

## TRADE POTENTIAL AND CONSERVATION ISSUES OF MEDICINAL PLANTS IN DISTRICT SWAT, PAKISTAN

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### Abstract

Use of medicinal plants for various health disorders is a common practice especially in rural areas. Poor economic condition and lack of modern health care facilities in remote areas are the major reasons for adopting traditional medicine. Mingora is considered as the main center of trade of medicinal plants not only of Swat but of the entire Hindu Kush-Himalayan Region of Pakistan. The city was analyzed for the trade potential of local medicinal plants. The present study reported trade and marketing profile of 99 species collected locally and sold in the national and international markets. A total of 99 taxa were collected belonging to 55 families and 80 genera. Helvellaceae was at the top among the largest families with 9 taxa, followed by Asteraceae and Solanaceae with 8 and 6 taxa respectively. Among the life form Chamaephyte was at the top with 27 taxa (27.27%), followed by Hemicryptophyte, Phanerophyte, Therophyte, Geophyte and Parasite with 25 (25.25%), 24 (24.24%), 17 (20.20%), 2 (2.02%) and 1 taxa (1.01%), respectively. Market analysis revealed that annual production and its share to the market was 8.056 and 6.644 million kg during the years 2004-2005 and 2005-2006 whereas, it gave rise to the circulation of Rs. 4475.00 and Rs. 5084.70 millions, respectively. Thus quantity traded decreased due to the unsustainable collection in the wild, while amount circulated increased due to rise in price kg<sup>-1</sup> as a result of increased demand from the national and international market. According to an estimate approximately 99,840 individuals (i.e. 8% of the total population of Swat) are associated with the collection or trade of these important medicinal plants in the valley. The study also revealed that availability of medicinal plants decreased day by day and this process is continued for the last two decades. According to local elders, most of the medicinal plants reported were abundant in the vicinities some 20 years back. However, their population was drastically decreased due to over exploitation, extension in agricultural lands, increased market pressure, lack of alternate earning opportunities in the area and unsustainable harvesting methods etc. All these threats have affected the population size of these medicinal plants in the wild. Therefore, early measures for the management of medicinal flora for sustaining its market supply and there by securing livelihood opportunities of rural communities are needed on urgent basis.

### Introduction

The availability of plant resources in the natural habitat has always been affected by the ways they have been utilized by the local community. Use of plants for medicinal purposes is well rooted in cultural esteem and religious beliefs throughout the world. Even in developing countries medicinal plants provide a real alternative for primary health care system (Buitron, 1999). Due to the high cost of conventional allopathic medicine and unavailability of health care facilities especially in rural areas, the locals are compelled to rely on medicinal plants (Ali & Qaiser, 2009; Qureshi *et al.*, 2009). According to an estimate between 35-70 thousand plant species are used in folk medicine world wide (Lewington, 1990; Fransworth and Soejarto, 1991). Products from hundreds of species are being collected from remote forests and meadows and traded to international markets and consumed (Olsen, 2005; Sher *et al.*, 2012). These harvests and sales provide an important source of income to huge number of rural households.

About 70-80% of the world population use traditional medicine for curing their ailments and diseases (Fransworth & Soejarto, 1991; Pei, 2001). But the percentage of people using traditional medicine decreased with time in developed countries i.e. 40-50% in Germany, 42% in the USA, 48% in Australia and 49% in France (Titz, 2004). This might be due to the unsustainable collection methods and decrease of medicinal plant in the wild.

On global scale with the dominance of few countries, approx. 0.467 m tons, worth US \$1.2 B medicinal plants were traded annually during 1991-2003 (Lange, 2006). Regarding the markets for medicinal plants, China is at the top followed by France, Germany, Italy, Japan, Spain, the UK and the USA. Japan is leading among the per capita consumption of botanical medicines in the world (Laird, 1999). The world market for herbal medicines were US \$19.4 billion, with Europe at the top (6.7) followed by Asia (5.1), N America (4.0), Japan (2.2) and the rest of the world (US \$ 1.4 billion) during 1999 (Laird & Pierce, 2002). According to Anon., (2003) global sales of herbal products were about US \$ 60 billion in 2002. While on the bases of average import trade volume Pakistan is at 9<sup>th</sup> position among the top 12 countries, with 10.65 thousand tons, worth US \$9.8138 m during 1991-2003 (Lange, 2006).

Very little is known regarding the biodiversity of Swat. Floristically most of the published work on the area is regarding its flora (Stewart, 1967; 1972; Beg and Khan, 1974; Ahmad, 1995; Ahmad and Sirajuddin, 1996). Very little is published on its economic importance and conservation concerns (Ali, 2003).

