

CHILGOZA PINE (*PINUS GERARDIANA*) FORESTS IN AFGHANISTAN: CURRENT STATUS, TRENDS IN REGENERATION, MANAGEMENT & PROTECTION WITH SPECIAL REFERENCE TO NURISTAN PROVINCE

Shahidullah Amn¹, Ramesh Chhetri² & Wasimullah Zaland³

^{1,2}Research Scholar, Forest Research Institute (Deemed To Be) University, Dehradun, Uttarakhand, India

³Research Scholar, Faculty of Agriculture, Kyushu University, Fukuoka, Japan

ABSTRACT

Chilgoza pine (*Pinus gerardiana*) is one of the most economical and ecologically important forest tree species in dry temperate forests of Hindu Kush-Himalayan region. Due to over-exploitation and mismanagement, this species is listed under near threatened category of the IUCN red list. This study aims to assess the current status, trends in natural regeneration, management and protection efforts of chilgoza forests in Nuristan province of Afghanistan. A total of 40 sample plots were surveyed to estimate the regeneration status of chilgoza pine with each circular plot having a size of 500 m² with a radius of 12.6 m. The regeneration status of chilgoza pine was found to be good in 12 plots (25.60%), medium in 18 plots (44.12%) and poor in the remaining 10 plots (30.28%). The overall regeneration rates of chilgoza in the forests were found to be medium (420 plants/ha). Comparatively higher regeneration rates were found on the North-eastern aspect than those on the South-western aspect. The majority of respondents had no awareness about the threatened status of the chilgoza species. It was also found that the majority of villages (90%) were involved in managing chilgoza forests by themselves. Thus, this study strongly recommends the preparation of sound management plan and enforcement of laws and acts for management and protection of the chilgoza forests in the country.

KEYWORDS: IUCN, Nuristan Province, Over-Exploitation, *Pinus gerardiana*, Regeneration

Article History

Received: 06 Jul 2019/ Revised: 23 Sep 2019/ Accepted: 14 Oct 2019

INTRODUCTION

Pinus gerardiana is economically and ecologically the most important forest tree species in Afghanistan, commonly known as chilgoza, chalghoza, pine nut or Himalayan nut pine (Farjon, 1988). It is one of the 110 pine species of genus *Pinus* L., found at an elevation between 1800 to 3350 m above sea level in temperate forest (Khan *et al.*, 2015), existing in East Asia, South and South-East Asia, West and Central Asia. Chilgoza pine trees are native to dry temperate forest found in Hindu Kush-Himalayan region (UNEP, 2008). Besides boosting the national economy, chilgoza pine also plays an important role in the socio-economic development of local communities. *Pinus gerardiana* produces edible nuts/seeds that are rich in many essential nutrients such as proteins, carbohydrates, fats, mineral matter and fibers (Thakur *et al.*, 2009). It is an excellent source of fine turpentine resin and its seeds are used as anodyne and stimulant while the seed oil is used against wounds and ulcer. The fresh seeds contain sugars (4.07%), proteins (13.03%), oils (52.15%) and moisture (25.36%)

(Shalizi and Khurram, 2016). The seeds have high demand in the local, national and international markets and fetch very good prices (Peltier and Dauffy, 2009). The price of 1 kg of pine nuts is ranges between 20-40 US\$ in the open market (CARD-F, 2017). Chilgoza pine forests are also a very good source of fuelwood (both cones and woods), medicinal plants, serving as pastures and shelter for wild and domestic animals and provide other environmental services.

According to Kumar *et al.*, (2016) there are numerous biotic and abiotic factors that affect the natural regeneration of chilgoza pine forests. In case of *Pinus gerardiana* forests, it regenerates naturally through the dispersal of seed. The production of seed from chilgoza trees may not be uniform every year (Malik and Shamet, 2008) like other pines and the production of the seed may follow a multi-year cycle, and is also influenced by various ecological elements that impact the coincidence of production of the mature female cone and the pollen density. Dispersal of the chilgoza seeds is also carried out by birds and rodents. There are very less chance for the survival of newly germinated seedlings of chilgoza as they are highly prone to drought, extreme heat, frost and low soil moisture (Kumar *et al.*, 2014).

Moreover, according to Akbar *et al.*,(2014) the major pests and diseases that can affect natural regeneration directly or indirectly are cone worms, cedar cone moths, cone borers, bark beetles, fungal diseases and parasitic plants. Ecologically, chilgoza pine trees prevent large scale soil erosion from the forest surface mainly in the semi-arid and dry temperate forest. In general, the chilgoza pine species has a socio-economic value for the livelihood of rural societies living close to the chilgoza forest stands (Malik, 2012). Kumar *et al.*, (2014) also reported that the natural regeneration of *Pinus gerardiana* occurs only by wind dispersal of seed with yearly cone production changing as a result of ecological conditions. The ongoing human-related disturbance may also reduce the capacity of natural regeneration in chilgoza pine forests. In other words, the absence of sound management plans has threatened the existence of this commercially and ecologically valuable species in its natural range (Kumar *et al.*, 2016).

