



# Life around the Juniper Forest

How Juniper Forests Contribute to Well being of Communities in Ziarat

Thushara Ranasinghe and Saima Baig

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## 1. Background

The project *Mainstreaming Biodiversity Conservation into Production Systems in the Juniper Forest Ecosystem* is funded by UNDP and GEF, and is being implemented by IUCN in close collaboration with the Balochistan Forest and Wildlife Department. The project aims to incorporate biodiversity and ecosystem aspects into activities in productive sectors such as agriculture and livestock in the Juniper forest ecosystem. Simultaneously, the project strives to explore opportunities for harvesting biodiversity benefits in terms of sustainable ecotourism, controlled hunting, medicinal plant collection and watershed and other ecosystem services. The overall aim is to contribute to the conservation of the Juniper forest in Pakistan in Ziarat District, which comprises of two tehsils (sub-districts), Ziarat and Sanjawi and is situated in the Province of Balochistan. The project was launched in April, 2007 and is working in four valleys namely; (1) Koshki – Zizri valley; (2) Main Ziarat valley, (3) Main Chautair valley; and the (4) Batay Thair – Nishpa valley.

The Juniper forest has already been identified as a critically threatened ecosystem. However, to date, the economic value of these Juniper forest ecosystems have not been determined, although they are famous all over Pakistan. Conservation efforts are thus often stymied by lack of an economic argument for their value, as opposed to alternative land-uses, especially at the policy decision-making level. In response, this study was proposed to estimate the economic value of the Juniper forest ecosystem in the project valleys, focusing primarily on goods for direct-use.

### Limitations of the study

The study area is rugged and mountainous and the valleys are spread over great distances. In each valley the households are also spread over large areas. Road and other access is also limited and most of the travel has to be done on foot. Due to this remoteness 79 households were surveyed across the four valleys.

There is also a lack of secondary literature about the forests. Not a lot of studies have been undertaken which limited the scope of this study. Cultural constraints also played a role in getting access to a range of individuals and in getting responses.

It must therefore be kept in mind that this study provides broad brush gross estimates of some of the values of these forests. It is the first attempt to increase the understanding of the benefits associated with them with the aim to convince policy makers that their conservation makes is crucial. The study therefore does not attempt to undertake an extensive analysis of the economic value of these forests. It is a rapid and simple study to get an initial understanding of the Juniper forests and the benefits they provide. All the values are gross values.

At the time of the study 1 US\$ = PKR 85.35

## 2. Introduction

### 2.1. *The Juniper Forest and its Biodiversity*

There tends to be huge under-investment in ecosystem conservation because ecosystem services and their associated biodiversity are generally under-valued by decision-makers. Most ecosystem goods and services are not part of market transactions, as such have no price and therefore, are not considered to be of any great value. This stems from a lack of understanding of the economic benefits arising from them and the economic costs that are incurred due to their loss. Lately, concerns over diminishing ecosystem services (such as water supplies and deteriorating water quality) have led to a renewed interest in conserving natural systems and increased recognition of the critical role that a well-managed natural environment plays in securing vital benefits (IUCN 2006)<sup>ii</sup>.

One such natural ecosystem is the Juniper Forest in Ziarat District, in the Province of Balochistan, Pakistan. The Juniper is defined as any tree or shrub of the genus *Juniperus*; aromatic evergreens of the family Cupressaceae, widely distributed over the North Temperate Zone<sup>iii</sup>. Juniper forests are the Juniper dominated or co-dominated communities<sup>iv</sup>.

The Juniper forest in Ziarat is important in terms of its age, extent and global significance. It has trees more than 5000 to 7000 years old<sup>v</sup> and which are often referred to as "living fossils" because of their longevity<sup>vi</sup>. It is the largest contiguous natural Juniper forest in Pakistan spanning 247,000 acres, as well as the second oldest in the world after California<sup>vii</sup>. It is home to a number of endemic flora and fauna species<sup>viii</sup>. In addition to the downstream populations who depend on the water catchment protection benefits from it, over 100,000<sup>ix</sup> people live beside the Juniper forest and depend on its resources in some way. These nomad tribal communities have a strong relationship with the forest and depend on its ecosystem services for their survival, subsistence and income.

