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RESEARCH ARTICLE

Understanding the Ethno-cultural domain of the Swat Valley, Northern Pakistan

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Abstract

Background: The use of medicinal plants goes back to thousands of years in the human history. In majority of the developing countries i.e. Pakistan, a huge part of the population rely on the traditional ways of treatments, e.g. herbal remedies. The picturesque Swat Valley is gifted with an astonishing biodiversity due to its varied geography and the availability of microclimatic niches. This immense plant biodiversity of the area has created a unique man-plant relationship (Ethnobotany). The research aims to establish scientific bases for selection and preferences of use of some particular medicinal plants in the ethno-medicinal culture of the area.

Material and methods: A number of questionnaires, semi-structured interviews and practical observations were used as methods for data collection in the project. The data was processed statistically to calculate important indices i.e. Relative Frequency of Citation (RFC), Frequency of Citation (FC), Relative Importance Index (RII), Smith's Salience Index (SII), Informant Agreement Ratio (IAR), Cultural Vale Index (CVI) and a newly suggested, Ali's Conservation Priority Index (CPI).

Results: It is clear from the results of the above useful indices, that the knowledge of a plant use in a particular cultural domain provides a great tool for understanding the versatility of a particular taxon. The IAR values clearly show the highest degree of consensus (8.7%) on the plants used for the Evil Eye followed by body cuts (8.2%) and mental/neural disorders (8.0%) ranking 1, 2 and 3 respectively. There is a clear dominance of *Berberis lyceum* in all five indices, i.e. SI, RII, CVI, CII, and the CPI. The other important plant *Skimmia laureola*, ranked second in the SI, fifth in the RII, seventh in CVI, third in the CII, but thirty-fifth in the CPI.

Conclusions: The use of MAPs is very common in the Swat Valley, as 85% people used some kind of botanicals for treating different sort of ailments. Some of these plants e.g. *Mentha longifolia*, having high rankings i.e. third in the SI and RII, suggest that these plants are quite well known in the ethno cultures of the study area and usually stay in the priority list of the inhabitants for different usages. The objective was achieved by concluding, that some particular plant species construct the core of the ethno-cultural domain of the community. It is highly recommended that more studies on such a theme be carried out on a wider scale, to get a better understanding of the socio-cultural interaction of the society and promote a sustainable eco-friendly ethno-culture in the area.

Introduction

Medicinal and Aromatic Plants (MAPs) have been used for thousands of years in human history (Samuelsson, 2004), by different civilizations for all sorts of ailments. The Sumerian clay tablet, a 4000-year-old medical document, records the earliest known plant remedies for various illnesses. Lange (2006) even traced back the use of MAPs records to 7000 years ago. In majority of the developing countries i.e. Pakistan, a huge part of the population rely on the traditional ways of treatments, e.g. herbal remedies. Many studies have been carried out to understand the intricate relationship between MAPs and regional populations in the different areas of Pakistan, some of which suggest that the use of medicinal plants is related to the culture of the area (Ahmad *et al.*, 2007), but no one has presented any sound proof of this relationship, by applying modern statistical methods. The current study was aimed to provide sound bases for the presence of an ethno-medicinal culture in the Northern parts of Pakistan.

The picturesque Swat Valley is gifted with an astonishing biodiversity due to the presence of a variety of phyto-geographical regions (Ahmad and Ahmad, 2004). Swat Valley is known for its beautiful lush green mountains and swift rivers around the world. The valley has a varied topography ranging from 700 to over 6000 meters, providing a complex biodiversity hotspot to be explored and protected. This immense plant biodiversity of the area has created a unique man-plant relationship (Ethnobotany). These plants not only provide medicines to the local community but act as an important resource of income generation and thus there needs to be a greater understanding of this relationship (Shinwari et al. 2003: Adnan and Hölscher, 2011).

In many developed countries, especially in North America and Western Europe, stakeholders and the general public are actively involved in decision making at the managerial level and the views of the public are sought and considered before concluding on any future environmental policies (While et al. 2005). Common examples on the involvement and consideration of public opinion can be seen in many cases in the UK, even on very minor issues i.e. public consultation on hunting with dogs and other mammals' management (Burns *et al.*, 2000). The issue of scoring and quantifying the public opinion in environmental biology and ecology is sometimes an issue, and requires large scale ecological surveys and a consultation of the general public, to make sure a reduced risk of human-wildlife conflict remains (Holsman and Peyton, 2003: White et al. 2005).

To extract and understand public opinion, questionnaires are considered as one of the cheapest and robust way of obtaining large amount of quantitative data. Many examples are present of such usage of questionnaire in understanding the perception and attitude of a community towards conservation strategies (Obiri and Lawes, 2002; White et al. 2003; White et al. 2005). Questionnaires are mostly aimed at the understanding of the actual behaviour of the subjects, but sometimes, they may focus on the hypothetical behaviour of the subjects (White et al. 2005). The types and nature of the questionnaires can vary, i.e. Closed-format questioning is a very common practice, and according to a review by White et al. (2005), the most common ways to carryout questionnaire surveys are by post, telephone and face to face interviews.

In the current study similar techniques were used to focus on the importance of the medicinal value of the flora and to find answers to questions like: how widespread is the ethno-medicinal knowledge in the study area? Precisely what plants constitute the cultural domain of the area? How well aware are the people about the ecological relationship between trees and the understory herbs? Is there any particular plant under serious stress from the anthropogenic stresses i.e. exploitation by the traders? What stakes are there for the future biodiversity of the District Swat in terms of conservation?

Materials and Method

In the study, two questionnaire surveys were carried out in the study area, to record the plant uses in a particular cultural domain as well as other secondary data about the peoples' perception of the biodiversity and conservation. The data was also used to calculate some very important statistical indices. The Questionnaire prompts were designed to elicit information about a specific quantifiable variable after Newing (2010). This particular method was chosen because it is robust and inexpensive and is commonly used in sociological and ecological surveys (White et al. 2005), but it is for the first time applied to the ethno-botanical survey in the area.

Questionnaire 1 was mainly concentrated on the elicitation of the background information about the ethno-medicinal knowledge flow in the community and ecological understandings of the locals and some secondary information (All the questionnaires are available with the senior author and will be provide on request if needed). Questionnaire 2

was aimed at the recording of ethno-medicinal uses of plants in a particular cultural domain and was used in order to find out the intricate links between the social and physical environment of the area. Before the commencement of the study, permission on the use of these questionnaires was obtained from the University of Reading Ethics Committee. This permission was granted after making some changes suggested by the Committee. A team of three qualified local residents was organized which helped during the field trips, in the understanding of local cultural norms to avoid unnecessary antagonism with the inhabitants of the area. Respondents were randomly selected after White et al. (2005) in order to get a representative sample of the population and to get a less probable selection from the population, the Snowball sampling method (Goodman, 1961; Salganik, 2004) was used with some minor modifications.