According to the IUCN Red list of threatened species, the *Pinus gerardiana* species are categorized under the “Near Threatened” status due to over-exploitation and mismanagement. The absence of sufficient information in several aspects such as ecology, soils, genetics, stands structure, natural regeneration, and marketing channel, the current status and trends in chilgoza pine forests have not been broadly studied in Afghanistan. The favorable climate of the region provides a significant opportunity for chilgoza pine forestation so that the communities can have a long-term assurance as to the means of income and employment. However, the decades-long conflict, deforestation, insecurity, mismanagement and lower yields than anticipated; destroy much of this advantage and opportunities for rural communities settled in the region. This lower yield is mainly caused by improper harvesting and post-harvest practices carried out by traders and labor hired for those purposes. The lack of best forest management practices, limited skills & knowledge as well as poor marketing and processing practices are the key challenges that restrict the overall development of the chilgoza pine forests. Thus, there is an urgent need for research to be conducted in order to see how best we can help in conserving the chilgoza pine forests to meet the pressing need of the society. Thus, taking in above-mentioned consideration this study was focused on chilgoza pine to understand the current status and trends in regeneration, management and protection with the following objectives:

- To ascertain the current status of chilgoza pine conservation program in Afghanistan.
- To identify problems in current natural regeneration status of chilgoza pine and to investigate the regeneration intensity of the species.

MATERIAL AND METHODS

Profile of the Study Area

The location selected for studying the current status of natural regeneration, protection, and management of *Pinus gerardiana* tree species, is situated in eastern Afghanistan, which governmentally comes under the Nuristan province. Geographically, this province is located at 31°34' to 31°38' N latitudes and 69°43' to 69°57' E longitude with the elevation ranging from 500-3350 m asl. According to administrative division, Nuristan province has 8 Districts namely (Wama, Waygal, Kamdesh, Bargi Matal, Noorgram, Duab, and Mandol) along with its capital city Paroon (Figure 1). Nuristan is one of the most inaccessible regions in the eastern Afghanistan, lost amongst the steep spurs of the Eastern Hindu Kush which covers an area up to 9,942 km². According to the land cover atlas of Afghanistan, the total area under the forest and high shrub cover is 231,907 ha, and these forests have over 219,386 ha of pine-needled (open and close) forests with 2,194 ha area covered with pine nut forests with the total production of around 1,141 MT cones. The highest population of the pine nuts trees is located in Noorgarm, Mandol, Duab and Paroon districts of the Province.

Nuristan has dry temperate climate defined by (short summers from June to August and long winters from October to April), during winter the precipitation is received commonly in the form of snow with an annual precipitation rate in the area ranging between 200-1000 mm. The people in the study area are living below the poverty line, majority of its population are farmers and daily wages workers that highly depend on the forest products containing the cutting of pine trees and grazing in order to sustain their livelihood. The study profile comes under the more hilly and remote areas of Afghanistan with a low literacy level and absence of quality education. Chilgoza pine is the most dominant and important forest tree species found in the study area which plays an important role in the livelihood of communities by providing food, fuelwood, medicinal plants, pasture and shelter for livestock.

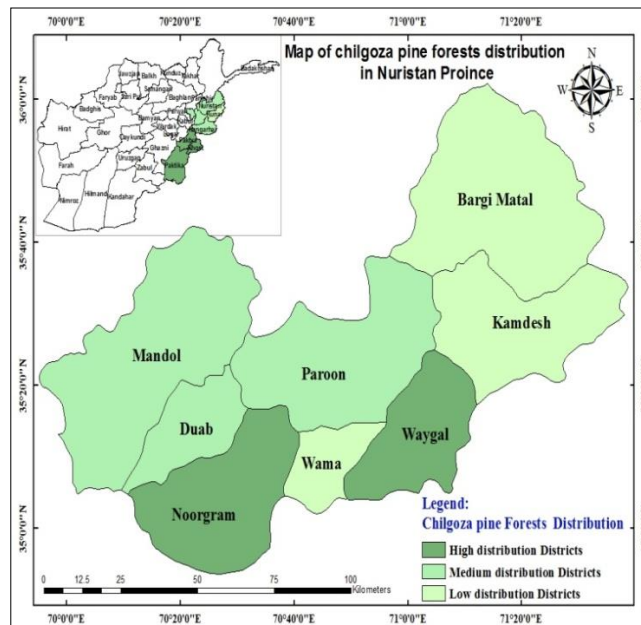


Figure 1: Study Area Location Map.

Sampling Design

For this study, the stratified random sampling method was used

Shape and Size of Sample Plots

Prefixed plots/grids sampling technique was used for the field measurement. Keeping in view various factors such as time, cost, species variability and terrain, a total of 40 sample plots were taken for the research study. The circular sample plots with a radius of 12.6 m were laid (ANSAB, 2010) to measure natural regeneration of chilgoza pine and its associated plants (Figure 2). Total numbers of plots were equally divided over the area so as to lay out 1 plot per 54.85 hectares. In each sample plot, seedling and sapling having a diameter of 10 cm at breast height were counted. Circumference was measured by using a tap and then converted to dbh. And for the natural regeneration of chilgoza pine estimation, the seedlings (up to 1m height) and saplings (1-3 m height) were considered. In each of the sampling plots the dbh of the largest *Pinus gerardiana* trees was also measured.

