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Full Length Research Paper

Ethnoecological evaluation of some medicinal and aromatic plants of Kot Malakand Agency, Pakistan

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A study of medicinal and aromatic plants (MAPs) was conducted during summer 2009 in the mountainous areas of Kot. The area has the largest pure stand of Chirr pine forest, hosting many economically important MAPs in the region. In this context the present study was conducted with the aims to identify important MAPs species and investigate linkages in the market channel starting from collectors to consumers. Ethnobotanical knowledge of local people was collected through questionnaire and interviews. This was followed by field survey, guided by community members. During the field local habitat and availability of MAPs was recorded. The survey revealed 54 species of plants with high medicinal and ethnobotanical importance. These plant species were used for the curing of different diseases in traditional system of medicines. Generally men had a greater knowledge than women regarding the MAPs of the area. However, the study showed that neither men nor women were aware of the vast array of herbs with medicinal properties that exist in their locality. During the survey it was noted that the trade of MAPs is highly uncoordinated and complex, involving many players. Out of 30 MAPs, only ten species viz: *Viola serpens, Berberis lycium, Calotropus procerra, Morchella Spp, Grewia optiva, Caraluma edulis, Acorus calamus, Zanthxyllum armatum, Mentha longifolia,* and *M. viridis* are collected mainly for sale purposes. These species were mostly collected by children and women for supplementary income. It was also observed that the rare and threatened species of MAPs were collected in a highly unsustainable manner, therefore, causing biodiversity loss and depletion of MAPs population. About 10% reduction was claimed on both parameters. At the end of study, the recommendations made included: training in plant identification, sustainable collection, processing, value addition, equitable sharing of benefits of MAPs, trade monitoring and cooperative system of marketing.

Key words: MAPs, local people, marketing, MAPs knowledge, distribution, collection trend

INTRODUCTION

The area under study was mountainous, covered with Chirr pine forest in association with *Dodonea viscosa* as dominant vegetation. This forest helps in maintaining a microclimate in the area and also helps to keep several fresh water springs and a perennial stream alive (Alyemeni and Sher, 2010; Hegland et al., 2001). This region has been regarded as a natural reservoir for the collection of a variety of wild MAPs collected without reference to conservation needs, and with limited tangible benefits occurring to local communities. It is, therefore, important to create awareness amongst communities, particularly for the species, which are under high bioenvironmental pressure in the area. The populace of the study area selected for present study were found to have little knowledge about the uses, trade, cultivation and ecology of MAPs. Conservation of natural bio-resources and ecosystem providing habitat to MAPs was noticed to be under constant pressure due to human population flux, overgrazing, over harvesting of such plants and terrace cultivation in the forest area. Unfortunately, the prevailing process of environmental degradation greatly altered the natural ecosystem of MAPs affecting adversely in an uninterrupted manner.

Gathering and processing of MAPs for family use or

livestock treatment is a centuries old practice virtually in all cultures (Olsen and Larsen, 2003). The use of traditional medicine for maintenance of health in most of the developing countries has been widely observed as a custom. Furthermore, an increasing reliance on the use of MAPs in the developed societies has been traced to the extraction and development of several drugs and chemo-therapeutics from these plants as well as from traditionally used rural herbal remedies. Moreover, in these societies, herbal medicines have become more popular in the treatment of minor ailments and also on account of the increasing costs of personal health maintenance. In Pakistan for instance, around 40000 Hakims (herbal drug practitioners) prepare their drug products from such plants, and survey records mentioned that about 2000 MAPs species grow in the country (Sher and Hussain, 2009; Sher et al., 2005). However, just a few of them are harvested and 90% medicinal herbs requirement of the country depends on imports (Sher et al., 2004, 2010c; Sher and Alyemeni, 2011). Such a situation of economic as well as heritage loss arose because information about MAPs is confined to people living in remote areas where such plants grow, and unfortunately, there is no initiative given to them. One example of such highly important plants, is Ephedra nebrodensis, a source of ephedrine used in current modern medical practices against bronchial asthma, high fever and as heart stimulant (Cottiglia et al., 2005; Bhattarai et al., 2010).