Different approaches for the collection of ethno-medicinal knowledge were the semi-structured questionnaires, free-listing questionnaires and interviews (available on request). Data collection was completed in 2010-11. Most of the population sampled was cooperative and willing to respond to the questionnaires and interviews. The majority of the people were found to have a considerable knowledge of the plant uses and where aware of the plants habitats. Interviews were supplemented with field walks; forest walks, and in some instances, if the locals were willing, asked to show the plant in the wild. Information regarding local plant names, their uses, part used, preparation and administration were recorded. In total, 116 informants have completed and returned Questionnaire 1, of which 84 (77 %) were male and 32 (23%) female. Questionnaires were made available in three different languages, i.e. English, Pashto and Urdu. Plant specimens were collected and prepared after drying for identification by experts in the Department of Botany of the Government Postgraduate Jahanzeb College, Swat and some with the experts at the University of Reading UK. Some of the plant specimens were preserved in the Herbarium of the University of Reading. A checklist of all the ethno-medicinal plants and their uses was developed (Table 1).For semi-structured interviews and free-listing Questionnaire 2, data from 39 respondents was recorded. Free-listing was carried out after Borgatti (1998) by asking the respondents to list all the plants used in a particular cultural domain. Free-lists for sixteen different diseases and health problems were collected.

Results and Discussions

The recorded data for Questionnaire 1 was analyzed by using Ms Excel and a statistical Chi Square Test (CST). However, the Chi Square Test of bi-relation between different variables did not yield any significant results and was thus discarded. Results were calculated in percentage and were graphically displayed for visual clarity and understanding. The results obtained from Questionnaire 1 indicate that the population sampled constituted 77% male and 23% female. It was also evident that only 19% of the population sampled was unemployed and 81% were employed, of which some are directly linked with farming and livestock (Figure 1). It is clear from the results that 85% people use medicinal plants for different ailments; only 15% did not use any medicinal plants directly for treatment of ailments, although, the use of such plants were part of their daily food, e.g. used as pot herbs, in making curries, etc. Over half of the respondents (59%) acquired the ethno-medicinal knowledge from different parts of the society not restricted to learn it from their family hierarchical lines (41%) while69% of the respondents had more than one family member with the knowledge of use of the same medicinal plant usage (Figure 1). The herbal market of the Mingora City plays an important role in the continuous supply of the MAPs to the major part of the community (62%). This may be due to the active role of the medicinal plant traders who normally hire local people as cheap labour for harvesting these plants from the wild and directly supplying them to the market. However this also shows the potential of further expansion of the medicinal trade, if an eco-friendly and sustainable approach is adopted.

A very significant number of people (75%) were aware of the interactions between the presence of trees and the MAPs in association as a sub-flora (Figure 2). The majority of the respondents (88%) believe that the Government should be blamed for being irresponsive to the loss of the forest canopy and have claimed the current efforts towards the protection of the area's forests as less-effective as the previous Swat State ruler. In the same manner a great pessimism was found among the respondents as they consider that MAPs use is decreasing due to many reasons; the most noticeable was the gradual scarcity of the plants in the wild and high prices in the local markets. Seventy-one percent of the respondents regarded a clear decline in use of the ethno-botanical medicines. Majority (92%) of the respondents showed disappointment and pessimism towards the future of the forests in the area while66% of the respondents were either unwilling or unable to actively participate in the conservation measures (Figure 2). This could be due to the reason of fewer available conservation projects which are predominantly run by Non-Governmental Organizations (NGOs).

Data analysis and results from Questionnaire 2

The Use-reports (UR) for medicinal plants were calculated after Tardio and Pardo-de-Santayana (2008) and Kufer et al. (2005) on the bases of the ethno-botanical information: "informant i states the use of the species s in a particular use-category (disease/health issue) u." The terminology was adopted from Tardio and Pardo-de-Santayana (2008) where N_S represent species (s1, s2,……., sN_S) in the total number of use-categories NC (u1, u2, ……uNC) while informants were denoted by N (i1, i2, …..iN). So the highest value of URsui can be 1 when a combination is found or zero if no combination is observed. So taking the variable s constant the URs can be expressed as:

$$UR_s = \sum_{U=u1}^{uNC} \sum_{i=i1}^{iN} UR_{ui} \quad Equation\ 1$$

As indicated by the equation 1, the UR of all the respondents (from i1 to iN) are summed up in the each use category for the species (e.g. the number of informants who stated the use of the species in the disease) and secondly all the UR of each category (from u1 to uNC) is summed, i.e. sum of all the uses of the species in the 16 diseases or health issues. Various different indices were calculated (Table 2) in order to understand the cultural importance of the medicinal plant use and the hidden risk factors to their conservation.

Relative Frequency of Citation (RFC)

This index is not reliant on the variable of the use-category (see Equation 2) and can be very easily calculated by dividing the Frequency of Citation (FC), by the number of respondents (N) in the study (Tardio and Pardo-de-Santayana, 2008). FC is the number of informants who mentioned the species, regardless of the use-category.

$$RFC_s = \frac{FC_s}{N} = \frac{\sum_{i=i1}^{iN} UR_{ui}}{N}\ Equation\ 2$$

Relative Importance Index (RII)

This index was created by Pardo-de-Santayana (2003), based on the use categories of the species only and does not take into account the sub-categories of the use (see Tardio and Pardo-de-Santayana, 2008). The following equation (see Equation 3) was used for calculating RII for 103 species used by the local community of the Swat District. In the equation RFC (max) is the relative frequency of citation over the maximum while RNU (max) is the relative number of use-categories over the maximum (for more details see Tardio and Pardo-de-Santayana, 2008). This index varies from 0 where no one mentions the use of the species to 1 where all the respondents mention the plants in all the use-categories.

$$RII_s = \frac{RFC_{s(\max)} + RNU_{s(\max)}}{2}\ Equation\ 3$$

Salience Index (SI)

The free-listing interviews and questionnaires were very useful to calculate Smith's Salience Index, which accounts for the frequency of mention and position of items in free-lists (Smith, 1993). The Value ranges from 0 to 1, the 1 being highly salient. The average saliency is calculated for all the species across the different use-categories. Using the symbology after Ghorbani et al. (2011), the following formula (see Equation 4) was used, where r_j is position of the item j in the free-list, and n is the number of all the items in the lists.

$$S_j = \frac{1r_j 1}{n1}\ or\ S_j = \frac{nr_j}{n1}\ \text{Equation 4}$$

Informant Agreement Ratio (IAR)

This was another measure used, in order to know the agreement of the community regarding the use of different plant species in a particular use-category. This consensus analysis was called "informant consensus factor (FIC)" by Trotter and Logan (1986) but Collins *et al.* (2006) named it as IAR. Using the formula (see Equation 5) below, n_{ur} is the number of citations in each category and n_t is the number of plants used in that category. The range is from 0-1, where 1 shows the limited number of plant used in a particular use-category, i.e. a high degree of consensus amongst the local population for the use of medicinal plants.

$$IAR = \frac{n_{ur} - n_t}{n_{ur} - 1}\ \text{Equation 5}$$

Cultural Vale Index (CVI)