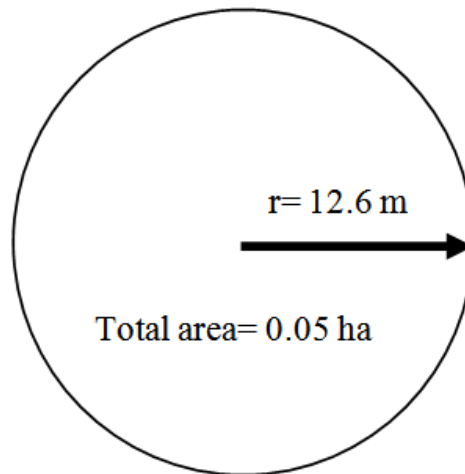


Figure 2: Sample Plot Design used in the Study.

To ensure the equal distribution of the plots and to avoid biases, a grid was drawn on the map having a known scale of the area. A map having a scale of 1:50,000 were selected and grids of 2x2cm (100 hectares according to the scale) were drawn on it. The radius of the sample plot was taken from the center point of each circle. In the map, the positions of the plots were taken with the help of satellite images of the area and its location on the ground was determined with the help of a compass. The data forms were filled in and the calculation of regeneration status per hectare was performed. The details of the sample plots and questionnaires survey are given in (Table 1).

Table 1: Total Coverage of the Study Area in Nuristan Province

S/N	Districts	Data Collection Sites Based on Samples Plots	Data Collection Sites Based on the Questionnaire Survey
1.	Noorgram	6 sample plots: Maleldara, Wodhoodara, shaamdara, Kaltandara, Titindara, and Pandawdara	18 questionnaires: Maleldara (4), Shaamdara (6), Bashgardara (2), Pandawdara (1), Titindara (3), and Kaltandara (2)
2.	Waygal	6 sample plots: Mandesh, Achwe, Arans, Hamshooz, Hafcholy, and Neshagram	15 questionnaires: Arans (5), Waygalsela (2), Mandesh (3), Hafcholy (2), and Achwe (3)
3.	Duab	8 sample plots: Kalayagal, Pyar, Korgal, Nelaab, Chandaldari, ZangalBashos, Gulsom and Palgal	14 questionnaires: Palgal (2), Chandaldari (1), Gulsom (3), Korgal (4), Pyar (2), and Kalayagal (2)

Table 1 Contd.,

4.	Mandol	5 sample plots: Kamata, Anesh, Candaw, Mawoo and Bandol	13 questionnaires: Anesh (5), Kamata (2), Bandol (3), and Mawoo (3)
5.	Paroon	6 sample plots: Dewa, Pashkay, Keshtakay, Kosht, Sosom, and Chatras	18 questionnaires: Sosom (4), Kosht (3), Keshtakay (2), Pashkay (2), and Dewa (7)
6.	Wama	5 sample plots: Bani, Kordar, Waw, Kandaw, and Nishegal	10 questionnaires: Nishegal (3), Kordar (3), Waw (1), and Kandaw (3)
7.	BargiMatal	2 sample plots: Peshorak and Afsaiy	6 questionnaires: Afsaiy (4) and Peshorak (2)
8.	Kamdesh	2 sample plots: Afsha and Geeti	6 questionnaires: Afsha (3) and Geeti (3)

Social Survey

This survey was aimed to assess the current status of chilgoza pine forests, trends in regeneration, perception on forest health, harvesting techniques, protection and management of chilgoza pine forests of Nuristan. Field observations were recorded on landscapes and information on any noticeable changes was marked. The data of this survey considered to be part of primary sources for data collection. This survey also focused on determining the activities, management and protection programs being implemented in Nuristan province. In this survey, the information was collected by community-based questionnaire methods.

Informal interviews were carried out to know the level of public awareness about the management, regeneration, protection, harvesting, storing and marketing of chilgoza pine forest. Key informants such as FGIGs, local NGOs, community leaders, forest department, etc. were interviewed. For focused group Individuals gathering, one questionnaire was set for GOs members; community members and local villagers involved in chilgoza pine management and living close to the chilgoza forest stands of Nuristan province. A total of 100 questionnaires were filled in by villagers and community members who were living around chilgoza pine forests. The number of people interviewed varied from a minimum of 6 people per district in (Bargi Matal and Kamdesh) to a maximum of 18 people in (Paroon and Noorgram) across the whole 8 districts of Nuristan province (Table: 1). Security and resource-wise viable villages were covered with extensive village-based questionnaires which were filled in to know the potential of production and challenges at the community level. Besides the local villagers and community members, 10 GOs and NGOs representatives engaged in Agriculture and forestry related activities were also interviewed. These interviews broadly focused on stakeholders, projects implemented by GOs and NGOs, awareness programs, making sound planning and strategies for chilgoza pine forests.

Secondary Data Source

For each of the sample plots, regeneration status was recorded through counting. The data forms were filled in and the calculation of regeneration status per hectare was made in the analysis. Secondary information was collected from related articles, thesis reports, journals, libraries, published reports, FAO atlas/database on needle forest and websites.

