

Full Length Research Paper

Ethnobotanical evaluation of some plant resources in Northern part of Pakistan

Hassan Sher^{1*} and Farrukh Hussain²

¹Department of Botany, G. P. Graduate Jahanzeb College Swat, Pakistan.

²Department of Botany, University of Peshawar, Pakistan.

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An ethnobotanical study on the medicinal and economic plants of Malam Jabba valley, District Swat was conducted with the aims of documenting the inventory of medicinal plants, examining the current status of the medicinal plants trade and investigating the linkages in the market chain starting from collectors to consumers. The survey reported 50 species of plants belonging to 33 families as ethnobotanically important. These species are used as drugs for treating diseases in traditional system of medicine. The detailed local uses, recipe preparation along with their local names and diseases treated were recorded for each species. Market survey revealed that the structure of medicinal plant trade is complex and heterogeneous, involving many players. The collectors are often not aware of the high market prices and medicinal values, and most of the collected material is sold to local middlemen at a very low price. There was an increase of 3 to 5 folds in prices from collectors to the national market. Training in sustainable harvesting and post harvesting of wild medicinal plant resource, trade monitoring, equitable sharing of benefits of wild resources, improved control on harvesting and trade for the conservation of resources, enhancement of cultivation efforts, future research into trade in wild harvested plants, community participation in natural resource management and value addition in the herbal products to maximize the benefits are recommended.

Key words: Malam Jabba Valley, Sustainable harvesting, plant resources.

INTRODUCTION

The study area "Malam Jabba Valley", the heart of the ancient kingdom of Gandhara, located in the North-West part of district Swat, Pakistan, is the greenest and most fertile valley among the Northern valleys Chitral, Swat, Dir, Indus and Kaghan. It lies between the Himalayan and the Hindu Kush foothills. The altitude of the valley varies from 1000 m at the valley entrance to 3200 m at the highest peak of Shagar Sar. Due to its geographical location within the monsoon belt villages of the lower part of the area are surrounded by fruit trees, the fields on either side of the water canal and road are full of wheat and Lucerne. In upper part of the valley, mountains and alpine ecosystems prevail with conifer forests and snow covered peaks. Accordingly, the valley gives home to vast diversity of useful plants, and among those

edible plants, spices, medicinal and aromatic plants are common.

The valley is bounded by district Shanglappar in the North-East; district Buner in the South-West and by main Swat River and road in the West. The area is situated between 35° - 20' to 35° - 45'N Latitude and 72° - 12' to 73° - 32'E Longitudes. Population of the valley is about 40,000 with a density of 200 persons per sq. km, and growth rate of 3.48 (1998) census. Most of the population of the study site depends upon agriculture, forest and live stock rearing. Some are Government civil servants, small business men, petty workers in Middle East and a few are paid labourers. The region is mountainous with one peak, Shagar Sar, measuring more than 3200 m in height. It occupies the floristically rich southern extension of Hindu Kush Raj of the Hindu Kush mountain range. The diversity of climate and geographic locations for plant growth signify the phytogeographic regions of which there are three i.e. 1) Sino-Japanese

*Corresponding author. E-mail: hassansher_2000@yahoo.com.

regions having II) Irano-Turanian in the North-North West and III) Saharo-Sindian regions in the South (Ali and Qaiser, 1986).

Traditionally forests and rangelands are the main sources of medicinal plants in Pakistan. These plants occur naturally in the forests and pastures of Swat district and are used as a basis for modern pharmaceuticals and, therefore, are commonly exploited commercially. Since these plants usually occur in wild form and have been collected from the forest for decades (Khan, 1985), their cultivation/*ex-situ* management has been neglected in the past; hence no nurseries or protected areas for commercially exploited medicinal plants exists in Swat. Secondly, lack of knowledge about the part used and time of collection lead to misuse of the species. The appropriate timings to collect the desired plant part of certain age will determine the yield percentage and quality of therapeutically active ingredients. Currently there is little evidence of the conservation of indigenous medicinal plant species in the study area. The crude and sometimes untimely gathering of medicinal plants does little to enhance their survival or effective population growth, and man's resulting domestic activities are placing some plant species under constant threat.

At the present time, a number of barriers exist to the sustainable cultivation, gathering and use of medicinal plants. These include lack of clear resource tenure and custodianships, little understanding of sustainable management parameters and knowledge of market requirements. These are coupled with inadequate institutional structures for the management of the dwindling medicinal plant populations and dearth of techniques, skills and experience to promote their sustainable use. The present study was, therefore, initiated to investigate and describe the existing population structure, status, availability and distribution of selected plants; and to find out the effect of exposure altitude and vegetation on their population set up. Moreover, the impact of current harvest on the population size of targeted medicinal plants was also determined. The findings might lead to locate ways and means to identify strategies to improve the management of the medicinal plant populations of the study area.

There are total of some 250,000 species of flowering plants in the world, much less than the species of animals (5 - 10 million). However, plants contribute a lot to our lives mainly due to their extra ordinary array of diverse classes of biochemicals with a variety of biological activities (Buckingham, 1999). The plant kingdom had immensely contributed to the health needs of man when no synthetic medicines were available and when no concept of surgical management existed. Even today almost 25% of all prescribed medicines in the developed world contain ingredients derived from medicinal plants (Sher et al., 2000).

