

INNOVATIVE APPROACH FOR THE MANAGEMENT OF MEDICINAL PLANTS: A CASE STUDY OF PLANT PINE NUTS (*PINUS GERARDIANA* WALL.)

MUHAMMAD ABDUL AZIZ^{1*}, MUHAMMAD ADNAN¹, AMIR HASAN KHAN²,
KAMEL A. ABDELLA³, ABDULAZIZ ALQARAWI³, ELSAYED FATHI ABD ALLAH³,
MASHAIL NASSER OMAR ALZAIN⁴ AND TAHIR MAHMOOD⁵

¹Department of Botany, Kohat University of Science and Technology, Kohat-26000, Pakistan

²Department of Botany, Shaheed Benazir Bhutto University Sheringal, District Dir (Upper) Khyber Pakhtunkhwa, Pakistan

³Plant Production Department, College of Food & Agricultural Sciences, King Saud University, Riyadh 11451, Saudi Arabia

⁴Princess Nourah bint Abdulrahman University, College of Science, Biology Department, Plant Production Department, Riyadh 11451, Saudi Arabia

⁵Department of Development Studies, COMSATS Institute of Information Technology, Abbottabad-22010, Khyber Pakhtunkhwa, Pakistan

*Corresponding author's email: azizmhsd@gmail.com

Abstract

Lack of attention to forest products' contribution to socioeconomic status has created a gap between the ecosystem services and its management. To fill this gap, current study has explored the management approaches, value chain activities, trade dynamics and economic potential obtained from the Nuts of medicinal plant *Pinus gerardiana* Wall. The main objective of the study was to highlight the prevailing gaps in knowledge, discussed the linkages among various players in the market, existing problems in the trade, and formulates future perspectives. Current study was completed with the help a comprehensive survey comprised of two phases. In the first phase, the local harvesters were interviewed about the various dynamics in the trade from harvest to supply to market. While in the second phase, market survey was carried out with traders and dealers to record the prices fluctuations of nut at various level in the market. Current study reports that pine nut is the largest Non Timber Forest Products (NTFPs) with great demand both in national and international market. Local people are unaware of the market linkages and quality standards. Most important value added activity was found to be the roasting activity and which is not done by the local harvester at the study area due to lack of expertise. Significant increase in market prices was recorded along the supply chain. The revenue come from the business is unequally distributed among various agents involved in the value chain. Overall, the business is informal and heterogeneous. Local communities should be educated about the value added activities and market demands. It is equally important to facilitate the local harvesters for finding certain market linkages to make easy their access to the national markets where they gain maximum revenue of medicinal plants and their other valuable forest products. It is the responsibility of state and other organization to help them while addressing the problems by improving the knowledge at the start of supply chain, improving the linkages among all steps in value chain and developing the sustainability at all levels.

Key words: Nuts business, NTFPs, Market value, Anthropogenic pressure, Nut classes.

Introduction

The medicinal plant, *Pinus gerardiana* Wall. commonly known as "Chilgoza or neoza pine" is a vital biological and economically valuable species found in some dry isolated valleys of Pakistan, Kashmir and Afghanistan (Champion *et al.*, 1965). The seeds of the plant equally contain sugars (4.07%), proteins (13.03%), oils (52.15%) and moisture (25.36%) (Malik & Shamet, 2009). Being nutritious and delicious, the seeds have a powerful demand both in national and international market and bring great costs (Peltier & Dauffy, 2009). Next to these, species additionally display a wide assortment of life history qualities (Richardson, 1998). Moreover it gives enormous advantages to people, including solid fragrant wood and other beneficial products. The local peoples have the right to harvest the nuts/seeds from the forests. In general, the *Pinus gerardiana* has high economic potential and keeps the guarantees live for the financial advancement of indigenous communities residing near these places. Because of its high market demand, practically every

cone of Chilgoza pine is harvested and only few cones are retained for the natural regeneration which are found at inaccessible places and are far away from the reach of the collectors occurring in steep slopes and other hard places (Singh *et al.*, 1973). The growing scene demand in market for pine nuts, and stable high costs call for better administration of existing pine nut assets and for investing in pine nut development within and outside their local range (Sharashkin & Gold, 2004).

Pinus gerardiana is an economical medicinal plant having valuable nuts having extraordinary demand both in national and international market (Aziz *et al.*, 2017). In Pakistan, the largest forests of *Pinus gerardiana* are in South Waziristan Agency as well as Sulaiman Mountain Range of Balochistan. The indigenous communities living in the proximity of these pine forests are greatly dependent on these forest product and earn handsome revenue every year. Local harvesters from the Sulaiman Mountain Range bring their pine nuts to the national market of Zhob which is considered one of the most prominent market in the country (Aziz *et al.*, 2017). In South Waziristan, the

market which supplies the nuts to other national markets of the country exists in Wana (Headquarter of South Waziristan Agency). To explore the various management approaches involved in the trade of medicinal plants and other NTFPs current study was planned in the far flung area of FATA, Pakistan. The local harvesters bring their nuts to this market where they sell their nuts to the representatives of national dealers. As the business runs in a very heterogeneous and irregular way in which several intermediate players are involved from the start to the last step of the supply chain giving no sense about existing hurdles and gaps in the business. As a case study from South Waziristan, current study has been planned to explore the management approaches, value added activities, trade dynamics and economic potential obtained from the Nuts of valuable medicinal plant *Pinus gerardiana* Wall. The main objective of the study was to highlight gaps in knowledge, to address the linkages among various players in the market, address the various dynamic involved in trade, and formulates future perspectives. The study would provide a systematic baseline for the improvement of livelihood of the indigenous communities by solving the issues concerned with the trade of medicinal plants and other forests products.

