Ethnobotanical and Economic Observations of Some Plant Resources from the Northern Parts of Pakistan

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Research

Abstract

A study on the economic value of plants being extracted from a coniferous forest of the Miandam valley of District Swat was conducted during Spring and Summer 2008. The aim of the study was to identify non-timber forest product plants being used from the target area, to identify the trade network that they are sold into, and to evaluate their value as they move within that network in order to make recommendations for socio-economic development of the area. Information was learned through semi-structured questionnaires and participatory interviews with resource uses and traders. 214 species in 79 families were identified as being useful in traditional livelihood. Of these, 150 were herbs, 36 trees, 26 shrubs and 4 climbers. Plant species are locally used as medicinal (115), multipurpose (35), fodder (31), fuel (30), vegetables (12), tools (12), timber (9), poisons (7), roof thatch (7), wild fruits (6), fences/hedges (5), veterinary (5), mud supporter (5), foods (4), spices/condiments (4), religious (4), honey bee (3), brooms (3), and evil repellent (1). Twenty out of 115 medicinal species are collected to sell. The gatherers have very little marketing skills and are often not aware of the high market value. As a result, most of collected materials are sold to local middlemen at low prices.

The study revealed that the availability of important medicinal and aromatic plant species is decreasing and the number of rare and threatened species among the medicinal and aromatic plants is increasing. Further study is, therefore, required to quantify the availability of species and to suggest suitable method for their production and conservation. Recommendations are, therefore, given in the spheres of training in identification, sustainable collection, value addition, trade monitoring and cooperative system of marketing.

Introduction

Miandam is located in the north east of district Swat and lies between 34^{0}34'' and 35^0-07'' N latitude, and 72^0 36'' and 73^0 35'' E longitude in the Hindu Kush mountain range. The elevation of the valley ranges from 3000 ft to 14,000 ft. The total area of the valley is about 36,768 acres. The valley is comprised of 11 big villages and 15 small hamlets with a population of about 20,000 people. The population of the area is mostly dependent upon agriculture and livestock rearing. About 1600 people of the total population are gathering different forest resources including medicinal and aromatic plant (MAP) species in the valley.

Pakistan hosts about 6000 species of flowering plants, out of which about 2000 species have medicinal, aromatic and economic value (Williams & Ahmad 1999). The MAP species have supported livelihood of many people in District Swat. They are being collected for export both to national and international markets. The high dependency of

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rural people on MAPs for subsistence and unsustainable harvesting practices has resulted over exploitation of resources in different sites of the study area. (Sher *et al*. 2005, 2010.) Similarly, conversion of natural habitats into agricultural land has greatly decreased the population size of many economically important forest resources including MAPs in different sites of the study area.

The traditional practice of extracting forest resources especially MAPs appears to be unsustainable. There is not evidence of resource tenure and custodianship, understanding of sustainable use and management parameters, harvesting and collection procedures and knowledge of market requirements. These are important barriers to the sustainable utilization of MAPs. Besides scientific understanding of population sizes, distributions, availability and abundance of plant species and their interactions with different stochastic environmental factors all play important roles in determining ecological sustainability of these resources. Similarly, quantitative and economic analysis of the effect of extraction on these ecological processes is very important to assess the effect of harvesting on development of the entire forest resources in general and MAPs in particular in order to formulate sustainable harvesting regimes.

Harvesting practices used by untrained collectors may endanger the recovery of some plants populations. Lack of knowledge about the part used, time of collection and economic value of MAP species has led to their mismanagement and least profitable exploitation. The appropriate timing to collect the desired parts of plants of certain age will determine the yield percentage and quality of therapeutically active biochemical ingredients. Gathering and processing of MAPs for family use in human and livestock treatment is a widespread, centuries old practice (Hussain *et al*. 2004). The use of traditional medicine for maintenance of health in most developing countries has been widely observed as a custom. Their collection and sale is an important economic activity in the northern parts of Pakistan and about 5000 families are involved in the collection and processing of MAPs in the region (Olsen & Larsen 2003). The most active members of plant gathering and processing are women and children from middle hill areas. These collectors receive minimum wages in the trade chain of medicinal herbs (Sher *et al*. 2005). Therefore, the local people are losing the preservation of traditional knowledge of medicinal plants and other important non-timber forest products. The present endeavour was initiated with the aim to identify non-timber forest product plants being used from the area (coniferous forests of Miandam valley, District Swat), to identify the trade network that they are sold into, and to evaluate their value as they move within that network in order to make recommendations for socio-economic development of the area.

Materials and Methods

A study on the ethnobotanical and economic evaluation of coniferous forest of the Miandam Valley of District Swat was conducted during Spring and Summer 2008. Prior to exploring of the forest resources, topo-sheet, map and other general information of the investigated area were obtained from the Forest Department, Swat. The area was accordingly divided into different sites and then visits were made first in April and May, second in June and July, and third in August and September, 2008.

A questionnaire was prepared and used as a tool for the collection of information. The questionnaire was divided into two parts: demographics and ethnobotanical data. The first part included demographic data, location name, age, education and profession. The second part included questions about the pattern of forest resources being utilization.

Field Survey

Prior to a visit to the research sites, the questionnaire was designed and pre-tested to find out if it actually worked. Revisions needed as a result of this pre-test were noted and undertaken in the following day of the visit.

Key informants were identified from each of 210 households determined to be present in the villages in the valley. Focus groups were held with key informants and others in each household. The traditional uses (including medicinal and other use) of plant resources were learned with both the questionnaire and through participatory techniques. Participation focused on learning how people were gathering plant materials. Informants were asked about their interest as local user of plants, collectors and traders of forest resources.