Data Analysis

The available socio-economic data collected from the questionnaires was analyzed by using computer software Microsoft Office (Word, Excel) and GPS data was analyzed by using remote sensing and GIS software. For each sample plots, regeneration status was recorded through counting.

RESULTS AND DISCUSSIONS

Regeneration Status of Chilgoza Pine Forests Based on Sample Plots

To determine the regeneration status of chilgoza pine forest, the data from the sample plots was arranged in three different groups, poor (low) regeneration, medium regeneration and good regeneration. Sample plots having up to 8 saplings per 0.05 ha were classified as "poor", those with 8-16 saplings were rated as "medium" and the ones with more than 16 saplings per 0.05 ha were grouped as "good" regeneration plots respectively.

The field survey indicated that the majority of the sample plots (44.12%) had medium regeneration while 30.28% sample plots fell under the poor regeneration category; only 25.60% sample plots were supporting good regeneration (Figure 3a). The *Cedrus deodara*, *Quercus baloot*, *Pinus wallichiana*, *Juglans regia*, and *Ziziphus jujuba*, etc, were the major associated species of *Pinus Gerardiana*. Higher rates of regeneration were recorded in Paroon, Waygal and Noorgram districts. However, while Kamdich and Duab were the districts with minimum regeneration rates (Figure 3a and 3b).

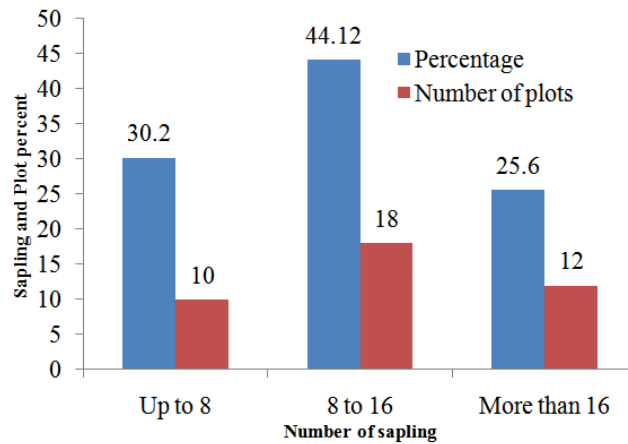


Figure 3(a): Regeneration Status and Number of the Saplings at Various Sample Plots, Poor = Up to 8, Medium = 8-16 and Good=16.

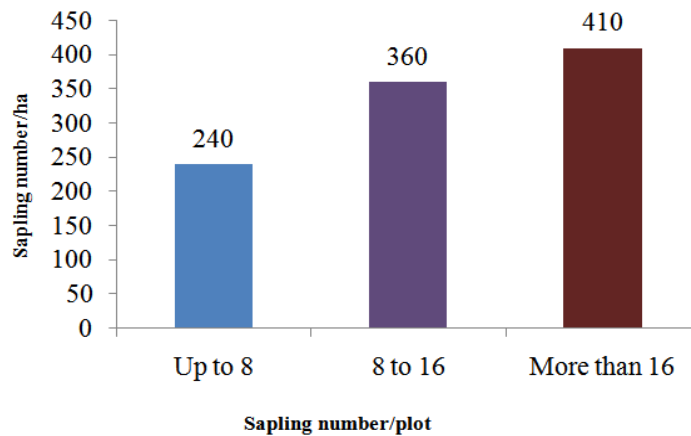


Figure 3(b): Shows the Number of Regeneration Saplings/ha.

It was also observed that chilgoza pine regeneration was affected by factors such as animal grazing, trampling by sheep and goats as well as eating by rodents and birds. Moreover abiotic factors such as strong heat from the sun,

deficiency of soil moisture, and desiccating winds also affected the growth of chilgoza seedlings. Furthermore, the soil moisture was a very important factor for regenerating seedling and water stress largely reduced conifer establishment even if the seed fall was found to be abundant.

Singh (1992) mentioned that animal grazing, birds, rodents and climatic factor affect regenerations in most of the forest species. The main factor responsible for the absence of natural regeneration in chilgoza pine was the practice of chilgoza cone collection by the local people and contractors (Ahmed, 1988).

Earlier, Ahmed *et al.*, (1991) reported that the number of newly regenerated seedlings was 494 per hectare in the Baluchistan province of Pakistan. It was higher than the number counted in most of the districts of Nuristan province through this study. At the study sites, natural regeneration was suppressed not only by livestock grazing in association with severe cone collection, but also by the occupation of the forests by *Quercus baloot*, *Cedrus deodara*, *Juglans regia*, in addition to fuelwood collection.

Aspect Versus the Number of Seedlings/Saplings

The arrangement and distribution of conifers trees vary based on changing in ecological factors such as precipitation, edaphic factors, latitude, longitude, elevation, etc. Therefore, the northern aspect is cooler and humid as compared to the southern aspect which is hot and dry. Subsequent to arranging the sampled data into two groups i.e. north-east and south-west, the numbers of seedlings and saplings, being the indicators of regeneration (good or bad) were grouped together. Random data of 10 sample plots was evaluated for each aspect to identify the influence of aspect on regeneration status. The collected data is given in (Figure 4). The data showed that the majority sample plots were supporting 65% saplings on the North-eastern aspect, and the 35% saplings were found on the South-western aspect.

