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Assessment of ethno-ecological knowledge, practices and perceptions among traditional communities of Karakorum Mountain Ranges: a special reference to *Berberis* spp.

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Abstract

Karakoram Mountain Ranges exhibit complex taxonomic floral composition and has remained one of the mother sanctuaries for cultures. Centuries long folk wisdom among these self-reliant cultures got purified over generations. However, since 1950s, a drastic decline has been noticed (80% dependency in 1950s to 20% in 2013). Present survey was an attempt to assess and explore ethnobotanical insights with a focus on Berberis. A total of 373 people of different age and gender were interviewed. People use Berberis for medicinal purposes (n=351; 92.2%; SE±0.057), firewood (n=72; 19.3%; SE±37.375), commercial (n=9; 2.41%; SE±1.692), cultural (n=9; 2.41%), fodder (n=60; 16.08%; SE±11.474), fencing (n=71; 19.03%; SE±6.895) and grazing (n=373; 100%; SE±1.035). Data was analyzed using Pearson correlational coefficient, student t-test and descriptive statistical tools. There is a highly significant relationship ($p< 0.000$) between different age groups and ethnomedicinal uses of Berberis. Berberis population is on decline and unwise developmental activities are major cause of habitat loss (n=32, -30.77%). *Berberis pseudumbellata* subsp. *gilgitica,* an endemic plant species has become critically endangered.

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Introduction

Medicinal plants and human civilizations have prehistoric relationship. They have been the ultimate source of medicinal therapy until synthetic drugs were developed in the nineteenth century (Djeridane *et al.* 2006). Indigenous communities around the world are a great source of advancement in health care for humanity (Basak *et al.* 2010; Muthu *et al.* 2006; Makkar *et al.* 2007). Ethnobotany compliments ethnopharmacological practices which have enhancing effect on advancement of modern medicine used to treat most pressing medical issues faced by the humanity today (Sheng-Ji 2001). Berberis is one of the important medicinal plant used as a very common ingredient in herbal medication systems viz; Eastern, Ayurvedic, Unani and modern system of medicines (Sing *et al.*, 2008, Chopra *et al.*, 1981; Chandra and Purohit, 1980). It has been reported useful in treatment of cancer, diabetes, jaundice, enlargement of spleen, AIDS, osteoporosis, cardiovascular ailments, ocular trachoma, hypertension, infectious diseases, cholera, diarrhea, dysentery, eye troubles, leprosy and bone fractures etc. (Khan *et al.*, 2013; Sing *et al.*, 2008; Asif *et al.*, 2007; Fatehi *et al.*, 2005; Caraballo *et al.*, 2004; Kuo *et al.*, 2004; Villinski *et al.*, 2003; Janbaza and Gilanib, 2000; Hwang *et al.*, 2002; Ivanoska and Philipov, 1997; Koo and Seang, 1996; Chopra *et al.*, 1981; Chandra and Purohit, 1980).

Berberidaceae is a small family of woody dicotyledonous plants comprising upon c. 17 genera. Genus Berberis is the most prominent among all other having approximately 650 species (Khan et. al. 2014; Perveen and Qaiser 2010; Bottini *et al.* 2007; Duke *et al.* 2002; Loconte, 1993; Loconte, 1984). Members of genus Berberis are widely distributed in the Northern Hemisphere (Perveen and Qaiser 2010; Loconte, 1993). There are 29 Berberis species have been identified from Pakistan. *Berberis pseudumbellata* subsp. *gilgitica* is endemic to Gilgit-Baltistan and has become critically endangered (Khan *et al.* 2014; Alam and Ali 2010). Different ethno-lingual races in the study area use two local names commonly to call Berberis i.e. 'Ishkeen and Churkuye'. Almost 70-75% population calls it 'Ishkeen'. Shina language is widely spoken language in the area.

Inventorying of ethnobotanically valuable flora is an important first step to understand the ethnomedicinal and socio-cultural significance of plant species (El-Hilaly *et al.* 2003; Sheng-Ji 2001; Phillips and Gentry 1993; Sher and Hussain 2009). However, detailed investigation of each plant species would reveal more important insights in relation to socio-cultural, ecological, religious and commercial aspects (Deil *et al.* 2005; Taylor *et al.* 2001). Such a detailed study of individual species may enable development and academic communities to exploit them wisely to impact poverty, market marginalization and potential advancement in creation of alternatives towards health care practices (Garrity 2004; Roe and Elliott 2004; Scherl 2004; Reynolds *et al.* 2005).

Plant-human interaction around these naturally variegated valleys is an integrally intertwined and interwoven aspect of rural lives. It is therefore, traditional communities are mostly dependent on the natural resources for meeting their medicinal, food, shelter, economic and other livelihood purposes (Ali *et al.* 2008; Khan and Khatoon 2007; Pie and Manandhar 1987). Ethnobotanical investigations are important not only for health care but also critical to establish and continue an ecological balance between human and nature (Balée 1994; Gómez-Baggethun *et al.* 2010).