Information on the market value of the plants was collected from local collectors, **hakim**s and shopkeepers. A simple procedure was adopted asking how, from whom, and to whom the plants were sold. Respondents were also asked about their annual revenues earned from the sale of the plants and their return on work invested. For each plant species the informants mentioned, they were also asked about its abundance, distribution and population size. This was judged by comparing 20 year old records with the current situation. In addition personal observations were made in the field to note any pertinent events which could help explain the presence, and relative abundance based on the ecological characteristics of the species. The effect of current harvest on the status of each commercially valuable plant species was also studied by comparing 20 years old records with respect to the present population size and status. The effect of current harvest on the population size was finally judged based on

the distance that local collectors traveled in the past as compared to the present.

Voucher specimens of the plants identified by the informants were collected from different sites of the studied valley and were dried and preserved. The fully dried specimens were mounted on herbarium paper identified with the help of available literature (Nasir & Ali 1971-91, Stewart 1972) and deposited in National Agriculture Research Centre, herbarium, Islamabad, (RAW), and University of Karachi, Botany Department, Sindh, Pakistan (KUH).

Results

Informants

160 households were contacted out of 210 possible. Generally, the respondents were elderly persons and their age group varied from 40 to 60 years.

Ethnobotanical uses

The flora of the study area provides useful species of ethnobotanical importance. The study documented 214 plant species belonging to 79 families (Table 1). They include 148 herbs, 36 trees, 26 shrubs and 4 climbers. Plant species are locally used as medicinal (115), multipurpose (35), fodder (31), fuel (30), vegetables (12), tools (12), timber (9), poisons (7), roof thatch (7), wild fruits (6), fences/hedges (5), veterinary (5), mud supporter (5), foods (4), spices/condiments (4), religious (4), honey bee (3), brooms (3), and evil repellent (1).

Ethnomedicinal uses

The study showed that the local people have knowledge about distribution, abundance, harvesting, uses and marketing of MAPs. Plants used medicinally were grouped into 12 sub-use categories according to specific disease treatment (Table 1). The highest numbers of plants were

Table 1. Plants found to be of economic value in th coniferous forest of the Miandam Valley of District Swat, northern Pakistan. Key to Major Use Categories (Evil: Evil repellent plants; Fen: Fences/hedges; Fod: Fodder plants; Foo: Edible food; Fru: Fruits; Fue: Fuel wood; Hon: Honey bee plants; Med: Medicinal plants; MS: Mud supporter; Poi: Poisonous plants; Roo: Roof thatching; Spi: Spices/condiments; Tim: Timber wood; Too: Tool making plants; Veg: Vegetables).

Scientific name	Family	Vernacular name(s)	Major Use Category	Life Form
Abies pindrow (Royle ex D. Don) Royle	Pinaceae	**Achar**	Tim, Fue	Tree
Alnus nitida (Spach) Endl.	Betulaceae	**Gerray**	Fue	Tree
Achillea millefolium L.	Asteraceae	**Jarai**, **Aqarqarha**	Med	Herb
Achyranthes aspera L.	Amaranthaceae	**Charchata**, **Largakhay**	Fod	Herb
Aconitum violaceum Jacquem. ex Stapf	Ranunculaceae	**Zaharmora**, **Jadwar**, **Daghra zahar**	Med	Herb
Aconitum laeve Royle	Ranunculaceae	**Zaharmora**, **Jadwar**, **Daghra zahar**	Med	Herb
Acorus calamus L.	Acoraceae	**Skha waja**	Med	Herb
Adhatoda vasica Nees	Acanthaceae	**Bekar**, **Bansa**	Med	Herb
Adiantum capillus-veneris L.	Pteridaceae	**Sumbal, Parsiaushah**	Med	Herb
Adiantum incisum Forssk.	Pteridaceae	**Masle sumbul**	Med	Herb
Adiantum venustum D. Don	Pteridaceae	**Sumbal**	Med	Herb
Aesculus indica (Wall. ex Cambess.) Hook.	Sapindaceae	**Jawaz**, **Qatil**	Fue, Med	Tree
Ailanthus altissima (Mill). Swingle	Simaroubaceae	**Bakyarna**	Med, Fue	Tree
Ajuga bracteosa Wall. ex Benth.	Lamiaceae	**Booti**, **Neel Kanti**	Med	Herb
Ajuga parviflora Benth.	Lamiaceae	**Booti**	Med	Herb
Allium cepa L.	Amaryllidaceae	**Piaz**	Veg	Herb
Allium humile Kunth	Amaryllidaceae	**Da ghra Ouga**	Med	Herb