Material and Methods

Study area: South Waziristan Agency (SWA) is the largest agency of the Federally Administered Tribal Areas (FATA) of Pakistan; spread over an area of 6,620 square kilometers; accounting for 24.3% of FATA's aggregate area. SWA is limited by North Waziristan Agency in north, Tank in east, Baluchistan in south and Afghanistan in west (Fig. 1).



Fig. 1. Area map of South Waziristan Agency, Pakistan.

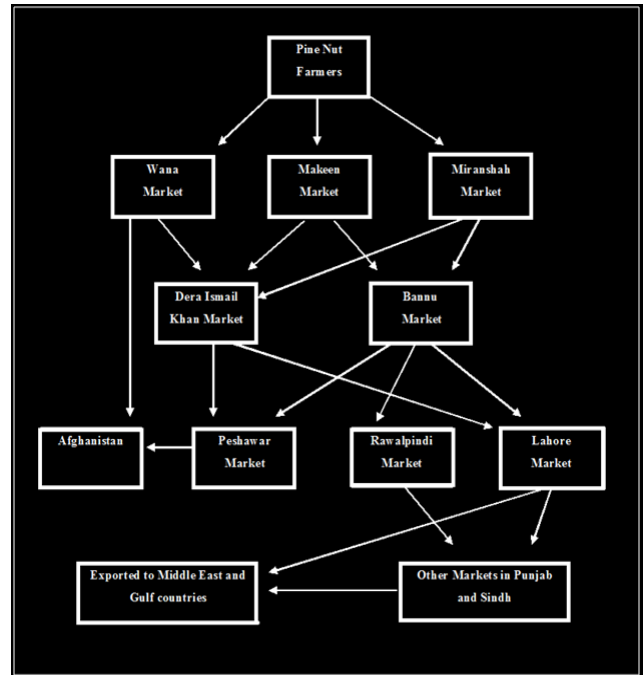


Fig. 2. Tree diagram showing the supply chain of nuts from SWA.

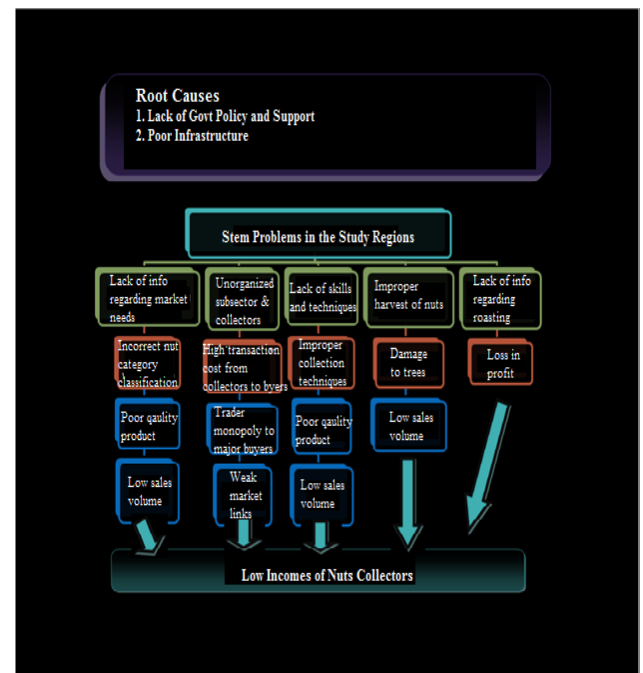


Fig. 3. Showing the problems tree for nut value chain.

SWA has a cool weather in winter with snowfall at higher elevation; while in summer, the weather is charming. Topographically South Waziristan agency comprises of hilly terrain including rocky and complex mountains. Rocky Mountains are the best homelands for the growth of gymnosperms especially for pine trees. The Agency is categorized into three subdivisions, Wana, Serwakai and Ladha; and eight Tehsils; Birmal, Ladha, Makeen, Sararogha, Serwakai, Tiarza, ToiKhulla and Wana. There are more than ten distinct tribes living in South Waziristan. Wazir and Mehsud are the two biggest tribes constituting more than three fourth of the aggregate population. Mehsud tribe is mainly populated in Tehsils

Ladha, Makeen. Sararogha, Serwekai and Tiarza. Wazir populace dwells for the most part in Tehsils Birmal and Wana. Dotani and Suleman Khel are the other tribes who live for the most part in Tehsil ToiKhula. Pushto is the commonly spoken dialect in South Waziristan.