Some species are over exploited while many others are under exploited (Cottiglia et al., 2005; Bhattarai et al., 2010; Sher et al., 2010). The present study area represents unique and enormous diversity of MAPs within a relatively small geographic area due to variation in topography, altitude and climate. The MAP species have supported livelihood of many people in the area. They are being collected for export both to national and international markets. The high dependency of rural people on MAPs for subsistence and unsustainable harvesting practices has resulted in over exploitation of resources in different areas of the country. Similarly, conversion of natural habitats into agricultural land has greatly decreased the population size of many MAPs in different sites of the study area. As a result many valuable species of MAPs have become rare and sparse in the area. The traditional practice of extracting forest resources especially MAPs is mostly unsustainable (Palmer, 1987; Olsen and Larsen, 2003). There is a lack of resource tenure and custodianship, understanding of sustainable use and management parameters, proper harvesting and collection procedures and knowledge of market requirements. These are important barriers to the sustainable utilization of MAPs. Besides scientific understanding of population size, distribution, availability and abundance of plant species and their interaction with different stochastic need to be understood properly (Radusiene and Janulis, 2004; Sher et al., 2010a).

Harvesting practices used by untrained collectors may adversely affect the recovery of some plants populations.

Studies have revealed that commercial collectors have non selective harvesting habits where changes in population size and structure of important MAP species occurred. Lack of knowledge about the part used and time of collection lead to misuse of species. The correct time of collection, plant age, and part collected, ensure the concentration of therapeutically active biochemical ingredients and their yield. Secondly, lack of knowledge concerning economic value of MAPs has led to their mismanagement and least profitable exploitation not entirely by local residents but also by visiting collectors (Sher et al., 2010a; 2010b). In the study area MAPs have been collected and sold in the local market by few local collectors. However, very limited knowledge is available on the potential MAP species, which can be utilized in the farming system. Keeping in mind, the attractive prices of MAPs both nationally and internationally, and demand the present project is developed to evaluate the potential of MAPs in “Kot”. It is hoped that the current study will yield better understanding of ecological characteristic of the MAPs and market potential.

MATERIALS AND METHODS

Study area

The study area “Kot” is located in northwest of Dargai in Malakand Agency (Pakistan). It lies between 34°- 45′N latitude and 71°- 52′E longitude over an area of about 41954 acres (Figure 1). Approximately half of the area is rangeland (42%) in hilly area, 15% is under cultivation, 30% is under forest, and 11% is barren (Sher and Hussain, 2009). The elevation of the area ranges from 1000 ft to over 7000 ft at the site peak. The study area is mountainous with mostly undulating terrain surrounded on all sides by mountains with considerable height. Lofty mountains and picturesque landscapes are major uniqueness of the present study area in Pakistan. Climate of the area is dry and falls under subtropical zone hosting subtropical chirr pine forest in association with *Dodonea viscosa. Pinus roxburghii* in association with D. *viscosa* are the main vegetation types of the area. Forest in the area in general and MAPs in particular are under severe biotic pressure in the form of human population growth, deforestation, overgrazing and encroachment for other purposes. Therefore, economically valuable plants are becoming less common in the area.

Survey procedure

A survey of MAP species was conducted during summer, 2009 in different ecologically and economically important site of the study area. Information about the knowledge of local people about MAPs local names, uses, part used, marketing, distribution, availability and abundance were gathered following standard procedure. Generally the key informants were elderly persons with the age group of 40 to 70 years who well understood the purpose of interview and discussion. A questionnaire was developed to conduct semi-structured interviews for recording information. To identify any amendments required to the questionnaire, a pre-test was conducted in the nearby village. Any revisions needed as a

Figure 1. Map showing the study area in Pakistan.

result of this pre-test were noted and undertaken in the following day of the study. However, information on the market value of the plants was collected from local collectors, hakims (herbal practitioners) and traditional shopkeepers. Information was gathered as to how and from whom the plants were obtained and to whom they were sold. Likewise shopkeepers were asked about the sources of the plants received by them. Respondents were also asked about their annual revenues earned from the sale of the plants and returned of the work and time invested. For every MAP species the local people were asked about its abundance, distribution and population size. This was judged by comparing 20 years old records with the current situation. In addition personal observations were made in the fields to note any pertinent events, which could help gain better understanding of the presence, relative abundance based on the ecological characteristics of the species.