Scientific name	Family	Vernacular name(s)	Major Use Category	Life Form
Allium jacquemontii Kunth	Amaryllidaceae	**Da ghra Ouga**	Med	Herb
Allium sativum L.	Amaryllidaceae	**Ougakai**	Med	Herb
Amaranthus spinosus L.	Amaranthaceae	**Da Ghany Chalvaray**	Fod	Herb
Amaranthus viridis L.	Amaranthaceae	**Chalvaray**	Fod, Veg	Herb
Aquilegia fragrans Benth.	Ranunculaceae	**Samer parna**	Med	Herb
Arenaria griffithii Boiss.	Caryophyllaceae	**Kinar**	MS, Roo	Herb
Arisaema flavum (Forssk.) Schott	Araceae	**Marjarey**	Med	Herb
Arisaema jacquemontii Blume	Araceae	**Margarai**	Pois	Herb
Artemisia brevifolia Wall. ex DC.	Asteraceae	**Tarkha**	Med	Herb
Artemisia scoparia Waldst. & Kit.	Asteraceae	**Dada tarkha**	Bro	Herb
Artemisia vulgaris L.	Asteraceae	**Tarkha**, **Afsanthen**	Bro	Herb
Asparagus adscendens Roxb.	Asparagaceae	**Tindorai**	Med	Shrub
Asphodelus tenuifolius Cav.	Xanthorrhoeaceae	**Ougakai**	Med	Herb
Atropa acuminata Royle ex Lindl.	Solanaceae	**Bargak**	Med	Herb
Avena sativa L.	Poaceae	**Jamdaray**	Med, Fod	Herb
Berberis lycium Royle	Berberidaceae	**Spin Kwaray**	Med, Fue	Shrub
Berberis vulgaris L.	Berberidaceae	**Tour Kwaray**	Med, Fue	Shrub
Bergenia ciliata (Haw.) Sternb.	Saxifragaceae	**Ghat Pana**, **Bogandi**	Med	Herb
Bergenia stracheyi (Hook. f. & Thomson) Engl.	Saxifragaceae	**Spinsar Ghat Pana**	Med	Herb
Bistorta amplexicaulis (D. Don) Greene	Polygonaceae	**Tarwa Pana**, **Anjabar**	Med	Herb
Bunium persicum B. Fedstch.	Apiaceae	**Zankai**	Spi	Herb
Bupleurum longicaule Wall. ex DC.	Apiaceae	**Gillo**	Med	Herb
Butea frondosa K.D. Koenig ex Roxb.	Fabaceae	**Da pali gul**, **Goli tisu**	Fod, Med	Herb
Calotropis procera (Aiton) W.T. Aiton	Apocynaceae	**Goli Madar**, **Goli akk, Spalmai**	Med	Shrub
Caltha alba Cambess.	Ranunculaceae	**Makan path**	Med, Veg	Herb
Cannabis sativa L.	Cannabaceae	**Bang**	Med	Herb
Capsella bursa-pastoris (L.) Medik.	Brassicaceae	**Bambesa**	Med	Herb
Caralluma edulis (Edgew.) Benth. ex Hook. f.	Apocynaceae	**Pamankai**	Veg	Herb
Carum carvi L.	Apiaceae	**Zankee**	Spi	Herb
Cedrus deodara (Roxb. ex D. Don) G. Don	Pinaceae	**Diar**	Tim, Fue, Med	Tree
Celtis australis L.	Cannabaceae	**Tagha**	Fue, Rel	Tree
Caesalpinia decapetala (Roth) Alston	Fabaceae	**Jara**	Fen	Shrub
Chamomilla recutita (L.) Rauschert.	Asteraceae	**Babona**	Med	Herb
Chenopodium album L.	Amaranthaceae	**Sarmay**	Med, Veg	Herb
Chenopodium botrys L.	Amaranthaceae	**Skha Kharawa**	Pois	Herb
Cichorium intybus L.	Asteraceae	**Han/ Kasni**	Med, Veg	Herb

Scientific name	Family	Vernacular name(s)	Major Use Category	Life Form
Citrullus colocynthis (L.) Schrad.	Curcurbitaceae	**Hunzal**, **Tuma**	Med	Herb
Colchicum autumnale L.	Colchicaceae	**Sarba Zeala**, **Atees**, **Suranjan Sherin**	Med	Herb
Colchicum luteum Baker	Colchicaceae	**Qaimat guallay Suranjan-e-Talkh**	Med	Herb
Commelina benghalensis L.	Commelinaceae	**Narray**	Med, Fod, Veg	Herb
Corydalis govaniana Wall.	Papaveraceae	**Desi Mamera**	Med	Herb
Corydalis stewartii Fedde	Papaveraceae	**Mamera**	Med	Herb
Corylus jacquemontii Decne.	Betulaceae	**Zangali Badam**	Med	Tree
Cotoneaster microphyllus Wall. ex Lindl.	Rosaceae	**Kharawa**	Med	Shrub
Crataegus curvisepala Lindm.	Rosaceae	**Thampas**	Med	Shrub
Cuscuta reflexa Roxb.	Convolvulaceae	**Zalai**, **Aptemum**, **Akash beel**	Med	Climber
Cynodon dactylon (L.) Pers.	Poaceae	**Kabal**	Fod	Herb
Cynoglossum lanceolatum Forssk.	Boraginaceae	**Gat gul**	Med	Herb
Cyperus brevifolius (Rottb.) Endl. ex Hassk.	Cyperaceae	**Taryela**, **nagar motha**, **saad kopi**	Fue	Herb
Daphne mucronata Royle,	Thymelaeaceae	**Laiughunai**	Fue, Fen	Shrub
Datura inoxia Mill.	Solanaceae	**Jesmasal**	Med	Herb
Datura stramonium L.	Solanaceae	**Dahthora**, **Harhnada**	Med	Herb
Debregeasia saeneb (Forssk.) Hepper & Wood	Urticaceae	**Ajlai**	Med, Fue	Shrub
Delphinium denudatum Wall. ex Hook. f. & Thomson	Ranunculaceae	**Jadwar**	Med	Herb
Dioscorea deltoidea Wall. ex Griseb.	Dioscoreaceae	**Kaneez**	Med	Climber
Diospyros kaki Thunb.	Ebenaceae	**Sur Amloke**	Fru, Fue	Tree
Diospyros lotus L.	Ebenaceae	**Toor amlok**	Fru, Fue	Tree
Dryopteris filix-mas (L.) Schott	Dryopteridaceae	**Ladorey**	Veg	Herb
Dryopteris juxtaposita H. Christ	Dryopteridaceae	**Kwanjey**	Veg	Herb
Echinops echinatus Roxb.	Asteraceae	**Manzari mangual**	Med,	Herb
Elaeagnus angustifolia L.	Elaeagnaceae	**Ghanum ranga**	Med, Fen	Shrub
Equisetum arvense L.	Equisetaceae	**Bandakai**	Med	Herb
Eruca sativa Mill.	Brassicaceae	**Jawawa** (**Taramera**)	Veg	Herb
Euphorbia helioscopia L.	Euphorbiaceae	**Mandanro**	Poi	Herb
Euphorbia wallichii Hook. f.	Euphorbiaceae	**Shangla**	Poi	Herb
Fagonia arabica L.	Zygophyllaceae	**Azghakai**, **Dhamasa**	Med	Herb
Ficus carica L.	Moraceae	**Inzer**	Fru, Med, Rel	Tree
Ficus palmata Forssk.	Moraceae	**Inzer**	Fru	Tree

