cymbopogon winterianus</i> Jowitt	Citronella	Citronella
10	<i>Matricaria chamomilla</i> L.	Chamomile	Chamomile
11	<i>Mentha arvensis</i> L.	Japanese Mint	Pudina
12	<i>Piper longum</i> L.	Long pepper	Pipala
13	<i>Rauvolfia serpentiana</i> (L.) Benth. ex Kurz	Serpentine	Sarpagandha
14	<i>Swertia chirayita</i> (Roxb ex Fleming) Karstn.	Chiretta	Chiraita
15	<i>Tagetes minuta</i> L.	Tagetes	Jangalisayapatri
16	<i>Valeriana jatamansi</i> Jones	Valeriana	Sugandhawal
17	<i>Zanthoxylum armatum</i> DC.	Toothache tree	Timur

- Nepal Agriculture and Research Council (NARC) was involved to develop cultivation technology of *Swertia chirayita* in Agriculture Research Station (ARS), Pakhribas, Dhankuta from its germination to farming level in 1998.
- A new chapter in the history of MAPs cultivation and herbal extracts and essential commenced with the establishment of

Herbs Production and Processing Company Limited (HPPCL) in 1981. HPPCL has its production farms and processing units for six essential oil species. Commercial production of different aromatic oil species (*Mentha*, *Citronella*, *Lemon grass*, *Palmarosa*, *Chamomile*, *French basil*) is in continuation by HPPCL on its farms with the participation of farmers.

- Dabur Nepal also is involved in production of different herbs such as Akarkara and Kuth. Dabur with its Nursery at Banepa has been producing and distributing seedlings/ saplings of more than a dozen of MAP in Nepal.
- Other companies involved in cultivation and promotion of MAPs are Natural Product, Chaudhary Biosis, Shambhala Herbal, and cooperatives. Some government agencies (DPR, NARC, NAST, other), I/NGOs, and private companies have been involved in RandD activities. Palm Agrotech and Bio-Energy Nepal (P) Ltd. has initiated commercial cultivation of Stevia and Aloe vera on contract basis with farmers since 2010. As a result, cultivated area, and production have been increased to some extent. The production of indigenous medicinal plants is not done however Cinnamon, Swertia and Zanthoxylum etc. are mainly grown in the community forests.
- 30 MAP species have been prioritized for research and agro-technology development by DPR in 2063 B. S.

In a recent national level study conducted in 2014, ANSAB prioritized commercially important species and products including MAPs to increase private sector involvement in this lucrative business creating more employment and revenue for the country (Subedi et al. 2014). The study suggested following preliminary list of most promising MAPs from the plantations could be considered along with the continuous process and mechanism of identifying, assessing and prioritizing, which would be based on the emerging markets and technology of production and value addition.

Medicinal herbs – chiraito (*Swertia chirayita*) and satuwa (*Paris polyphylla*) in all mountain regions; atis (*Aconitum heterophyllum*) from the western mountain regions.

Essential oils – chamomile (*Matricaria recutita*), menthe (*Mentha arvensis*), lemongrass (*Cymbopogon spp.*), citronella (*Cymbopogon spp.*), palmarosa (*Cymbopogon spp.*) in the Terai through cultivation.

In this context it is mention worth that MAPs cultivation should be emphasized in harmony with their natural habitats based on agro-ecological zones. The suggested list has given in ANNEX – II.

Conservation:

Conservation of MAPs in situ has become a challenge for Nepal. Although there is positive impact of community forestry user groups in conserving MAPs in most areas. High value of MAP species such as Kutki, Jatamansi, Atis, Ban lasun, Satuwa are in threatened stage with continuous collection from nature as the cultivation practice not being developed in the country. 60 high value species already categorized in various degree of threat by IUCN and CAMP should given priority for conservation.

National Parks are the protected areas for in-situ conservation of biodiversity including MAPs. From Terai to Himalayan areas there are 10 National Parks.

There are 12 botanical gardens under the Department of Plant Resources, where ex-situ conservation of CITES listed plants, Endangered plant species are being done including important MAPs.