Sampling procedures

After a general preliminary survey, the population size of different MAPs was analysed by using quadrats size of 20×20 m size. The qudrats were taken randomly at uniform intervals along evenly spaced transects throughout the study area. The qudrats were taken on transect layed in four directions from a systematically selected points. From the fixed point, after every 200 m to four directions on the determined angles, qudrats od 20×20 m were layed. In this way the whole site was sampled. Tally counter was used to count the steps. The density, frequency, coverage, altitude and aspect were recorded in quadrats. All those plants whose roots lie inside or beneath the quadrats line, irrespective of their shoots, were counted. Similarly in some species bunches forming compact inseparable cluster, offered difficulty in defining a single individual. For such species the entire bunch was counted as one individual.

RESULTS

Indigenous knowledge and MAPs

The present study, documented 54 species of plants having high medicinal and ethnobotanical values. The out-come is presented in tabular form (Tables 1 to 3). The reported plants were grouped into 12 sub use categories according to specific disease treatment (Table 1). The highest numbers of plants were found to be

Table1. Medicinal and aromatic plants of Kot, categorized on the basis of medicinal uses.

No.	Use category (Medicine, Diseases)	Botanical name	Total species
1	Anti helminatic	*Rumex nepalensis, Oxalis corniculata, Polygonum avicular,*	03
2	Diabetes	*Opuntia dillenii, Zizyphus jajuba, Z.oxyphylla*	03
3	Kidney Stone and Kidney Problem	*Origanum vulgare, Otostegia limbata*	02
4	Laxative	*Debregessia salicifolia, Cynodon dactylon*	02
5	Liver diseases and jaundice	*Teucrium spp, Morus alba, Onosma hispida, Silybium marinum*	04
6	Chest pain, fever and sore throat	*Ajuga bracteosa, Berberis lycium, Caraluma edulis, Cotoneaster microphylla, Fagonia critica, Justicia adhathoda, Zanthxyllum armatum*	07
7	General body tonic, Backach, aarthritis	*Morus nigra, Ficus carica, Acacia modesta, Grewia optiva, Asparagus* spp, *Viola srepens, Morchella esculenta, Lotus corniculata, Butea monosperma*	10
8	Stomachic and Gastro-intestinal problems	*Mentha longifolia, M. viridis, Malva neglecta, Cynoglossum spp, Foeniculum vulgare, Rumex nepalensis, Acorus calamus, Plantago lanceolata, P. Ovata*	10
9	Skin diseases, itching, scabies and eczema	*Verbascum thapsus, Rubus fruticosus, Dryopteris spp, Adiantum* spp, *Olea ferruginea, Chenopodium spp, Calotropus procerra, Melia azadarach*	8
10	Nervous disorder	*Cichorium intybus, Podophyllum hexandrum, Aconitum leave*	3
11	Swelling	*Verbascum thapsus, Quercus incana, Daphane mucronata, Xanthium stramonium, Pinus roxburghii*	05
12	Cuts and wound	*Berberis lycium, Verbascum Thapsus*	2

be used for the treatment of stomach and gastro-intestinal problems (10 species). Similarly 9 species were used as general body tonic and arthritis, 8 species used for curing of skin disease, aching, scabies and eczema, 07 species were used for curing of sore throat, chest pain and fever; 03 species were used as antihelmentic, 04 species for curing of liver diseases, 02 species for the removal of kidney stone. 03 species for swellings, 02 species for cuts and wound healing, 03 species for curing of nervous disorders, 02 species as laxative, and 03 species were used for the control of diabetes. Sustainable harvesting of the plants depends on the parts used, time and method of harvesting. Therefore, information regarding the harvesting and use of specific parts of MAP species were also collected. Out of 50 MAP species, about 12 plants were used and harvested for their roots and rhizomes. Other most common plants parts were leaves (16 species) followed by whole parts 15 species, flowers (4 species), fruit and seeds (5 species), bark (3 species) and exudes (2 species) (Figure 2).

Knowledge about MAPs and collection trend

In the project area the numbers of MAPs actually known by the local people were less. It was observed that about 65% of the MAPs were known to the local communities while the remaining medicinal flora was unknown to them. It is worth mentioning that elderly men were more aware than women and younger members of the community. The present study also showed that the involvement of local in the collection of MAPs varied from site to site with the change in altitude. Some MAPs like *Carelluma edulis, Mentha longifolia, M. viridis, Calotropis procerra* etc were collected by highest number of people in lower parts of the hills. While some other MAPs, for instance, *Viola serpens, Morchella*

Table 2. Density, frequency (%) and availability trend of MAPs.