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Foeniculum vulgare Mill.	Apiaceae	**Kaga valaney**, **Sonf**	Med	Herb
Fragaria vesca L.	Rosaceae	**Da Zmaki toot**	Fru	Herb
Fumaria indica Pugsley	Papaveraceae	**Papra**, **Shahtara**	Med	Herb
Geranium wallichianum D. Don ex Sweet	Geraniaceae	**Srazela**, **Ratanjothe**	Med	Herb
Gentiana kurroo Royle	Gentianaceae	**Gensing**	Med	Herb
Gynandriris sisyrinchium Parl.	Iridaceae	**Cabdichar**	Med	Herb
Hedera nepalensis K. Koch	Araliaceae	**Prewatai**	Med	Climber
Heracleum candicans Wall. ex DC.	Apiaceae	**Kadu Pana**	Med	Herb
Hyoscyamus niger L.	Solanaceae	**Bargag**	Med	Herb
Hypericum oblongifolium Choisy	Hypericaceae	**Shin chai**	MS	Shrub
Hypericum perforatum L.	Hypericaceae	**Shin chai**	Med	Herb
Hyssopus officinalis L.	Lamiaceae	**Goli Zofa**	Med	Herb
Indigofera heterantha Wall. ex Brandis	Fabaceae	**Ghwarija**	Fue, Roo	Shrub
Isodon rugosus (Wall. ex Benth.) Codd	Lamiaceae	**Sperkai**	Med	Shrub
Jasminum officinale L.	Oleaceae	**Rambil chambil**	Med	Climber
Juglans regia L.	Juglandaceae	**Ghuz**	Fru, Tim, Fue	Tree
Juniperus communis L.	Cupressaceae	**Awbeer**	Fue	Tree
Lathyrus aphaca L.	Fabaceae	**Korkamanai**	Fod	Herb
Launaea procumbens (Roxb.) Ramayya & Rajagopal	Asteraceae	**Shauda pai**	Med, Fod	Herb
Lepidium sativum L.	Brassicaceae	**Halam**	Med	Herb
Lotus corniculatus L.	Fabaceae	**Fateh khana**, **Bopali**	Med, Fod	Herb
Malva officinalis (L.) Schimp. & Spenn. ex Schimp. & Spenn.	Malvaceae	**Panerak**	Veg	Herb
Melia azedarach L.	Meliaceae	**Tora bakyana**	Fue, Vet	Tree
Mentha longifolia (L.) Huds.	Lamiaceae	**Valenay**	Med	Herb
Mentha spicata L.	Lamiaceae	**Podina**	Med	Herb
Micromeria biflora (Buch.-Ham. ex D. Don) Benth.	Lamiaceae	**Naray shamakay**	Fod, Hon	Herb
Morchella vulgaris (Pers.) Boud.	Morchellaceae	**Gujhai**	Foo	Herb
Morchella elata Fr.	Morchellaceae	**Da kwar Guchhi**	Foo	Herb
Morchella esculenta (L.) Pers.	Morchellaceae	**Spina Guchhi**	Foo	Herb
Morus alba L.	Moraceae	**Toot** (**Panjakha**)	Med, Tim, Fue, Fru, Too	Tree
Morus nigra L.	Moraceae	**Tour Toot**	Med, Tim, Fue, Fru, Too	Tree
Morus laevigata Wall. ex Brandis	Moraceae	**Shah Toot**	Tim, Fue, Fru ,Too	Tree

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Myrsine africana L.	Primulaceae	**Babrang**, **Marurang**, **Manru**	Med	Herb
Myrtus communis L.	Myrtaceae	**Barge abulanse**	Med	Shrub
Narcissus tazetta L.	Amaryllidaceae	**Gulinargus**	Med,	Herb
Nasturtium officinale R. Br.	Brassicaceae	**Talmera**	Veg	Herb
Neolitsea chinensis (Gamble) Chun	Lauraceae	**Pewand zeala**, **medachob**, **Khadang**	Med, Fod	Herb
Nepeta govaniana (Wall. ex Benth.) Benth.	Lamiaceae	**Bardranjbuya**	Med	Herb
Olea ferruginea Royle	Oleaceae	**Khona**	Rel, Fru	Tree
Onosma hispida Wall. ex G. Don	Boraginaceae	**Kwaga abai**	Med	Herb
Origanum vulgare L.	Lamiaceae	**Shamakay**	Hon	Herb
Otostegia limbata (Benth.) Boiss.	Lamiaceae	**Spin azghai**	Fen	Herb
Oxalis corniculata L.	Oxilidaceae	**Tarukay**	Med	Herb
Paeonia emodi Wall. ex Royle	Paeoniaceae	**Mamekh**	Med	Herb
Papaver dubium L.	Papaveraceae	**Qashqash**	Med	Herb
Periploca aphylla Decne.	Apocynaceae	**Bararra**	Med	Shrub
Picea smithiana (Wall.) Boiss.	Pinaceae	**Mangazai**	Tim, Fue	Tree
Peganum harmala L.	Nitrariaceae	**Spalani**	Evil	Herb
Pinus roxburghii Sarg.	Pinaceae	**Chir**	Fue, Tim, Too	Tree
Pinus wallichiana A.B. Jacks.	Pinaceae	**Peyoach**, **Kail**	Fue, Tim, Too	Tree
Pistacia integerrima J.L. Stewart ex Brandis	Anacardiaceae	**Kakar singi**, **Shanai**	Med, Fue	Tree
Plantago lanceolata L.	Plantaginaceae	**Jabai**	Med	Herb
Plantago major L.	Plantaginaceae	**Gwa jabai**	Med	Herb
Platanus orientalis L.	Platanaceae	**Chinar**	Tim, Fue, Too	Tree
Plectranthus rugosus Wall. ex Benth.	Lamiaceae	**Sperkay**	Hon, Roo	Shrub
Podophyllum hexandrum Royle	Berberidaceae	**Kakora**	Med	Herb
Polygonatum multiflorum (L.) All.	Asparagaceae	**Nooreallam**	Med	Herb
Polygonatum verticillatum (L.) All.	Asparagaceae	**Nooreallam**	Med	Herb
Polygonum aviculare L.	Polygonaceae	**Masloon**	Med	Herb
Populus alba L.	Salicaceae	**Spina Supida**	Fue	Tree
Populus nigra L.	Salicaceae	**Toura Supida**	Fue	Tree
Portulaca oleracea L.	Portulacaceae	**Warkharae**	Veg	Herb
Primula denticulata Sm.	Primulaceae	**Mamera**	Med	Herb
Prunus persica (L.) Batsch	Rosaceae	**Tangwan**	Fru, Fod, Fue	Tree
Pteridium aquilinum (L.) Kuhn.	Dennstaedtiaceae	**Kwanjai**	Veg	Herb