Swat has a variety of phytoecologic and agroclimatic combinations supporting the existence of a wide variety of natural resources. It is the largest among valleys of the Hindu Kush and spread over 6226 km<sup>2</sup> area and is located between 34° 30' – 35° 55' N and 71° 45' – 72° 50' E. The valley has altitudinal variation ranging from 600m in the south to more than 6000m in the North, the highest peak

being that of Falaksair 6261m. Most of the area of the valley comes under Sino-Japanese region (Ali and Qaiser, 1986; Ahmad and Sirajuddin, 1996) with Monsoon rains mostly in summer, establishing a variety of biotic communities within the influence of various temperature and precipitation regimes. Swat being the centre of trade and commerce of the Hindu Kush and Himalayan region possess special importance with reference to medicinal plants. A total of 1550 taxa of flowering plants are reported from Swat (Stewart, 1967) out of which 345 are ethnobotanically important (Ahmad and Sirajuddin, 1996; Ahmad and Hussain, 2008). The present studies were conducted to analyse the market potential of medicinal plants during 2004-05 and 2005-06, dependency of locals for healthcare and partial subsistence.

### Materials and Methods

Medicinal plants present in the market were collected along with pertinent information regarding their local and *Tibbi* names, uses, market value, supply and demand in the market by interviewing the local *Hakims* (local health practitioners), plant dealers and elderly people. Various stakeholders were identified and were also interviewed including the collectors, middlemen, local dealers and exporters. Data were analyzed for potential and fluctuation in their trade during the years 2004-2005 to 2005-2006. All the traded plants were categorized into 3 groups i.e. locally consumed, nationally traded and exported. Unit price, quantity traded, area of collection were analyzed by interviewing the people involved in trade. All the specimens collected were preserved and identified according to the Flora of Pakistan (Nasir and Ali, 1970-1979; Nasir and Ali, 1980-1989; Ali and Nasir, 1989-1992; Ali and Qaiser, 1993-2009) Flora Iranica

(Rechinger, 1957-2001) and other pertinent literature. Members of fungi were identified with the help of Ahmad *et al.*, 1997; Surcek, 1988; Demoulin and Mririott, 1981 and Mirza and Qureshi, 1978. Life form was determined using Raunkiaer (1934). Rarity of plants was determined as per modification from Oosting (1956).

List of the stakeholders can be obtained from the first author upon request.

### Results and Discussion

A total of 99 taxa were collected belonging to 55 families and 80 genera. Helvellaceae was at the top among the largest families with 9 taxa, followed by Asteraceae and Solanaceae with 8 and 6 taxa respectively. Among the life form Chamaephyte was at the top with 27 taxa (27.27%), followed by Hemicryptophyte, Phanerophyte, Therophyte, Geophyte and Parasite with 25 (25.25%), 24 (24.24%), 17 (20.20%), 2 (2.02%) and 1 taxa (1.01%), respectively (Table 2).

Regarding the plant habit Perennial herbs were at the top with 55 taxa (55.55%), followed by Annual herbs, Trees, Shrubs and Biennial herbs with 20 (20.20%), 13 (13.13%), 9 (9.09%) and 2 taxa (2.02%), respectively (Table 2).

Regarding the rarity very rare plants were at the top with 27 taxa (27.27%), followed by common, rare, infrequent and abundant with 26 (26.26%), 23 (23.23%), 19 (19.19%) and 4 taxa (4.04%), respectively (Table 2).

Analysis of the medicinal plants market showed that the quantity of medicinal plants traded decreased from 8.056 million to 6.644 million kg. While the price per plant species increased due to which the total amount of money circulated increased from Rs. 4476 to Rs. 5084.7 million as shown in Table 1. This might be due to the increased demands from the national and international markets.

**Table 1. Fluctuation in trade of medicinal plants in the market during 2004-5 to 2005-6.**

Year	Trade (Million kg)	Trade trend
2004-2005	8.056	Quantity traded decreased
2005-2006	6.644	
<b>Circulation of money in the two years amount (Million Rs.)</b>		
2004-2005	4476.00	Amount circulated increased
2005-2006	5084.70	

According to the market analyses, export of these medicinal plants is carried out from the four major markets of the country i.e. Peshawar, Lahore, Karachi and Rawalpindi. However, some plant dealers of Swat directly export 21 medicinal plants (annotated with † in Table 2) to other countries. Although the number of species of medicinal plants exported is few but the quantity is large. Supply of these medicinal plants is directly related with the season and demand from the foreign countries.