This index (CV in the original text of Reyes-García et al. 2006) is one of the most useful indices used in ethno-biology, first introduced by Reyes-García et al. (2006) following the multiplication of the factors of Turner (1988). The following formula (see Equation 6) can be used for calculating the index, where three factors are multiplied together: NUs is the number of use categories, NC is the total number of use categories, FCs is the number of informants mentioning the species to be useful in all categories and N is the total number of informants in the survey. The third factor is the sum of all the uses mentioned by the different informants in a particular category and is divided by the total number of the informants.

$$CV_s = \left[\frac{NU_s}{NC}\right] X \left[\frac{FC_c}{N}\right] \times \left[\sum_{U=u1}^{uNC} \sum_{i=i1}^{iN} \frac{UR}{N_{Ui}}\right] \text{Equation 6}$$

For example, in the current survey, *Mentha longifolia* was reported to be used only in two categories, i.e. gastric problems and throat infections, so its NUs = 2; the total number of use categories are 16, so NC=16 (NUs/NC = 2/16). The FCs value for *Mentha longifolia* is 27, as that many people suggested the plant being useful out of 39 which is the total number of the respondents (N), e.g. (FCs/N = 27/39). Twenty six people considered the plant being useful in gastric problem and one person recorded it being useful in the throat infection, so the third factor of the formula would be 26/39+1/39. Combining all the three factors CVs or CVI = (2/16) x (27/39) x (26/39 +1/39) = 0.0599. The range of this index is from 0 to NC, where 0 is the condition where no one mentions the plant being useful.

Cultural Importance Index (CII)

This is another useful index and is part of the cultural value index discussed above. As seen in the CVI, this index takes not just the use of the number of use of the species but the spread of use in different use-categories and was thus called by Tardio and Pardo-de-Santayana (2008), the index of "versatility of a species".

$$CII_s = \left[\sum_{U=u1}^{uNC} \sum_{i=i1}^{iN} UR/N\right] \text{Equation 7}$$

The Cultural Importance Index is considered a sub-factor of the Cultural Value Index, and both have the same function i.e. understanding the spread of a medicinal plant in a particular cultural domain (see Equation 7).

Ali's Conservation Priority Index (CPI)

It is clear from the observation of the above useful indices, that the plant use in a particular cultural domain is a great tool for understanding the versatility of a particular taxon. If we estimate the importance factor and calculate the plant part-use in a particular culture by giving it a numerical value on some sort of graduated scale, then adding it to the salience value and cultural importance index values of a plant, we can easily calculate a new index which can be called as "Ali's Conservation Priority Index (CPI)". The index can clearly demonstrate the extinction stress of a particular taxon. The index has proved to be very useful in identifying future vulnerable species in the study area and could be generalized to other places where no or little restriction persists from the authorities on the collection and exploitation of MAPs. Swat District is one of those regions where everyone has open access to the wild plant resources and can easily exploit the flora by over harvesting and over grazing, etc. The following formula (Equation 8) for the index is recommended:

$$CPI = \frac{SI + RII_s + Part\ used\ value}{3} \text{ Equation 8}$$

In the formula, the SI is the Saliency Index of a plant species and the RII is the Relative Importance Index of the species under consideration. The Part used value can be added from the Table 3 which plays an important role in the distribution and extinction of a plant. Plants which are used as a whole in ethno-medicinal recipes or in any other economic or social part of a culture are under high risk of extinction, and should be prioritized for conservation. The main condition of use of this index is that the plant under consideration must be the one collected from the wild. Plants of which only fruits or leaves are used in ethno-remedy or other socio-cultural practices are comparatively less prone to extinction. The value of the index ranges between 0 and 1, while 0 being no risk and 1 the highest risk and the one with the high value close to 1 should be prioritized for conservation in that region.

As trees can contribute many different parts which could be medicinally useful (i.e. wood, bark, twigs, leaves, fruits, seeds, resins, etc.), the value of the most important part is recommended to be used. For example, if leaves and roots both are used as ethno-medicines, the value for roots shall be used from the table for the calculation of CPI. The

results suggest that the highest number of plants recorded were herbs (61%), followed by trees (26%), shrubs (11%) and the lowest recorded was climbers (0.9%) (Figure 3). Lamiaceae family was contributing nine species to the ethno-medicinal culture of the area, followed by the Apiaceae (7), Fabaceae (6), Rosaceae (5) and Solanaceae with (4) species. Asteraceae, Brassicaceae, Cucurbitaceae and Zingiberaceae contributing 3 while the rest of the families aiding with 2 species each.

The IAR values clearly indicate the highest degree of consensus (8.7%) on the plants used for the Evil Eye followed by body cuts (8.2%) and mental/neural disorders (8.0%) ranking 1, 2 and 3 respectively. The highest IAR ranking for the use category of Evil Eye suggests that the people of the area still follow the old rituals and have a unanimous belief on ghosts and spirits. Interestingly, the lowest IAR ranking was obtained for a very common health issue of headache (1.7%) (Table 4). Throat infection ranked fourth and gastric problems fifth in the ranking. Nutritional disorders ranked 15, suggesting that people have different approaches to maintain their dietary requirements and have low consensus on the plants consumed for solely nutritional purposes. This disagreement may also suggest that people are ill-informed about dietary requirements or a micro-culture exists in the different parts of the society.

From the free-listing results, it is clear that the core of the medicinal plant domain of the Swat Valley, based on the Salience Index, consists of: *Berberis lycium*, *Thymus linearis*, *Mentha longifolia*, *Punica granatum*, *Curcuma longa*, *Ajuga bracteosa*, *Syzygium aromaticum*, and *Skimmia laureola* (Table 5).
There is a clear dominance of *Berberis lyceum* in all five indices, i.e. SI, RII, CVI, CII, and the CPI. The other important plant *Skimmia laureola*, ranked second in the SI, fifth in the RII, seventh in CVI, third in the CII, but thirty-fifth in the CPI. *Mentha longifolia* ranked third in the SI, and RII, suggests that the plant is quite well known in the study area and is normally prioritized for its use. This plant also ranked high in the CVI and CII rankings, 5th and 2nd respectively. The fourth ranking of the plant in the CPI puts it in the list of high conservation priority species (Table 5). *Punica granatum* is ranked fourth in the Saliency and Relative Importance indices. Its third ranking in the CVI shows its higher versatility in the local cultural. The plant ranked seventy-second in the CPI, shows a very low risk of extinction and thus does not require any immediate prioritization for conservation in the regional conservation policies (Table 5).

Table 6 indicates that *Berberis lycium* Royle has a high saliency value of (0.077) and shows the priority of use of the plant in the Swat District. This plant also has the highest RII value (0.58), and the highest CVI (1.00). The highest value for CPI (0.6926) in the Table 6 puts the plant in the highest threat level to extinction in the wild.
Skimmia laureola was the second most salient (0.03) species of the area and its familiarity and use makes it second choices option in the Free-lists, after *Berberis lycium*. The CVI value (0.02) puts the plant in seventh position in the ranking table (Table 5). As the CVI values takes the use categories as well as the use reports into consideration. It is worth noticing that *Curcuma longa* is not a plant locally grown or collected from the wild, but is imported from other parts of Pakistan or India. This pattern shows a strong trade links of the local markets with the rest of the national and international markets, and there is clear potential of growth in both imports and exports of the important MAPs. This may also mean that plants like curcuma longa should be tried for cultivation in the Valley, so that the import revenue is saved for other growth sectors. Cultivated plants have a great potential in the area, e.g. *Allium sativum* and *Allium cepa* are not just widely cultivated and used in spices, curries, etc. but are well known and are also known for their therapeutic properties.