Collection and sale of medicinal plants is an important

economic activity in the Malakand division, and about 5000 families are involved in the collection and processing of medicinal plants in the region (Sher and Hussain, 1998a). The most active members of plants gathering and processing are women and children from middle hills. These collectors receive the minimum in the trade chain of medicinal herbs (Sher and Shakespear, 2000). Income from the gathering and sale of medicinal plants is thought to be marginalized by a lack of awareness regarding local and overseas market requirements. Local shopkeepers, agents and Hakims, obtain supplies from individuals who have little experience in medicinal herbs preparation or in understanding of its value. As a result valuable economic and medicinal plants of the investigated site are becoming rare and sparse and some are at the verge of local extinction.

The present endeavor was, therefore, carried out to document the inventory of economic and medicinal plants along with their local uses, names, part used and method of recipe preparation. Moreover, the investigation is designed to determine snapshot of the hitherto unmonitored aspects of medicinal plant ecology and their socioeconomic influences on low income group families.

MATERIALS AND METHODS

A study on the Ethnobotanical evaluation of economic and medicinal plants was conducted during summer 2003 in various parts of Malam Jabba valley, district Swat. The investigated area was divided into different altitudinal zones with the help of map and top sheet. Accordingly frequent visits were made to the area first in April - May, second in June - July and third in August 2003. Questionnaires were used and devised to identify and document the traditional knowledge of local people and their immediate family about the collection, sale and processing of medicinal plants and their uses within the communities.

Information and data on various aspects of the plants such as traditional uses, collection method, time and marketing of each species in the area were gathered from the local experienced persons through interviews and discussions. Data on the market value of the plants was collected from local collectors, shopkeepers (Export Promotion Bureau Office, Malakand division). Information was gathered as to how and from whom the plant materials were obtained and to when 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 targeted plants and returned of work invested. The respondents of various age groups were interviewed and their interest as local collectors and traders were noted through the questionnaires. Generally one person was selected and contacted from amongst 10 houses and were asked about the plant.

The plants were gathered from different altitude and sites. They were dried and preserved properly. The fully dried specimens were mounted on herbarium sheets with scotch tape, plants were identified with the help of available literature (Nasir and Ali, 1971 - 91; Stewart, 1972; Beg and Khan, 1974, Beg and Samad, 1974). The nomenclature was confirmed from National Herbarium, NARC, Islamabad. A set of voucher specimens were deposited in the National Herbarium, NARC, Islamabad and also in the Botany Department G.P.G Jahanzeb College Saidu Sharif Swat.

RESULTS

The study reported that the local people utilize 50 species of medicinal plants for the curing of various human diseases. They were distributed among 33 families comprising of 26 dicots families, one monocot family (Liliaceae), 3 Gymnosperm families (Cupressaceae, Ephedraceae and Pinaceae) while Fungi and Pteridophytes were represented by one family Helvelaceae and Pteridaceae, respectively. Among Dicots, family Lamiaceae (5 species) followed by Rosaceae (4 species), Asteraceae, Fagaceae, Polygonaceae, and Ranunculaceae each with 3 species were important families. The remaining families had less than 3 species of Ethnomedicinal importance in the study area.

The study showed that plants play an important role in the traditional system of medicine of local population. Some plants are used singly, while many others are used in combination with other plants or items such as wheat flour, sugar and ghee, etc. Similarly, certain medicinal plants are considered useful in only one specific disease where as several others have multiple such uses. The following is the description of local medicinal uses long with local names, part used, family and botanical name of medicinal plants in the area.

Ethnomedicinal description of the plants of Malam Jabba Valley District Swat

- A. Group : Fungi
 1. Family : Helvelaceae
 1. Botanical Name : *Morchella esculanta* L.
 Prs ex Fr.
 Part used : Fruiting body
 Habit : Saprophyte
 Local name : Guchii

Local uses: Locally the morels are fried with cows ghee and used after meal which is considered as a general body tonic. It is also used as a delicious food.

- B. Group : Pteridophyta
 2. Family : Pteridaceae
 2. Botanical Name : *Dryopteris juxtapostia* Christ
 Part used : Young shoot
 Habit : Herb
 Local name : Kwanjay

Local Uses: It is used as a local vegetable, which is believed to enhance digestion power.

- C. Group : Gymnosperm
 3. Family : Cupressaceae
 3. Botanical Name : *Juniperus excelsa* Brand
 Part used : Leaves
 Habit : Tree
 Local name : Shahroos

Local Uses: Locally the dried leaves of *Juniperus* is mixed with *Skimmea laureola* Leaves and burned in combination to control the evil eyes, and gods.

4. Family : Ephedraceae
 4. Botanical Name : *Ephedra gerardiana* Wall.
 Part used : Stem
 Habit : Shrub
 Local name : Someni

Local Uses: The powder plant is boiled with water and use twice a day after meal in morning and evening, and is used as remedy for hay fever and cold.