Medicinal plants supplied to the national market (annotated with \* in Table 2) are either directly exported or sent to other major cities of the country for consumption by local people. In the season (March to June) of plants growth, some medicinal plants are sent to Lahore or Rawalpindi in partly fresh or raw form there they are dried and graded according to the market standards and are sent to various areas of the country

where Pansars and Hakims prescribe them for various ailments at higher prices.

The population explosion has exerted an immense pressure not only on local trade of medicinal plants but export rates have also been immensely affected. In the last few decades these medicinal plants were exported to Germany, Switzerland, USA and other European countries. But with the introduction of cultivation technology in these countries, beside the destruction of local flora, the export has been decreased drastically. In Pakistan medicinal plants has immense potential but unfortunately trade has not yet been standardized, nor has any attempt been made to investigate the conservation status of the species involved in trade. All the medicinal plants are available for local consumption. Twenty one of which are exported (denoted with \* in Table 2) and twenty two of them are supplied to national market (denoted with † in Table 2).

Table 2. List of medicinal plants, with pertinent data of their trade.

S.No.	Botanical name	Vernacular name	Life form	Habit	Occurrence	Price kg <sup>-1</sup> (Rs.)		Quantity traded (000 kg)		Rarity
						2004-05	2005-06	2004-05	2005-06	
1.	* <i>Acorus calamus</i> L.	Skawaja	Cham	P H	Mingora, Barikot	120	270	300	290	Common
2.	* <i>Berberis lycium</i> Royle	Koarai	Phan	S	Khwazakhela, Madyan	100	150	40	36	Common
3.	* <i>Dioscorea deltoidea</i> Wall. ex Kunth	Kaneez	Cham	P H	Kalam, Madyan	47	100	0.025	0.012	Rare
4.	* <i>Mallotus philippensis</i> (Lam.) Muell.	Kamela/ kambela	Hemi	P H	Mingora, Marghuzar	120	280	2.0	1.9	Infrequent
5.	* <i>Myrtus communis</i> L.	Barg-e-abulanse	Phan	S	Kokarai, Marghuzar, Jambil,	30	60	1.23	1.2	Rare
6.	* <i>Polygonatum multiflorum</i> (L.) All.	Musli sapaid	Cham	P H	Madyan, Bahrain, Kalam	700	1250	3.0	2.5	Very rare
7.	* <i>Polygonatum verticillatum</i> (L.) All.	Noori alam	Cham	P H	Bahrain, Kohistan	850	1600	3.4	3.3	Very rare
8.	* <i>Rheum australe</i> D. Don	Chotial/ rewandcheni	Cham	P H	Mankial, Madyan	70	100	3.2	2.9	Infrequent
9.	* <i>Saussurea lappa</i> Dene.	Kust/ kut	Hemi	P H	Mankial, Kalam	1200	1600	2.9	2.9	Very rare
10.	† <i>Adiantum capillus-veneris</i> L.	Sumbal/Pursiaushah	Cham	P H	Miandam, Fatehpur, Madyan	150	260	70.5	69.9	Infrequent