Figure 1. Respondent sex ratio and their employment status, use of medicinal plants (MAPs) and knowledge acquisition in swat valley are shown in percent. The percentage for different categories (♂ (male), ♀ (female), EM (Employed), UE (Unemployed), UMPAs (Use of medicinal plants), NUOMAPs (No, use of MAPs), FF (From family), FOPOTS (From other part of the society) was calculated using excel and were superimposed into the graph configuration.

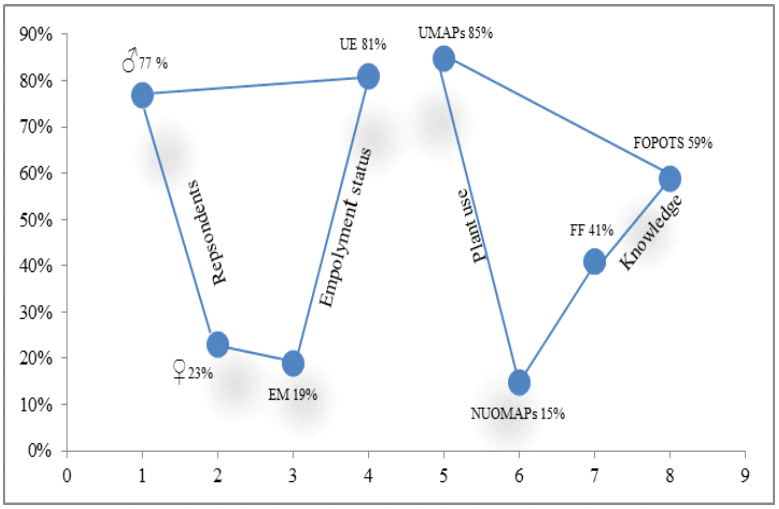

Figure 2. Main drug market role, medicinal plant use in family, plant extraction, importance of the trees in the area, view about the government role, trend in the use of MAPs, future perception of forest conservation and self-role in conservation in Swat valley are depicted. The parameters i.e. PBFTMT (Plant bought from the main town), FAWE (From anywhere else), OFMU (other family member use), NOFUI (No other family use it), DFTF (Direct from the forests), FTM (From the market), MAPsDOT (MAPs depend on trees, MAPsNDOT (MAPs not dependent on trees), NER (No effective role), LE/E (Less effective/effective), D (Decreases), I/NC (Increase/no change), NS/LS (Not safe/Less safe), S (Safe), AI (Active involvement) NR/CPR (No role/cannot play role) are shown in percentage.

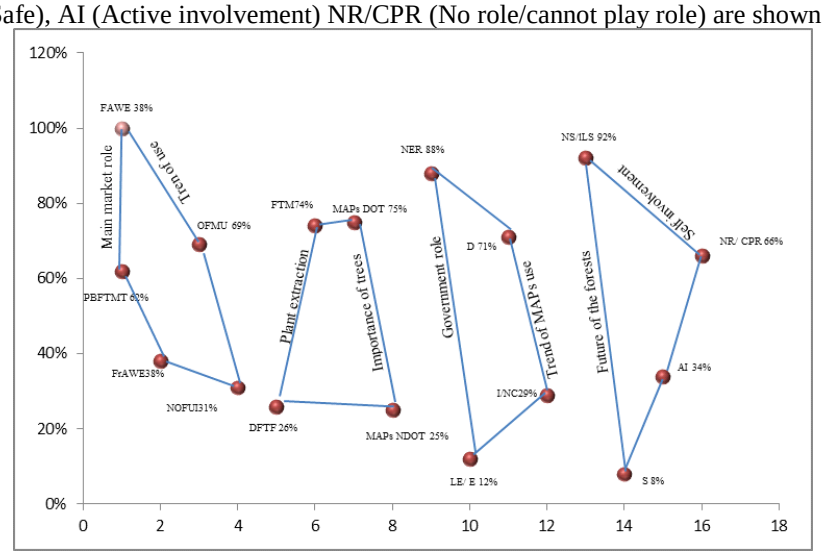

Table 1. Plants reported in the freelisting survey, their scientific, English, and local (Pashto) names and their uses.

No	Plant Names	English name	Part Used	Family	Pashto Name	Uses
1	*Mentha longifolia* L.	Peppermint	Whole plant	Lamiaceae	وښلی	Gastric and ulcers
2	*Curcuma longa* L.	Turmeric	Underground stem	Zingiberaceae	کورکمان	Spices, cuts and bruises, carminative
3	*Adiantum capillus-veneris* L.	Maidenhair fern	Leaves	Adiantaceae	سمبل	Scorpion bite, Backache
4	*Ajuga bracteosa* Wall. ex Benth.	Bugle	Whole plant	Lamiaceae	بوتي	Sore throat, jaundice, astringent, & tonic
5	*Capsella bursa-pastoris* (L.) Medic.	Shepard's purse	Whole plant	Brassicaceae	بمبۍسه	Fodder and pot herb
6	*Salvia moorcroftiana* Wall. ex Benth.	Wild clary	Leaves	Lamiaceae	خړګ	Pot herb
7	*Allium cepa* L.	Onion	Whole plant	Solanaceae	پیاز	Main ingredient of curry, spices and eaten raw.
8	*Nasturtium officinale* R. Br.	Watercress	Whole plant	Brassicaceae	تلمیره	Pot herb and salad
9	*Punica granatum* L.	Pomegranate	Fruits	Lythraceae	انار/اننګ وړی	Used in spices and for gastric problems. Juice is nutritious.
10	*Gymnosporia royleana* Wall. ex Lawson in Hook.f.	Maytenus	Leaves	Celastraceae	سپۍرکی	Honey bee plant, used in digestive problems
11	*Berberis lycium* Royle	Barberry	Roots, fruits	Berberidaceae	کوری	Stomachache, used in jaundice, and refrigerant
12	*Thymus linearis* Benth.	Wild Thyme	Leaves	Lamiaceae	د غره سپۍرکی	Coughs, cold, fever, rheumatism
13	*Mirabilis jalapa* L.	Four O' clock flower	Leaves	Nyctaginaceae	ګل باده	food colouring, used as food, diuretic and purgative
14	*Syzygium aromaticum* (L.) Merr. Perry	Clove	Fruits	Myrtaceae	لونګ	Highly valuable plant; the fruits and flowers are used in curries, etc.
15	*Foeniculum vulgare* Mill.	Fennel	Whole plant	Apiaceae	کاګه وښلی	Digestive disorders, flavouring agent, used in confectionery
16	*Prunus amygdalus* Batsch.	Almond	Fruits	Rosaceae	بادام	Tonic, and used in neural disorders, served as a good gesture of hospitality
17	*Sesamum indicum* L.	Sesame	Seeds	Pedaliaceae	کونزلي	Used in confectionery, high oil content
18	*Rosa indica* L.	Rose	Flowers	Rosaceae	ګلاب	Rose water is used for ophthalmic cures, digestive disorders, and scents
19	*Cinnamomum verum* J. Presl.	Cinnamon	Stem, bark	Lauraceae	خوږ لرګی	Aromatic bark is used in spices, especially in rice preparation, the main ingredient of "garam masala" means hot spice.
20	*Terminalia chebula* Retz.	Black Myrobalan	Fruits	Combretaceae	اریړه	Very potent in digestive disorders, and urinary problems
21	*Plantago lanceolata* L.	Ribwort Plantain	Whole plant	Plantaginaceae	ژبی	Husk is used as laxative, the plant is anti-fungal in nature and is also cooked as pot