Scientific name	Family	Vernacular name(s)	Major Use Category	Life Form
Punica granatum L.	Lythraceae	**Nangoray**, **Narsawai**, **Anarpos**	Fru, Med	Shrub
Pyrus pashia Buch.-Ham. ex D. Don	Rosaceae	**Shangetei**	Fru	Tree
Quercus dilatata Lindl.	Fagaceae	**Toor banj**	Fue, Fod, Too	Tree
Quercus incana W. Bartram	Fagaceae	**Spin banj**	Med, Fue, Fod, Too	Tree
Ranunculus arvensis L.	Ranunculaceae	**Ziar Gulay**	Poi	Herb
Ranunculus muricatus L.	Ranunculaceae	**Ziar Gulay**	Fod	Herb
Rheum webbianum Royle	Polygonaceae	**Chotial**, **Rewand chini**	Med	Herb
Rhus semialata Murray	Anacardiaceae	**Samaqdana**	Med	Herb
Ricinus communis L.	Euphorbiaceae	**Harhanda**	Pois	Shrub
Rosa moschata Mill.	Rosaceae	**Kurach**, **Gulab**	Med, Fen	Shrub
Rosa webbiana Wall. ex Royle	Rosaceae	**Phalwari**	Med,	Herb
Rubia cordifolia L.	Rubiaceae	**Srajarai / mangeet**	Fod	Herb
Rubus fruticosus L.	Rosaceae	**Karwara**	Med, Fen	Herb
Rumex dentatus L.	Polygonaceae	**Shalkhay**	Veg	Herb
Rumex hastatus D. Don,	Polygonaceae	**Tarukey**	Med	Herb
Saccharum griffithii Munro ex Boiss.	Poaceae	**Kahay**	Too	Herb
Saccharum spontaneum L.	Poaceae	**Naray kahay**	Too	Herb
Salvia lanata Roxb.	Lamiaceae	**Spera botai**	Med	Herb
Salvia moorcroftiana Wall. ex Benth.	Lamiaceae	**Kherghwag**	Med, Roo	Herb
Salix alba L.	Salicaceae	**Wala**	Too	Tree
Salix babylonica L.	Salicaceae	**Wala**	Too, Roo	Tree
Salix tetrasperma Roxb.	Salicaceae	**Wala**	Too	Tree
Sambucus wightiana Wall. ex Wight & Arn.	Caprifoliaceae	**Benakai**	Fue, Roo	Herb
Sapindus detergens Roxb.	Sapindaceae	**Reta**	Med,	Shrub
Sarcococca saligna (D. Don) Müll. Arg.	Euphorbiaceae	**Ladanr**	Roo	Herb
Saussurea atkinsonii C.B. Clarke	Asteraceae	**Sharshamay**	Med	Herb
Saussurea lappa (Decne.) Sch. Bip.	Asteraceae	**Kut**	Med	Herb
Senecio chrysanthemoides DC.	Asteraceae	**Da Ghra Gul**	Med	Herb
Sesamum indicum L.	Pedaliaceae	**Tori Kowanzali**, **til seah**	Med	Herb
Silene vulgaris (Moench) Garcke	Caryophylaceae	**Matorangay**	Med	Herb
Sisymbrium irio L.	Brassicaceae	**Rai**, **Khak Sher Kamsal arway**	Med	Herb
Skimmia laureola (DC.) Siebold & Zucc. ex Walp.	Rutaceae	**Nazar Panra**	Evil, Vet	Herb
Solanum nigrum L.	Solanaceae	**Kamacho**, **Makoha**	Med, Vet	Herb
Solanum surattense Burm. f.	Solanaceae	**Manraghonay**	Vet	Herb
Solanum xanthocarpum Schrad. & H. Wendl.	Solanaceae	**Marraghonary**	Poi	Herb