Botanical name	Density (ha)	Frequency (%)	Availability trend
Acacia modesta	700	30	Decrease
Acorus calamus	1600	15	Decrease
Ajuga bracteosa	6500	55	Decrease
Amaranthus viridis	5000	40	Decrease
Anethium gravelenesis	100	10	Decrease
Butea monosperma	280	13	Decrease
Caralluma edulis	5000	20	Decrease
Calotropis procerra	3000	20	Decrease
Grewia optiva	50	8	Decrease
Fagonia critica	600	10	Decrease
Mentha longifolia	5000	30	Decrease
M. viridis	4000	15	Decrease
Morchella esculenta	6	2	Decrease
Lotus corniculata	1000	15	Decrease
Morus alba	100	10	Decrease
M. nigra	110	10	Decrease
Olea cuspidita	311	8	Decrease
Oxalis corniculata	3000	30	Decrease
Viola serpens	3000	20	Decrease
Onosma hispida	121	8	Decrease
Plantago lanceolata	600	30	Decrease
P. ovata	400	15	Decrease
Solanum nigrum	600	15	Decrease
S.surranthensis	700	25	Decrease
Origanum vulgaris	4000	40	Decrease
Polygonum avicular	6000	40	Decrease
Zanthoxyllum armatum	60	10	Decrease
Nasturtium officinalis	4378	30	Decrease
Ficus carica	251	10	Decrease
Justicia adhathoda	1500	35	Decrease
millilotus phillipinensis	5431	30	Decrease
Myrsine africina	289	14	Decrease
Dodonea viscosa	7000	85	Decrease

esculenta, and *Onosoma hispida* were collected from upper parts of the hills. Such a tendency in collection, selectively lead to 4 to 6 time decrease of the plant species in lower hilly areas. However, 2 to 4 time decrease in population density was observed in the upper hilly areas as compared to data of the previous year. During current study, it was generally observed that the over collection of MAPs, intensity of grazing, and deforestation synergistically affected the potential density and population cover of MAPs. As a result the density and population cover of most of the medicinal plants showed 3 to 5 times reduction.

Availability and distribution

The MAPs were found in almost all the habitat throughout the study area. However, the pattern of distribution of individual species was found to be quite variable according to differences in altitude, variable aspect and habitat in contrast to the previous year. Some species were still found to be quite abundant while some others occurred in restricted habitat in the study area. *Ajuga bracteosa, Polygonum avicular and Pinus roxburghii* etc. existed in highest number in most of the area. *Morchella esculenta, Caraluma edulis, Berberis lycium* and *Grewia optiva* were recorded only in a few site of the study area.

Similarly *M. longifolia, M. Virids, V. serpens, and Dryopteris juxtapostia* were restricted to moist and shady locality. Due to severe drought and over harvesting these species were absent in most of the sites where they were abundant a year ago.

The collectors have to walk longer distance as

Table 3. Medicinal and aromatic plants of Kot, Malakand Agency, Pakistan.

