CONSERVATION OF *PINUS GERARDIANA* (CHILGHOZA PINE): A CASE STUDY OF HUDUR VALLEY, DISTRICT DIAMIR, GILGIT-BALTISTAN, PAKISTAN

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ABSTRACT

The current study on ‘‘Conservation of *Pinus gerardiana* (Chilghoza pine): A case study of Hudur valley, District Diamir, Gilgit-Baltistan, Pakistan’’ was carried out in Chilghoza forest of Hudurd valley, District Diamer. The study area is situated in the foothills of Hindukush Mountain Range at an elevation of 2500 to 5000 m with an area of 334.295 km². The main objective of the study is to find out the current status of Chilghoza forest in Huder Valley. Data on *Pinus gerardiana* was collected through Point-Centered Quarter Method from 80 sample plots. Four stands of Chilghoza forest were selected randomly for the enumeration of data from different locations and aspects. In each stand a transect line was laid out and after every 30 m twenty plots were taken for collection of data on species composition, their DBH and heights. This data was used to estimate growing stock and carbon stock in the study area. *Pinus gerardiana* is present in all four stands as the leading dominant specie. Average Density of all stands was calculated as 342.88 trees/ha with basal area 55.34144 m^2/ha. The average volume of all stands was calculated as 132.324m^3/ha. The distribution of *Pinus gerardiana* is satisfactory in almost all the stands however the distribution of associated species are poor. Due to poor distribution and gaps in small size middle and in large classes, *Juniperus excelsa* and *Quercus ilex* seem to be losing ground in this forest due to anthropogenic activities including felling, grazing, sliding, burning and other natural factors. The study recommends devising a proper management plan for Chilghoza forests in consultation with local communities.

INTRODUCTION

Pinus gerardiana locally known as Chilghoza pine is a native species of Western Himalayas and the Hindukush mountains of Pakistan and Afghanistan extending south to the Sulaiman range in Balochistan. It is found in the inner dry valleys of Chitral, Kuram, Upper Swat and Gilgit Baltistan (Sheikh, 1993). It usually occurs at elevations between 1800-3350 m. It often occurs in association with Blue pine (*Pinus wallichiana*), Deodar (*Cedrus deodara*) Juniper (*Juniperus excela*) and Oak (*Quercus ilex*) (Richardson and Rundel, 1998).

The species has aptly been described as the ‘‘*Champion of Rocky*

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Mountains" as it grows under difficult sites conditions as prevailing in the inner Himalaya. The species occurs in dry temperate region experiences low temperature and scanty precipitation received mostly in the form of snow during winter. Besides, the species is an excellent soil binder and prevent large scale soil erosion from the otherwise lose and fragile strata in the region (Sehgal and Khosla, 1986).

In Pakistan, *Pinus gerardiana* is found in Gilgit Baltistan, Upper Dir and the North-eastern portion of the Zhob district in Baluchistan. The rampant decline in growth of Chilghoza pine throughout the world due to different reasons coerced the conservationists in the arena of natural resource management to include it in IUCN Red list of Threatened species (Akbar *et al*., 2014).

Gilgit-Baltistan is situated in the extreme north of Pakistan, bordering China and Afghanistan in the north (35˚-37') and India in the east (72˚-75'), covering an area of 72,496 square kilometers. The whole area falls within the high mountain ranges of Karakorum, Himalayas, Hindukush and Pamir with most of the area situated above 4500 meters above sea level. Climatic conditions vary widely in the Gilgit Batistan, ranging from the monsoon-influenced moist temperate zone in the western Himalaya, to the arid and semi-arid cold desert in the northern Karakoram and Hindu Kush. Below 3000 m, precipitation is minimal, rarely exceeding 200 mm annually. However, there is a strong gradient with altitude, and at 6,000 m, the equivalent of 2000 mm per year falls as snow. Temperatures in the valley bottoms can vary from extremes of 40°C in summer to less than –10°C in winter (Govt. of Pakistan, 2003). The total forest area of Gilgit Baltistan is 337,491 ha which falls in dry temperate zone (Bukhari *et al*., 2012).