5. Family : Pinaceae
 5. Botanical Name : *Cedrus deodara* (Rox.ex lamb) D.Don
 Part used : Resin
 Habit : Tree
 Local name : Diyar

Local Uses: Locally 2 to 3 drops of resin extract are taken with a glass of milk early in the morning before break fast to treat urticaria and other skin diseases.

- D. Group : Monocot
 6. Family : Liliaceae
 6. Botanical Name : *Allium humile* Kunth
 Part used : Whole plant
 Habit : Herb
 Local name : Palan

Local Uses: By chewing their leaves and bulb the locals treat vomiting and headache.

7. Botanical Name : *Colchicum luteum* Baker
 Part used : Corm
 Habit : Herb
 Local name : Chunar phund

Local Uses: The local people mix the corm of *Colchicum luteum* with egg and fry it with cow's ghee. It is given to aged men and women in the evening before going to bed, and is considered as remedy for joints pain.

8. Botanical Name : *Frittelaria roylei* Hook.f
 Part used : Rhizome
 Habit : Herb
 Local name : Chor

Local Uses: Locally the rhizome of *Frittelaria* is boiled in milk and taken early in the morning before break fast, and is considered as a general body tonic.

- E. Group : Dicot
 7. Family : Apiaceae
 9. Botanical Name : *Bunium persicum*
 Part used : Seed
 Habit : Herb
 Local name : Zera

Local uses: Locally it is mainly collected for commercial purposes, only.

8. Family : Araliaceae
 10. Botanical Name: *Hedera nepalensis*
 Kock
 Part used : Whole plant
 Habit : Climber
 Local name : Zelai

Local Uses: The powdered plant of *Hedra* is boiled with milk and used early in the morning for the treatment of diabetes.

9. Family : Asteraceae
 11. Botanical Name: *Artemisia maritima* L.
 Part used : Whole plant
 Habit : Herb
 Local name : Loam

Local Uses: Locally the dried plant of *Artemisia* is boiled in water and the extract is cooled and used after meal in the evening before going to bed, and is consider as an Anthelmentic agent.

12. Botanical Name: *Cichorium intybus* L
 Part used : Root
 Habit : Herb
 Local name : Haspa booti

Local Uses: Locally the powdered root is taken with a glass of milk for the treatment of general body fever and vomiting.

- 13 Botanical Name: *Saussurea lappa* Clarke
 Part used : Root
 Habit : Herb
 Local name : Kuth

Local Uses: Locally the dried root of *Saussurea lappa* is mixed with egg and fried with cow's ghee and used twice a day as an anti-spasmodic agent. The mixture is also used as a carminative agent.

10. Family : Berberidaceae
 14. Botanical Name : *Berberis lycium* Royle
 Part used : Root
 Habit : Shrub
 Local name : Hees

Local Uses: Locally the dried root is mixed with egg and fried in cow's ghee and used for the treatment of fractured bones and wounds healing. It is also considered as a general body tonic.

11. Family : Caprifoliaceae
 15. Botanical Name: *Viburnum nervosum*
 D.Don
 Part used : Fruit
 Habit : Herb
 Local name : Asos

Local Uses: Locally the fresh fruit of *Viburnum nervosum* is eaten for the curing of stomach-ache.

12. Family : Cuscutaceae
 16. Botanical Name : *Cuscuta reflexa* Roxb
 Part used : Whole plant
 Habit : Climber (parasite)
 Local name : Amol

Local Uses: The powdered plant is taken with a glass of milk twice a day after meal for the treatment of diabetes.

13. Family : Dioscoraceae
 17. Botanical Name: *Dioscorea deltoidea*
 Wall.
 Part used : Rhizome
 Habit : Climber
 Local name : Kanis

Local Uses: Locally the dried rhizome of *Dioscorea deltoidea* is fried in cow's ghee and used early in the morning before break fast for the treatment of kidney problems.

14. Family : Ebenaceae
 18. Botanical Name: *Diospyrus lotus* L
 Part used : Fruit
 Habit : Tree
 Local name : Amlok

Local Uses: Locally the decoction of ripened fruit is used for the curing of dysentery.

15. Family : Fagaceae
 19. Botanical Name: *Quercus semecarpifolia*
 Sm
 Part used : Fruit
 Habit : Tree
 Local name : Meer

Local Uses: The powdered of the ripened fruit mixed with wheat flour and then fried with cow's ghee. The mixture is locally called Halva, and is locally considered as a general body tonic.

20. Botanical Name : *Quercus dilatata* Lindle
 ex Royle
 Part used : Fruit
 Habit : Tree
 Local name : Tor banj

Local Uses: It is similar to *Quercus semecarpifolia* but inferior in quality.

21. Botanical Name: *Quercus incana*
 (Husskn) H.N
 Part used : Fruit
 Habit : Tree
 Local name : Spin banj

Local Uses: Also similar to *Quercus semecarpifolia* but inferior in quality.