S/N.	Botanical name	Local name	Part used	Habit	Altitude (ft)	Aspect	Abundance
1	*Achyranthus aspera*	Warkharray	Y.S	H	500-3000	Open	3
2	*Viola serpens*	Banafshah	L.Fl	H	1000-5000	N.W	3
3	*Calotropis procerra*	Spalmai	YS.Fl	H	500-1700	Open	3
4	*Berberis lyceum*	Kwarray	Ba	S	1200-5000	Open	3
5	*Cynoglossum* spp	Ghwajaba	R	H	500-1700	N.W	2
6	*Onosoma hispida*	Tarray	R	H	800-5000	N.W	2
7	*Nasturatium officinale*	Talmera	Y.S	H	500-4000	Water canal	3
8	*Artemisia maritime*	Tarkha	Fr.L	H	1200-4000	S	3
9	*Morchella esculenta*	Guchi	W.P	Fu	1000-5000	N.W	1
10	*Cichorium intybus*	Hon	L.R	H	1000-4000	N.W	2
11	*Polygonum avicular*	Da Zmakay Tout	R	H	1200-3000	N.W	2
12	*Acorus calamus*	Skhawaja	R	H	1000-3000	W. canal	2
13	*Euphorbia helioscopa*	Prawatai	R	H	1000-3000	N.W	3
14	*Millilotus phillipinensis*	Kambela	L.Fr	T	1000-3600	S	3
15	*Myrsine africiana*	Marrorang	L	S	1200-4000	N.W	3
16	*Ajuga bracteosa*	Boti	Y.S	H	1700-4000	S	3
17	*Mentha longifolia*	Valeny	Y.S	H	500-4000	W. canal	3
18	*M. viridis*	Pudina	Y.E	H	500-4000	W. canal	3
19	*Origanum vulgare*	Shamakai	Y.S	H	1000-5000	N.W	3
20	*Olea ferruginea*	Khuna	R	T	500-3000	N.W	2
21	*Malva neglecta*	Zelai	L	H	1500-4000	Open	5
22	*Plectranthus rogosus*	Sperkai	L	S	1500-3500	Open. S	3
23	*Budelgeia* spp	---	W.P	S	1500-4000	Open. S	3
24	*Dodonea viscosa*	Ghwarraskay	Fr.ba	T	500-3000	S	3
25	Vitex negundo	Marvandai	FrL	T	500-4000	S	3
26	*Ficus carica*	Inzar	Fr	T	1000-4000	S.N.W	3
27	*Morus alba*	Spin toot	Fr	T	1000-4000	S.N.W	2
28	*Acacia modesta*	Palosa	Gum	T	500-2500	S	4
29	*Olea ferruginea*	Khuna	Fr. L	T	1800-5000	S	3
30	*Oxalis corniculata*	Tarukay	WP	H	1800-4000	NW	3
31	*Plantago lanceolata*	Jabai	Fr	H	1400-4000	NW	3
32	*Zizyphus oxyphylla* *Z. Jajuba*	Bera Elanai	Fr Fr	T T	500-2000	NW	4
33	*Rumex nepalensis*	Shalkhay	RL	H	1200-5000	NW	4
34	*Geranium* spp	Sra zeal	R	H	1700-4000	NW	2
35	*Daphane mucronata*	Leghonai	R	S	1000-2000	NW	2

Table 3. Contnd

36	*Cotoneaster miccrophylla*	Karwarra	R	S	800-3000	S	2
37	*Rubus fruticosus*	Karwarra	Fr. L	S	800-3000	S	3
38	*Salvia moorcroftiana*	Kharghwag	R L	H	1500-4000	S	5
39	*Verbascum thapsus*	Khardag	L.Fr	H	500-5000	S	3
40	*Withiania somnifera*	Marghonai	R	H	600-3000	S	3
41	*Solanum nigrum*	Kamachu	WP	H	1500-7000	S	2
42	*Galium* spp	---	WP	Cl	3000-7000	NW	2
43	*Grewia optiva*	Pastawani	Fr	T	1700-4000	S	2
44	*Urtica dioica*	Sizonkai	YS	T	1700-4000	NW	3
45	*Chenopodium* spp	Skawonai	LR	H	1500-2800	S	2
46	*Debregessia salicifolia*	Ajlai	L	T	2000-4000	NW	2
47	*Quercus incana*	Spin Banj	Fr	H	1000-4000	Open	3
48	*Cynodon dactylon*	Kabal	WP	H	1500-6000	All	4
49	*Pinus roxburghii*	Nakhtar	Resin	T	1600-5000	All	5
50	*Otostegia limbata*	Spin azghai	R	S	500-2000	S	3
51	*Nepeta* Spp	Mutrinjai	WP	H	700-4000	NW	3
52	*Caralluma edulis*	Pamenkay	WP	H	1500-2800	S	2
53	*Hedra nepalensis*	Praivata	L	Cl	1500-8000	NW	4
54	*Gymnosporea royleana*	Bashkand	St	S	1500-4000	S	3