Survey procedure: Prior to the data collection, both collectors and traders of the pine nuts were asked and identified. Survey was completed in two stages with the help of volunteer group during the mid year of 2016. In the first phase of the study, meetings and gathering dialogues were made with the local harvesters. In the second phase of the study, market survey was conducted by interviewing the national traders and dealers from the local market of Wana, D.I. Khan and Bannu to evaluate the value chain and to estimate the sale revenue obtained by the trade of the pine nuts because they are the main suppliers to national markets in big cities of the country having all the information regarding the price rate of nuts at various market levels. For this purpose, we designed two different types of questionnaires i.e. one for collectors while the other was designed for market traders. From the collectors, the information and data was gathered relating to different aspects of collection, method of collection, packing pattern, time of collection, marketing time, processing methods and problems regarding the business. They were also asked for annual income obtained from the nuts and return to the work invested. However no information was recorded about the proportion of nuts brought to the market because the collectors were not able to mention a precise estimation.

In the second stage of the study, interviews were conducted with the dealer at market places in their Godowns. Each dealer was asked about regulatory/institutional links of value chain, pine nut classes. Information was taken about the various nut classes, value added activities, prices along the chain, the targeted markets, process of supply, normal issues in the business, cost estimated and other relevant information. Soon after finishing the fieldwork, the recorded information was enhanced with a few suitable modifications to adjust the data with respect to the primary goal of the study.

Results and Discussion

Dynamics of pine forest management: Due to the remoteness from other areas in Pakistan, especially the tribal belt of the country, governmental and non-governmental organizations are not active to regulate the forests and other natural resources in the study area. In the study zone, ownership of forests is on tribe/faction premise that is according to the size of the plain land owned by the family and the income from the forest is divided among the family members. The far-flung and high up forests, where access is very troublesome, are collective forests. The chilgoza forests are secured, and ban line has been imposed on green cuttings and grazing of domestic animals and in case of violence, punishment is enforced. The communal cum individual nature of pine forests reinforce the social security among the groups. Furthermore assumes a key part in their protection. Normal size of the forest controlled by every tribe/family relies on the bit of plain land controlled by that tribe/faction.

Pine trees bearing nuts take 20-25 years to produce nuts and stay profitable for around 75-80 years. The indigenous communities harvest and protect the forest by their social security council but they give no attention towards the plantation of new saplings in their respective area. However very small proportion of the local population try to plant the nut/seeds to grow and regenerate during the snow fall season with a myth that the snow helps in the breakage of seed coat and in the subsequent season (for the most part in March-April) germination would be ensured but the rate of survival of the species is very low which does not create the sought results. There is an enhanced strategy for forestation by utilizing sapling method however unfortunately no Pine Nut nursery is working in the area to give the saplings. Pine Nut is a critical source of revenue in forested territories of Shakai, Angoor Adda and Mehsud ranges of SWA.

Harvesting and post harvesting techniques used for pine nuts collection: In the 1950s, conventional collecting rules made it conceivable to regard trees and to permit a little bit of seeds to reach the ground. Harvest and post-harvest management are the important activities in the sustainability of natural botanical diversity. Study participants claimed that people migrate to their respective forests during the time (September to October) of nut harvesting. Local people harvest most of the cones (about 80%) in the first pick while the remaining is chopped up in the following week. As there are no collecting instruments/seat straps, the cones at the outskirts of the tree reaped by pulling the branches, which causes breakage of branches and results in a tremendous loss in yield next years. After harvesting the cone and extraction of nuts from the cones, they sell them to the local traders immediately without drying. Some unsold proportion of the nuts is stored in the traditional stores for later selling as well as for social obligations. Nuts in the market as well as in the traditional stores have short shelf life as a result of oxidative rancidity; attack by storage fungi and by nut borer. Hence, drying is the foremost step to extend the shelf life of chilgoza nuts. It is well known that drying prevents postharvest losses of nuts by inhibiting fungal activity, prevents insect damage and improves chemical and physical stability of food (Bansal & Garg, 1987). After chopping the cones from their respective trees, following practices made by collectors before supplying them to the market.

Extraction methods of pine nuts: The first treatment done after copping the nuts from the trees is to dump the cones in a heap inside a room and is secured with tarpaulin and trash. During this stockpiling period, chances of losses occur and it was mentioned by the local collectors that about 30% of losses occurs if proper precautions are not made. Following 8-10 days, the scales of the cones are burst up and open and then the cones bearing nuts are put on a local cot (Charpai) and beaten with a stick to remove the nuts from the cones. The procedure has an inherent obstacle that a few nuts stay at the base of the cone. There is no special device used to extricate these left over nuts from the cones and the cone gatherers expel them with sharp wooden sticks. During

this procedure, a few nuts are broken and the degree of loss goes as high as 10%. Generally the nut recovery from these cones is 5%. There is no utilization of cones once the nuts are extricated from them and they are utilized just for fuel purposes.

Grading of Nuts: Proper reviewing and grading of nuts is not done by the Pine Nut collectors. Just the broken bits of nuts and cone are removed manually. Distinctive sized sieves and locally made "Chaj" are utilized for grading and cleaning the inert matter. However, keeping in view the international and local best practices, the locals people isolate the nuts into different classes. Different measures exist to recognize the nature of Pine nuts, if received can bring higher costs and also help the possibilities of fare.