The forest lies in the mountain zone with elevation ranging from 1,181 masl to 3,488 masl<sup>x</sup> and contains a low species diversity with juniper plant species such as *J. excelas polycarpus*, trees belonging to the families Cupressaceae such as *Astragalus* spp and *Onobrychis* spp etc., The area also includes other trees such as Wild Ash, Wild Pistachio, Wild Almond, Makhi, Surai and Zralg etc. There are 54 species of floral plants out of which more than 50% are known for their medicinal/ ethnobotanic importance<sup>xi</sup>. Recorded mammals include Himalayan Black bear, Markhor wild goat, Chiltan Markhor, Straight-horned Markhor and Balochistan Black bear and birds such as Streaked Laughing Thrush, Simla Black Tit and Bar-tailed Tree Creeper etc<sup>xii</sup>. Ziarat district has a dry-temperate climate, with winter temperatures ranging between (-) 16<sup>o</sup> C – 20<sup>o</sup>C. The hottest month is July (27.4<sup>o</sup>C) the coldest is January (7.9 °C). In the peak of winter, temperature often falls below freezing point<sup>xiii</sup>. The forest has faced extensive degradation, mainly as a result of conversion to agriculture especially for orchard cultivation, extraction for constructions of houses and walls of the wells, flood protection barriers etc, and exploitation for firewood<sup>xiv</sup>. In Zarghun Valley alone, 3,900 kg of Juniper wood is cut down annually for domestic use<sup>xv</sup>. The lack of substitute fuel wood or other energy resources is a very big threat to the existence of these forests.

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<sup>1</sup> For Further details on medicinal plants species, please see the document 'Flora of Ziarat; Ethnobotanic and Medicinal Importance'

## 2.2. Geography, Climate and Land Use

Maximum precipitation is received during the months of January - March in winter and July - August in summer and annual rainfall ranges from between 200 - 300 mm per annum. Light showers are frequent during the monsoon season at higher elevations. Relative humidity ranges between 35% in January to 60% in September and snowfall occurs in winter between the months of November and April with a maximum (68 cm) in February. The mean annual rainfall of Ziarat Tehsil decreased to 247.2 mm in the mid 1990s and has seen further reduction by the end of the 1<sup>st</sup> decade of the 21<sup>st</sup> century due to a period of drought from 1998 to 2004<sup>xvi</sup>.

The sources of water in the district include rain and snow, springs, tube wells, storage dams, and wells and karez<sup>2</sup>, most of which are drying out due to excessive pumping out of water by tube wells<sup>xvii</sup>. Generally high delta crops and orchards are grown in the district. Water recharge capacity is generally high due to vegetation and the gravel beds of the streams. The overall water balance in the district is positive but most of it drains out of the district. In 2007 - 2008, there were 1,907 wells, 73 tube wells, and a significant number of karazes (most of them dysfunctional), springs and other sources for irrigating 5,721 acres, 730 acres and 1,900 acres respectively. Thus the total irrigated area in the district was 8,351 ha. All tube wells were electrically operated. In the Pishin-Lora, Nari and Zhob river basins, the major problem is lowering of the water table due to ground water mining issues<sup>xviii</sup>.

According to the Integrated District Development Vision of the Government of Balochistan (IDDV), the total geographical area of Ziarat District is 3,670 km<sup>2</sup> (Ziarat Tehsil 1,489 km<sup>2</sup>, Sanjawi Tehsil 2,181 km<sup>2</sup>). The total cultivated area was 5,458 ha of which current fallow was 2,420 ha and net sown area 3,038 ha. Only 15 ha were double cropped. Out of total uncultivated area of 80,374 ha, cultivable area was 2,557 ha. 69,357 ha were reported under forest and the remaining 8,460 ha were not available for cultivation. The area of legally designated forests is 78,792 ha. Ground water is highly valuable in the district due to the increase in fruit cultivation, which has been promoted extensively in the last few decades. This orchard cultivation has increased steadily over the years. In Ziarat, the production of apples was 21,788<sup>xix</sup> tonnes on an area of 2,240 ha in 2006 -07 and it was 31,593<sup>xx</sup> tonnes on the same area during 2007 - 08. The yield of apple per unit area has increased 45 percent (to 14.1 tonnes/ha in 2007 - 08 from 9.7 tonnes/ha in 2006 - 07).