						herb
22	*Mentha arvensis* L.	Wild Mint	Whole plant	Lamiaceae	وښلی	Very commonly known and used remedy for digestive problems, stomach-aches. Also reported for throat and mouth infections
23	*Cymbopogon citratus* Springs.	Lemon grass	Whole plant	Poaceae	لیمن گراس	Teas are prepared, sometimes mixed with green tea to enhance the flavour, diuretic.
24	*Allium sativum* L.	Garlic	Whole plant	Amaryllidaceae	اوګه	Curry ingredient, flavouring and aroma, used in blood pressure and is recommended in heart problems, some people recommend its use for weight loss.
25	*Momordica charantia* Descourt.	Bitter melon	Fruits	Cucurbitaceae	کړله	Used as vegetable, blood purifier, astringent and digestive.
26	*Caralluma edulis* (Edgew.) Hook.f.	Not known	Stem, bark	Apocynaceae	پمنکی	Very bitter plant, cooked and the water is drained, blood purifier, and good for skin diseases.
27	*Malus domestica* Borkh.	Apple	Fruits	Rosaceae	مڼه	Well known tree in Swat, for its taste and aroma widely used, blood problems, nutritious.
28	*Brassica rapa* L.	Mustard plant	Seeds	Brassicaceae	شړشم	Pot herb, oil is used for cooking and is grown widely.
29	*Skimmia laureola* (DC.) & Zucc. ex Walp.	Skimmia	Stem, leaves	Rutaceae	نظر پاڼه	Highly salient plant in the community, used for the protection from evil eye, good aroma and also used for digestive problems.
30	*Zingiber officinale* Roscoe	Jujube	Underground stem	Zingiberaceae	ادرک	Spice ingredient, used in curries, rice preparation, etc., refrigerant and carminative. Also for blood thinning, heart diseases and arthritis.
31	*Peganum harmala* L.	Aspand seeds	Leaves	Nitrariaceae	سپیلنی	Another plant usually used for rituals like protection from evil eye, etc famous for good aroma.
32	*Camellia sinensis* (L.) Kuntze.	Black tea	Leaves	Theaceae	چای	Commonest drink, milky and strong (doodhpati) is the traditional style. It is also a diuretic and stimulant.
33	*Camellia sinensis* (L.) Kuntze.	Green tea	Leaves	Theaceae	چای	Green tea is very traditional. Diuretic and stimulant. Normally consumed after heavy meals.
34	*Morus nigra* L.	Mulberry	Stem	Moraceae	توت	High sugar contents make it very sweet and commonly served to guests with green tea. Digestive and laxative in properties.

35	*Saccharum officinarum* L.	Sugarcane	Leaves	Poaceae	گنی	Small pieces are cut and chewed on the move, high sugar content and stimulant. Main crop of sugar in the country.
36	*Senna alexendria* L.	Senna	Leaves	Apiaceae	سنه	Leaves are used as tea for various ailments including cough, digestive disorders, etc.
37	*Glycyrrhiza glabra* L.	Liquorice	Roots	Fabaceae	خوږه زبله	Mouth ulcers, peptic ulcers. Expectorant and endocrinal activity suppresser.
38	*Nicotiana tabacum* L.	Tobacco	Leaves	Solanaceae	تماکو	Snuff tobacco is commonly used for making snuff and is a valuable cash crop. Mosquito repellent.
39	*Elettaria cardamomum* (L.) Maton.	Cardamom	Whole plant	Zingiberaceae	وړه لاچي	A very well known for its aroma, a must ingredient of all spices. It is used for mouth ulcers and throat clearing, etc.
40	*Juglans regia* L.	Walnut	Stem, bark	Juglandaceae	غوز	Nuts are consumed as tonic; bark of the tree bark is used for gum infections and colourings.
41	*Acorus calamus* L.	Sweet flag	Underground stem	Acoraceae	سخا وژه	Used for its aroma in scents, known for its aphrodisiac activity and neurotoxicity.
42	*Viburnum foetens* (D.Don) Wall ex. DC.	Viburnum	Fruits	Adoxaceae	چمیاری	Fodder, fuel wood, fruits are eaten.
43	*Zizyphus jujuba* Mill.	Jajube	Fruits	Rhamnaceae	مرخنی	Fruits and leaves Emollient, laxative and fruit is considered tonic.
44	*Fumaria indica* (Hausskn.)	Common Fumitory	Whole plant	Fumariaceae	پاپړه	Considered a very potent blood purifier, helps with body heat and used as tonic.
45	*Papaver somniferum* L.	Opium	Latex, seeds	Papaveraceae	قشقاش	A well known plant for its neurotoxins and alkaloids. Seeds are used in confectionary; leaves are boiled and used as tea in pain relief.
46	*Cuminum cyminum* L.	Cumin	Seeds	Apiaceae	زیره	Important part of Indian and Pakistani spices, wide use in different dishes. Aromatic and carminative.
47	*Olea ferruginea* Royle	Olive	Fruits	Oleaceae	خونه	The small fruits are eaten; leaves are used as anti pyretic and antiseptic. Fuel wood.
48	*Pinus wallichiana* A.B.Jackson	Blue pine	Whole plant	Pinaceae	پېوچ	Timber used in construction, highly valued for its wood and leaves are used for mats.
49	*Quercus dilatata* Lindl. ex Royle	Black oak	Whole plant	Fagaceae	بنج	Fuel wood, timber wood.
50	*Coriandrum sativum* L.	Coriander	Seeds	Apiaceae	دنیال	Used in spices and known for