Scientific name	Family	Vernacular name(s)	Major Use Category	Life Form
Sonchus asper (L.) Hill	Asteraceae	**Shauda pai**	Fod, Vet	Herb
Sorgum halepense (L.) Pers.	Poaceae	**Spirkey**	Fod	Herb
Spiraea chinensis Maxim.	Rosaceae	**Krachae**	Roo	Herb
Stachys parviflora Benth.	Lamiaceae	**Sper Botai**, **Kundiyari**	Pois	Herb
Stellaria media (L.) Vill.	Caryophyllaceae	**Oulalai**	Fod	Herb
Swertia alata C.B. Clarke	Gentianaceae	**Chirat botay**	Med	Herb
Taraxacum officinale F.H. Wigg.	Asteraceae	**Ziar guali**	Fod,	Herb
Taxus wallichiana Zucc.	Taxaceae	**Banrya**	Med, Fue	Tree
Thymus serpyllum L.	Lamiaceae	**Zangali ajwain**, **Sperkai**	Med	Herb
Trachyspermum ammi (L.) Sprague	Apiaceae	**Sperkai**	Spi	Herb
Tribulus terrestris L.	Zygophylaceae	**Markundai**	Med	Herb
Trifolium repens L.	Fabaceae	**Shaftal**	Fod	Herb
Trigonella foenum-graecum L.	Fabaceae	**Malkhwazi**	Spi	Herb
Urtica dioica L.	Urticaceae	**Jalbang**	Veg	Herb
Valeriana jatamansi Jones	Caprifoliaceae	**Mushk-e-Bala**	Med	Herb
Verbascum thapsus L.	Scrophulariaceae	**Khardag**	Med	Herb
Verbena officinalis L.	Verbenaceae	**Shamakai**	Fod	Herb
Viburnum grandiflorum Wall. ex DC.	Adoxaceae	**Amoch**, **Ghuz mava**	MS	Shrub
Viburnum nervosum D. Don	Adoxaceae	**Amoch**, **Ghuz mava**	MS	Shrub
Viola biflora L.	Violaceae	**Banafsha**	Med	Herb
Viola serpens Wall. ex Ging.	Violaceae	**Banafsha**	Med	Herb
Vitex negundo L.	Verbenaceae	**Maravandai**	Rel, MS	Shrub
Withania coagulans (Stocks) Dunal	Solanaceae	**Paneer doda**, **Shapiyanga**	Med	Herb
Withania somnifera (L.) Dunal	Solanaceae	**Kotilal**, **Asgand**	Med	Shrub
Woodfordia fruticosa (L.) Kurz	Lythraceae	**Zangali anar**	Med, MS	Shrub
Zanthoxylum armatum DC.	Rutaceae	**Dambara**	Med	Tree
Ziziphus sativa Gaertn.	Rhamnaceae	**Markhanai**, **Unnab**	Fru, Fod	Tree
Zizyphus mauritiana Lam.	Rhamnaceae	**Karkana**	Fru, Roo, Fod	Shrub
Zizyphus vulgaris Lam.	Rhamnaceae	**Markhanai/Beer**	Fue, Fod	Tree

found to be used for the treatment of stomach and gastrointestinal problems (15 species). Similarly 10 species were used as general body tonic and arthritis, 10 species used for curing of skin disease, aching, scabies and eczema, 05 species were used as anti helmenthic, 7 species were used for curing of sore throat, chest pain and fever, 4 species for treating liver diseases, 6 species for the removal of kidney stone, 3 species for swelling, 2 species for cut and wound healing, 2 species for curing of nervous disorder, 2 species as laxative and 3 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 MAPs species were also collected. Out of 115 MAP spe-

cies, about 20 plants were used and harvested for their roots and rhizomes. Other most common plants parts were leaves (18 species) followed by other plant parts (Figure 1).

Level of knowledge about plant resources

The study revealed that the level of knowledge differs in extent among gender, occupational and social groups. For example the **Hakim**s and tenants possess comparatively higher knowledge about MAPs than the general population. Similarly, men have more knowledge than women. Among the men elders were more aware than the younger members of the community.

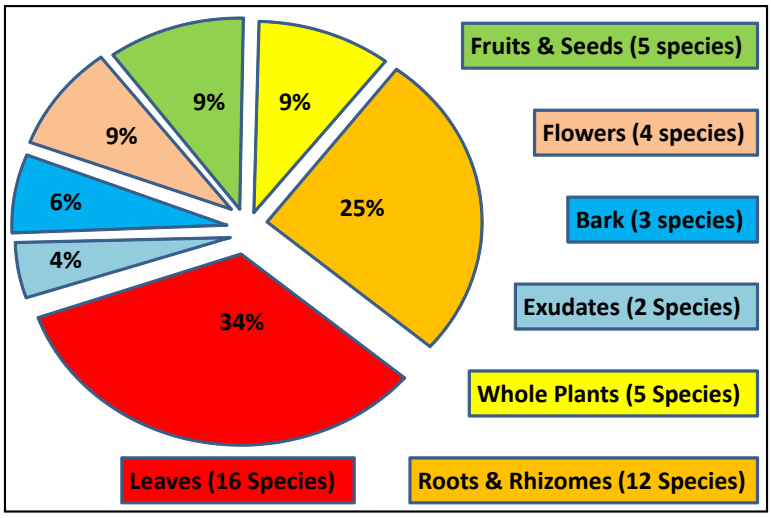

Figure 1. Medicinal and aromatic plant species by category of parts used in coniferous forest of the Miandam Valley of District Swat, northern Pakistan.

Market study

The survey revealed that the marketing of MAPs in the area is in the hands of specific collectors and few local shopkeepers. In the study area there are several regular collectors among the residents. They collect considerable quantities of MAPs and supply them to various domestic and national trading centers of Pakistan including local bazaars in Mingora, Peshawar, Islamabad, Lahore and Karachi as well as abroad. The study revealed that out of 114 reported MAPs a total twenty species (Table 2) have high market value and are collected in large amounts for sale. Among these plants the highest price is paid for *Morchella esculenta* (L.) Pers., *Viola serpens* Wall. ex Ging., *Valeriana jatamansi* Jones, *Podophyllum hexandrum* Royle, *Trachyspermum ammi* (L.) Sprague, and *Bistorta amplexicaulis* (D. Don) Greene . The prices of each species vary from year to year and also depend on demand and supply.

Table 2. Prices and production volumes for maketable medicinal plants of Miandam Valley, northern Pakistan when sold in Miandam, Madam and other markets.