Provisions concerning quality of nuts: After harvesting, the nuts are referred to various classes on the basis of their quality requirements. Basically nuts are referred to three classes i.e. Extra class, Class I and Class II. In the study area, the classification is not based on any national or international standards but the local people classified the nuts on the basis on some distinguishing characters which the nuts have. United nations economic commission for Europe (UNECE) has recommended commercial quality standards to help and facilitate the international trade of forest products, protect the interests of consumers, to enhance profit and to encourage the high quality of the produce (UNECE, 2013). Various parties involving in trade of various products including the governmental organizations, traders, producers, importers and exporters and public and private sector organizations use these standards. The main purpose of the application of these standards is to define the quality requirements of nuts at the export control stage. In the table 1, a review of the quality requirements have been given so as to compare the classification (Extra Class, Class I and Class II) of the nuts in the area with the verified international standards.

Furthermore the UNECE has recommended general rules for each class irrespective of class quality are as follows:

- Should be intact but only slight and light superficial damage may be ignored
- Nuts should be free from pest, fungus, excreta, rotting, from blemish, having no stained surface or discoloration
- It should be clean free from any foreign matter
- Nuts should be sufficiently developed and are not shrunken affecting the general morphology and its quality
- Having no rancidity, extra taste and abnormal external moisture contents (7 percent is permissible)

As already we discussed the issues that proper grading is not done at collector level in the area. It is the gap in knowledge that make it impossible for the player at the low level to get maximum benefits from their products. Despite the provisions of the international rules it is now possible to clearly and give a grade to each and every nut but in the study area, the classification is done on only some basic distinguishing characters. Following is the classification of the harvesters and local traders.

Extra class: Pine Nuts in this class must be of superior quality. The local collectors assigned different characteristics to this. They must be characteristic of the species or commercial type and be of uniform colour. They should be basically free from imperfections and flaws except for exceptionally slight shallow deformities, given that these don't influence the general appearance of the produce, its quality, its protection or its presentation in the package.

Class I: Pine Nuts in this class must be of good quality. They should be normal for the species as well as business sort. They may have the following slight imperfections, provided that these don't influence the general appearance of the create, its quality, its protection or its presentation the bundle:

1. Slight imperfections in shape
2. Slight imperfections in development
3. Slight imperfections in color

Class II: This class incorporates Pine Nuts which don't fit the bill for consideration in the higher classes, yet which fulfill the base necessities indicated previously.

Packing: Pine Nuts packing is done in 80 kg of gunny packs. The cost of discharge pack is Rs 60-80. The inappropriate packing techniques and handling is one of the big problem due to which high post harvest loss is occurred. Sometimes the loss due to the improper post harvest practice (such as storage, packing, handling, transportation) reaches from 30 to 40 % of the total nut production.

Apart from the above practices, no further value addition is made in the area. Sometimes the raw cones are sold to the commission agents without roasting. Local gatherers in SWA do not roast due to lack of awareness about the procedure. Delay in achieving the market lessens the heaviness of the nut, which prompts to diminish in rancher's winning.

Marketing, value chain analysis and commercialization: The study watched that the local collectors supply their nuts to the nearby market of Wana. Collectors have no contact with national markets and traders. Subsequently the collectors face economic loss and the middle man gets all the possible benefits because of the unawareness of the collectors about national market concerns. The current study provides the optimum estimates of the increase in prices along the supply chain in various markets and various levels. One can expect the increase and significant difference and the main reason, which can be a big factor in price rise because, lack of knowledge among local dealers and harvesters concerning its demand at national and international level. The local harvesters have no direct linkage with the final market that is why the nomadic gatherers supply their nuts to the local market existing in the value chain where they sell the nuts at a minimum price as compared to its demand at national level and international market. It is necessary to have proper knowledge about the better understanding of the market because it will increase their annual income

and increase revenue each year. From the neighborhood market of Wana the nuts then supply to the national markets of Bannu and Lahore. Trade of the nuts has been ignored by the state due to which the market of pine nuts is running in an informal way just like markets of medicinal plants which are also harvested and collected on local basis and state has no interest, check and balance (Sher *et al.*, 2014). An effervescent private market has significant results as long as protection is ensured at all level along the marketing chain to avoid the exploitation of the participants at lower and as well as the local natural environmental condition are not disturbed by the over harvester. On account of this, the market works in hazy area, decision makers are normally uninformed of the essentialness of the exchange of such forest product and of the antagonistic effects that unsustainable harvesting of these plants and their products may have had ever lasting effects both on environment and human well being. These concerns can be justifying educational efforts, collective marketing activities by collectors, and regulations of harvesting as government policies.