						carminative nature, flavouring agent.
51	*Artemisia maritima* L.	Sea wormwood	Leaves	Asteraceae	جوکی	Anthelmintic and used as ethno-veterinary drug.
52	*Gentiana kurroo* Royle	Gentian	Leaves	Gentianaceae	بگنہ	Tonic, antispasmodic, febrifuge.
53	*Cichorium intybus* L.	Chicory	Leaves	Asteraceae	ہنٕ	For gastro intestinal problems, cuts and bruises, for gall stones, etc.
54	*Cupressus torulosa* D.Don.	Cupressus	Seeds	Cupressaceae	سروہ	For its oil, aroma, used for sore throat.
55	*Trigonella foenum-graecum* L.	Greek hay	Seeds, leaves	Fabaceae	ملخوزی	Used as pot herb, for arthritis.
56	*Aesculus indica* (Wall. ex Camb.) Hook.f.	Indian horse chestnut	Whole plant	Sapindaceae	جوز	Agricultural tools making fuel wood, fodder.
57	*Alianthus altissima* (Mill.) Swingle.	tree of heaven	Whole plant	Simaroubaceae	بکیانہ	Fuel wood, considered as an alien species to the Valley.
58	*Mentha spicata* L.	Mint	Leaves	Lamiaceae	پودینہ	Used in different sauces, mixed with yoghurt and salt.
59	*Robinia pseudoaccacia* L.	Black locust	Whole plant	Apiaceae	کیکر	Fuel wood mainly. Flowers are aromatic and attract bees.
60	*Picea smithiana* (Wall) Boiss.	Spruce	Whole plant	Pinaceae	منگزی	Timber tree, leaves used in teas, leaves used in mats.
61	*Buxus sempervirense* Hook. f.	Boxwood	Whole plant	Buxaceae	شمشاد	For wood carving and musical instruments.
62	*Onopordum acanthium* L.	Cotton thistle	Whole plant	Asteraceae	وریڑکی	Ornamental and oil is also extracted from the seeds.
63	*Teucrium stocksianum* Boiss.	Germander	Leaves	Lamiaceae	کوندِی بوٹی	Known for antispasmodic activity and its essential oil is highly appreciated.
64	*Micromeria biflora*(Buch-Hamp. ex D.Don) Benth.	Indian wild thyme	Leaves	Lamiaceae	شمکی	Known for its aromatic nature and its neural healing activity, also used as pot herb.
65	*Quercus incana* Lindl. ex Royle	Oak	Whole plant	Fagaceae	بنج	Nuts are used as diuretic and the tree mainly as a fuel wood.
66	*Solanum miniatum* Benth.	Black night-shade	Fruits	Solanaceae	کماچو	Used for its laxative activity, some consider it as antispasmodic.
67	*Urtica dioca* L.	Nettle	Leaves	Urticaceae	سیزونک ی	Used as pot herb and known for its effectiveness in rheumatism.
68	*Melia azedarach* L.	China berry	Leaves, fruits	Meliaceae	شندِی	Anthelmintic and vermifuge, also use for body heat release.
69	*Vitex negundo* L.	five-leaved chaste tree	Leaves	Lamiaceae	مارکوند ی	Antiseptic and antibacterial, it is also used as anti-inflammatory.
70	*Aloe vera* (L.) Burm. f.	Alove	Leaves	Asphodelaceae	کمال پانہ	Known for its effectiveness in skin problems, also used as diuretic and kidney stone problems.
71	*Kalanchoe pinnata* (Lam.) Pers.	Air plant	Leaves	Crassulaceae	پتر چٹ	It is used for its poisonous glycosides and sometime

						cause heart problems in livestock. It can act as a immune-suppresser.
72	*Dodonea viscosa* (L.) Jacq.	Hop bush	Whole plant	Sapindaceae	غوړاس کی	Fuel wood, aromatic leaves are burnt in houses for some rituals.
73	*Euphorbia helioscopia* L.	Sun spurge	Whole plant	Euphorbiaceae	شوده پی	A poisonous plant, livestock suffer with severe health disorders if eaten.
74	*Cucumis sativus* L.	Cucumber	Fruits	Cucurbitaceae	بادرنگ	Eaten raw, low calories fruit (vegetable) common element of salad.
75	*Zingiber cassumunar* Roxb.	Ginger	Underground stem	Zingiberaceae	تټه کار	Used in beauty products and spices.
76	*Daucus carota* L.	Wild carrot	Underground root	Apiaceae	گازره	High vitamin A contents, common vegetable, and used as fodder.
77	*Valeriana jatamansi* Jones	Indian Valerian	Whole plant	Valerianaceae	مشک باله	Antispasmodic and also used in cholera.
78	*Capsicum annum* L.	Pepper	Fruits	Solanaceae	مرچکی	Curry essential ingredient, high potency of vitamin C, very common spice.
79	*Eriobotrya japonica* (Thunb.) Lindl.	Loquat	Fruits	Rosaceae	الوکاټ	Digestive, high sugar content, demulcent and expectorant.
80	*Cassia fistula* L.	Golden shower tree	Fruits	Apiaceae	لاندېس	Fever, arthritis and neural disorders.
81	*Musa balbisiana Lacatan*	Banana	Fruits	Musaceae	کېله	Highly nutritious, tonic, juices and milk shakes.
82	*Malva neglecta* Wall.	Buttonweed	Leaves	Malvaceae	پنېرک	Common herb cooked, digestive and emollient.
83	*Citrus* × *limon* (L.) Burm.f.	Lemon	Fruits	Rutaceae	لیمو	Juice, flavouring agent in all sort of traditional dishes, high vitamin C.
84	*Fragaria nubicloa* (Hook.f.) Lindl.	Wild strawberry	Fruits	Rosaceae	ځمکنی توت	Fodder, fruit is eaten.
85	*Diospyrus lotus* L.	Persimmon fruit	Fruits	Ebenaceae	تور املوک	Fruit is eaten, leaves used as fodder, fuel wood.
86	*Olea europaea* L.	Olive	Fruits	Oleaceae	خونه	Oil is used in cooking, massage and as anti fungal. Very nutritious and considered sacred.
87	*Arachis hypogaea* L.	Peanuts	Seeds	Fabaceae	مونګ پلي	Highly nutritious, eaten raw and roasted.
88	*Thalictrum falconeri* Lecoy.	Meadow rue	Leaves	Ranunculaceae	مامیره	Used in opthalmia.
89	*Chenopodium album* L.	Goosefoot	Whole plant	Chenopodiaceae	سارمی	Pot herb and digestive.
90	*Periploca aphylla* Decn.	Periploca	Leaves	Asclepiadaceae	برررہ	Commonly used for feeding livestock, the latex is applied as a poultice in tumours and swelling, used as anti-fever.
91	*Pteridium aquilinum* (L.) Kuhn	Bracken	Whole plant	Hypolepidaceae	کونجی	Pot herb, cooked with yogurt and eaten with maize bread, full of mineral nutrients
92	*Polygonum biaristatum*	Equal-	Leaves	Polygonaceae	پولپولک	Fodder, fish poison.