Gilgit-Baltistan hosts valuable natural forests but these forests are under severe anthropogenic pressure. All forests in Chilas, Darel and Tangir valleys of Diamer District are owned by the local communities and are classified as 'Private Forests' (Rao and Marwat, 2003). These forests are regulated under the Gilgit Private Forests Regulation, 1970 and the Rules notified in 1975. In accordance with the Accession Deed of 1952 with the Govt. of Pakistan, the ownership of the private forests of Chilas, Darel and Tangir in Diamer District rests with the local communities. However, these forests are under the management of the forest Department. These forests have been degraded due to commercial logging that was regulated under various working schemes and illicit felling. Nobody has given any attention to rehabilitation and regeneration of these forests.

Chilghoza pine has enormous value in the private forest of Diamer economic value. Diamer has the biggest forest resources in Gilgit Baltistan (GB). The forests cover is about 217,088 hectares which constitutes more than 75% of the total forest in the GB. All of the forests are classified as private and none has

any legal protection. The forests in Diamer are mainly classified as Dry Temperate Coniferous Forests. These forests are subjected to commercial logging through private contractors who do not care about regeneration (Rao and Marwat, 2003). This situation is often aggravated by repeated extensions in contract periods, allowing additional trees for felling and issuing permits beyond the limit of sold volume of timber.

The Chilghoza forests of Gilgit-Baltistan have been under over-exploitation without any proper management plan. No attention has been given to the sustainable management of forests based on scientific principles. Few studies have been conducted on these forests but mostly are focused on socio-economic and livelihood aspects of the forest communities. The Chilghoza forests are faced with serious problems of regeneration but no reliable data is available to devise proper management plan for these forests. In this context, the current study was conducted in Hudur Valley of District Diamer. The main objective of this study is to assess the current status of Chilghoza pine forests in Hudur, Diamer.