Ba=Bark, R= Root, Fr = Fruit, WP = Whole plant, Fl = Flower, H = Herb, S = Shrub, YS. Young Shoot, L = Leaves, T = Tree, NW. North-West, S = South, 1. = Very rare; 2. = Rare, 3. = Common, 4. = Abundance, 5. = Dominant; Cl. = Climber

compared to the situation 20 years ago, demonstrating the current non availability and highly scattered distribution of MAPs in the area. Normally 3 to 6 h work in 3 to 4 km distance is required to collect a bundle of desirable MAPs. Some collectors told that it was easier 20 years ago to gathered a bundle MAPs within two hours. Furthermore, the manual collection cost has gone higher and money wise daily output is decreased. As a result the collectors lost their interest, which caused shortage of supply to the wholesalers. Some collectors were found adding various adulterants to increase the bulk of their collection. In general, all such factors endangered regular supply of MAPs to the herbal drug industry, and for making quality products the imports of such plants became an alternative causing losses to the national market. The current study also observed that the demand of mentioned species was increasing from year to year. It was also verified that these species were marketed in large quantities ranging from 50 to 120 mond per annum per species. A clear increase in marketing size was observed as compared to earlier collection. The overall population density of those species was lower near the residential areas as compared to high altitude and remote areas. Some of the species were still frequently found at some sites while many species were disappearing from several places included in the current study area. Current study revealed a common threat to most of the MAPs in the study region due to lack of: habitat conversion, fragmentation and degradation caused by inappropriate management, overgrazing, deforestation, fire, and unsustainable harvesting threats. The underlying causes were: poverty, increase in human population density, uncertain land tenure, lack of knowledge and awareness.

Marketing and marketing channels

During field survey it was exposed, that MAPs marketing in the study area, was confined to some

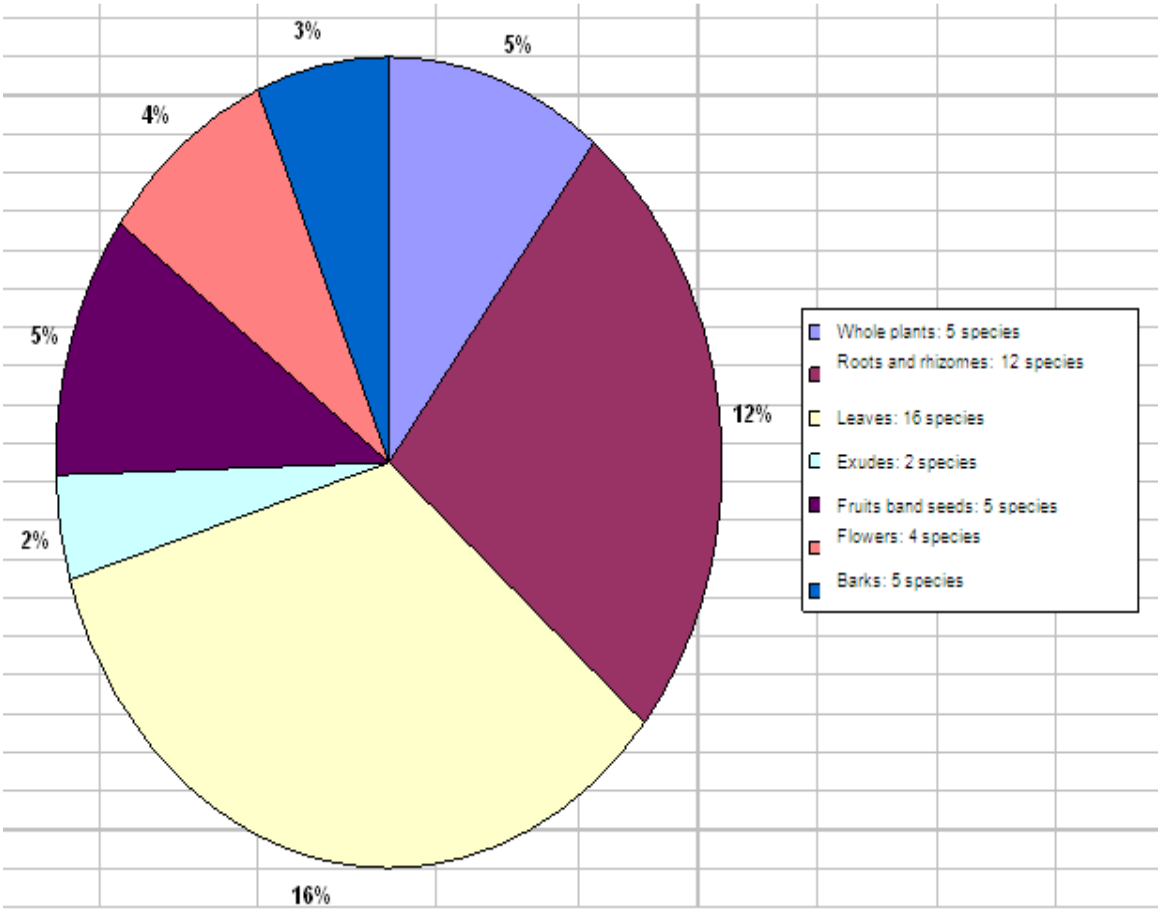

Figure 2. Number of MAP species and its different parts use category.