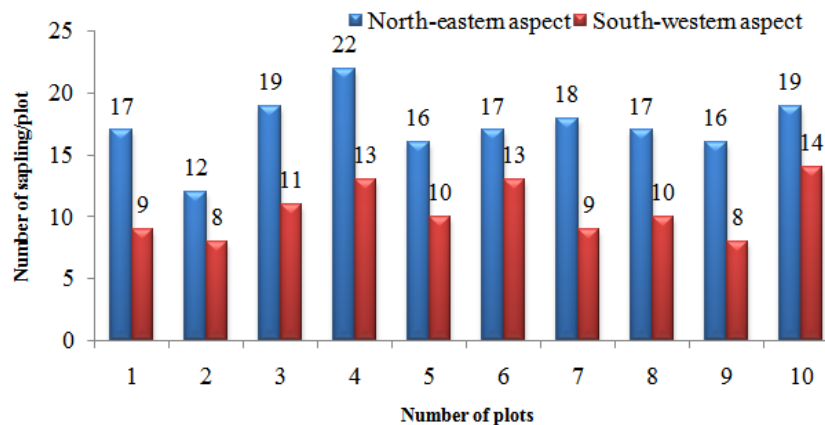


Figure 4: Displaying Regeneration Numbers at Different Sample Plots on North–Eastern South–Western Aspects.

Importance of Chilgoza Pine Forest to Local Communities

In the light of this study, Pine nuts forests are very important to the local villagers of Nuristan that are living close to the forest area. The local communities are extremely dependent on these forests. The surveys found that *Pinus gerardiana* is the most valuable NWFPs product among the other NWFPs such as Jujube, Mushroom, *Pistacia khinjuk*, walnut, acorns, etc. The result is shown in (Figure 5).

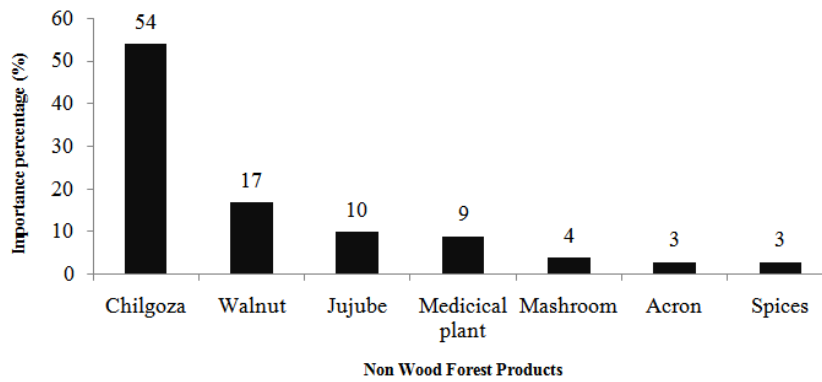


Figure 5: Importance of Chilgoza Pine Nuts Compared to other NWFPs.

Perceptions of Chilgoza Forest Health

Degradation of the chilgoza pine forests is one of the key factors of poor natural regeneration. Most of the natural regeneration was observed the understory layers of chilgoza trees stands. According to the villagers, a less number of Chilgoza seed germinate in the chilgoza pine forest in every spring season but it is not sufficient to keep all the chilgoza pine natural regeneration from declining.

To rate the health of natural regeneration, 47% of villagers answered that the regeneration health was medium and 35% responded that the regeneration was poor, while the 18% answered for good regeneration (Figure 6).The villagers also mentioned that allowing of grazing and collection of firewood in their pine forests reduced the natural regeneration level, while in those areas that are banned for animal grazing and firewood collection, the natural regeneration level were high, but these villagers seem to be aware that uncontrolled grazing and collection of fuelwood reduced their forest gradually, but they do not have enough education or financial power to develop the condition.

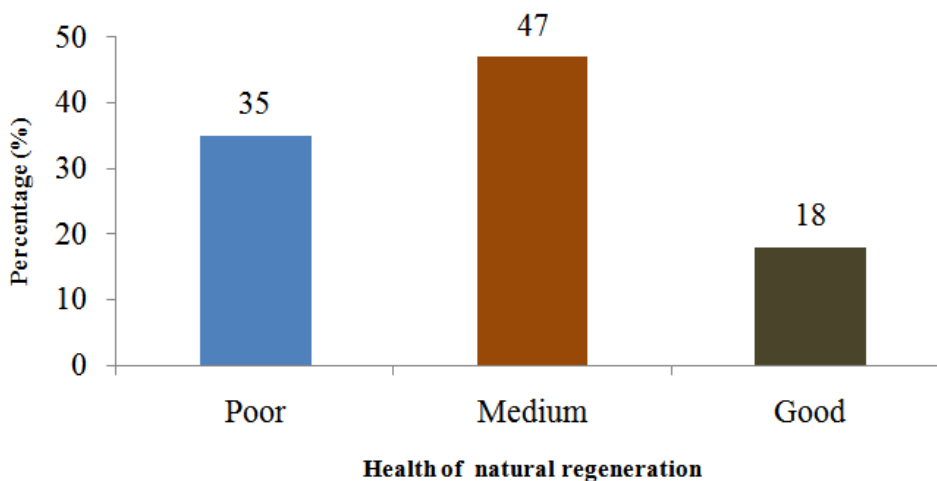


Figure 6: Rate of Natural Regeneration Health in Chilgoza Forest Stands.