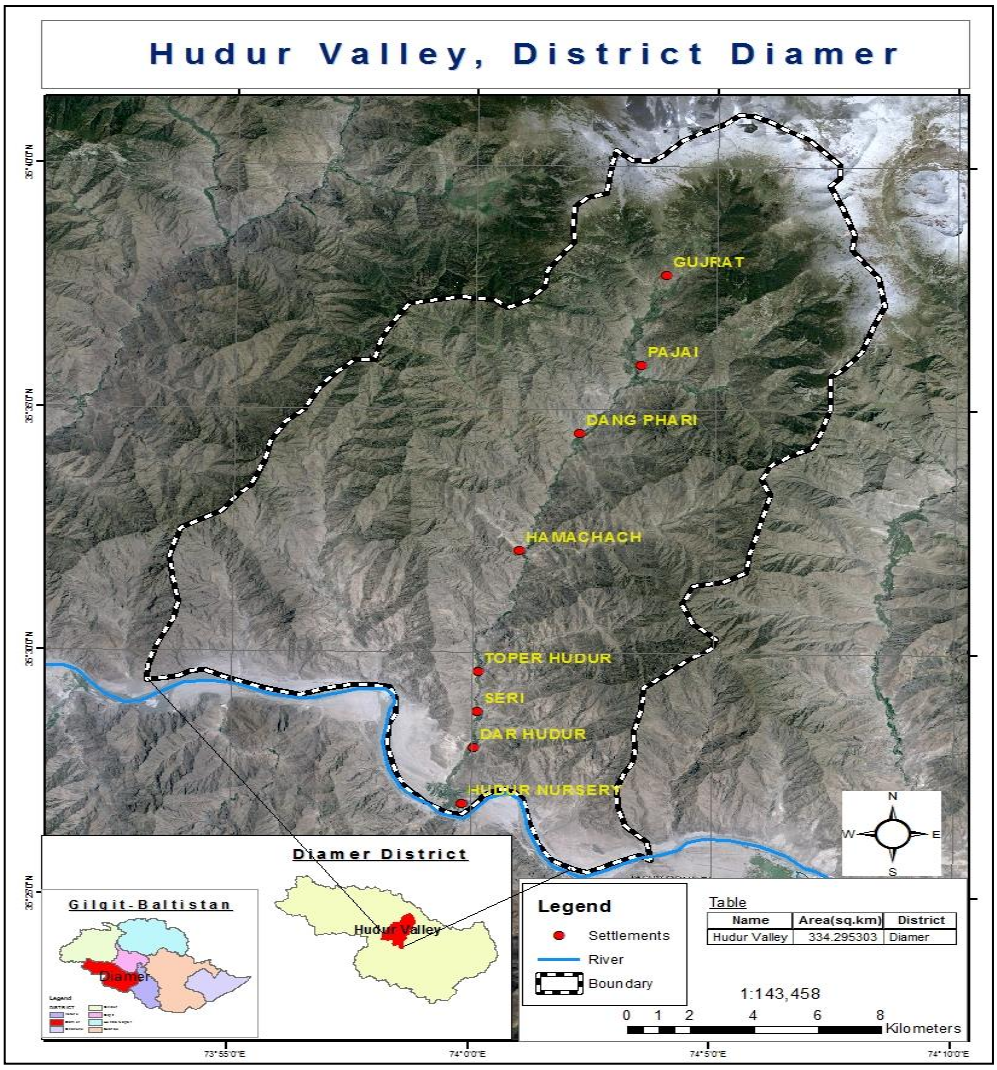
MATERIAL AND METHODS

Data on the status of *Pinus gerardiana* was collected through field survey conducted in Huddur Valley of District Diamer, Gilgit Baltistan in August, 2015 using Point-Centered Quarter (PCQ**)** Method. The (PCQ) Method is perhaps the most popular of the plotless sampling techniques (Akbar *et al*., 2014). Four stands were randomly selected in different locations in the Chilghoza pine forest of Hudur Valley. Sample points were selected along a transect, in each stand 20 points were taken at every 30 m interval. The area near each random point (sample point) is divided into four imaginary quadrants. Within each quadrant, the distance from the random point to the nearest tree is measured. As there were four quadrants so total of four trees were measured at each sample point. For each individual tree, the species name, its diameter and height were recorded. Diameter at breast height (dbh) was measured at 1.37 m height above the ground with the help of diameter tape. The tree height was measured with clinometer and recorded on the form. The plots estimates were converted into per ha estimates and projected for the study area. The following formulae were used to determine plot area, basal area and volume.

Plot area (ha) = 10000 m^2/(Mean point to plant distance)^2

Basal Area of Species = sum of basal area of species per quadrate

Volume = basal area*height*form factor



RESULTS

Average Density, Basal Area and Growing Stock

The elevation of the selected stands ranged from 2560 m to 2906 m and the aspects of these stands were north south and west. The average density of the forest was 342. 88 trees per ha with mean basal area of 55.34 m^2/ha and growing stock of 132.32 m^3/ha. Stand No.1 was found to be more dense than other stands in terms of individual trees per ha but in terms of basal area and volume, Stand No. 2 was found on higher side as compared to other stands as

shown in Table 1. Stands on western aspects have highest basal area and volume followed by southern and northern aspects.