The edible nuts of the species have high commercial demand for various communities all around world. Local communities harvest the nuts, supply them to national and international markets, and earn big revenue each year. The undertaken study is the first effort related to the trade, analyzing the economic benefits, highlighting the underlying threats of the valuable product from an area which has been suffering from "War on terror" for the last one decayed. In the area, market of pine nut is an informal one because state and regulatory authorities have no solid frame of policy due to which the trade has been ignored till today. In the area the production of pine is the largest Non Timber Forest Products (NTFPs) on which many collectors are economically dependent. The current study observed that the people have adopted the gathering of nuts as an economic activity in the area. Local collectors bringing the pine nuts to the market and sold to the agents of national traders. Studying the area as source, we examined the patterns of collection of Pine nut as an economic activity and the likely destinations of these products in national markets. The nuts extracted from the pine is the unique product of South Waziristan agency. South Waziristan is an important producer of this valuable species and is supplied to different markets in other cities of Pakistan. Since in the area, pine nuts produces have no proper market linkages and direct access to major national markets, such as Lahore markets and others. Larger part (98%) of the pine nut makers supply nuts to the neighborhood markets of Wana, Miranshah, Makeen, and so forth, from where the market dealers make supplies to D.I. Khan, Bannu, Peshawar, Lahore and other potential markets in Pakistan (Fig. 2).

Generally two cities i.e., Bannu and Lahore have the trading centers with well established markets that supply various centers in different cities of Pakistan and outside the country. This informal type of market in the area is just like other informal markets of plants' products present in different parts of the world giving an important source of income to local collectors, dealers, middle man, merchants, wholesalers and retailers (Mati & de Boer, 2011; Lev &

Amar, 2002; Lev & Amar, 2000; Bussmann *et al.*, 2007; Iqbal *et al.*, 2000; Towns *et al.*, 2014; van Andel *et al.*, 2012; Quiroz *et al.*, 2014; Botha *et al.*, 2004; Lee *et al.*, 2008; Williams, 2003). Usually such kinds of markets exist in grey zones, that is why decision makers are always ignorant of the significance of the exchange of such products and of the negative effects on the business income and loss of economic benefits influencing the long term welfare of the indigenous groups.

A little extent of these nuts straight forwardly supplied to Tank, D.I. Khan and Bannu markets. Because of its higher financial and restorative esteem this forest item is offering at around Rs. 2500-3000 for each kg in retail showcases in major cities of Pakistan. Thus the product offers a good opportunity for the producers to earn their livelihood. As the pine is not abundantly available in common but it grows in special terrain with specific environmental conditions. The condition available for the pine in South Waziristan agency are appropriate and therefore the nut offers an open door to develop the species adding to the financial development of the area on long term sustainable basis. The collection and harvesting of forest products by the indigenous communities has a long history. Kunkel (1984) has reported the harvesting of pine nut of 29 different species in different studies. The collection of nuts in the area is done as an economic activity and is a source of livelihood for the indigenous communities. An early study directed by Martin (1995), reported that the harvesting of pine nut is giving a pay to 13000 people groups in Suleiman mountain Range of Pakistan. The significant value addition in the pine sector is the roasting of nuts which is not done in the area due to lack of expertise. This sector offers the chance of expanding the length of local value chain of Pine Nut to give better financial comes back to the nearby farmers and communities. Cone gatherers and local people involved in the business have no sufficient information about the economic status of the nuts are not aware of the market value and price in primary and secondary whole sale market. This lack of awareness affect the bargaining of the local collectors and ultimately the middleman gets the benefits of their ignorance. Therefore, the local collectors often isolated from the last consumer and do not have a decent understanding of market needs beyond the limited information provided by the dealers and traders. Survey has indicated there are no powerful market linkage has been produced to get benefits from them. Furthermore local collectors have no affiliated association with each other to advertise their market exposure. The pine nut business people do not have any entrance to formal/casual wellspring of fund and consequently cannot showcase outside SWA. The dealer in the local and nearby markets of SWA pay half of the pay at the season of exchange and the remaining half is paid following one to two months. The local traders and dealers in SWA do not charge any commission as they buy themselves and defer half installment for one to two months and in some cases for much more. Commission rate in different markets fluctuates from 2 to 2.5%. Makers trail no marking practice. The formers are uninformed of the marking idea and its significance in advertising of the item.

Prices along the marketing chain: Data gathered from dealers in the respective markets in Wana, Bannu, and D.I. Khan about the marketing chain has been given (Table 2). These prices were recorded through interviews group discussions and meetings with the dealer in the respective markets. In the pine nut business, the prices are increasing during the marketing channels from year to year based on supply and demands. The prices, which have recorded, are the average prices for the year 2016. As the nut having various classes so the price of each category increases, step wise along the market channel and difficulties are occurring side by side. The increase in the prices is due to two main factors 1: transportation charges and labor costs (Table 3) 2: profit in support of the involved individuals (Table 4).

Apart from the above factors, dealers due to which the prices become higher as compared to primary level prices do the process of roasting. A major factor responsible for the increase in the price of nut along the commercial chain is the lack of proper knowledge and facilities available for the collectors as it has been describe in the (Fig. 3).

A comparison was established to evaluate the price in the local market of Wana and Lahore to compare the rate in both of the markets and was found that 36% net income could be obtained if it is sold by the farmers directly in Lahore. No significant value added activities have been done in the middle markets. Further there is no significant incremental increase in value if that little esteem expansion is done in SWA or in a middle person showcase like Bannu or D.I. Khan markets.