	Aitch. &Hemsl.	leaved				
93	*Aconitum violaceum* Jacq. ex Stapf	Aconite	Underground stem	Ranunculaceae	د غره زهر	Gout & rheumatism, aphrodisiac.
94	*Berginia ciliata*(Haw.) Sternb.	Yeo	Whole plant	Saxifragaceae	گټ پاڼه	Wound healing, fractured bones.
95	*Paeonia emodi* Wall. ex Royle	Peony	Underground roots	Paeoniaceae	مامیخ	Backache, tonic, epilepsy.
96	*Justicia adhatoda* L.	Malabar nut	Leaves	Acanthaceae	بيکنې	Used as an antispasmodic, bronchodilator, and mucolytic agent in asthma and other respiratory conditions.
97	*Citrullus lanatus* (Thunb.)	Water melon	Leaves	Cucurbitaceae	هندوانه	Refrigerant, diuretic.
98	*Vigna aconitifolia* (Jacq.) Marechal	Moth bean	Leaves	Fabaceae	------	Eaten as a vegetable and the ripe seeds, whole or split, are eaten cooked.
99	*Digitalis lanata* L.	Foxglove	Flowers, leaves	Plantaginaceae	---	Cardiac stimulant, used in blood pressure.
100	*Eucalyptus globulus* Labill.	Euclyptus	Leaves	Myrtaceae	لاچي	Used in teas, fuel wood, and bee plant.
101	*Mangifera indica* L.	Mango	Fruits	Anacardiaceae	آم	Juice and shakes are common; refrigerant, digestive, laxative.
102	*Saccharum spontaneum* L.	Kans grass	Leaves	Poaceae	د سيند گيا	Fodder, laxative.
103	*Hypericum perforatum* L.	Perforate St John's-wort	Leaves	Hypericaceae	شين چای	Herbal tea, used to treat piles.

Table 2.Different indices calculated and their description used in the understanding of ethno-cultural domain of Swat valley.

No	Index	Description
1	RFC	Relative Frequency of Citation
2	RII	Relative Importance Index
3	SI	Salience Index
4	IAR	Informant Agreement Ratio
5	CVI	Cultural Value Index
6	CII	Cultural Importance Index
7	CPI	Ali's Conservation Priority Index

Table 3.Different plant parts and their quantitative used values using Ali's Conservation Index (CPI).

S. No	Part Used	Values
1	Whole plant and underground parts (roots, rhizomes, etc.)	1
2	Stem, twigs and latex (collected from injury)	0.75
3	Leaves, flowers	0.5
4	Fruits, seeds, natural excretes, i.e. gums, resins	0.25
5	Cultivated plants (for any plant part)	0.00

Table 4. Informants Agreement (IA) Ratio for different use categories.

No.	Disease/Ailment	IAR	Agreement %	Rank
1	Evil Eye	0.83	8.7	1
2	Body cuts	0.78	8.2	2
3	Mental disorders	0.76	8	3
4	Throat infections	0.74	7.7	4
5	Gastric problems	0.73	7.6	5
6	Tooth and mouth problems	0.73	7.6	6
7	Ear infections	0.68	7.1	7
8	Urinary disorders	0.64	6.7	8
9	Diabetes	0.63	6.6	9
10	Fever	0.6	6.3	10
11	Eye infections	0.53	5.6	11
12	Blood pressure	0.51	5.4	12
13	Skin problems	0.5	5.2	13
14	Body pain	0.41	4.3	14
15	Nutritional disorder	0.3	3.2	15
16	Headache	0.16	1.7	16

Table 1.The top 30 plants and comparison of their ranks based on their indices: SI=Salience Index, RII= Relative Importance Index, CVI= Cultural Value Index, CII= Cultural Importance Index, CPI=Conservation Priority Index.

Plant species	Ranks				
	SI	RII	CVI	CII	CPI
Berberis lycium Royle	1	1	1	1	1
Skimmia laureola (DC.) & Zucc. ex Walp.	2	5	7	3	35
Mentha longifolia L.	3	3	5	2	4
Punica granatum L.	4	4	3	5	72
Curcuma longa L.	5	6	4	6	3
Ajuga bracteosa Wall. exBenth.	6	2	2	4	2
Syzygium aromaticum (L.) Merr. & Perry	7	8	13	7	74
Thymus linearis Benth.	8	7	6	8	40
Prunus amygdalus Batsch.	9	10	10	10	73
Mentha spicata L.	10	11	15	9	102
Allium sativum L.	11	9	8	11	101
Quercus dilatata Lindl. ex Royle	12	16	21	15	5
Micromeria biflora (Buch-Hampex D.Don) Benth.	13	12	9	12	41
Papaver somniferum L.	14	13	11	14	75
Nicotiana tabacum L.	15	15	16	18	77

Terminalia chebula Retz.	16	14	12	13	76
Brassica rapa L.	17	19	19	17	78
Thalictrum falconeri Lecoy.	18	26	26	24	44
Momordica charantia Descourt.	19	23	24	21	79
Gymnosporia royleana Wall. ex Lawson in Hook.f.	20	17	17	16	42
Eucalyptus globulus Labill.	21	20	18	27	43
Foeniculum vulgare Mill.	22	22	23	20	7
Mirabilis jalapa L.	23	21	22	19	45
Peganum harmala L.	24	24	25	22	46
Zizyphus jujuba Mill.	25	27	28	25	80
Fumaria indica (Hausskn.)	26	18	14	23	6
Pteredium aquilinum (L.) Kuhn	27	25	20	26	8
Aconitum violaceum Jacq. ex Stapf	28	44	45	32	9
Kalanchoe pinnata (Lam.) Pers.	29	41	44	31	47
Sesamum indicum L.	30	30	31	34	82

Table 2. The top 15 reported plants based on the Salience Index, SI=Salience Index, RII= Relative Importance Index, CVI= Cultural Value Index, CII= Cultural Importance Index, CPI=Conservation Priority Index.

Plant Names	**SI**	**RII**	**CVI**	**CII**	**CPI**
Berberis lycium Royle	0.077	0.58	1	1.33	0.69
Skimmia laureola (DC.) & Zucc. ex Walp.	0.038	0.25	0.02	0.66	0.27
Mentha longifolia L.	0.036	0.27	0.05	0.69	0.36
Punica granatum L.	0.032	0.27	0.13	0.58	0.13
Curcuma longa L.	0.029	0.25	0.09	0.53	0.37
Ajuga bracteosa Wall. exBenth.	0.028	0.31	0.21	0.61	0.41
Syzygium aromaticum (L.) Merr. & Perry	0.023	0.16	0.01	0.41	0.09
Thymus linearis Benth.	0.019	0.17	0.03	0.35	0.18
Prunus amygdalus Batsch.	0.018	0.14	0.01	0.3	0.09
Mentha spicata L.	0.017	0.14	0.008	0.35	0.008
Allium sativum L.	0.016	0.15	0.02	0.3	0.013
Quercus dilatata Lindl. ex Royle	0.016	0.1	0.004	0.25	0.34
Micromeria biflora (Buch-Hampex D.Don) Benth.	0.014	0.14	0.01	0.28	0.17
Papaver somniferum L.	0.012	0.13	0.01	0.25	0.09
Nicotiana tabacum L.	0.012	0.1	0.007	0.2	0.08

Conclusions

The use of MAPs is very common in the Swat Valley, as 85% people used some kind of botanicals for treating different sort of ailments. The common knowledge in the area regarding this important flora makes a unique and well established ethno-culture in the society. The use of these plants shows a trendtowards decrease which can be clearly attributed to factors like, uncontrolled harvesting, insignificant role of the government, and lack of lack of conservation knowledge and strategies will soon irreversibly damage the flora and consequently the rich ethno-medical knowledge will also vanish forever.It can be established by interviewing the locals that most of residents are aware of the fact that the on-goingdegradation of the forest canopy will severely harm the sub-flora, but most of them are unwilling or unable to do much about it. There is also a blame game situation being played in the Valley, people are blaming the government and *vice versa*. The study has established that people and plants have deep intricate relationship and the people of the area have developed a certain cultural domain of plant use. It was observed that not all of the plants of the area very familiar and thus the selection is not at random but there are certain plants more actively used in this cultural than the others, i.e. plants are more versatile than others.