Table 1. Summary of Stands

Stand No.	Elevation (m)	Coordinate	Aspect	Density/ha	B.A m²/ha	Volume m3/ha
1	2560	N35° 59' 23" E74º 58' 36"	North	289.55	48.33	72.028
2	2660	N35° 49' 24" E74º 42' 32"	West	199.18	99.52	210.294
3	2688	N35° 35' 25" E74º 06' 58"	South	737.23	48.33	199.864
4	2906	N35° 52' 29" E74º 39' 19"	North	145.54	25.18	47.1108
Average				342.88	55.34	132.324

Stand No 1. Dar Hudur

The Stand was located between N35° 59' 23″ and E 74º 58' 36″ at an elevation of 2560 m above sea level, with a slope of 50°on Northern aspect in Hudur valley. Average Density of the Stand was calculated as 289 trees/ha with basal area 48.33 m^2/ha. The volume of this stand was calculated as 72.028 m^3/ha. The stand comprises three tree species which include *Pinus gerardiana, Quercus ilex* and *Juniperous excelsa*. Figure No 4.1 shows distribution of trees in different DBH classes for three different species. The highest frequency of *Pinus gerardiana* was found in class 41-50 followed by 31-40 cm dia class and it was lowest in 81-90 cm class. DBH classes 1-10, 61-70 and 91-100 has zero frequency. The frequency of oak was found highest in two classes 11-20 and 31-40 as compared to its frequency in other classes, its lowest frequency was found in 21-30, 41-50 and 51-60 DBH classes. The classes 1-10, 61-70, 71-80, 81-90 and 91-100 have zero oak frequency indicating that older trees of oak are missing in the area. While small number of Juniper was found in 11-2, 21-30 and 51-60. Due to heavy open grazing, the general condition of the stand is poor and degraded. Due to the poor distribution in small size classes, *Juniperus excelsa* and *Quercus ilex* seem to be losing ground in this stand.

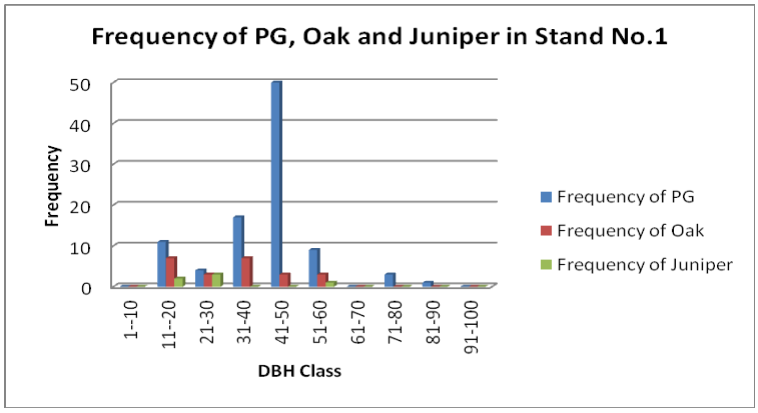


Fig. 1. Stand No. 1

Stand No 2. Seri

This stand lies between N35° 49' 24″ and E74º 42' 32″ at an elevation of 2660 m above sea level, while degree of slope is 45° on Western exposure in Hudur valley. Density of the stand was calculated as 199 stems per ha with basal area 99.52 m^2/ha. The volume of stand No.2 was calculated 210.29 m^3 per ha. The Figure No 4.2 shows distribution of trees in different DBH classes for three different species for Stand No 2. The highest frequency of *Pinus gerardiana* was found in class 51-60 and following this class 31-40 has the second highest number of *Pinus gerardiana*. The lowest was in 1-10, 11-20, 61-70 and 81-90. DBH class 91-100 has zero frequency. The frequency of oak was found the highest in class 31-40 while 11-20 and 51-60 have high number as compared to other classes. The classes 1-10, 41-50, 61-70, 81-90 and 91-100 have zero oak frequency. While juniper was found highest in 11-20 and 31-40 and 21-30, 51-60 and 71-80 have also small number of Juniper. The dia classes having less or no trees of these species indicate that anthropogenic disturbances prevail in the area.