A growing number of ethnobotanists and anthropologists have univocally reported fast erosion of ethnobotanical folk wisdom around the world (Khan *et al.* 2013a; Sheng-Ji 2001; Begossi *et al.* 2002; Case *et al.* 2005; Lozada *et al.* 2006; Monteiro *et al.* 2006; Ferguson and Messier 1997; Pieroni *et al.* 2004; Shanley and Rosa 2004; Anderson 2005; Zent 2001; Turner and Turner 2008; Khan *et al.* 2013; Hamayaun 2005). According to Hocking (1958) people among these traditional communities were 84% dependent on their

indigenous folk medication practices. However, Khan *et al.* (2013) reported that in Hunza Valley people have lost ethnomedication practices and only a minor fragment (1.4%) use to practice.

Present study was aimed at documentation and exploration of folk wisdom, perceptions and practices regarding Berberis species among agro-pastoral communes living in Karakoram Mountain Ranges. In present scenario, these societies need special attention to explore them scientifically which has never been realized before (Qureshi *et al.*, 2006). Any delay on this part can lead to their annihilation in the hands of weathering forces of globalization.

Material and methods

Study area

Study area falls in the western part of Central Karakoram National Park (CKNP). During 2012-14 study focused 27 villages which were categorized into three major valleys viz; Bagrot, Rahimabad-Naltar and Rakaposhi (Nagar). CKNP is unique for its geomorphological, biodiversity and socio-cultural spectra. Keeping in view its global importance, it was declared as National Park in 1993. It is situated in Gilgit-Baltistan, Pakistan and falls into four administrative districts: Hunza-Nagar, Gilgit, Skardu, and Ghanche. It is the largest protected area (10,000 km²) in Pakistan having biggest glacial mass in the world outside poles. It extends over 35°N to 36.5°N Latitude and from 74°E to 77°E Longitude (Khan *et al.* 2014). Area is inhabited by 16 major tribes speaking four different languages of distinct origins i.e. Shina, Brushaski, Gujari, Domaki. Settlements start from the river bed to sub-alpine zones (1300 m to 3500 m above sea level). most recently, most of the area is accessible by jeep connected through link roads or pony tracts. However, more than 13 villages have become connected with Karakoram Highway constructed in seventies (1970s).

Sampling

***Sample frame*:** Sample frame was consisting upon three (3) major valleys stretched over 27 villages with 5480 households. A total of 52,048 souls are living in the study area. Population is living in small and medium sized settlements (villages) with dense or sparse distribution.

Fig. 1. Study area reflected within the Karakoram Mountain Range and Gilgit-Baltistan (right), while study area exhibited within geography of Pakistan (left).

***Sample size*:** Using following mathematical calculations and sample size (ss) calculator a total of 382 (male 197, 52.81%; female 176, 47.18%) sample size was calculated. However, during the course of study only 373 individuals were interviewed. This makes 97.6% of the total sample size drawn. Sample size (both male and female) was divided into three age groups each making a total of six (6) different groups i.e. below thirty (≤30 = 130, 34.85%), in-between 31 and 60 (≥31≤60 = 143, 38.33%) and above 61 (≥61 = 100, 26.80%).

Sample size calculations

$$ss = \frac{Z^2 * (p) * (1-p)}{c^2}$$

where

Z = Z value (e.g. 1.96 for 95% confidence level)

p = percentage picking a choice, expressed as decimal (0.5 used for sample size needed)

c = confidence interval, expressed as decimal (e.g., 0.04 = ±4)

***Sampling type*:** During the survey, stratified random sampling technique was employed across purposefully categorized geographic, gender and age strata.

Data collection: A detailed structured instrument was used to collect uniform data from different strata

of sample. Personal observations were also recorded to supplement the questionnaire data collection (Kvist *et al*. 2001). Questionnaire was oriented to maximize quantification of responses (Fraser and Junqueira 2010).

Data processing and analysis

Data gathered using instrument was digitized into MS Excel 2010 and then transferred to SPSS v.16.1. Various descriptive and inferential techniques were applied to analyze data including frequencies, standard error of mean, Pearson correlational coefficient, student t-test and regression analysis were performed.