16. Family : Geraniaceae
 22. Botanical Name : *Geranium wallichianum*
 D.Don ex sweat
 Part used : Root

Habit : Herb
Local name : Ratan jok

Local Uses: The dried root of *Geranium wallichianum* is mixed with Hen-egg and then fried in cow's ghee and used twice a day for the treatment of Rheumatism.

17. Family : Hypericaceae
23. Botanical Name : *Hypericum perforatum* L.
Part used : Leaves
Habit : Herb
Local name : Shen chai

Local Uses: Locally green tea is prepared from their leaves, and is considered as a stimulant and carminative agent.

18. Family : Juglandaceae
24. Botanical Name : *Juglans regia* L.
Part used : Fruit and bark
Habit : Tree
Local name : Ghoz

Local Uses: The ripened fruit of *Juglans regia* is used as a brain tonic while the bark of stem and root is used for teeth cleaning.

19. Family : Lamiceae
25. Botanical Name : *Ajuga bracteosa* wall ex Bth
Part used : whole plant
Habit : Herb
Local name : Phund Kash

Local Uses: Locally the powdered plant is cooked with cow's ghee and used early in the morning before break fast for the treatment of fever and vomiting.

26. Botanical Name : *Mentha longifolia* L.Huds
Part used : Leaves and Stem
Habit : Herb
Local name : Dhoop

Local Uses: The decoction of the leaves and stem is used for the treatment of cough and vomiting.

27. Botanical Name : *Mentha spicata* L.
Part used : Leaves and stem
Habit : Herb
Local name : Pudina

Local Uses: The powdered plant is mixed with sugar and taken with a glass of water early in the morning before breakfast to control vomiting. The recipe is also considered as a carminative agent.

28. Botanical Name : *Salvia morrcroftiana* wall ex Bth
Part used : Leaves and stem
Habit : Herb
Local name : Khardag

Local Uses: The leaves are warmed with mustard oil

and applied on the swollen skin to release puss, while the inner part of the stem is chewed and is considered as an aphrodisiac agent.

29. Botanical Name : *Thymus serpyllum* L.
Part used : Whole plant
Habit : Herb
Local name : Kanesh

Local Uses: Locally green tea is prepared from its leaves and stem, and is considered as a remedy for fever, cough and cold.

20. Family : Pappilionaceae
30. Botanical Name : *Indigofera heterantha* L.
Part used : Root
Habit : Shrub
Local name : Kese

Local Uses: Locally the powdered roots are taken with a glass of milk twice a day to combat headache and chest pain.

21. Family : Peonaceae
31. Botanical Name : *Paeonia emodi* Wall ex HK.f
Part used : Rhizome
Habit : Herb
Local name : Mameikh

Local Uses: The powdered Rhizome of *paeonia emodi* is mixed with cow's ghee and taken twice a day after meal, and is considered as a general body tonic.

22. Family : Podophyllaceae
32. Botanical Name : *Podophyllum hexandrum* Royle
Part used : Rhizome
Habit : Herb
Local name : Kakorra

Local Uses: Locally the Rhizome is crushed and used with cow ghee for the treatment of backache and cancer.

23. Family : Polygonaceae
33. Botanical Name : *Persicaria amplexicaule* D.Don
Part used : Root
Habit : Herb
Local name : Anjabar

Local Uses: Locally the root of *Persicaria* is mixed with egg and fried in cow's ghee, and is considered as a general body tonic.

34. Botanical Name : *Rheum emodi* Wall
Part used : Root
Habit : Herb
Local name : Chutial

Local Uses: Locally the dried root of *Rheum emodi* is mixed with egg and fried in ghee and used twice a day for the removal of kidney stone and other kidney problems.

35. Botanical Name : *Rumex dentatus* L.
 Part used : Leaves
 Habit : Herb
 Local name : Ovawol

Local uses: Locally the leaves of *Rumex* are warmed and applied on the wounds for their healing.

24. Family : Primulaceae
 36. Botanical Name: *Primula macrophyla*
 D.Don
 Part used : Flower
 Habit : Herb
 Local name : Mammara

Local uses: The powdered flowers are applied to the eyes and is considered to improve eyesight, and control eye diseases.

25. Family : Ranunculaceae
 37. Botanical Name : *Aconitum chasmanthum*
 Stapf ex Ham lex
 Part used : Rhizome
 Habit : Herb
 Local name : Zaharmora

Local uses: The Rhizome of *Aconitum chasmanthum* is crushed and mixed with cow ghee and used as a general body tonic.

38. Botanical Name : *Aconitum heterophyllum*
 Wall
 Part used : Rhizome
 Habit : Herb
 Local name : Zaharmora

Local uses: The use is similar to *Aconitum chasmanthum*.

39. Botanical Name: *Caltha alba* Jacq.
 Part used : Leaves
 Habit : Herb
 Local name : Maspal

Local uses: Locally the leaves of *Caltha alba* are applied on the wounds for healing.

26. Family : Rosaceae
 40. Botanical Name: *Prunus armeniaca* L.
 Part used : Fruit
 Habit : Tree
 Local name : Khubani

Local uses: The decoction of the dried fruits is considered as laxative and purgative.