Problems and constrains for the business: Lack of market concerns and demands, local harvesters have no access to the large national and international markets. Figure 3 describes information regarding the existing constrains and problems and giving the idea for solutions with in the marketing channels, which was compiled through interviews and group discussions. Several interlink problems exist in the trade affecting the economic status of the local harvesters. The trade is very complex and highly uncoordinated involving several players. Main problems are the lack of awareness about the international demands, disorganization of subsector and collectors, lack of collection skills and techniques and lack of roasting process. The local harvesters have no proper market linkages and are unable to bargain the prices with the dealers at different markets levels. The main gaps in the knowledge are the lack of governmental support and ignorance in this informal market which can be addressed by the involvement. People in the area, collecting of pine nuts are done physically in an extremely risky way. Harmful strategies damage branches of trees, which influences the following year's generation. Post collect operations of nuts extraction, evaluating and pressing are done utilizing extremely customary devices and aptitudes, which brings about expanding wastages.

Management steps to be undertaken: Pakistan is a signatory of the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and different others (Khan, 2012). Henceforth Pakistan has perceived the significance of value and conservation

of its biological diversity. The Ministry of Environment has drafted a Biodiversity Action Plan (BAP) as a team with included partners. BAP has proposed activities for in-situ and ex-situ protection of Pakistan's biodiversity. Although, the nation has still to go far to casing laws and arrangements to ration all its hereditary materials and to create reciprocal and multilateral trade of plant germplasm, appropriate breeders, farmers and community rights, and comprehensive action plans to achieve the objectives of trade sustainability and its linkages with conservation. However no consideration has been paid to the economical protection and exchange of the pine nuts in the country. The valuable species and the product, which is obtained, are at the mercy of the local slaughters due to the lack of unsustainable harvesting techniques. A balance ought to be required in collecting and its manageability. As the trade has become market-oriented and international, the activities of the local collectors are so much threatening because they are totally unaware of its conservation and sustainability and they only keep in mind their present economic benefits. Olsen and Larsen (2003) described that the exchange and gathering of plant products is for the most part processed by incompetent people. Therefore, plants products loss their value on their way to their last market while being liable to over extraction and damaging gathering strategies. A study conducted by Kumar *et al.*, (2016) in Indian Himalaya, it was reported that in the share of the financial income due to the chilgoza in the total financial income of the household varies between 5% and 25%; this share can exceed 25% for the poorest villagers (Peltier & Dauffy, 2009). Nut acquired from species get high cost (extending from Rs. 400-600/kg) in the open market. Out of the assessed 800 q nuts produced in the Kinnaur, around 750 q (worth Rs. 2 crore) is exported out to other parts of the country or even out of the country (Anonymous, 1997; Anonymous, 2002). The bigger extent of nut creation originates from Kinnaur alone and remaining prerequisite of this nut is met through import from Afghanistan (Karwaskara, 1981). It is its scarce supply to all around that urgent requirement to reevaluate the economic and ecological significance of pine forests so as increase the nuts production by utilizing the techniques of horticulture, agroforestry and other forest relative techniques (Sharashkin, & Gold, 2004). This is because, chilgoza pine are mostly located in natural forest and are not cultivated by local people because of its slow growth and takes long time to produce commercial nuts. But due to dependency of local people, it has been classified as social forestry species in spite of its being a conifer (Seghal & Khosla, 1986).

These economical pine could become a significant forestry/agroforestry species if certain varieties are developed in order to adapt the local ecological conditions and grow fast (Sharashkin & Gold, 2004). Because it has been found that, the crop have significant scope to domesticate and improve by establishing clonal seed orchards and to control the breeding for the development of nuts production both in quantity and quality (Singh, 1992). This may be due to fact that chilgoza exhibited wide variation in most of the characters, with high heritability and genetic gain was recorded for some character, indicates that these characters could be improved by selection (Kant *et al.*, 2006).

Table 1. Shows Provisions concerning tolerances (Recommended by UNECE).

Defects (allowed)	Tolerances allowed percentage of defective produce, by number or weight		
	Extra	Class I	Class II
(a) Product not satisfying the minimum requirements can be tolerated, of which no more than	3	5	7
Shrunken or shriveled product and not fully developed	1	3	5
Mouldy	0.5	0.5	1
Product having rancidity or it is damaged by fungus or pest.	0.5	2	3
Having living pest or other microorganism	0	0	0
Oily, mottled, yellow peak	1	2	2
Germinating pine nuts	1	2	4
Nuts having superficial defects on the seed coats	2	4	6
(b) Size tolerances			
For produce not conforming to the size indicated, in total	5	10	10
(c) Tolerances for other defects			
Empty shells, loose shells, fragments of shells and hulls, dust (by weight), foreign extra matter	0.05	0.05	0.05
Number of empty and loose shells per 2.5 kg	1	1	1
Broken nuts	1	3	10

Table 2. Showing the market value of pine nut.

Pine nut market	SUS/ Maund of 40 Kg		
	Extra class	Class I	Class II
Wana	673	625	567
Bannu	846	807	684
D.I. Khan	836	750	663
Lahore	1105	1048	1009

Table 3. Showing the net profit in the market at Lahore (National market).