The research has tried to establish a new concept of threat level to the plant and make an index for conservation priority. This new index can be applied to areas where plants are openly collected from the wild. The index can calculate extinction risk to a particular plant, using the plant part-used as an important factor. Plant parts used are given categorical numerical values (Table 3). This index can also be defined as the extinction risk factor. The calculation of the index requires the Smith's salience index value (Smith, 1993), as this value is in fact the priority of use of a certain item by a person or population. Adding the Smith's salience and Cultural Importance Indices (CII) which is the measure of versatility "diversity of use" (Tardio and Pardo-De-Santayana, 2008) together, with the part use value and dividing them by three to get the average value. The maximum theoretical value for CPI is 1 suggesting the plant needs to be put in the high priority list of conservation. If the plant is well known and highly versatile and then if its part used is putting it in danger of extinction, the stacks for its conservation would be very high.

The main objective of this research was to understand the cultural domain of the MAPs use in the Swat Valley. The objective was achieved by concluding, that some particular plant species make the core of the cultural domain of the community. It was the first time ever someone attempted to establish this fact systematically in the area.The usual trend of ethno-medicinal researches from the area focuses on the compilation of plant uses in general. It is highly recommended that more studies of this nature should be carried out on a wider scale, to get abetter understanding of the socio-cultural practices of the society and promote a sustainable approach towards MAPs use in the area.

References

Adnan M. & Hölscher D. Medicinal plant abundance in degraded and reforested sites in Northwest Pakistan. Mountain Research and Development, 2011; 30, 25-32.

Adnan SM, Khan AA, Latif A, Shinwari KZ. Threats to the sustainability of ethnomedicinal uses in Northern Pakistan (a case study of Miandam Valley, District Swat, NWFP, Pakistan). Lyonia, 2006;11(2): 87-96.

Ahmad, F. Geo-informatics application to investigate agricultural potential in Cholistan desert. J of Food Agric & Enviro, 2007;5**,** 310-314.

Ahmad H, Ahmed R. Agro ecology and biodiversity of the catchment area of Swat River. The Nucleus, 2004; 40(1-4), 67-75

Borgatti SP. Elicitation Methods for Cultural Domain Analysis. in J. Schensul & M. LeCompte (Ed.) *The Ethnographer's Toolkit*, 1998; 3. Walnut Creek: Altamira Press.

Burns LEV, Marsh J, Soulsby L, Winter M. Report of the committee of inquiry into hunting with dogs in England and Wales. *HMSO*, Norwich, UK, 2000.

Collins WD, Ramaswamy V, Schwarzkopf M D, Sun Y, Portmann RW, Fu Q, Casanova SEB, Dufresne JL, Fillmore DW, Forster PMD, Galin VY, Gohar lK, Ingram WJ, Kratz, DP, Lefebvre MP, Li J, MarquetP, Oinas V, Tsushima Y, Uchiyama T, Zhong WY. Radiative forcing by well-mixed greenhouse gases: Estimates from climate models in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4). J of GeophyResear, 2006; 111, D14317.

Ghorbani A, Langenberger G, Feng L, Sauerborn J. Ethnobotanical study of medicinal plants utilised by Hani ethnicity in Naban River Watershed National Nature Reserve, Yunnan, China. J of Ethnopharma, 2011; 134, 651-667.

Goodman LA, Snowball sampling. Ann of Math Statis,1961; 32 (1), 148–170.

Goodman SM, Ghafoor A. The ethnobotany of Southern Baluchistan, Pakistan, with particular reference to medicinal plants. Fieldiana Botany, 1992; 0, I-V, 1-84.

Holsman RH, Peyton RB. Stakeholder attitudes toward ecosystem management in southern Michigan. Wild Soc Bull, 2003; 31, 349–361.

Kufer JH Förther E, Pöll M, Heinrich. Historical and Modern Medicinal Plant Uses—The Example of the Ch'orti' Maya and Ladinos in Eastern Guatemala. J of Pharm and Pharmaco, 2005; 57(9), 1127–1152.

Newing H. 'Qualitative analysis' in Newing, H., Eagle, C., Puri, R., Watson, C., Conducting research in conservation: social science methods and practice, Routledge, 2010.

Obiri JAF, Lawes MJ. Attitudes of coastal-forest users in Eastern Cape Province to management options arising from new South African forest policies. Enviro Conserv,2002; 29, 519–529.

Reyes-García VT, Huanca V, Vadez W, Leonard, Wilkie D. Cultural, Practical, and Economic Value of Wild Plants: A Quantitative Study in the Bolivian Amazon. Economic Botany, 2006; 60(1),62–74.

Salganik MJ, Heckathorn DD. Sampling and estimation in hidden populations using respondent-Driven sampling. SocioloMethodo, 2004*;* 34 (1), 193–239.

Samuelsson G. Drugs of Natural Origin: a Textbook of Pharmacognosy, 5th Swedish Pharmaceutical Press, Stockholm, 2004.

Smith JJ. Using Anthropac 3.5 and a spreadsheet to compute a free-list salience index. Cultu Anthropo Methods, 1993;**9,** 8-12.

Tardio J, Pardo-de-Santayana M. Cultural importance indices: A comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain),Economic Botany, 2008;62, 24-39.

Trotter RT, Logan MH. Informant Consensus: A new approach for Identifying potentially effective medicinal plants. 91– 112 In N. L. Etkin, ed., *Plants in Indigenous Medicine and Diet: Biobehavioral Approaches*. Redgrave Publishing Company, New York, 1986.

Turner MG, Hargrove WW, Gardner RH, Romme WH. Effects of fire on landscape heterogeneity in Yellowstone National Park, Wyoming. J of Veget Scien, 1994;5**,** 731–42.

Turner MG.*Landscape heterogeneity and disturbance*. Springer-Verlag, Berlin, 1987.

Turner NJ. The importance of a rose: Evaluating the cultural significance of plants in Thompson and Lillooet Interior Salish. American Anthropologist, 1988; 90, 272–290.

White PCL, Jennings NV, Renwick AR, Barker NHL. Review: Questionnaires in ecology: a review of past use and recommendations for best practice. J of Appli Ecol, 2005;42, 421-430.

White PCL, Newton-Cross, GA, Moberly RL, Smart JCR., Baker PJ, Harris S. The current and future management of wild mammals hunted with dogs in England and Wales. J of Enviro Manag, 2003; 67, 187–197.