Scientific Name	Local Name	Part Used	In Miandam			In Madam		Oher markets
			Price/ Kg (Rs)		Total prod / year	Price / Kg (Rs)	Total prod / year	Price / Kg (Rs)
Adiantum venustum D. Don	**Persusha**	dried herb	10	14	2000	18	9500	40
Ajuga bracteosa Wall. ex Benth.	**Booti**	dried herb	15	60	15	80	100	200
Allium sativum L.	**Ouga**	dried whole plant	50	40	200	25	50000	50
Berberis lycium Royle	**Kwaray**	dried root bark	20	50	70	120	100	150
Bistorta amplexicaulis (D. Don) Greene	**Tarwa Pana**	dried rhizome	50	20	2500	25	60000	40
Caltha alba Cambess.	**Makan path**	fresh floral shoot	10	14	5000	-	-	-
Cichorium intybus L.	**Han**	fresh root	10	-	-	-	-	-
Diospyros lotus L.	**Toor amlok**	dried/ ripe fruits	10	13	9000	20	600000	30

Scientific Name	Local Name	Part Used	In Miandam			In Madam		Oher markets
			Price/ Kg (Rs)		Total prod / year	Price / Kg (Rs)	Total prod / year	Price / Kg (Rs)
Dryopteris juxtaposita H. Christ	**Kwanjay**	Fresh whole frond	10	13	5000	15	1000	20
Mentha longifolia (L.) Huds.	**Valenay**	dried shoots	10	30	20	60	150	100
Morchella esculenta (L.) Pers.	**Gujhai**	dried whole fruiting body	300	5000	20000	6000	1000	11000
Paeonia emodi Wall. ex Royle	**Mamekh**	dried herb	80	30	1000	40	7000	80
Pistacia integerrima J.L. Stewart ex Brandis	**Shanai**	dried insect galls, leaves and bark	80					
Podophyllum hexandrum Royle	**Kakora**	dried rhizome	75	140	50	170	100	400
Punica granatum L.	**Nangoray**	dried capsule	50					
Skimmia laureola (DC.) Siebold & Zucc. ex Walp.	**Nazar pana**	fresh leaves	20	20	1000	40	6000	70
Trachyspermum ammi (L.) Sprague	**Sperkai**	dried fruit	150	120	10	150	50	180
Valeriana jatamansi Jones	**Muske Bala**	dried rhizome	200	120	1500	160	60000	200
Viola serpens Wall. ex Ging.	**Banafsha**	dried herb	30	200	3000	270	70000	320
Zanthoxylum armatum DC.	**Dambara**	dried fruit	100	60	20	90	100	120

During the survey it was generally observed that for obtaining the plant materials from the study area, the dealers from national markets send representatives to local dealers in Mingora and put 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 (Table 2). 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 (Table 2). Some times daily wages laborers working for Rs. 200-300 per day are employed by the local agents for plant collection but this is not usual.

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 3). 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 collectors' level was their lack of awareness of the price of the plants in the trade markets.

Investment of work by collectors

Time invested was based on the relative availability of the species with respect to the distance and the characteristics of the plant parts. Usually 4-8 hours work at 3-4 km distance was required to gather a bundle of roots of 40-50 kg of for plants like *Dioscorea deltoidea* Wall. ex Griseb., *B. amplexicaule*, *P. hexandrum*, *Paeonia emodi* Wall. ex Royle and *V. jatamansi*. The flowers of *V. serpens* and *Hypericum perforatum* L. required 6-8 hours time at 3-4 km to collect one kg of flowers (Table 4). Each species is collected manually with high labor cost as compared to other daily activities conducted by locals so the collectors get much less money for their labor.

Table 3. Market value chain of average prices in Pakistan rupee (PKR) Rs. per kilogram of plant material at different market points. measured from the source of medicinal plant material in Miandam Valley, northern Pakistan.

Scientific Name	Parts Collected	Demand Form	Rates (Rs. per kg)				
			Collectors	Markets			
			Collector	Local Market	Whole Sale	National	Inter-national
Aconitum laeve Royle	rhizomes	dried	60	100	150	200	300
Aconitum heterophyllum Wall. ex Royle	rhizomes	dried	60	100	150	200	300
Berberis lycium Royle	bark	dried	40	60	80	150	----
Berberis vulgaris L.	bark	dried	50	80	100	200	----
Bistorta amplexicaulis (D. Don) Greene	rhizomes	dried	80	120	150	200	300
Dioscorea deltoidea Wall. ex Griseb.	rhizomes	dried	30	50	80	150	250
Morchella esculenta (L.) Pers.	fruiting bodies	fresh	5000	10000	18000	25000	35000
Podophyllum hexandrum Royle	rhizomes	dried	140	170	200	250	500
Paeonia emodi Wall. ex Royle	rhizomes	dried	40	60	100	150	200
Viola serpens Wall. ex Ging.	leaves & flowers	dried	200	250	350	500	1000
Valeriana jatamansi Jones	rhizomes	dried	160	200	300	350	500

Table 4 indicates that the population of the selected species has been reduced by more than half in the last 20 to 30 years. The local people traveled one to two km for the collection of some quantity (e.g., 50 kg of rhizomes of *D. deltoidea*, *P. hexandrum*, *P. emodi*, *V. jatamansi* and *B. amplexicaule* and one kg flower / leaves of *V. sepens* and *H. perforatum*) of the species in the past and now they traveled 2 to 4 km for the same quantity. Similarly they used to spend one to 4 hours 20 to 30 years ago and now they spend 3 to 8 hours for the same collections.

Table 4. Differences in work investment (distance traveled and time spent) for collection of targeted plants in Miandam Valley, northern Pakistan over a 20 year period of time.

Scientific Name	Distance Traveled (km)		Time Spent (hours)		Form of material sold
	2008	1988	2008	1988	
Aconitum laeve Royle	3	1	4-5	2-3	dried
Aconitum heterophyllum Wall. ex Royle	3	1	4-5	2-3	dried
Berberis lycium Royle	3	1	4-5	2-3	dried
Berberis vulgaris L.	2	1	3-4	1-2	dried
Bistorta amplexicaulis (D. Don) Greene	3	1	4-5	2-3	dried
Dioscorea deltoidea Wall. ex Griseb.	3	1	4-5	2-3	dried
Hypericum perforatum L.	3-4	2	6-8	3-4	fresh
Morchella esculenta (L.) Pers.	3	1	4-5	2-3	dried
Paeonia emodi Wall. ex Royle	3	1	4-5	2-3	dried
Podophyllum hexandrum Royle	3	1	4-5	2-3	dried
Valeriana jatamansi Jones	3	1	4-5	2-3	dried
Viola serpens Wall. ex Ging.	3-4	2	6-8	3-4	fresh

Collectors involved

The information at the local level had shown that in the study area children were the main collectors (60%) followed by women (30%) local men (15%) and outsiders (5%).