11.	† <i>Adiantum incisum</i> Forsk.	Masle sumbal	Cham	P H	Fatehpur, Madyan, Miandam	120	250	80.0	58.8	Infrequent
12.	† <i>Bergenia ciliata</i> (Haw.) Sternb. f. <i>ciliata</i>	Bogandi	Cham	P H	Kalam	230	400	60.78	60	Very rare
13.	† <i>Bistorta amplexicaulis</i> (D. Don) Green	Anjabar/ tarwa panra	Cham	P H	Upper Swat	300	450	500	430	Rare
14.	† <i>Colchicum latenum</i> Baker	Suranjan talkh	Geo	B H	Mankial, Madyan	420	700	80.0	57.80	Very rare
15.	† <i>Morchella delciosa</i>	Pashakalai Guehhi	Ther	A H	Madyan	8000	10000	1.2	1.0	Very rare
16.	† <i>Morchella esculenta</i>	Spina Guehhi	Ther	A H	Kalam, Madyan	8000	10000	6.0	5.0	Very rare
17.	† <i>Morchella rotunda</i>	Guehhi	Ther	A H	Shahpur, Madyan	8000	10000	2.1	0.9	Very rare
18.	† <i>Paeonia emodi</i> var. <i>emodi</i>	Mamekh	Cham	P H	Kalam, Kohistan	8000	12000	80.25	54.5	Very rare
19.	† <i>Pistacia chinensis</i> subsp. <i>integerrima</i> (J.L. Stewart) Rech.f.	Kakarsingi/ Shinai	Phan	Tree	Kalam, Kohistan	85	200	55.55	54.5	Very rare
20.	† <i>Podophyllum emodi</i> Wall. ex Royle	Kakora	Cham	P H	Bahrain, Kohistan	350	450	35.5	34	Very rare
21.	† <i>Valeriana jatamansi</i> Jones	Mushki bala/ asuran	Cham	P H	Madyan, Mankial	250	300	400	299.4	Rare
22.	† <i>Viola pilosa</i> Blume	Goli bamafsha/	Ther	A H	Kohistan	500	700	6000	4899.2	Rare
23.	† <i>Bergenia srachevi</i> (Hook. f. & Thoms.) Engl.	Kamar panra/ pakhanbed	Cham	P H	Kalam	120	250	70	65	Very rare
24.	† <i>Colchicum atchisonii</i> (Hook. f.) E. Nasir	Suranjan sherin	Geo	B H	Mankial, Madyan	400	650	70	69.80	Rare
25.	† <i>Morchella conica</i> Pers.	Da Kohistan Guehhi	Ther	A H	Madyan	8000	10000	20.8	18.0	Very rare
26.	† <i>Morchella crassipes</i>	Da bala Guehhi	Ther	A H	Madyan	8000	10000	2.0	2.0	Very rare
27.	† <i>Morchella elata</i> Fr.	Da kwar Guehhi	Ther	A H	Bahrain, Madyan	8000	10000	8.5	5.0	Very rare
28.	† <i>Morchella selibera</i>	Topai suri Guehhi	Ther	A H	Asharay, Madyan	8000	10000	1.0	1.0	Very rare
29.	† <i>Morchella ultima</i>	Zaira Guehhi	Ther	A H	Alpurai, Madyan	8000	10000	1.2	1.0	Very rare
30.	<i>Acacia modesta</i> Wall.	Palosa	Phan	T	Mingora, Kokarai	650	800	2.2	1.5	Common
31.	<i>Achillea millefolium</i> L. subsp. <i>millefolium</i>	Aquaqarha/ Jarai	Hemi	P H	Madyan	500	800	0.6	0.5	Rare
32.	<i>Achyranthes aspera</i> L.	Charechata/ Largakhuy	Hemi	P H	Mingora, Khwazakhela	50	70	0.2	0.2	Common
33.	<i>Aconitum violaceum</i> Jacquem. ex Stapf	Zahkarmora/ da ghra zahar	Cham	P H	Madyan, Ushu	1200	1900	0.8	0.8	Very rare
34.	<i>Aesculus indica</i> (Wall. ex Camb.) Hook.f.	Qatil/ jawaz	Phan	T	Madyan, Kalam	250	600	0.9	0.8	Rare