41. Botanical Name : *Rosa webbiana* Wall
 Part used : Fruit
 Habit : Shrub
 Local name : Phalol

Local uses: Locally the fresh ripened fruit of *Rosa webbiana* is used as antispasmodic agent.

42. Botanical Name : *Rubus fruticosus* L.
 Part used : Fruit

- Habit : Herb
 Local name : Ach

Local uses: Locally the ripened fruit of *Rubus fruticosus* is used to improve digestion power.

43. Botanical Name : *Sorboria tomentosa*
 Part used : Inflorescence
 Habit : Shrub
 Local name : Beree

Local uses: Locally the inflorescence of *sorboria* are mixed with mustard oil and applied on the new born child skin to remove skin rashes and also applied on the wound as antiseptic agent.

27. Family : Rutaceae
 44. Botanical Name: *Skimmea laureola* (DC)
 Sieb and Zucc
 Part used : Leaves
 Habit : Herb
 Local name : Namer

Local uses: The dried leaves are burnt with the bark of *Betula utilis* to expel evils and evil eyes.

28. Family : Saxifragaceae
 45. Botanical Name: *Bergenia ciliata* (Haw)
 Sternb
 Part used : Root
 Habit : Herb
 Local name : Badmia

Local uses: Locally the powdered root is boiled with water for an hour after this the remaining gum like substance is applied on the cut wound for healing purposes. It is also considered as blood purifier.

29. Family : Scrophulariaceae
 46. Botanical Name: *Verbascum thapsus* L.
 Part used : Leaves
 Habit : Herb
 Local name : Khar ghwag

Local Uses: The leaves of *verbascum* is mixed with Brassica oil and used as antiseptic agent.

30. Family : Solanaceae
 47. Botanical Name : *Hyoscymus niger* L.
 Part used : Seed
 Habit : Herb
 Local name : Shamala

Local uses: The seeds of *Hyoscymus niger* is applied to the teeth to relieve toothache.

31. Family : Urticaceae
 48. Botanical Name : *Urtica dioica* L.
 Part used : Whole plant
 Habit : Herb
 Local name : Jon

Local uses: Locally the powdered plant is smoked as cigarette for the curing of asthma and also for urticaria.

32. Family : Valerianaceae

49. Botanical Name : *Valeriana jatamansi*
Jones
Part used : Rhizome
Habit : Herb
Local name : Mashkebala

Local uses: Locally the Rhizome of *Valeriana* is crushed and mixed with cow's ghee and used for the curing of epilepsy.

33. Family : Violaceae
50. Botanical Name : *Viola serpens* Wall
Part used : Whole plant
Habit : Herb
Local name : Kotan pel

Local uses: Locally it is collected for commercial purpose, only.

Market study

The recordings of the present study in Malakand division, Mingora is the main trade centers for many medicinal plants, and they supply considerable quantities of plants to various national trading centers of Pakistan including Peshawar, Islamabad, Lahore and Karachi, and also abroad. Figure 1 shows the direct linkages in the market channels between the various herbal markets in Malakand Division and national level. Mingora receives material from various areas of harvest including the study areas, while Lahore herbal market acts as the major center of trade in the country receiving imported material from abroad and from the country sources. The plants under study were sent to various trade centers in the country either directly or through intermediary markets.

In district Swat, the trade and collection of medicinal plants are highly uncoordinated and vary from area to area and species to species. For obtaining plants from the study area, the dealers from national markets send representatives to local dealers in Mingora and place their demand. The local dealers pass the message to their agents, i.e. the local shopkeepers of the valley. These agents inform small shopkeepers and collectors. The collectors gather the species for the local shopkeepers and agents. The collectors are illiterate and do not negotiate for the price of the plant materials and gather sizeable quantities but do not receive reasonable returns. The dealers of Mingora get the material from the agents when that is ready. In this way the medicinal plants pass through three or four hands (Figure 1). Some times daily wages labourers for Rs. 100 - 150 per day are employed by the local agents for plant collection but this is not usual.

It is generally observed that in the surveyed valley, the local agent (middleman) receives handsome returns. The local shopkeepers or other persons acting as agents of the traders of the regional herbal markets are the major buyers from the local collectors. It is also observed

that the local wholesalers control prices information to the collectors which has enabled them to maintain high profits.

The export of crude herbal items of the selected species to different countries is largely through individual and local exporters in Joddia Bazzar, Karachi and Akbari Mandi, Lahore. The selected species are currently exported to Germany, Japan, France, Switzerland, Middle East, India and South Africa.

Extent of trade from the valleys

The present study indicated that *Viola serpens* (5 m/tons), *Valeriana jatamansi* (1.3 m/tons) and *Persicaria amplexicaule* (2 m/tons) were collected in reasonably great quantities from the surveyed areas each year during 2002 - 2004 and sold in the herbal markets of Mingora. The present assessed take out the valleys is not based on the optimum exploitation of these species in the targeted valley. Market demand for most of these species seems more than the existing supply and similarly, the potential of supply can be quite higher than the present take out. The difference is due to uncoordinated demand and supply and unawareness about the availability of certain species and their demand in the market.