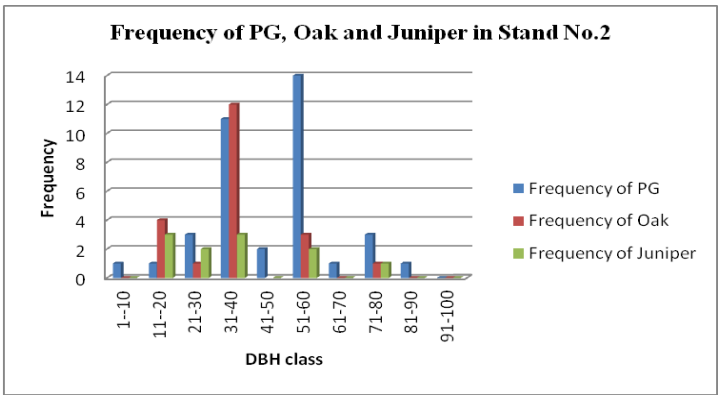


Fig. 2. Stand No. 2

Stand No 3. Toper Hudur

This is located in Hudur valley lies between N 35° 35' 25″ and E 74º 06' 58″ at an elevation of 2688 m above sea level, while degree of slope is 40, facing on Southern exposure. Density of the stand was calculated as 737 stems per ha with basal area 48.33 m^2/ha. The volume of stand No.2 was calculated 199.864 m^3 per ha. The As shown in Figure No 4.3 all the three species have fairly distributed in different DBH classes in the stand. The highest frequency of *Pinus gerardiana* was found in class 41-50 and following this class 21-30, 31-40 and 71-80 has the second highest number of *Pinus gerardiana*. There were also sufficient number of trees in 11-20 and 51-60 DBH classes. The lowest was found in 1-10 and 81-90. DBH class 91-100 has zero frequency. The frequency of oak was found the highest in class 21-30 while 11-20 and 31-40 have also high number as compared to other classes. The classes 1-10, 81-90 and 91-100 have zero oak frequency. While juniper was found highest in 21-30 and considerable frequency was also found in 11-20, 31-40, 41-50 and 71-80. The size class distribution of *Pinus gerardiana* is satisfactory the whole pressure is on the other associated species.

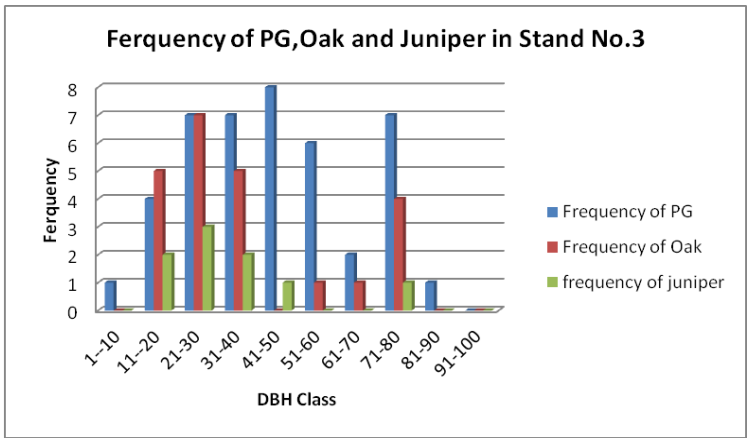


Figure 3 : Stand No 03

Stand No 4. Dang Phari

This stand of is situated at N35° 52' 29″ E74º 39' 19″ elevation 2906 m above mean sea level with 30 degree of slope facing Northern exposure. Density of the stand was determined as 145 trees per ha with basal area 25.18 m^2/ha. The volume of stand No.4 was calculated 47.110 m^3 per ha. The Figure No 4.4 shows distribution of trees in different DBH classes for different species for the Stand. The highest frequency of *Pinus gerardiana* was found in class 21-30 and following this class 31-40 has the second highest number of *Pinus gerardiana*. There were considerable number of trees in 11-20, 41-50, 51-60, 61-70 and 71-80 DBH classes. DBH class 1-10, 81-90 and 91-100 has zero frequency of *Pinus*

geradiana. The frequency of oak was found the highest in class 21-30 while 31-40, 41-50 and 51-60 have small number as compared to other 21-30. The classes 1-10, 11-20, 61-70, 81-90 and 91-100 have zero oak frequency. While juniper was found highest in 21-30 and few trees of juniper were found in 31-40, 41-50 and 51-60. In this forest, distribution pattern of *Pinus gerardiana* is satisfactory which may control through introduce new recruits while *Quercus ilex* and *Juniperu sexcelsa* indicated that these species may vanish soon from this forest, if current activities not stopped.