local shopkeepers and a few local collectors with limited awareness. The MAPs resources can provide better income, if the local start collection and cultivation of some MAPs on scientific lines. The current trade and collection trends of MAPs were found to be highly uncoordinated and heterogeneous in the area. It was noticed that mostly a total of ten MAPs species viz:

Viola serpens, Berberis lycium, Calotropus procerra, Morchella Sp, *Grewia optiva, Caraluma edulis, Acorus calamus, Zanthxyllum armatum, Mentha longifolia* and *M. viridis* were collected for sale purposes. For these ten species, the dealers from Mardan and Dargai cities (Pakistan) occasionally put demand. The local dealers from Kot village pass the message to collectors of the area. They gathered the plants for the local shopkeeper. The collectors are illiterate and do not negotiate the price of the plant materials, as a result do not received reasonable returns with greater loss of plant material.

DISCUSSION

The forest, grassland and even agriculture land of the study area supported a number of plant species, of which many had potential economic, medicinal and other ethno-botanical values (Palmer, 1987; Sher et al., 2005). Majority of the people living within and around the study area relies on the plant resources for centuries. The study showed that the local people had rich indigenous knowledge about distribution, abundance, harvesting, uses and marketing of MAPs. The indigenous knowledge, however, differed in extent among gender, occupational and social groups. For example, the Hakims and tenants possess comparatively higher knowledge about MAPs than the general folks. Similarly the men have more knowledge than women.

The results of the present study also revealed the pattern of distribution and availability of economically valuable MAPs. However, a variation was noticed, probably due differences in grazing, habitat loss, harvesting intensity and chirr pine forest stand. These factors are known to adversely affect the natural regeneration and seriously decreased the availability of some of the species particular to the different sites of the study area (Henry et al., 1999). The population size of some MAPs (especially *Morchella esculenta, V.serpens, Acorus calamus, Caraluma edulis, Lotus corniculata* and

Zanthoxyllum armatum etc.) near residential area was highly threatened due to rapid destruction of habitat for agriculture purposes and expansion of settlements in the area. These losses were surely coupled with unsustainable harvesting and over grazing. The present study revealed that the stock of MAPs in the wild followed by its supply to the market is decreasing at a very fast rate.

MAPs are one of the major sources of income for communities in the study area. These plant species are known to provide basic healthcare for millions of citizens and possess immense cultural value. The resource base is being eroded at an alarming rate. In this context, it is widely accepted that studies should include resource relationship existing between population density and level of harvesting (Hegland et al., 2001; Sher and Hussain, 2009). In this perspective, the present endeavour showed that the overall potential population density size and frequency of the commercially important MAPs decreased two to three times more than the previous population size. The present study also revealed that due to unscientific mode of collection only few individuals, that is, 10% of the species reach to maturity throughout the study area. This observation showed an inappropriate situation for the establishment of their population within the existing vegetation community. The study also demonstrated that the involvement of locals in the collection of MAPs varies with the variation in altitude and remoteness of the site from residential area. Out of the documented MAPs about 12 species viz ;

Morchella esculenta, Grewia optiva, Fagonia critica, *Lotus corniculata, M. longifolia, Berberis lycium, Caralluma edulis, Acorus calamus, Z. armatum, V. serpens* and *Withina somnifera* have high market value in both national and international markets (Alyemeni and Sher, 2010).

It is generally accepted that for any resources a relationship exists between resources stock, population size and sustainable rate of harvest (Hegland et al., 2001; Sher et al., 2010b). Low stocks are likely to produce small sustainable yields, particularly if the species is slow growing and slow reproducing. For instance, *C. edulis* has low stock in the study area. Our findings on its potential density showed 10% reduction as compared to the data of the previous year.