Among the selected plants species, the most valuable is *V. serpens* locally priced at Rs. 200/Kg followed by *V. jatamansi* at Rs. 150/kg, and *P. amplexicaule* at Rs. 90/Kg. The prices of each species vary from year to year and also depend on demand and supply. Based on the quantities taken out from the study area in year 2003 and 2004 and the prices obtained at the collector level, the total revenue was about Rs. 0.7 million. The money generated from the trade of the economic and medicinal plants in Malakand division is about Rs. 20 millions. The targeted species has nearly 3.5 percent share in the total revenue of Malakand division.

The present study also indicated that the household collection ranged from 12 kg to 150 kg per house hold. The collection of targeted species was taken as an important activity by about 315 households. Assuming that total 35 days were involved in the harvesting and collection of target plants and that about 1.7 persons were involved per household, the total employment generated by the activity comes to about 15,500 person days per year including port rage. Average collection in the 315 households is over 100 kg per year. In 2003/2004, this meant net revenue of Rs. 1500 per house hold. Households in the study area reported earnings between Rs. 1500 to Rs. 2000 per year from the sale of selected species.

The present endeavor also estimated that the total beneficiaries from the targeted plants trade in the study area may number 405 house holds. The number of house holds of various categories of beneficiaries and the income distribution was presented in Table 1. In

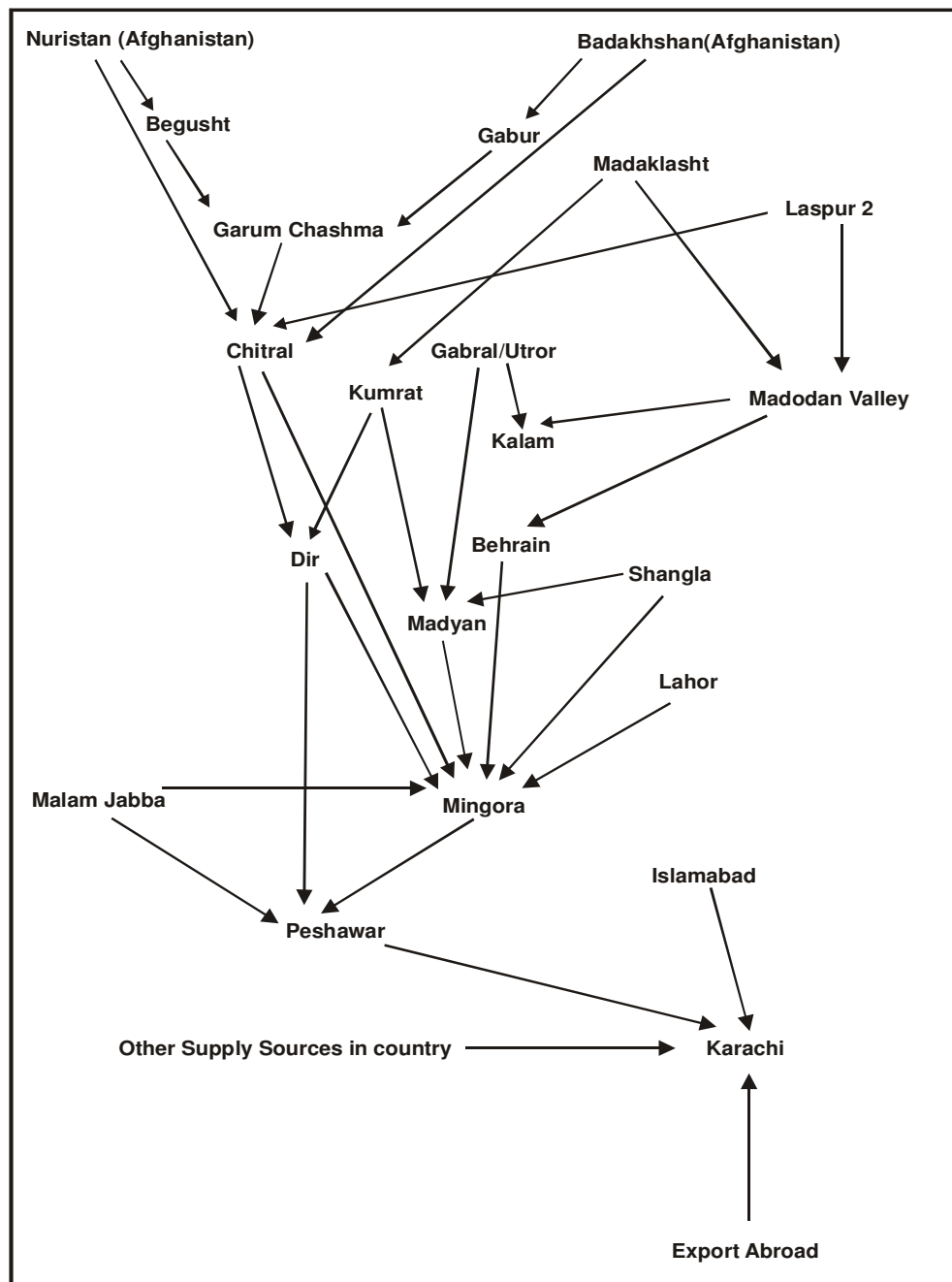


Figure 1. Market channels from collection sites and other areas to local, national and international markets. *Study area.