Parameter	SUS		
	Extra class	Class I	Class II
Profit (\$US / Maund)	432	182	105
Profit (\$US / Truck)	54086	21923	13221
Commission \$US (Per Truck)	3455	3275	3155

Table 4. Showing the transportation and other charges along the market chain of pine nuts.

Parameters	Cost estimated (\$US)
Loading of truck (125 bags)	12
Transportation charges per truck	576
Miscellaneous charges (along the way)	38
Market fee per truck	4
Munshiyana per truck	0.48
Unloading charges	13
Commission rate (%) per truck	2.5%

Conclusion and future recommendation: *Pinus gerardiana* is an economical medicinal plant having valuable nuts having extraordinary demand both in national and international market. To explore the various management approaches involved in the trade of medicinal plants and other NTFPs current study was planned in the far flung area of FATA, Pakistan. The study would work as a baseline to highlight the various problems in commercialization of medicinal plants from the area. Current study was undertaken to understand the harvest and trade of pine nuts by exploring the management approaches, value chain activities, trade dynamics and economic potential obtained from the Nuts of medicinal plant *Pinus gerardiana* Wall.

Current study was completed by interviewing the local harvesters, dealers and traders. During interviews it was found that, pine nut is the largest Non Timber Forest Products (NTFPs) with great demand both in national and international market. Local people are unaware of the market linkages and quality standards. Most important value added activity was found to be the roasting activity and which is not done by the local harvester at the study area due to lack of expertise. Significant increase in market prices was recorded along the supply chain. The revenue came from the business is unequally distributed among various agents involved in the value chain. Overall, the business is informal and heterogeneous. During the process of interview and group discussion it become possible to investigate the possible interventions which would help the local community to grow and groom up with respect to economic level and the business would become a stronger engine of growth for upraising of the community economic status. It is recommended that improving market linkages between producers and buyers will result in increased economic benefit for local collectors, and dealers, enabling their communities to become hubs of significant economic activities with a multi-dimensional impact on the economic development of local owners in the agency.

To improve the economic status of the local harvesters and owners certain management steps should be taken. Following recommendation are put forward for the improvement of the wellspring of the local people in the area are as follow;

- To educate and teach the indigenous people about the proper collection, utilization and commercialization of NTFPs and medicinal plants.
- Tool kits and Technical assistance should be given in processing and proper storage facility establishment to improve quality and reduce wastage of collected products.
- To provide knowledge and awareness on pre-drying treatment, proper packing of nuts and other medicinal plants and their products, market requirements and

proper collection techniques which will result in better prices to increase profit for harvesters.

- Plantation should be encouraged in the area by providing best quality saplings.
- Linkage and association should be strengthening by giving the info to farmers and local harvesters. This will increase their exposure to the market dynamics.
- The forest department should be involved in the ownership process and give support to the local owners by providing tools and techniques to them.
- It is equally important to address the threat to medicinal plants. As an example pine is an important medicinal plant, so the vulnerability of the pine to over exploitation and risk of elimination should be managed programmatically.
- To instruct the general population about the long term advantages, to force ban on unlawful exercises, and to create group rights and outline an extensive activity arrangements to accomplish the goals of exchange supportability and its linkages with protection.
- Projects should be designed to analyze the regeneration potential pine and conservation status of various important medicinal plants to further strengthen the protection of the forests in the area.

Acknowledgments

Authors are thankful to the indigenous community at the study area for their logical support during the survey and data collection. We pay our special thanks to market trader and dealer at various markets during the survey. The authors would like to extend their sincere appreciation to the Deanship of Scientific Research at King Saud University for its funding to the Research Group number (RG-1435-014).