Results and discussion

Different uses and use categories

across the traditional landscape, Berberis is used for various purposes. These needs can be categorized into at least six (6) broad classes viz; medicinal, firewood, fencing, grazing, fodder, commercial and cultural. Culture use in negligible and infrequent (n=9; 2.41%). Research did not find any use of Berberis for construction. Details of remaining five categories are given below;

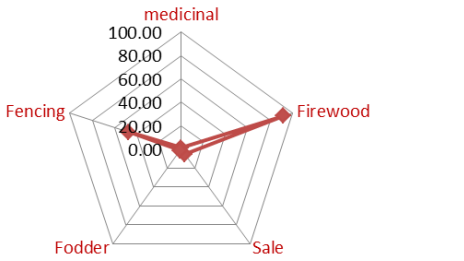

Fig. 2

Medicinal use

Respondents identified 28 distinct quantities used differentially as medicine. Most frequent annually used quantities are; 1.4 kg (n=119, 33.9 %), 1.0 kg (n=54, 15.5%), 0.25 kg (n=47, 13.4%) and 0.5 kg (n=25, 7.1%). Remaining 24 varied categories ranging from 0.019 kg to 6.8 kg, which are uncommon. On an average each household in the area uses 1.17 kg annually (fig. 2).

Firewood

During the study 19.3% (n=72) responded to the question regarding Berberis quantities use for firewood purpose at household level. Respondents mentioned 11 different quantities i.e. 8, 10, 15, 20, 24, 30, 32, 35, 36, 82.8 and 1600. Among these 11 quantitative categories, 36 kg (n=24, 6.4% and valid % = 33.3) is the most frequent quantity used among the communities followed by 10 kg (n=19, 5.1% and valid % = 26.4) and 15 kg (n=9, 2.4% and valid % =12.5). Remaining quantitative categories used have less than 1% (n ≤ 3, and valid % ≤ 4.2) for each. Data representation shows that people most commonly use quantities in-between 10 kg and 36 kg for their fire purpose at houses (Fig. 3). In the valley of Bagrot a total of 2244.8 kg (2.244 MT, 34.02%) is used as firewood at household annually. Similarly, in Rahimabad-Naltar total quantity is 4311.6 kg (4.311 MT, 65.34%) and in Rakaposhi it is only 42 kg (0.63%).

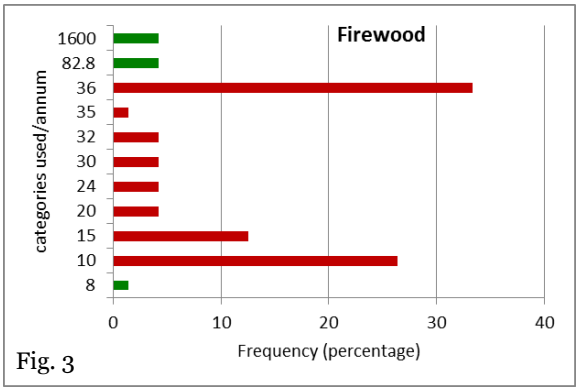

Fig. 3

Sale

Out of total (n=373) respondents, only 2.4% (n=9) interviewee replied to the question 'what quantities of Berberis they sell every year on an average?' 97.6% (n= 364) left this question without any reply, which was considered as missing data when processed using SPSS for calculations and analysis. These mottled quantities range in-between 1 kg and 12 kg. Moreover, these quantities are categorized into three (3) groups i.e. 1 kg, 3 kg and 12 kg. Out of total respondents

which are more or less involve in sale of Berberis hold equal share of only 0.8% (n=3). A total sale during 2012-13 was only 48 kg. Among three major valleys, Bagrot 16 kg (33.33%) and Rahimabad-Naltar 32 kg (66.67%). This study did not record any sale in Nagar Valley.

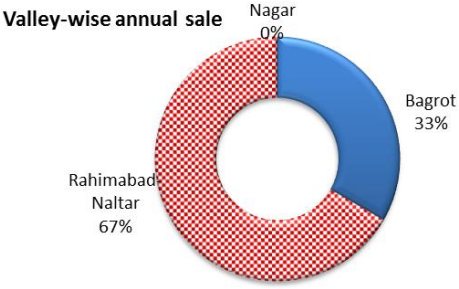

Fig. 4

Fodder

During the study only 16.1% (n=60) responded to the question. Amongst different quantities used, 150 kg (n=21, 35.0%), 180 kgs (n=6, 10%) and 300 kgs (n=6, 10%) per annum. Remaining categories were less common used by only 5% (n=3) each. A total of 8724 kg (8.724 MT) Berberis is collected every year for fodder purpose. Every year in Bagrot, 2908 kg (2.908 MT, 33.33%) and Rahimabad-Naltar 5486 kg (5.486 MT; 62.88%) is being collected. Nagar (Rakaposhi) valley as compared to others shows a least trend of using Berberis as fodder i.e. 330 kg (3.78%) annually. Statistical presentation shows a positive but very weak correlation between fodder quantitative ranks and their use frequency. Communities more frequently use quantities ranging between 150-300 kg per annum (Fig. 5).