Table 2. (Cont'd.).

S.No.	Botanical name	Vernacular name	Life form	Habit	Occurrence	Price kg <sup>-1</sup> (Rs.)		Quantity traded (000 kg)		Rarity
						2004-05	2005-06	2004-05	2005-06	
35.	<i>Ajuga bracteosa</i> Wall.	Neelkant/ boti	Hemi	P H	Kokrai, Mingora	120	250	41	36	Infrequent
36.	<i>Arisaema flavum</i> (Forsk.) Schott.	Marjari	Cham	P H	Kalam, Kohistan	460	760	0.3	0.3	Rare
37.	<i>Artemisia scoparia</i> Waldst. & Kit.	Dada tarha	Cham	P H	Bahrain, Madyan	120	200	0.5	0.5	Rare
38.	<i>Artemisia vulgaris</i> L.	Afsanthen	Cham	P H	Malamjaba	120	200	0.9	0.6	Rare
39.	<i>Calotropis procera</i> subsp. <i>hamiltonii</i> (Wight) Ali	Spalmat/ Goolmadar	Cham	P H	Charbagh, Barikot	20	50	0.5	0.3	Common
40.	<i>Coralluma edulis</i> (Edgew.) Hook.f.	Pamankai	Hemi	P H	Malamjaba, Olandar	500	800	0.6	0.51	Very rare
41.	<i>Cedrus deodara</i> (Roxb. ex D. Don) G. Don	Safofi deodar	Phan	T	Kalam, Ushu	1500	2500	0.005	0.005	Rare
42.	<i>Chenopodium ambrosioides</i> L.	Skaboti	Hemi	P H	Marghuzar, Mingora	30	50	0.23	0.19	Common
43.	<i>Chenopodium botrys</i> L.	Skva kharawa	Hemi	P H	Marghuzar, Mingora	30	50	0.21	0.11	Common
44.	<i>Cichorium intybus</i> L.	Kasni/ han	Hemi	P H	Marghuzar, Mingora	50	80	0.15	0.13	Common
45.	<i>Corydalis govaniana</i> Wall.	Desi mamera	Hemi	P H	Malamjaba	250	650	0.25	0.51	Rare
46.	<i>Corylus colurna</i> L.	Zangali badam	Phan	T	Malamjaba	800	1200	0.70	0.56	Very rare
47.	<i>Cuscuta reflexa</i> Roxb.	Akashbeel	Para	P H	Mingora, Barikot	30	50	0.30	0.025	Abundant
48.	<i>Daphne micronata</i> Royle	Leghonai	Cham	P H	Charbagh, Wadigram	20	50	0.08	0.05	Common
49.	<i>Datura innoxia</i> Miller	Jesmasel	Cham	P H	Fatchepur, Ushu	20	80	0.06	0.05	Abundant
50.	<i>Datura stramonium</i> L.	Datohorai/ josmasil	Cham	P H	Mingora, Totalai	60	250	0.20	0.06	Abundant
51.	<i>Eruca sativa</i> Mill.	Jamama	Hemi	P H	Madyan, Kohistan	20	30	0.4	0.3	Common
52.	<i>Euphorbia prostrata</i> Ait.	Zardani khurd	Hemi	P H	Malamjaba, Kabal	50	80	0.45	0.3	Common
53.	<i>Fagonia indica</i> Burm. var. <i>indica</i>	Azghakai/ damasa	Hemi	P H	Sama, Barikote	50	100	0.5	0.5	Infrequent
54.	<i>Foeniculum vulgare</i> Mill.	Kaga/ somf	Ther	A H	Madyan, Kohistan	120	180	0.8	1.0	Common
55.	<i>Fumaria indica</i> (Hussein.) Pugsley	Papra/ shahitara	Ther	A H	Mingora, Barikot	50	90	0.25	0.3	Abundant
56.	<i>Geranium wallichianum</i> D. Don ex Sweet	Rathanjooth/ sra zeal	Cham	P H	Kalam	80	100	0.18	0.2	Rare
57.	<i>Glycyrrhiza glabra</i> var. <i>glabra</i>	Khugawali	Phan	S	Kalam, Miadam	100	120	6.8	5.4	Infrequent
58.	<i>Hyssopus officinalis</i> L.	Goli Zolia	Hemi	P H	Kalam, Malamjaba	700	1000	1.2	0.25	Infrequent
59.	<i>Juglans regia</i> L.	Dandasa	Phan	T	Utror, Gabrar	150	260	3.4	2.02	Common
60.	<i>Juniperus communis</i> L. var. <i>saxatilis</i>	Awbeer	Phan	T	Ushu, Gabral	100	200	0.5	0.4	Rare
61.	<i>Justicia adhatoda</i> L.	Bekar/Bansa	Cham	P H	Mingora, Kabal	150	260	2.5	1.095	Common
62.	<i>Kyllinga brevifolia</i> Rottb.	Taryela nagarmotha	Hemi	P H	Madyan, Bahram	150	200	0.66	0.12	Common
63.	<i>Lepidium sativum</i> L.	Alan/ tukm-e-malanga	Ther	A H	Madyan, Kohistan	120	240	1.4	0.56	Infrequent
64.	<i>Lotus corniculatus</i> L.	Bopali/ Fatch Khani	Hemi	P H	Madyan, Kohistan	120	200	4.8	3.9	Common
65.	<i>Matricaria recutita</i> L.	Barge Abulanse/ Manu	Hemi	P H	Marghuzar, Mingora	300	800	1.5	0.41	Rare
66.	<i>Melita azedarach</i> L.	Shandai	Phan	T	Mingora, Jambil	20	50	2.6	2.0	Common
67.	<i>Mentha longifolia</i> L.	Velamai	Hemi	P H	Mingora, Barikot	30	60	10.5	9.0	Common
68.	<i>Morchella hybrida</i>	Guehhi	Ther	A H	Mankial, Madyan	8000	10000	6.0	6.5	Very rare

Table 2. (Cont'd.)