Also, the health natural regeneration in respective forest areas was calculated and compared amongst Nuristan districts. At the District level, Noorgram, Paroon and Waygal have healthy natural regeneration, while Duab and Mandol have fair natural regeneration, and the district Kamdesh, Wama and Bargi Matal the health regeneration are poor (Figure 7).

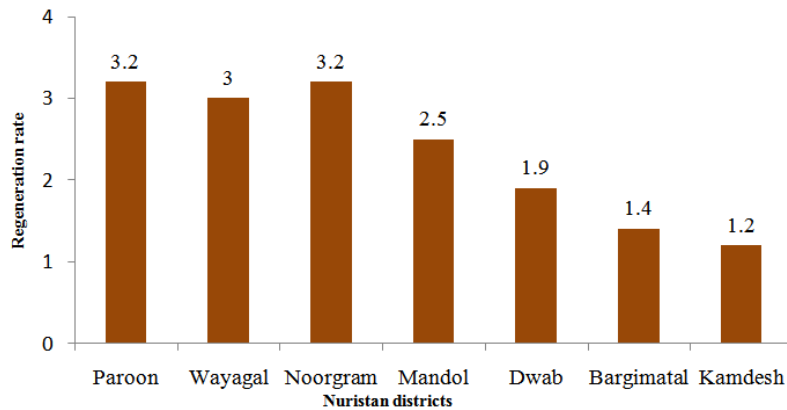


Figure 7: The Health of Chilgoza Pine Natural Regeneration Among Districts Based on Villagers’ Perception. 1= Poor Regeneration, 2= Medium or Fair Regeneration and 3= Good Regeneration.

Fuelwood collection, harvesting too many cones, livestock grazing, browsing, pests and diseases, droughts and natural disasters are all the problems that may reduce the natural regeneration of chilgoza pine. During harvesting, all cones on chilgoza pine trees are commonly removed. Due to inaccessibility, very few cones remain at the top of the chilgoza trees, which result in some new naturally regenerated seedling, but after germination, newly regenerated seedlings are grazed by livestock and injured during fuelwood collection and felling other trees from the chilgoza forests (Figures 8a & 8b).

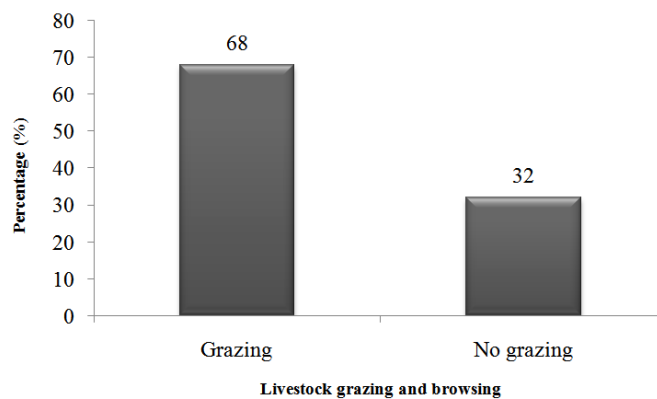


Figure 8(a): Percentages of Livestock Grazing in Chilgoza Forests.

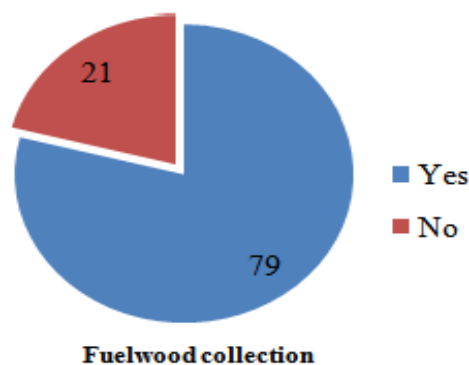


Figure 8(b): Fuelwood Collection in Chilgoza Pine Forest Stands Based on Villagers’ Perception.

The field survey also has shown that regeneration of chilgoza pine is different among districts and is affected by livestock grazing, harvesting of too many cones and collection of fuelwood as well as climatic variations and other disturbances. The natural regeneration was good in Paroon, Mandol and Waygal districts due to prohibit the firewood collection and livestock grazing by local people in these districts.