Holy and religious plants

Table 1 shows that a total of six species, namely *Celtis australis* L., *Ficus carica* L., *Olea ferruginea* Royle and *Vitex negundo* L. were considered holy or religious trees. They were mostly grown in holy and sacred places such as in shrines, mosques or grave yards.

Tool making species

Twelve species, including *Morus nigra* L., *Morus alba* L., *O. ferruginea*, *Saccharum griffithii* Munro ex Boiss., *Saccharum spontaneum* L. and *Quercus dilatata* Lindl. were utilized in toll making purposes like plough, digger handle, axles handles, cart handles, and water wheel. Writing pens were made from *S. griffithii* and *S. spontanum*. The needles of *Pinus roxburgii* Sarg. and *Pinus wallichiana* A.B. Jacks. are used for fruit packing. Similarly, *P. roxburgii* leaves and the stems of *S. griffithii* and *S. spontanum* are used for making brooms (Table 1).

Fuel wood

A total of 30 species (Table 1) are used for fuel wood. All of the human population in district Swat is dependant on the forests for fuel wood requirements so these plants are essential.

Fodder

Twenty-eight species are used as fodder. Fodder is drawn from forest, pasture and rangeland.

Vegetables and Wild Fruits

Twelve wild plants are collected and used as vegetables. Most of these are consumed locally, because of low quantities, higher cost of collection and low prices. Six wild fruit species are gathered with very small quantities marketed.

Discussion

The study identifies that the people of the area rely on 214 plants for medicines, food, fuel, fodder, building materials and other daily products. In spite of the economic importance of any of these species, it is unclear if any are either locally endangered or appears to be on the verge of becoming locally extinct. FAO, (1995) reported the major links between forestry and food security viz: environment, production and socio-economic linkages, which are interrelated. Therefore, forestation with the participation of local population could play a useful role in raising the living standard of these rural people as forests are just one element within the complex fabric of rural life.

The natural vegetation of the study area is under heavy pressure as a result of overgrazing, illicit cutting, and unauthorized collection of MAPs. Although, plants have varied ethnobotanical uses, they may not be well managed. Olsen and Larsen (2003) and Hussain *et al*. (2004) reported that the number of endangered species is increasing due to environmental degradation, over grazing and over exploitation in the form of medicinal plants extraction and deforestation.

Most of the reported species have multiple uses and these are invariably used for treating local health care needs and for earning extra income. McDicken and Mehl (1990), besides highlighting the improvement aspect in multipurpose trees, also touched upon fruit and fodder aspects of these species. The present study revealed that multipurpose trees and other woody perennials are important sources of food and income generation for rural households. In addition to these advantages, some species have other uses such as fodder, fuel wood, timber wood and medicine. Gunasena (1994) reported that in Sri Lanka, fruit trees (e.g., break fruit, *Artocarpus altilis* (Parkinson) Fosberg) were supplementing or substituting for the staple rice diet. In Swat several species of fruit trees may serve as a genetic resource base for improvement of commercial species. Some are already used as root stock for grafting/budding of commercial fruit varieties. Exchanging of germplasm in these fruit trees having a wider range of distribution would be very useful. Examples are: *Juglans regia* L., *Diospyros lotus* L., *F. carica*, *Pyrus communis* L., *M. alba* and *M. nigra*. There is a need to conserve these resources for the future, as they are refuges for valuable and endangered animals, especially birds, as well as for our own survival.

Most of the species identified from Swat are marketable and provide the opportunity to supplement household income. The market information revealed that district Swat is the collection and trading center for many MAPs. It has a well-established market which supplies sizeable quantities of MAPs to various trading centers of Pakistan and abroad. Sher *et al.* (2005) also reported that majority of marketable MAPs are collected from Northern areas of Pakistan including Swat. The present study noticed that the structure of MAP trade is complex involving many players. The middlemen who purchase material from collectors sell them 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. The price may go quite high as the materials move from the collectors to international markets. The present study observed that prices increase 3 to 5

fold from collectors to local dealers. However, income derived from the sale of wild plant species is of particular importance to the poorer households who must supplement food production with cash in order to meet basic needs.

It was also observed that the MAP 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 likely beyond the regeneration rate. Similar observations were also reported by Sher *et al*. (2010) and Sher *et al*. (2005). They stated that the trade and collection of plant materials is mostly handled by unskilled persons. As a result valuable MAPs are damaged due to lack of scientific methods of collection. It was also discovered that collectors now have to exert greater effort and to walk longer distances to collect the same materials of MAPs when compared to twenty years ago. We recorded an increase in elevation and remoteness of the area within the Swat valley where plants are collected, involvement of children and women in the collection of, and dependence on MAPs increased. This agrees with the studies of Khan (1998) who reported that women and children usually gather medicinal plants as a part time business, in the northern areas of Pakistan.

Conclusions and Recommendations

The area has endemic and endangered plant species, some of which are of medicinal and economic importance. Indigenous knowledge behind their uses, collection and management is 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 decline of availability MAPs in the area and eroding of indigenous knowledge is the inadequacy of the MAPs market and lack of government support for it. This is, therefore, an issue of national policies and must be addressed.

The study recorded some valuable information about specific MAP species that merits further inquiry. For instance, *Rheum webbianum* Royle is widely distributed and quite common in Swat valley. Chinese scientists have developed small-scale enterprises for species like this including preparation of jam and prickles, etc. *Rheum webbanium* could be developed similarly in our country.

The population cover and potential density of MAPs appears to be rapidly decreasing. We call for development of adequate size *in-situ* conservation plots for 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. In order to ensure the management and conservation of MAPs, documenting of indigenous knowledge systems and their constant and consistent support is essential for success of conservation in Swat.

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