S.No.	Botanical name	Vernacular name	Life form	Habit	Occurrence	Price kg <sup>-1</sup> (Rs.)		Quantity traded (000 kg)		Rarity
						2004-05	2005-06	2004-05	2005-06	
69.	<i>Myrsine africana</i> L.	Babrang/ marurang	Phan	S	Jambil, Islampur	50	150	1.8	2.0	Common
70.	<i>Neolitsea caipala</i> (D. Don) Kostermans	Medachob/ pewan zeela	Phan	T	Marghuzar, Barikot	300	500	8.3	3.0	Very rare
71.	<i>Periploca aphylla</i> Decne.	Barara	Hemi	P H	Kanra Baba, Malamjaba	30	50	1.5	0.5	Common
72.	<i>Primula denticulata</i> Smith.	Da stargo mamer/ asli mamera	Cham	P H	Mankial, Khistian	180	200	3.0	3.0	Very rare
73.	<i>Primula</i> spp.	Manera zeela	Cham	P H	Kalam	180	250	0.82	0.6	Very rare
74.	<i>Pteridium aquilinum</i> (L.) Kuhn.	Kwanji	Cham	P H	Bahrain, Madyan	120	300	0.15	0.09	Infrequent
75.	<i>Punica granatum</i> L.	Narsawai/ anarpos	Phan	S	Mingora, Marghuzar	80	210	2.0	1.20	Common
76.	<i>Quercus dilatata</i> Royle	Banjkarori	Phan	T	Kokarai, Jambil	50	120	2.6	0.6	Rare
77.	<i>Rhus javanica</i> L.	Sanaqdana	Phan	P H	Madyan, Kalam	80	120	0.14	0.08	Rare
78.	<i>Rosa brunonii</i> Lindl.	Church/ qurach	Phan	S	Khwazakhela, Sakhra	30	50	0.45	0.2	Common
79.	<i>Rubia cordifolia</i> L.	Manjeet/ srajrai	Phan	P H	Kalam, Ushu, Utror	40	100	0.08	0.07	Infrequent
80.	<i>Rubus fruticosus</i> L.	Karwara	Phan	S	Olandar	50	60	1.6	0.9	Rare
81.	<i>Rumex dentatus</i> L.	Shalkai	Cham	P H	Mingora, Madyan	20	90	0.10	0.09	Infrequent
82.	<i>Sapindus detergens</i> Roxb.	Reta	Phan	T	Islampur, Marghuzar	120	300	3.25	1.9	Rare
83.	<i>Saussurea aitchinsonii</i> C.B. Clarke	Gewan boti	Hemi	P H	Mankial, Kalam	600	900	3.0	2.9	Very rare
84.	<i>Seriphidium brevifolium</i> (Wall. ex DC.) Ling & Y.R. Ling	Afsanthen/ tarha	Cham	P H	Malamjaba	50	120	1.1	0.12	Rare
85.	<i>Sesamum indicum</i> L.	Tori kwanzali	Ther	A H	Kohistan	120	300	2.5	2.0	Infrequent
86.	<i>Sisymbrium irio</i> L.	Rai/ khak sher	Ther	A H	Matta, Olandar, Sakhra	50	90	0.4	0.2	Infrequent
87.	<i>Skimmia laurole</i> DC.	Nazar panra	Phan	S	Kohistan	120	300	8.5	5.49	Very rare
88.	<i>Solanum nigrum</i> L. var. <i>nigrum</i>	Makoh/ kachmacho	Ther	A H	Kokarai, Marghuzar	10	50	0.4	0.5	Common
89.	<i>Solanum surratense</i> Burm.	Manraghona	Hemi	P H	Mingora, Kokarai	10	50	1.8	0.98	Common
90.	<i>Stachys parviflora</i> Benth.	Kundiyari/ sper boti	Hemi	P H	Madyan, Ushu	300	400	1.1	0.90	Rare
91.	<i>Taxus wallichiana</i> Zucc.	banrya	Phan	T	Utrur, Kalam	500	900	1.9	2.2	Very rare
92.	<i>Thymus linearis</i> subsp. <i>linearis</i>	Zangali ajvaim/ sperkai	Hemi	P H	Mankial, Madyan	100	120	2.5	2.9	Infrequent
93.	<i>Tribulus terrestris</i> L.	Markundai	Cham	P H	Shamozai, Mingora	30	100	1.5	0.5	Common
94.	<i>Trigonella foenum-graecum</i> L.	Malhktuzai	Ther	A H	Khwazakhela	50	90	0.8	0.9	Infrequent
95.	<i>Verbascum thapsus</i> L.	Khardag/ khargwagh	Cham	P H	Malamjaba, Mingora	20	80	1.15	0.9	Common
96.	<i>Withania coagulans</i> (Stokes) Dunal.	Paneerdoda/ shapianga	Hemi	P H	Matta, Mingora, Charbagh	30	120	1.6	1.2	Infrequent
97.	<i>Withania somnifera</i> (L.) Dunal	Kotlail/ asgand	Hemi	P H	Mingora, Kabal	10	50	1.0	0.9	Infrequent
98.	<i>Zanthoxylum armatum</i> DC.	Dambara	Phan	S	Jambil, Kokarai	200	400	1.8	0.9	Rare
99.	<i>Ziziphus jujuba</i> Mill.	Marikanai	Phan	T	Khwazakhela, Totalai	200	500	2.5	1.2	Infrequent