This survey showed that the following problems hinder the germination and establishment of natural regeneration in chilgoza pine forests of Nuristan province:

- Damage to the regeneration during felling and dragging trees for timber and trampling by human/animal during such operations.
- Cutting of cone-bearing branches by human beings while collecting pine nuts.
- Browsing and trampling of regeneration by animals while grazing in chilgoza forests. Longer establishment period of chilgoza pine seed.
- Chilgoza pines seedlings find it hard grow on bare rocks and thin topsoil: Loss of soil due to excessive harvesting and its consequent exposure to wind and rain erosion.
- Massive pest and insect attack (up to 30%) on the falling chilgoza seed.
- Chilgoza trees leave little space for the new crop to come up due to large crowns and branches.

Management, protection and restoration of chilgoza pine forests

Due to the lack of livelihood projects in Nuristan, the villagers are extremely dependent on the forests products which results in trees cutting, uncontrollable grazing, and seed collection causing a serious threat to the sustainability of these forests. This continued disturbance in the chilgoza forests has reduced the species to the level of a threatened status. However, the local people had no information about the threatened status of chilgoza pine in the IUCN red list. In the area studied, the forests are owned by the villagers, while the provincial government has no direct involvement in the management and conservation of these forests. For the management of forest it was found that the 90% of the villagers have their tribal rules. Community leader has the responsibility for the implementation of law and rules, and the maintenance of the respective forests. In some areas, the local communities have a penalty system for firewood collection, grazing of animals, for early cone collection and cutting of chilgoza trees. It was also noticed that the grazing was prohibited in chilgoza forest stands. In other areas, the chilgoza pine forests are protected by forest guards which are hired by the local communities. These guards are responsible for protecting and conserving the chilgoza forests as well as reporting of any violation in the forests to the shura leaders. In case of any destruction, the offenders were subjected to pay an offence of US\$ 100 per tree. The Natural Resources Directorate at MAIL is the key administrative association that is working for the protection, conservation, restoration and management of natural forests. Due to the lack of budget, security and expertise, the governmental organizations are yet to implement enough projects in Nuristan province. Since no research has been previously done on chilgoza pine forests in the mentioned province; this study is very important and provide a basis for further studies that will result in the development of a sound management plan in the area.

CONCLUSIONS

In the Nuristan mountain range, regeneration status of chilgoza pine was assessed. Chilgoza pines play an important role in the livelihood of local communities that are extremely dependent on forests. This over-dependence results in the cutting of trees, heavy seed collection and uncontrollable grazing causing a great threat to the sustainability of this vegetation in

Nuristan province of Afghanistan. The regeneration potential of *Pinus gerardiana* is on a declining rate due to biotic factors like animal grazing, trampling by sheep and goats, eating by rodents and birds, incessant harvesting of cones by local people coupled with abiotic factors such as strong heat of the sun, deficiency of soil moisture, and desiccating winds, flood, drought, snowfall and forest fire, cumulatively affected the growth of chilgoza seedlings.

Comparatively higher regeneration rates were found on the North-eastern aspect than those on the South-western aspect. The regeneration status of chilgoza pine was found to be good in 12 plots (25.60%), medium in 18 plots (44.12%) and poor in the remaining 10 plots (30.28%). The overall regeneration rates of chilgoza in the forests were found to be medium (420 plants/ha). The majority of respondents had no awareness about the threatened status of the chilgoza species. It was also found that the majority of villages (90%) were involved in managing chilgoza forests by themselves. Hence, it is inferred that the regeneration potential of *Pinus gerardiana* is on a declining rate in the above-mentioned mountain range due to high anthropogenic pressures. The main local problems to this mountain range are unlawful tree cutting, improper nuts collection, and unrestricted grazing. These various problems are affecting the ecological and physiological factors related to this species, which in turn can be answerable for the declining regeneration rate of *Pinus gerardiana*. For increasing the chance of survival of the species, different types of pre-treatments should be examined. Further ecological studies about biotic and abiotic perspectives affecting the regeneration of *Pinus gerardiana* are required which would serve as a guide for the chilgoza pine forest management in its natural conditions.

RECOMMENDATIONS

Based on the conclusions of results from the study following recommendations are suggested:

- Like other forests of the country, chilgoza forests must be managed under a proper management plan. For that purposes, a complete inventory of the standing stock should be prepared and the following information is needed to be collected i. e. crop grown, the number of trees/ha and natural regeneration status in the forest, etc.
- Directorate of Agriculture, Irrigation, and livestock should take immediate steps with the participation of local community to stop illicit cutting and overuse of rangelands. In this regard, long-term mutual planning and collaboration are needed.
- Enforcement of Forest Acts and Rules.
- Alternate livelihood options should be explored and promoted to enhance the income level of the project community.
- The community should be mobilized for the sustainable use of natural resources through extension programs. For this, a comprehensive awareness and conservation strategy should be devised for various target groups.
- Rotational grazing system should be implemented and it should be ensured that the biomass consumption should not exceed 50% and that livestock should be distributed evenly over the forest area.
- People should be trained for pre and post-harvest management of chilgoza nuts and establishing market linkages with chilgoza wholesalers and exporters to pass on the increased benefits from the sale of chilgoza nuts to the local community.
- Proper equipment and tools, as specified in earlier, should be given to the seed collectors so that the injuries and disabilities could be avoided up to a maximum extent.
- Capacity building training should be conducted on natural reforestation or self-reforestation, animal grazing management, pine nuts nursery establishment, new pine nuts forest establishment, cones harvesting techniques

and methodology, cones processing techniques and methodology, nuts extraction techniques and practices, nuts processing, sorting, grading, packaging, nut storage, marketing of pine nut and value addition aspects so that the product could bring more profits for the communities.