References

- Anonymous. 1997. IUCN report of red listed endangered species in Western Himalaya. Red Data Book.
- Anonymous. 2002. Exploitation of major and minor forest products. Dept Report. Chapter 4.
- Aziz, M.A., M. Adnan, S.K. Hussain, A. Hashem, A.A. Alqarawi and E.F. Abd_Allah. 2017. Comparative regeneration status of *Pinus gerardiana* in two forest-use types of Sulaiman Mountain Range near Pak-Afghan border region: historical, current and future perspectives. *Pak. J. Bot.*, 49(1): 227-236.
- Bansal, N.K. and H.P. Garg. 1987. Solar crop drying. In: (Ed.): A.S. Mujumdar. Advances in drying (Hemisphere Publishing Corporation, New York, USA. P. 279-343).
- Botha, J., E.T.F. Witkowski and C.M. Shackleton. 2004. Market profiles and trade in medicinal plants in the Lowveld, South Africa. *Environ. Conserv.*, 31: 38-46.
- Bussmann, R.W., D. Sharon, I. Vandebroek, A. Jones and Z. Revenc. 2007. Health for sale: the medicinal plant markets in trujillo and chiclayo, northern peru. *J. Ethnobiol. Ethnomed.*, 3: 37.
- Champion, H.G., S.K. Seth and G.M. Khattak. 1965. Forest types of Pakistan. Pakistan Forest Institute of Peshawar.
- International Nut and Dried Fruit Council Foundation (INC). (2015/2016). *Global statistical review on nuts & dried fruits*.
- Iqbal, M., S. Ahmad and H. Sher. 2000. Market survey of medicinal herbs in Malakand, Peshawar, Lahore and Karachi. Switzerland: *Inter-cooperation Organization Suisse pour le Development et la Cooperation*, 23-45.
- Kant, A., V. Dutt and D.R. Sharma. 2006. Genetic variability in phenotypic characters of *Pinus gerardiana*. *Ind. For.*, 132(6): 681-690.
- Karwaskara, A.C. 1981. Revised working plan for the Kinnaur Forest Division. The mall, Shimla, India.
- Khan, A.A. 2012. A draft strategic framework to arrest the plight of medicinal plants in Pakistan. In *Workshop Conserv Sustain Util Med Plants Pak*. Edited by Proceeding PARCTASO-PGR. Islamabad, Pakistan: National Herbarium PARC., 8-11.
- Kumar, R., G.S. Shamet, H. Mehta, N.M. Alam, R. Kaushal, O.P. Chaturvedi, N. Sharma, B.A. Khaki and D. Gupta. 2016. Regeneration complexities of *Pinus gerardiana* in dry temperate forests of Indian Himalaya. *Environ. Sci. Pollut. Res.* DOI 10.1007/s11356-015-6010
- Kunkel, G. 1984. Plants for Human Consumption. Koenigstein, Ger: Koeltz Sci. Books.
- Lee, S., C. Xiao and S. Pei. 2008. Ethnobotanical survey of medicinal plants at periodic markets of Honghe Prefecture in Yunnan Province, SW China. *J. Ethnopharmacol.*, 117: 362-377.
- Lev, E. and Z. Amar. 2000. Ethnopharmacological survey of traditional drugs sold in Israel at the end of the 20th century. *J. Ethnopharmacol.*, 72: 191-205.
- Lev, E. and Z. Amar. 2002. Ethnopharmacological survey of traditional drugs sold in the Kingdom of Jordan. *J. Ethnopharmacol.*, 82: 131-145.
- Malik, A.R. and G.S. Shamet. 2009. Storage of *Pinus gerardiana* seeds: biochemical changes and its applicability as seed vigour test. *Res. J. Seed Sci.*, 2(3): 48-55.
- Martin, G.J. 1995. Ethnobotany. London: Chapman & Hall.
- Mati, E. and H.J. de Boer. 2011. Ethnobotany and trade of medicinal plants in the Qaysari Market, Kurdish Autonomous Region, Iraq. *J. Ethnopharmacol.*, 133: 490-510.
- Olsen, C.S. and H.O. Larsen. 2003. Alpine medicinal plant trade and Himalayan mountain livelihood strategies. *Geogr. J.* 2003, 169: 243-254.
- Peltier, R. and V. Dauffy. 2009. The Chilgoza of Kinnaur. Influence of the *Pinus gerardiana* edible seed market chain organization on forest regeneration in the Indian Himalayas. *Fruits*, 64(2): 99-110.
- Quiroz, D., A. Towns, S.I. Legba, J. Swier, S. Briere, M. Sosef and T. van Andel. 2014. Quantifying the domestic market in herbal medicine in Benin, West Africa. *J. Ethnopharmacol.*, 151: 1100-1108.
- Seghal, R.N. and P.K. Khosla. 1986. Chilgoza pine the threatened social forestry tree of dry temperate Himalaya. *National Symposium on Research in Social Forestry for Social Development*, 1-2.
- Sharashkin, L. and M. Gold. 2004. Pine nuts (Pignolia): species, products, markets, and potential for U.S. production. In: Northern nut growers association 95th annual report. Proceeding for the 95th annual meeting, Columbia, Missouri, USA, pp. 16-19.
- Sher, H., A. Aldosari, A. Ali and H.J. de Boer. 2014. Economic benefits of high value medicinal plants to Pakistani communities: an analysis of current practice and potential. *J. Ethnobiol. Ethnomed.*, 10(1): 71.
- Singh RV, D.C. Khanduri and K. Lal. 1973. Chilgoza pine (*Pinus gerardiana*) regeneration in Himachal Pradesh. *Ind. For.*, 99(3): 126-133.
- Singh, N.B. 1992. Propagation, selection and establishment of clonal seed orchard of chilgoza pine (*Pinus gerardiana* Wall.). *Ind. For.*, 118: 901-908.
- Towns, A.M., D. Quiroz, L. Guinee, H. de Boer and T. van Andel. 2014. Volume, value and floristic diversity of Gabon's medicinal plant markets. *J. Ethnopharmacol.*, 155: 1184-1193.
- United nations economic commission for europe (UNECE). 2013. Standard DDP-12 concerning the marketing and commercial quality control of pine nut kernels. 2013 Edition. United Nations, New York and Geneva.
- Van Andel, T., B. Myren and S. van Onselen. 2012. Ghana's herbal market. *J. Ethnopharmacol.*, 140: 368-378.
- Williams, V.L. 2003. Hawkers of health: an investigation of the Faraday Street traditional medicine market in Johannesburg, Gauteng. Gauteng Directorate for Nature Conservation. *Plant Ecol Conserv Ser.*, 15.

(Received for publication 12 June 2017)