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<sup>2</sup> Underground tunnels constructed to gather subsoil water, through gravitational pull, at the foot of hills. Sub-soil water seeping as a natural spring may also be referred to as a karez.

### 2.3. Population in the study area<sup>xxi</sup>

The highest number of households was recorded in Chautair Valley followed by Ziarat and Koshki Valleys. The lowest number of households is in Nishpa Valley at 158, however here the average household size is the highest at 12. The lowest household size is recorded in Ziarat Valley at 9 persons per household (Table 1).

**Table 1: Population in the study area<sup>xxii</sup>**

Valley	Number of Households	Population	Avg HH size
Koshki Valley	192	1,742	9.07
Ziarat Valley	275	2,395	8.70
Chuatair Valley	612	7,200	11.76
Nishpa Valley	158	1,930	12.21



### 3. Ecosystem Services

The Juniper ecosystem is unique and supports biodiversity of global importance. The designation of the forest as one of the best examples of less stressed Juniper forest as a World Heritage Site has been under discussion. The other ecosystems found in the district include broad leaved scrub (comprising of wild olive, *Acacia modesta* and *Dodonaea viscosa* in degraded areas) wetland ecosystem (although limited to water reservoirs and seasonal streams) as well as a diversity of agricultural ecosystems with their associated plant and animal species.

Figure 1 is from the MA 2003<sup>xxiii</sup> and depicts ecosystem services and their links to human well-being. As defined by the MA, ecosystem services are “the benefits people obtain from ecosystems” in the form of “products, functions and attributes”. It defines the services provided by ecosystems as follows:

- *Provisioning services*: these include food, fuel, medicines, building materials, handicrafts and other products that are used and consumed by the population.
- *Regulating service*: these comprise of processes and functions which protect and enable human settlement and economic activity, and include climate regulation, storm buffering, coastline protection and disease prevention.
- *Supporting services*: these include ecosystem services such as the provision of primary production, nutrient cycling, soil formation and landscapes.
- *Cultural services*: these comprise of the non-material aesthetic, spiritual, educational, bequest and heritage significance of ecosystems locally, nationally and globally.

All of these ecosystem services are directly or indirectly linked to human-wellbeing components and are essentially its determinants and constituents as depicted in Figure 1.

*Security*: “Humans can be said to live in a state of security when they do not suffer abrupt threats to their well-being. Those who are poor, sick, or malnourished generally have fewer assets and coping strategies and are more likely to be more severely affected”<sup>xxiv</sup>. This is linked with all the services depicted in the figure and described above. Security of the communities and their wealth is subject to the status of the services. Any negative changes can impact on the security of the human being.