Table 1. Income distribution from the trade of targeted plants in Malam Jabba, Swat during 2002 - 2004.

Beneficiaries	Number of House hold	Gross Income (Rs)	Percent of Total gross Income	Gross Income per house hold (Rs)
Collector Households	315	2000	20	400
Porter households	50	100	3	400
Village trader households	20	500	11	1000
Middlemen agent	20	800	15	1500
Total	405	3400	49	3300

Table 2. Average price in Rs. per kg of plants at different market points.

Botanical Name	Collection Month	Demand Trend	Collector Rate Rs. Per KG	Markets rate in Rs. Per Kg			
				Local Market	Whole Sale	National	International
<i>Persicaria amplexicaule</i>	May September	Increases	90	120	150	200	300
<i>Valeriana jatamansi</i>	May September	Increases	150	200	300	350	500
<i>Viola serpens</i>	March May	Increases	200	250	350	500	1000

Table 3. Work investment for collection of targeted plants in Malam Jabba Valley.

Name of Plants	Distance Traveled (km)		Time Spent (h)		Form of material sold
	Present	20 Years ago	Present	20 Years ago	
<i>Persicaria amplexicaule</i>	2	1	3-4	1-2	Fresh
<i>Valeriana Jatamansi</i>	3	1	4-5	2-3	Fresh
<i>Viola Serpens</i>	3-4	2	6-8	3-4	Fresh

terms of per household benefits, the village trader appeared as the largest beneficiary. However, trading is a full time activity for much of the year. Also the agent (middlemen) received a higher proportion of the income after marketing the produce directly.

Price fluctuations of species at collector level and beyond

The present study evaluated that the price of the plants gradually increases from collector to local, national and international markets at each step in the chain (Table 2). The price was lowest at the collectors level and increasing many fold from collectors to the national markets and abroad. However, while guessing at the increase of the price from the collector level and beyond, it may be kept in mind that considerable weight of the plant material is lost during drying, cleaning, processing, grading, packing etc. at each level when value is added to the material. This weight loss varies from species to species and the modes of processing for sale. One of the reasons for the low price at collector's level was their unawareness of the price of the plants in the trade markets.

Investment of work by collectors

The time spent was based on the relative availability of the species with respect to the distance and the characteristics of the plant parts. Normally 4 - 8 h work in 3 - 4 km distance was required to gather a bundle of roots of 40 - 50 kg of the plants like *P. amplexicaule* and *V. jatamansi*. The flowers of *V. serpens* required 6 - 8 h time in 3 - 4 km to collect one kg of flowers (Table 3). Each species is collected manually through high labour cost as compared to other daily activities of the locals, and the collectors get very less money for their labour.

Table 3 indicates that the population of the selected species has been reduced more than half in the last 20 to 30 years. The local people traveled one to two km for the collection of some quantity (50 kg of rhizomes of *V. jatamansi* and *P. amplexicaule* and one kg flower/leaves of *V. serpens*) of the species in the past and now they traveled 2 to 4 km for the same quantity. Similarly they use to spend one to 4 h, 20 - 30 years ago and now they spend 3 to 8 h for the same collections. As a result, the collectors lose their interest which causes shortage of supply to the end user. Some collectors add various adulterants to increase the quantity. In one example, in *V. serpens* in a quarter of the leaves three quarters of the adulterants were added including leaves of other plants, petioles and even pebbles (personal observation). When the supply is not ensured and the pharmaceutical companies do not get the quality products, the national market encourages the import of the plants.

Collectors involved

The information at the local level had shown that in the study area children were the main collectors (50%), followed by women (30%), Afghan refugee men (15%) and local men (5%).

DISCUSSION

Medicinal plants are an important source of drugs in traditional system of medicine (Sher and Hussian, 1998a). They are used locally as a crude drug for the treatment of human and livestock health care since time immemorial. Even today, they are the main source of traditional health care especially in the remote hilly areas. The present investigation reported 50 plants species used by the local indigenous system of medicine

for the curing of various diseases. Most of the species were used for curing various diseases such as stomachic, dysentery, fever and rheumatic pain. Similarly results were also reported by Arshad and Akram (1999), who reported few plants species of varied health care from Rawalpindi. However, their documented plants were different from those of our plants used for same purposes. It was also observed that some plants had single medicinal use while many other species had multiple uses. Kamali and Khalifa (1997) reported that 15 different medicinal plants were used for the curing of malaria in the central Sudan Sher (2000), also observed that most of the wild medicinal plants were frequently used for the curing of constipation, diarrhea and dysentery by the hill side dwellers of district Swat, Pakistan.