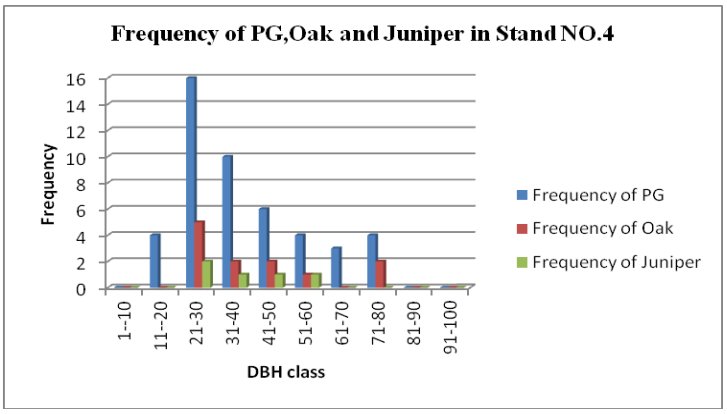


Fig. 4. Stand No. 4

Discussion

The pattern of size classes' distribution of different species indicates that the distribution of *Pinus gerardiana* is satisfactory in all four stands and this distribution shows a regular pattern which ensures the sustainability of this species in the area. The survey shows that *Pinus gerardiana* is present in all (04) stands as the leading dominant specie. On the other hand, the distribution of *Juniperus excelsa* and *Quercus ilex* is poor in almost all the stands. This is probably due to the divergence of the anthropogenic pressure from Chilghoza to other species. As overgrazing, cutting, sliding, burning and farming are prevailing in the area, the natural forests are under tremendous pressure. However, due to the economic value of Chilghoza nuts, top priority is given by the local communities to conservation and protection of Chilghoza pine. Rest of the species do not receive such attention from the local people. It is feared that if this situation continues these species will face severe threats of disappearance leading to loss of biodiversity in the area. Similar findings have been reported by other researchers for different areas, including Ahmed (1984), Wahab *et al.* (2008), Akber *et al.* (2013), Hussain *et al.* (2013) and Akber *et al.* (2014) .

Conclusion and Recommendations

The density of *Pinus gerardiana* is quite good in almost all stands as compared to the other associated species. The average density of all four stands was found to be 342.88 trees/ha with basal area 55.34 m^2/ha and average volume of 132.324m^3/ha. Highest density was found in Stand No.3 in terms of individual trees per ha but in terms of basal area and volume, Stand No.2 was found on higher side as compared to other stands. Stands on western aspects have highest basal area and volume followed by southern and northern aspects.

The size class distribution shows that growing stock and regeneration of *Pinus gerardiana* is satisfactory. However, the existing densities of *Quercus ilex* and *Juniperus excela* are inadequate and need proper protection and management to conserve and manage these specie on sustainable basis so that the requirements of local communities are fulfilled without causing damage to the resource base and ecosystem. As Chilghoza is a major source of income for local communities, therefore, they give full protection to Chilghoza forest and every member of the community tries his best to conserve Chilghoza forest. Oak is also protected due to its fodder value. However, other species are given no protection.

Based on the findings of the field surveys and in-depth discussions with local communities and officials of Forest Department it is recommended that an integrated natural resource management plan be prepared and implemented in consultation and participation of local communities. Besides the economic value of Chilghoza forests for edible nuts production, their role in biodiversity conservation, watershed management and carbon sequestration need to be assessed and documented.

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