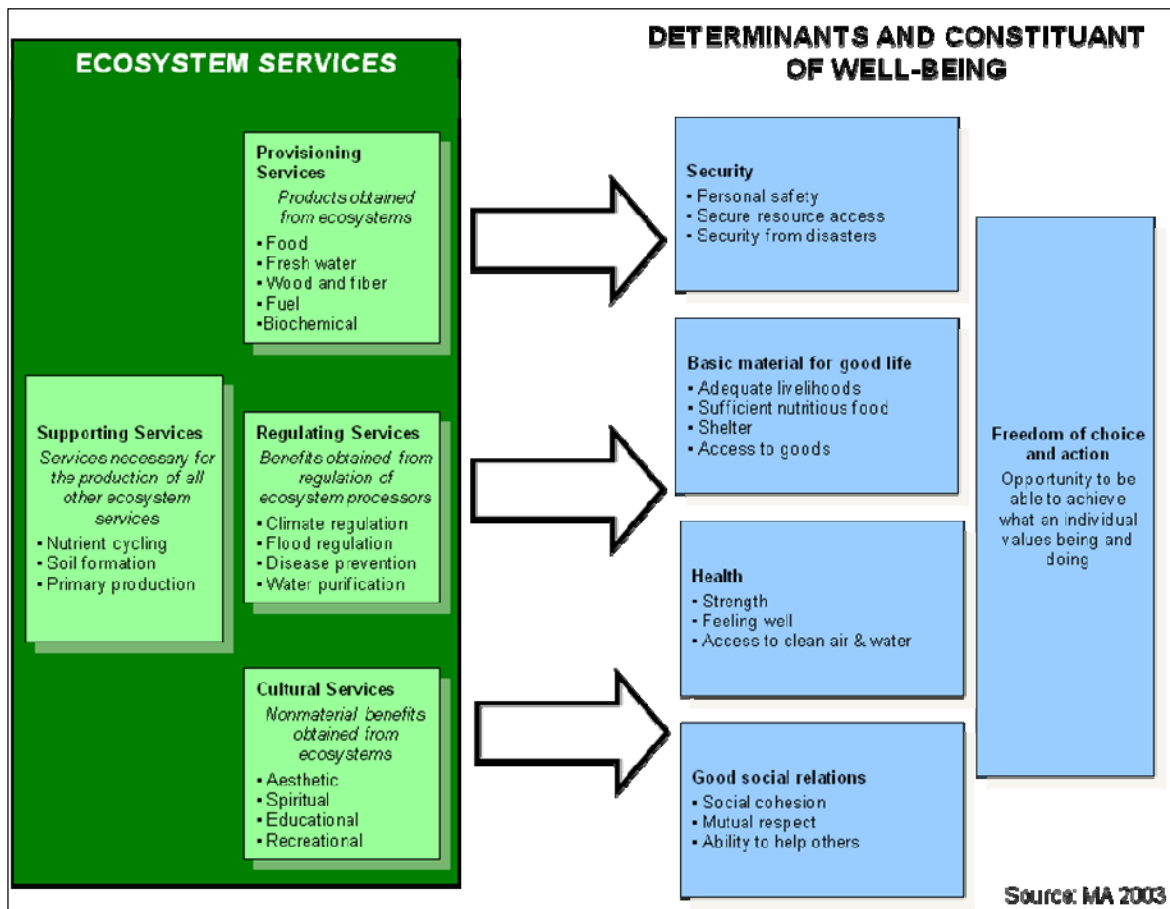
*Basic material for good life*: “The basic materials for a good life include adequate income, household assets, food, water, and shelter”<sup>xxv</sup>. This is linked with provisioning services and regulating services such as food and water purification etc.

*Health*: “Human health is measured in a variety of ways. Life expectancy, infant mortality, and child mortality are measured fairly intensively”<sup>xxvi</sup>. This has a strong relationship with provisioning of foods and regulating services such as regulation of diseases and breeding of insects which carry diseases and purification of water and air etc.

*Good social relations*: “Humans enjoy a state of good social relations when they are able to realize aesthetic and recreational values, express cultural and spiritual values, develop institutional linkages that create social capital, show mutual respect, have good gender and family relations, and have the ability to help others and provide for their children”<sup>xxvii</sup>.

*Freedom of choice and action:* “Freedom is defined as the range of options a person has in deciding on and realizing the kind of life to lead”<sup>xxviii</sup>.

**Figure 1: Ecosystem services and Human well-being**



What this means is that the level of constituents of well being, such as income, health, poverty, vulnerability, unity and freedom, of the communities that depend on ecosystem services is determined by the quality of the ecosystem and thus on the quantity, quality, distribution of and access to ecosystem services.

Similarly the Juniper forest ecosystem contributes to the well being of human populations by providing various services. People rely on these services for their livelihoods through agriculture and livestock. They also depend on the forest watershed for water and on herbs and medicinal plants for their health.

In order to determine the contribution of Juniper ecosystem services to the wellbeing of people living around the forest in Ziarat, it is necessary to understand the types of ecosystem services provided. It is also important to assess how many of these services are actually used by people. This would help to establish the value of these services to the local economy.

### 3.1. Valuing Juniper Forest

The communities in Ziarat use goods and services from the forest for direct consumption and as an input into the production of livelihood activities. Table 2 describes the different kinds of ecosystem services from the Juniper forest and the significance of their value as low, medium and high to the local populations.

**Table 2: Juniper forest ecosystem services and significance of their values**

Juniper Forest Ecosystem Services	
Ecosystem Services	Value to Local Populations
<b>Provisioning</b>	
Foods, fodder, medicine etc	△△
Fresh water	△△△
Timber and fiber	△△
Fuel wood	△△△
<b>Supporting</b>	
Nutrient recycling	△△
Soil formation	△
Primary production	△△
Water cycle	△
<b>Regulating</b>	
Micro climate stabilization	△△
Flood regulation	△△
Disease prevention	△△
Water purification	△△
Slope stabilization	△△
Carbon sequestration	△△
Pest regulation	△△
Pollination	△△△
Natural hazard regulation	△△
<b>Cultural</b>	
Aesthetic	△
Spiritual	△△
Educational	△
Recreational & ecotourism	△△
△- Low value △△- Medium value △△△-High value	

Economic valuation of Juniper forest requires estimating the benefits from direct, indirect and other uses of ecosystem services and understanding their significance in overall livelihood package of the households. This forms an important part of the livelihood analysis.