It is well established that a relationship exist between the growth of plants and the impact of grazing. The regeneration response of most of MAP species to over grazing was poor (Belal and Springuel, 1996). Although most of the medicinal and aromatic plants are non-palatable species, but under certain conditions even their mature plants are grazed and browsed. As a result all the species do not reach to the maturity to complete their life cycle. Therefore, over grazing reduced the regeneration of species.

In ecological terms, overgrazing is a dove tall to the degradation of existing vegetation and reduces the spread of selected species not only through direct consumption but also through materially altering their habitat. However, still a detailed study is required to establish such a relationship in different sites of different intensities of grazing and impact on various plant species. However, indirect effects of overgrazing included soil compaction, mechanical injuries to seeding and soil organism (Damgaard, 2009). These practices are known to increase the susceptibility of the soil to erosion and loss of soil fertility. The browsed part of the species is susceptible to fungus infestation. As a result most of the plants now appear rare sparse in most of the grazing sites.

There is a close relationship between harvesting intensity and the period of harvesting which might lead to serious consequences as regards the regeneration of plants. Incorrect time and inappropriate methods of collection affect the three vital attributes essential for the replacement of plants species (Buhler and Schmeed, 2001; Sher et al., 2010a). The established attributes are as follows:

(1). The means of dispersal or persistence at the site before and after collection/disturbance: Local people, for example, often collect whole plant of *C. edulis* before [they have] reaching to maturity and development of their reproductive parts leaving no room for regeneration.
(2). The ability of the species to establish and grow to maturity in a developing plant community: For example, *Berberis lycium* and *Acacia modesta* are slow growing plants and the wrong time of harvesting and disturbance drastically reduce their ability to survive in the plant community.
(3). The time taken to reach critical life stage and due to incorrect harvesting of the species: *V. serpens, C. edulis and M. longifolia* are not allowed to complete their annual life cycle of vegetation and reproductive growth.

It is generally concluded that biological response of the MAPs to the collection intensity and period varies from species to species. The local harvest rhizomes of selected rhizomatous plants in summer where the plants utilize their roots chemistry and nutrition for the development of aerial parts especially to produce better reproductive growth (that is, to give fruits and seeds). While the local gather the whole plant (as much as they found) of *V. serpens* when they are in full blooming conditions. Both the rhizomes and flowers are the critical parts of the plant for regeneration and sustainability performance within the plant community. The wrong time of collection not only depletes the active chemical ingredients but also affect the potential of their production and sustainability. Therefore, these selected plants are more vulnerable to the present ongoing practice and methods of collection in the study area and elsewhere. While for

V. serpens the time of collection is appropriate but poor harvesting techniques (that is, the uprooting of whole plant) and over exploitation exacerbate severe threat to this species by causing unnecessary levels of damage. As a result the population size of *V. serpens* and other MAPs is reducing. Nevertheless, low regeneration rate and high rate of extraction at wrong time, is coupled with the loss of habitat and related biodiversity.

Conclusion

The present study showed that in most parts of the study area, there is a pure stand of Chirr Pine forest. The area also host many endemic and endangered species of MAPs, where many of them are plants of medicinal and economic importance. The study also revealed that only a few species were known to the people while several species of medicinal and aromatic plants were completely unknown to the community as a whole. Therefore, this study suggests that local community should receive education on the identification and importance of indigenous medicinal and aromatic plant species. Indigenous knowledge behind the uses, collection and management of MAP species is fastly eroding. One reason for this is the lack of awareness among the local community regarding the economic and medicinal importance of MAPs. Another factor contributing in the declination of MAPs cover and eroding of indigenous knowledge is the inadequacy of the MAPs market and lack of government support. This is, therefore, an issue of national policies and must be address.

The approach to improve or restore the ill effects of resources misuse and economic degradation should be in multiple directions, from improving the economic standard to changing the attitudes of the local people should be adopted in future. The population cover and potential density of MAPs are fastly decreasing, adequate size of in-situ conservation plot is urgently required for the better management of MAP species.

One important lesson learned from this study is that the establishment of a community based enterprise that depends on local biodiversity can be a strategy to provide more equitable returns to community groups and hence incentives for conserving the resource base. This type of study may help in better understanding of local forest resources and potential MAPs. Lack of knowledge regarding the local potential at the national level would eventually lead to the genetic erosion of MAPs and the related indigenous knowledge system. In order to ensure the management and conservation of MAPs, documenting of indigenous knowledge system and its constant and consisting support is essential.

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