Cham = Chamaephyte, Hemi = Hemipterophyte, Ther = Therophyte, Phan = Phanerophyte, Geo = Geophyte, Para = Parasite

P H = Perennial Herb, A H = Annual Herb, B H = Biennial Herb, S = Shrub, T = Tree

\* These plants are supplied to/traded in national market

† These plants are exported

The price of medicinal plants is not constant. It fluctuates with the season as well as with the demand and supply from the market. The price of dry plants is almost double and at times triple the price of plants sold in fresh or wet form.

In the season of the plant growth (i.e. from March to July and August) the flow into the market increases therefore, the selling price of the small supplier decreases. If demand from the market is greater then the price rises for big suppliers. The profit ratio is not same for the collectors, traders and exporters. In fact the difference is unnecessarily high (Fig. 3).

The sale price for the collectors is far less than the purchase price for the middlemen and exporters. This difference sometimes reaches to three fold of the price for the collectors e.g. the sale price of Banafsha (*Viola serpens*) for collectors is Rs.20 to 25 its price for the dealers is Rs.180 and its price for the Dawakhanas or Manufacturing factories is above Rs.500. Similarly the rhizomes of Mushkebala (*Valeriana jatamansi* Jones.) are sold by the collectors for Rs.30 kg<sup>-1</sup>, by the middlemen at Rs.90 kg<sup>-1</sup> and by the exporters at Rs.260 to 300 kg<sup>-1</sup> (Figs. 1 & 2).



Fig. 1. Packing of *Valeriana jatamansii* (Mushkibala) in the market.



Fig. 2. Traditional methods of storage (left) and grading (right) in the market.

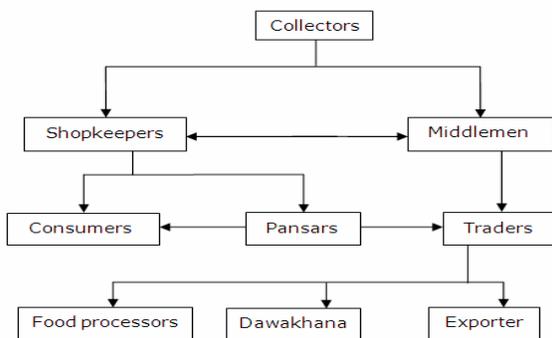


Fig. 3. Flowchart of people involved in trade of medicinal plants.

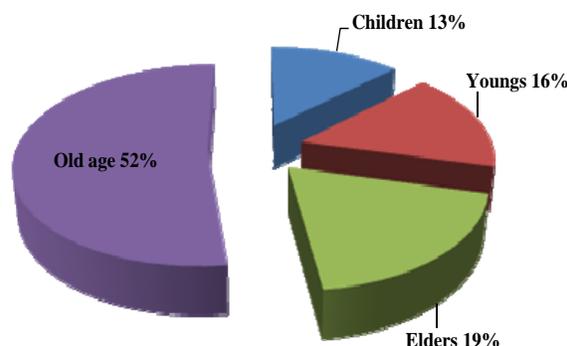


Fig. 4. Age wise knowledge (%) of medicinal plants among the local community in the study area.

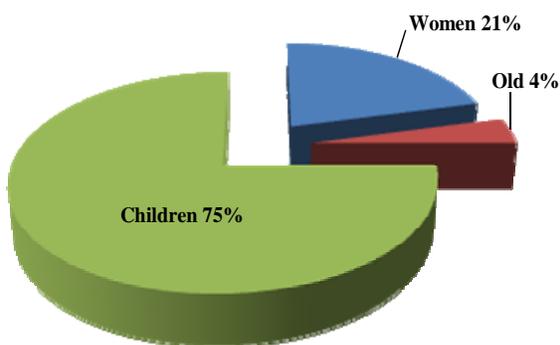


Fig. 5. Percentage of family members involved in collection of medicinal plants.