*Provisioning Services:* The Juniper ecosystem in Ziarat provides a number of provisioning services such as food (fruits), fodder, medicinal plants, freshwater, timber, fuel wood and fiber etc. The most significant of these are the provisioning of fresh water, fuel wood, fodder and medicinal plants. The communities living around the Juniper forest get fresh water for their household uses, agriculture and other uses from the Juniper watershed. Since this area is remote almost the households' entire energy requirement is met through the use of fuel wood from the forest. Livestock is one of the major livelihood activities and almost 100% of

grazing and collection of fodder is dependent on the forest. The semi-nomad tribes living in the area use traditional medicines and medicinal plants from the forest, which play a major role in fulfilling their health related needs.

*Supporting Services:* Four supporting services have been mentioned in table 2. There is no adequate scientific data to measure the exact values of these services, however the supporting services of nutrient cycling, soil formation, primary production are generally acknowledged contributions of forest ecosystems. The significance of the values has been assigned based on the available limited literature and observations.

*Regulating Services:* Flood regulation, microclimate stabilization and slope stabilization were some of the services that the communities acknowledged as having value for them. Another service mentioned in the table is pollination of crops by insects, which is one of the globally best known and well discussed services of natural systems. Since the orchard is the main agricultural output around the Juniper forest area, natural pollination plays a major role in crop yield.

Due to the lack of data, time and resources this service was not estimated. However, there are examples of crop pollination such as orchards and economic value of such pollination. For example, pollination services of insects have been estimated in USA about 35 years ago in 1974 (McGregor 1974) and others subsequently. The pollination service of insects can vary widely for each crop depending on geographic location, availability of natural habitat, and use of pesticides (Kremen et al. 2002a).

The economic value of native insect crop pollinators has been estimated in USA in 2006<sup>xxix</sup>. According to Losey and Vaughan (2006), the value of crop production resulting from pollination by native insects in USA during 2001 - 2003 for fruits and nuts, vegetables and field crops and annual value attributed to the native bees' pollination services has been estimated at US\$ 3,074.13 million. This example shows the economic value of insects living in the natural ecosystems to support crop production. Unfortunately, the data required to undertake a similar study in the Juniper tract was not available and therefore this was not estimated as part of this study. However, this service cannot be neglected in decision making or in other words this should be taken into account to support the conservation of natural Juniper forest ecosystem in Pakistan. For example, apple, cherry, pear, onion, pumpkin and vegetables are main crops cultivated in this area. The dependence of fruits specifically grown in the area depends on insect pollination and is determined to be apple at 1.0, cherry 0.8, pear 0.7, onion 1.0 and pumpkin 0.9 by Losey and Vaughan (2006).

*Cultural Services:* The area where the Juniper forest is located is a popular tourist destination in Pakistan. Since this forest has been identified as the second largest Juniper community in the world and due to the age of the trees there is extensive scope here for educational activities and scientific research.

## 4. Methodology

The valuation methodology for this study was developed to assess the value of water use and the subsistence value from Juniper products and their contribution to local livelihoods. These two criteria were deemed priorities based on the available data and their importance to the local communities. The methodology incorporates hydrological services into the livelihoods analysis to estimate the economic benefits from the use of water for household and agricultural purposes. Based on this design a questionnaire was developed to get answers to a series of questions regarding the economic, hydrological and livelihood values associated with Juniper ecosystem services.

### 4.1. Objectives of This Assessment

- To assess the contribution of forest ecosystem services to the well-being of communities around the Juniper forest in Ziarat, Baluchistan
- To provide the results to conservation and development decision-makers, planners and managers in Pakistan, particularly in Baluchistan.

### 4.2. Assessing water use value

As any other watershed the Juniper forest also supplies water to users around the forest as well as downstream, which is used by these communities for different purposes to varying financial and economic ends. This component of the assessment expresses the economic value of some selected uses of water by analyzing the benefits associated with these uses on production.