Medicinal plant diversity is waiting for effective conservation strategy in the days to come. Hence, population and diversity of MAPs particularly the high value ones, are highly declining in their natural habitats leading to threatened, extinct categories.

CONCLUSION

Selection of plant species is an initial important step for the development of the MAPs. Economic feasibility is the major rationale for a decision to bring medicinal plant species into cultivation.

A large variation in climatic and soil conditions in Nepal sustain a variety of medicinal plant species, which may be cultivated according to their niche. For developing the medicinal plants sector, there is an urgent need to:

- Document indigenous as well as industrial uses of medicinal plants,
- Develop and improve the agro-technology for valuable medicinal plants,
- Conduct regular research and training on better harvesting and processing techniques,
- Setup a community-based management of medicinal plants farming and marketing,
- Analyze the market policies,
- Conserve the critical habitats of rare medicinal plant species.

Thirty priority species identified for agro-technology by DPR should be promoted and supported. Supportive government policies, assured markets, profitable price levels, access to simple and appropriate agro-techniques, and availability of trained manpower, Good Agriculture and Collection Practices (GACP) are some of the key factors for successful cultivation of medicinal plants.

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Annex-I
Quantity of NTFPs (including MAPs) collected

Name	Botanical name	Quantity per Fiscal year in kg				
		2067/68	2068/69	2069/70	2070/71	2071/72
Atis jara	Delphinium himalayai	736.0	1,876.0	753.0	1,688.0	780.0
Amalbed	Rheum austral (petiole)	7,094.0	225.0	650.0	4,837.0	5,050.0
Amala	Phyllanthus emblica	124,520.0	18,400.0	67,038.0	27,050.0	12,000.0
Indreni seeds	Citrullus colocynthus/ Trichosanthes palmata	650.0	2,805.0	300.0	0.0	0.0
Kachur	Curcuma zedoaria	13,550.0	0.0	0.0	0.0	0.0
Kantakari	Solanum surratense	5.0	15.0	0.0	0.0	0.0
Kainyo phul	Pavetta tomentosa	0.0	0.0	0.0	600.0	0.0
Kakarsingi	Insect gall of Pistacia integrima	140.0	950.0	512.0	1,780.0	715.0
Kaulo ko bolka	Persea odoratissima	231,535.0	221,431.0	146,652.0	148,935.0	122,732.0
Kamraj	Helmintostachys zeylanica	150.0	0.0	0.0	0.0	0.0
Karachalithi	Rheum australe	800.0	1,360.0	1,700.0	3,759.0	0.0
Kaladanaa	Eulophia	7,924.0	8,207.0	8,394.0	13,866.0	25.0
Kutki	Neopicrorhiza scrophulariiflora	47,218.0	21,704.0	10,304.0	34,019.0	40,680.0
Kumkum pat	Didymocarpus pedicillatus	0.0	0.0	0.0	100.0	0.0
Kurilo	Asparagus racemosus	12,389.0	5,862.0	3,817.0	10,185.0	0.0
Guchchi chyau	Morchella spp.	1,022.3	137.3	319.2	1,298.0	675.5
Gurjo	Tinospora cordifolia	0.0	0.0	250.0	30,286.0	0.0
Gokul dhup	??	0.0	0.0	0.0	500.0	0.0
Ghod tapre	Centella asiatica	0.0	2,500.0	0.0	1,300.0	0.0
Chyau	Mushroom	5,572.0	4,017.0	1,037.0	10,674.5	4,409.0