- Governmental and Non-governmental organizations with the coordination of local forest communities can help local people to develop direct linkages with the national and international markets avoiding the middle-men and agents that will ensure maximum benefits to the community.
- All the stakeholders, such as government line departments (agriculture, forest, etc.), community members, national and international organizations can establish a collective chilgoza processing plant in the valley to prepare export quality chilgoza products, which could be sent particularly to middle-eastern and other countries where the product could get higher prices.
- Afforestation and filling up of the blanks in forests in animal prohibited blocks for 4 to 5 years to grow up the trees to a reasonable height, above the trampling/browsing limit.
- Establishment of a network of nurseries to supply planting stock at doorsteps at subsidized rates, through forest department, allied government departments, Non-governmental organizations, and community-based organizations and through private persons.
- Establishment of one processing plant of pine nuts in Eastern region of Afghanistan in cooperation of producers and marketers association in order to process pine nut; extract pinnate from the cone, sort, grade and package them for the national and international market.
- Pine nut is the oil-rich product, therefore, oil extraction facilities are recommended, conditional on market demand, high economic benefit, and availability of low-grade pine nut.
- Motivate private entrepreneurs to invest in the proposed processing and packaging facilities with the technical and financial support of MAIL or donor-funded project.
- Local communities are inherently interested in chilgoza forest conservation; the Governmental and Non-governmental organization should implement livelihood projects, restoration projects, fuelwood and fodder alternatives projects for local communities.

REFERENCES

1. ANSAB. 2010. *Report on Forest Carbon Stock of Community Forest in three watersheds (Ludikhola, Kayarkhola and Charnawati)*. Asia Network for Sustainable Agriculture and Bioresearches, Federation of Community Forest Users, Nepal, International Centre for Integrated Mountain Development and Norwegian Agency for Development Cooperation. 49 pp.
2. Ahmed, A. 1988. *Population studies of some planted tree species of Quetta*. *Journal of Pure and Applied Sciences*, 7: 25-29.
3. Ahmed, M., Ashfaq, M., Amjad, M., and Saeed, M. 1991. *Vegetation structure and dynamics of Pinus gerardiana forests in Baluchistan, Pakistan*. *Journal of Vegetation Science*, 2(1): 119-124.
4. Akbar, M., Khan, H., Hussain, A., Hyder, S., Begum, F., Khan, M., and Ali, S. 2014. *Present status and future trend of chilgoza forest in Goharabad, District Diamer, Gilgit-Baltistan, Pakistan*. *Journal of Biodiversity and Environmental Sciences*. 5(5): 253-261.

5. CARD-F, 2017. *Pine Nuts Value Chain: An Assessment Report, focus on LoyaPaktia region.*
6. Farjon, A. 1998. *World checklist and bibliography of conifers.* -v+ 298 pp. UK: Royal Botanical Gardens Kew.
7. Khan, H.M.A., Zaman, M., Hyder, A.A.S., and Nafees, 2015. *Diameter size class distributions of Pinus gerardiana Wall. ex D. Don from Gohar Abad Valley District Diamer, Gilgit-Baltistan, Pakistan. Journal of Biodiversity and Environmental Sciences, 6(2): 50-56.*
8. Kumar, R., Shamet, G. S., Mehta, H., Alam, N. M., Kaushal, R., Chaturvedi, O. P., Sharma, N., Khaki, B.A. & Gupta, D. 2016. *Regeneration complexities of Pinus gerardiana in dry temperate forests of Indian Himalaya. Environmental Science and Pollution Research, 23(8), 7732-7743.*
9. MAIL. 2012. *Chilgoza Pine Forest Conservation and Restoration Plan-Draft Report.*
10. Malik, A.R. Shamet, G.S. and Majid, A. 2008. *Seed stratification of Pinus gerardiana Wall: Effect of stratification duration and temperature. Indian Forester, 134(8): 1072-1078.*
11. Peltier, R. and Dauffy, V. 2009. *The chilgoza of Kinnaur. Influence of the Pinus gerardiana edible seed market chain organization on forest regeneration in the Indian Himalayas. Fruits, 64(02): 99-110.*
12. Singh, P.L., Gupta, N., Singh, A.L. 1992. *Deterioration of physicochemical properties of chilgoza (Pinus gerardiana Wall.) seed during storage. Indian Journal of Plant Physiology, 3: 231–237.*
13. Thakur, N.S., Sharma, S., and Sharma, K.D. 2009. *Standardization of pretreatments for chilgoza Pinus gerardiana nut drying. Journal of Food Science and Technology Mysore, 46(2): 142-145.*
14. UNEP. 2008. *Biodiversity profile of Afghanistan: An output of the national capacity needs self-assessment for global environment management for Afghanistan. Kabul: United Nations Environment Program, pp. 15-48.*