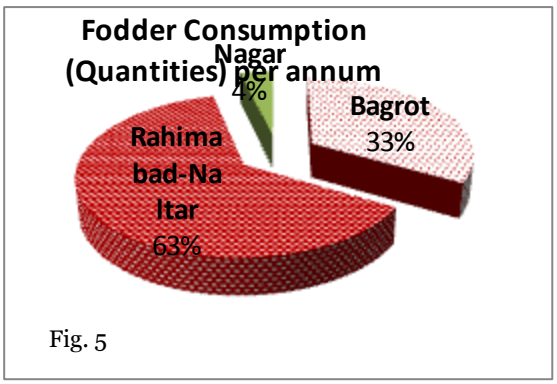

Fig. 5

Fencing

Berberis use for fencing purpose is one of the major consumption sites. Out of total sample size (n=373) only 19.0% (n=71) responded on the question about Berberis quantities used for fencing. Ten different quantities so expressed range between 12 kg and 300 kg. among all 20 kg (n= 26, 7.0%; Valid percent 36.6%) is the most frequent consumption quantity followed by 72 kg (n= 15, 4.0%; Valid percent 21.1%), 25 kg (n=9, 2.4%; Valid percent 12.7%) and 15 kg (n=5, 1.3%; Valid percent 11.3%). Remaining six (6) categories showed lesser frequency (< n= 3, < 1.0%; Valid percent < 4.2%) of use. A total of 3352 kg (3.352 MT) is used annually in the area. Each major valley has a varied consumption of Berberis for fencing annually. Rahimabad-Naltar showed highest quantities used for this purpose (1680 kg=1.68 MT; 50.12%) followed by Bagrot Valley with second highest quantity (1164 kg = 1.164 MT; 34.73%). Nagar (Rakaposhi) Valley showed the least utilization of Berberis for fencing with a per annum quantity of 508 kg (0.508 MT; 15.16%).

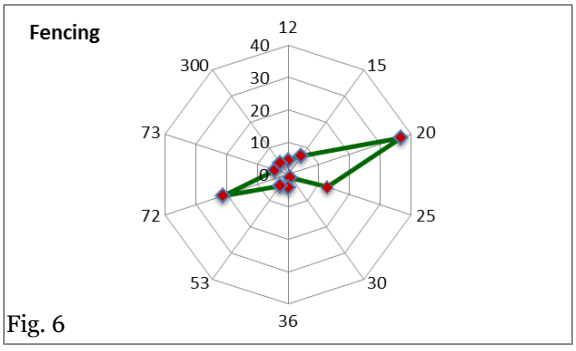

Fig. 6

Analysis shows a declining linear trend between consumption categories and their respective percentage frequency utilization. Moreover, there is a weak relationship between the two aspects of the parameter under discussion (Fig. 6).

Population change

For the last fifty (50) years, there is no change in Berberis population (n=200, 53.6%). However, 30.3% (n=113) still believe that population has changed. Furthermore, 16.1% (n=60) people told that they do not know whether it has changed or not.

Change direction: Out of change believers 12.9% (n=48) told that population has decreased significantly (Fig. 7). However, 14.5% (n=54) favor a slight decreased. Whereas, 2.1% (n=8) interviewee told that the population has increased significantly, for 1,6% (n=6) there is a slight increase in the population.

Population change factors

Only 27.9% (n=104) respondents said that plantation (n=6:1.6%) has healthy contribution towards population growth. However, commercialization (n=21: 5.6%), over grazing (n=23: 6.2%), development activities (n=32: 8.6%), medicinal exploitation (n=6: 1.6%) and other (n=16: 4.3%) factors have negative impact. Population change factor analysis shows that developmental activities are the most ruinous factor followed by over grazing and commercialization, to name top three ones. This change has occurred across all varieties (general) and not to a specific variety. Moreover, this change is 94.23% unhealthy and only 5.76% healthy (Fig. 7).

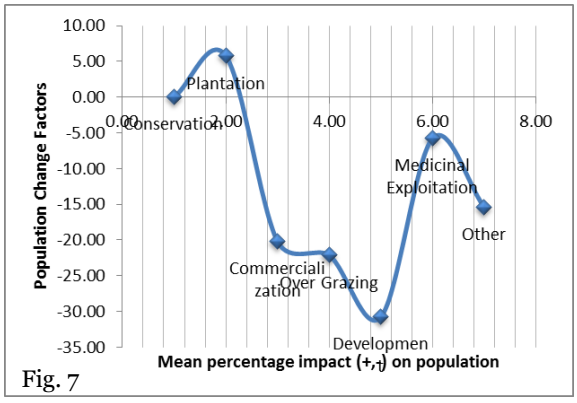

Fig. 7

Aknowledgement

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