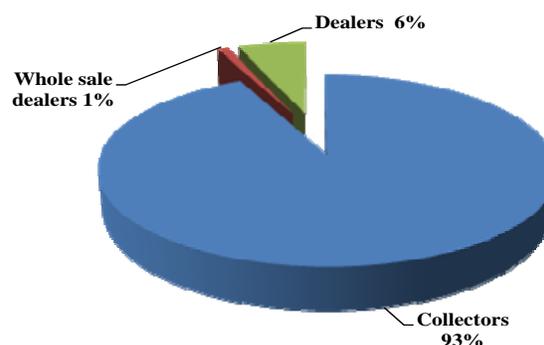


Fig. 6. Percentage of professionals involved with trade of medicinal plants.

The study of medicinal plants from various standpoints is increasing in the global context. Swat being the trade centre for medicinal plants of the Hindu Kush-Himalayan region cannot be left unexplored. A number of case studies have been done in the area but none of them are concentrated on the potential of the area with special reference to its local production. Not even a single study was directed towards elaborating the conservation concerns of the species. Out of 99 species reported, 22 are supplied to the National market, 21 are exported contributing Rs. 1,82,75,63,700 to the local, National and International market.

According to the market analysis trade of these medicinal plant species provide seasonal job opportunities to 99840 individuals in Swat District. Among which 75% are children, 21% are women and the rest of 4% are other age people (Figs. 4 & 5). Similarly, 93% of the people involved in trade are the collectors, 6% are dealers and the rest of 1% are wholesale dealers (Fig. 6). Among these species *Morchella conica*, *Dioscorea deltoidea*, *Juglans regia*, *Polygonatum verticilatum*, *Berginia ciliata* and *Withania somnifera* are used as body tonic and aphrodisiac agent. *Artemisia vulgare*, *Melia azadrach*, *Rumex dentatus*, *Rosa moschata* and *Berberis lyceum* are used for stomachaches and considered as digestive elements. *Pistacea integerrima*, *Geranium wallichianum*, *Thymus linearis*, *Podophyllum emodii* and *Cichorium intybus* are used for kidney and liver problems including kidney stones removal. *Adiantum capillus-veneris*, *Geranium wallichianum*, and *Solanum nigrum* are used as febrifuge. *Adiantum capillus-veneris*, *Paeonia emodii* and *Lotus corniculatus* are used for curing backache and considered as body tonic. *Colchicum luteum*,

*Polygonatum verticilatum*, *Valeriana jatamansi*, *Aesculus indicus*, *Zizyphus sativa*, *Datura stramonium* and *Aconitum violaceum* are used for rheumatism and analgesic. Where as *Taxus bucata* and *Artemisia vulgaris* are used as antispasmodic agent (Saqib *et al.*, 2006). *Pistacea integerrima* and *Zizyphus sativa* are used for cough, cold, asthma and other respiratory infections.

### Conclusions and Recommendations

Swat valley is rich in floristic diversity generally and Medicinal plants in particular. It has immense potential of possessing the representative flora and fauna, exposed to the process of irreversible losses in all the adjoining areas. The study revealed that availability of medicinal plants decreased day by day and this process is continued from the last 2 decades. According to local elders, most of the medicinal plants reported were abundant in the vicinities of settlements some 20 years back. However, its population drastically decreased due to increased marketing pressure, lake of alternate earning opportunities in the area, Nowadays the medicinal plants are collected in large volumes from remote valleys. All these threats have dragged some of the species towards extinction. Early measures to manage medicinal flora for sustaining its market supply and there by securing livelihood opportunities of rural communities is imperative. The following measures should be taken into consideration in order to ensure the sustainable use of medicinal plants in Swat valley.

1. Uprooting of the endangered species should be banned to check the irreversible loss of these species.
2. The plant collectors are needed to be trained in proper harvesting methods.
3. Introduction of selected medicinal plants as minor crops will not only reduce the pressure on the natural vegetation but will also improve the Socio economical conditions of the farmers.
4. Rotational or controlled grazing pattern should be used to ensure sustainability of medicinal plants.
5. Correct identification of medicinal Plants is essential and for this purpose collaboration among the taxonomists and the local Herbalists is vital.
6. The collectors should be educated for pre and post harvesting methods e.g. identification of plants, their proper time of collection and preservation.
7. The price and quality of medicinal plants in the market is not uniform, so necessary measures should be taken in this regard for the uniformity

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