The market information revealed that district Swat is the collection and trading centre for many medicinal plants. It has a well-established market which supplies sizeable quantities of targeted plants to various trading centers of Pakistan and abroad. Khan (1985) and Zaidi (1998) also reported that majority of marketable medicinal plants are collected from Northern areas of Pakistan including Swat. The present study noticed that the structure of medicinal plant trade is complex involving many players in the study area. The middlemen who purchase material from collectors sell this either to small shops in the region or to regional middlemen or agents of large dealers, and through this chain of middlemen the material reaches the wholesale dealers of large cities. Wholesalers supply the plant materials then to retailers or pharmaceutical companies or exporters. In this chain the wholesalers earn more as compared to others. The price may go quite high as the drug moves from the collectors to international market. Similarly Khan (1998), Sher and Hussain (1998a) and SDC/IC (1999) also reported that the middlemen and wholesalers earn a lot of profit from medicinal plants, therefore, when the plants reach to the international market, their price become double or tripled. The present study also observed that the prices of targeted plants increase 3 to 5 folds from collectors to local dealers, which may further be doubled or tripled at national markets.

It was also observed that the medicinal plant trade in Pakistan in general and district Swat in particular, is largely in the unorganized private sector with very little state control. Often the plant species which are rare or threatened are collected without any check, therefore, causing biodiversity loss and depletion of wild natural resources. The targeted plant species are collected from the wild of the study area on what is apparently a first-come, first-serve basis. There is no management structure tied to the harvesting of resources at present. Therefore, collection volume is much more and beyond their regeneration rate. Similar observations were also reported by Cunningham et al. (1998) and Lange (1998). They stated that the trade and collection of plant mate-

rials is mostly handled by unskilled persons. As a result valuable medicinal plants are damaged due to lack of scientific methods of collection. Secondly over-extraction, destructive harvesting techniques and habitat loss are severe threats to medicinal and aromatic plants in Europe and same is true for our study area. It was also discovered that collectors now have to put more efforts and to walk longer distances to collect the same materials of targeted plants when compared to twenty years ago.

The present study also revealed that with the increase in elevation and remoteness of the area within the study valley, of the involvement of children and women in the collection of, and dependence on medicinal plants increased. This agrees with the studies of Khan (1998), and SDC/IC (1999) who reported that women and children usually gather medicinal plants as a part time business, in the northern areas of Pakistan.

The present study, therefore, suggest that some management measures should be taken with the participation of local communities through village organization to conserve medicinal plant resources from becoming extinct. The foremost important thing is to give awareness/training to local communities on multidimensional basis about sustainable exploitation of medicinal plant wealth in hillsides and information on price of marketable species. The natural regeneration of economically important medicinal plants is adversely affected by deforestation, over grazing, unabated urbanization and by their unauthorized collection in the study area. This agree with Beg and Khan (1974), Hussain et al. (1996) and Sher and Hussain (1998b) who reported that unsustainable mode of medicinal plants collection and habitat loss has put the conservation status of many medicinal plants at risk in District Swat.

The present study, therefore, recommended that conservation measure with the participation of local communities should be taken to conserve and restore the degraded habitat of medicinal plant resources. The foremost important thing is to increase awareness among the local inhabitants of Malam Jabba Valley, Swat, that they are the protectors of these vital indigenous resources, which can be exploited for several useful purposes.

Recommendations

Medicinal plants are the source of sustained income, provided efforts are made to stream line the regeneration protection and extraction of medicinal plants on proper scientific lines. Collection of medicinal plants carried out by the collectors may be streamlined in such a manner so as to provide ample regeneration time to the plants keeping their optimum time of growth in view. The area once used for collection may be declared as protected area and collection may be debarred for a period of 2 to 4 years.

Over exploitation, habitat loss, destructive harvesting techniques and low monetary return of the materials are among the most important problems at collector's level. Collectors are not aware of the proper harvesting time and methods and as a result cause damage to the resource base. Secondly, over exploitation and habitat changes, due to the human population increase across most parts of the study area, have eroded the targeted plant population level. In the last three decades there has been a steady degradation of the rich floral landscape of the region.

The study recommend that, in order to have an effective natural resource management and sustainable utilization programme, it is extremely important to ensure that the benefits of the resources are fairly shared with the communities, who are the real owners of the resources. The sense of ownership can only be generated when the communities at large sees the benefits coming from the resource, not only for them, but also for their next generations. Nonequitable and exploited benefit sharing often lead to unsustainable practices.

With the growing interest in medicinal plants, both in the country and abroad, it is necessary to develop a long term strategy to conserve and sustainably harvest these plant products. There is also a need for both community based efforts and better state control on the harvesting and trade of medicinal plants to enable the conservation of the resource base. An alternative source of income through cultivation should be generated for the community, thereby preserving precious wild plant resources.

The study also suggests that one or two years protected area have an increased quantity and diversity of medicinal plants. The study, therefore, recommended rehabilitation/recovery practices of the present work in order to enhance restoring of vegetation in general and medicinal plants wealth in particular. Furthermore, it is also necessary to establish management and conservation areas of adequate size in the natural habitats of medicinal plants with the participation of local communities. In case of species that are threatened, clear guidelines should be developed and annual quotas of plant parts which may be collected should be clearly established, and made known to all concerned parties and stakeholders. A proper mechanism of the implementation of collection quotas should be designed to enforce the conservation and management efforts.

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