Chabo	Piper chava	0.0	0.0	0.0	80.0	0.0
Chiuri	Aesandria butyracea	0.0	0.0	0.0	15.0	4,800.0
Chiraito	Swertia chiravita	55,422.0	84,858.0	38,097.0	211,602.0	3,312.0
Chitro	Berberis aristata	8,130.5	0.0	55,183.0	32,206.0	10,951.0
Jatamansi	Nardostachys grandiflora	68,263.0	13,596.0	36,631.0	25,509.0	77,252.0
Jangali jira	Carum carvi	30.0	0.0	0.0	0.0	0.0
Jhyau	Lichens	1,950.0	0.0	1,950.0	0.0	0.0
Jimur	Zanthoxylum armatum	51,297.0	17,896.0	38,887.0	240,206.0	72,290.0
Tukiphul	Taraxacum officinale	100.0	3,600.0	0.0	300.0	0.0
Toklapatta	??	0.0	300.0	300.0	0.0	0.0
Thingure sella	Tsuga dumosa	8,000.0	0.0	0.0	0.0	0.0
Titepati	Artemisia indica	16,494.0	8,218.0	7,579.0	9,700.0	3,455.0
Tejbokra	Cinnamomum tamala (bark)	35,343.5	13,500.0	3,000.0	9,050.0	0.0
Tejpat	Cinnamomum tamala (leaves)	754,723.5	30,776.0	342,249.0	1,567,093.0	52,633.0
Tedupat	Diospyros sp.	42,187.0	33,200.0	7,015.0	39,500.0	0.0
Daruahaldi	Mahonia nepaulensis	0.0	1,300.0	0.0	50,810.0	0.0
Dalchini	Cinnamomum tamala	1,782.0	2,154.0	5,140.0	392,307.0	1,186.0
DShupi boktra	Juniperus (bark)	12,875.0	0.0	1,200.0	13,145.0	0.0
Dhupi pat	Juniperus (leaves)	27,223.0	20,370.0	1,200.0	76,695.0	11,950.0
Nagbeli powder	Lycopodium clavatum (powder)	200.0	1,150.0	1,538.0	0.0	0.0
Nagbeli lahara	Lycopodium clavatum (plant)	0.0	0.0	290.0	5,413.0	0.0
Nirmasi	Delphinium nudatum	314.0	54.0	694.5	2,107.0	0.0
Padamchal	Rheum australe (root)	4,385.0	16,533.0	11,495.0	28,517.0	62,834.0
Palkhanved	Bergenia ciliata (rhizome)	166,225.0	79,850.0	54,412.0	86,954.5	34,838.0
Pavan ko bokra	Persea odoratissima (bark)	20,502.0	57,750.0	7,086.0	22,740.0	0.0
Pipala	Piper longum	918.0	3,215.0	2,044.0	105.0	0.0
Pangra	Entada phaseoloides	0.0	0.0	0.0	400.0	0.0
Bairadanti jara	Potentilla fulgens	300.0	0.0	0.0	0.0	412.0

Bankarel biyan	??		1.0	0.0	40.0	1,700.0	0.0
Ban lasun	Allium wallichii	2,157.0	3,163.0	1,638.5	54.0		1,038.0
Barro	Terminalia bellirica	0.0	0.0	0.0	700.0		0.0
Bisfej	Polypodium vulgare	4,117.0	230.0	0.0	1,415.0		0.0
Buki pul	Anaphalis sp.	30.0	6,495.0	3,510.0	0.0		0.0
Bojho	Acorus calamus	2,647.0	4,222.0	20,617.0	22,324.0		2,005.0
Bringaraj	Eclipta prostrata	0.0	9,008.0	0.0	2,500.0		120.0
Bhiyakur	Dioscorea deltooides	30.0	0.0	0.0	0.0		0.0
Bhutksh	Selinum tenuifolium	544.0	0.0	0.0	0.0		0.0
Majitho	Rubia manjith	41,166.0	63,960.0	19,101.0	39,291.0		0.0
Masalapat	Eucalyptus sp.	0.0	300.0	0.0	80.0		0.0
Musali	Chlorophytum arundinaceum	28,426.0	4,040.0	11,354.0	0.0		0.0
Mon sahad	??	0.0	0.0	0.0	2,750.0		0.0
Yarsagumba	Cordyceps sinensis	888.7	511.0	280.3	1,294.9		350.4
Ramphal	??	0.0	0.0	1,250.0	1,507.0		0.0
Ritha	Sapindus mukorossi	569,759.5	284,124.0	148,125.0	384,651.0		46,464.0
Rudrakshya	Elaeocarpus shhaaricus	341,675.0	261,880.0	0.0	938,490.0		0.0
Laghupatra	Podophyllum hexandrum	5.0	10.0	0.0	0.0		0.0
Lohaban	Pine resin	0.0	250.0	0.0	0.0		0.0
Banlasun	Allium wallichii	7,227.0	810.2	2,000.0	4,901.0		0.0
Brahmi	Centella asiatica	10.0	0.0	1,228.0	2,948.0		268.5
Bishjara	Aconitum sp.	2,180.0	900.0	12,201.0	5,570.0		50.0
Bishma jara	Aconitum spicatum	55.0	1,240.0	48.0	6,008.0		0.0
Satwari	Asparagus racemosus	5,447.5	500.0	2,600.0	2,784.0		0.0
Satuwa	Paris polyphylla	41,869.0	47,753.0	12,820.5	8,533.0		2,954.0
Salla ko simta	Pine cones	10,306.0	40,940.0	0.0	0.0		0.0
Sikakai	Acacia concinna	477.0	10.0	0.0	0.0		1,635.0
Siltimur	Litsca cubeba	2,550.0	500.0	596.0	2,200.0		0.0

Silajit	Rock exudation	1,050.0	200.0	3,190.0	5,042.0	4,730.0
Sisno jara	Urtica dioica	50.0	0.0	125.0	150.0	449.0
Sugandhawal	Valeriana jatamansi	16,156.0	6,143.0	18,224.0	30,147.0	9,382.0
Sunpati	Rhododendron anthopogon	3,915.0	3,020.0	0.0	33,480.0	0.0
Setakchini jara	Smilax spp.	18,600.0	11,765.0	12,366.0	21,286.0	0.0
Somnalata	Ephedra gerardiana	2,500.0	300.0	275.0	113.0	1,000.0
Harro	Terminalia chebula	0.0	0.0	0.0	2,000.0	0.0
Miscellaneous	Others	49,657.0	870,705.5	46,023.0	187,387.8	1,099,653.9
Total		2,883,465.4	2,577,774.0	1,175,329.0	4,833,938.62	3,079,023.4

Source: Department of Forests (DoF), Babarmahal, Kathmandu, Nepal

ANNEX-II

Indigenous MAPs recommended for cultivation in ecological zones

Ecological zone	Altitude (m)	Estimated no. of MAPs	Recommended for cultivation
Alpine and Trans-Himalayan region	4000 – 5000	45	<i>Dactylorhiza hatagirea</i> , <i>Hippophae tibetana</i> , <i>Picrorhiza scrophulariiflora</i> , <i>Rheum australe</i> <i>Swertia multicaulis</i> <i>Nardostachys grandiflora</i>
Sub-alpine	3000 – 4000	114	<i>Aconitum heterophyllum</i> <i>Dactylorhiza hatagirea</i> , <i>Ephedra gerardiana</i> , <i>Fritillaria cirrhosa</i> <i>Juniperus communis</i> <i>Juniperus recurva</i> <i>Nardostachys grandiflora</i> <i>Podophyllum hexandrum</i> <i>Rheum australe</i> <i>Rhododendron anthopogon</i>
Temperate	2000 – 3000	225	<i>Artemisia indica</i> <i>Cinnamomum tamala</i> , <i>Gaultheria fragrantissima</i> <i>Lilium nepalense</i> <i>Maharanga emodi</i> <i>Panax pseudo-ginseng</i> <i>Paris polyphylla</i> <i>Rubia manjith</i> <i>Swertia chirayita</i> <i>Taxus wallichiana</i> <i>Valeriana jatamansi</i> <i>Zanthoxylum armatum</i>
Sub-tropical	1000 – 2000	340	<i>Artemisia indica</i> <i>Cinnamomum glaucescens</i> <i>Cinnamomum tamala</i> <i>Phyllanthus emblica</i> <i>Valeriana jatamansi</i>
Tropical		310	<i>Acacia catechu</i> <i>Aegle marmelos</i> <i>Asparagus racemosus</i> <i>Phyllanthus emblica</i> <i>Piper longum</i> <i>Rauvolfia serpentina</i> <i>Tinospora cordifolia</i> <i>Terminalia bellirica</i> <i>Terminalia chebula</i>