The following methodology was followed in assessing the data and estimating the economic value of water from the Juniper.

The water use assessment concentrated on domestic and agricultural uses of water. The main water users around and in the downstream areas of the Juniper forest were identified. Reconnaissance visits provided a picture of water use, output and number of beneficiaries both for household use and irrigated agriculture. Although there are urban/commercial and industrial uses of water from Juniper, due to the time and financial limitations these were not assessed. Data was collected on the economic benefits of annual domestic use of water for drinking, cooking and washing etc. and an analysis was undertaken to the value of water for household purposes.

Irrigated agriculture is one of the major water consuming economic activities in this project area. Therefore, the water used by sampled households for different crops they cultivated during the year was assessed. Primary information was gathered on crop production during the given year in addition to the data from secondary sources such as published and unpublished reports.

The concept of water foot print was used to estimate crop water requirement for each crop cultivated in the study area. Water footprint is defined as: “an indicator of water use that looks at both direct and indirect water use. The water footprint of a product (good or service) is the total volume of fresh water used to produce the product, summed over the various steps of the production chain”<sup>xxx</sup>. The global average water requirement to produce one kilogram of harvest for different crops has been calculated by Hoekstra (2008)<sup>xxxi</sup> and IFC (2010)<sup>xxxii</sup>. In this analysis, these global averages were used to calculate the amount of

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<sup>3</sup> IFC – International finance Corporation, the World Bank Group

water consumed by the different crops. The water requirement for a particular crop was estimated by multiplying the water footprint of per kilogram of the product by total production during the given year. Assuming that the water from the Juniper forest is about 50% of the total water footprint, the value of water from Juniper for crop production was calculated. The price per liter of water use in calculating the value of water for crop production is PKR 0.08 per liter of irrigation water. Cost of irrigation water through tube wells was used as a substitute price in this study, which is PKR 0.08 per liter of water.

The two analyses carried out present the gross annual value per household from different water uses.

### ***4.3. Assessing the livelihoods and their significance***

Land around the Juniper forest area is occupied, managed and used by its nomad inhabitants for hundreds of years. Therefore, for the second part of the analysis a livelihoods assessment was undertaken to estimate the value of the Juniper goods collected from the forest.

Most of the uses of the forest are at subsistence level and very little is used for commercial purposes. Assessment of livelihoods provides information about the nature and dynamics of local livelihoods around the Juniper forest, composition of different livelihood activities and their significance to the communities. Such an assessment gives an indication of the economic contribution of Juniper ecosystem services towards the livelihood of the dependent households.

The following steps were undertaken to assess and analyze data and to estimate the values for different livelihood components around the Juniper ecosystem.

Secondary information sources as well as questionnaires were used to gather information on the characteristics of the human community in the Juniper forest area. The information included the size of the population, their socio-economic composition, main livelihoods, and social and economic relations within the forest. Questionnaire based interviews provided information on land and resource use, livelihood, socio-economic factors which are essential components. The information recorded from the household interviews included both quantitative and qualitative information on the type of livelihood activities, their importance, income and expenditure for the past year. The sample size selected for the survey was 79, which represent respondents from the four project valleys. Information was also collected about total agricultural land area, types of crops cultivated, yield, cost of cultivations, value of the outputs including quantity consumed and sold; size of the livestock, livestock products such as milk, meat, wool, dung etc, and the quantity consumed and sold during the particular year and; annual sales of livestock and income generated from them, and any other types of livelihood activities such as cottage industries and businesses.

Information was also collected regarding different Juniper forest products and services use, quantities, subsistence and commercial use, their market prices or prices of substitutes. The Juniper forest product extraction, consumption and selling was identified as one component of the overall household livelihood strategy. Therefore the study attempted to estimate the economic value of product extraction, consumption and sale as a percentage of the total in-kind and cash income of the households. Some of the Juniper forest ecosystem services were not taken in to account due to the lack of necessary data to value their contribution as well as time and resource constraints.

The analysis results highlight the level of dependency on the ecosystem services by the inhabitants for their livelihoods. The results also indicate the impacts on the populations in the face of any changes to the forest.

## 5. Findings

### 5.1. *Livelihoods of the communities around the Juniper*

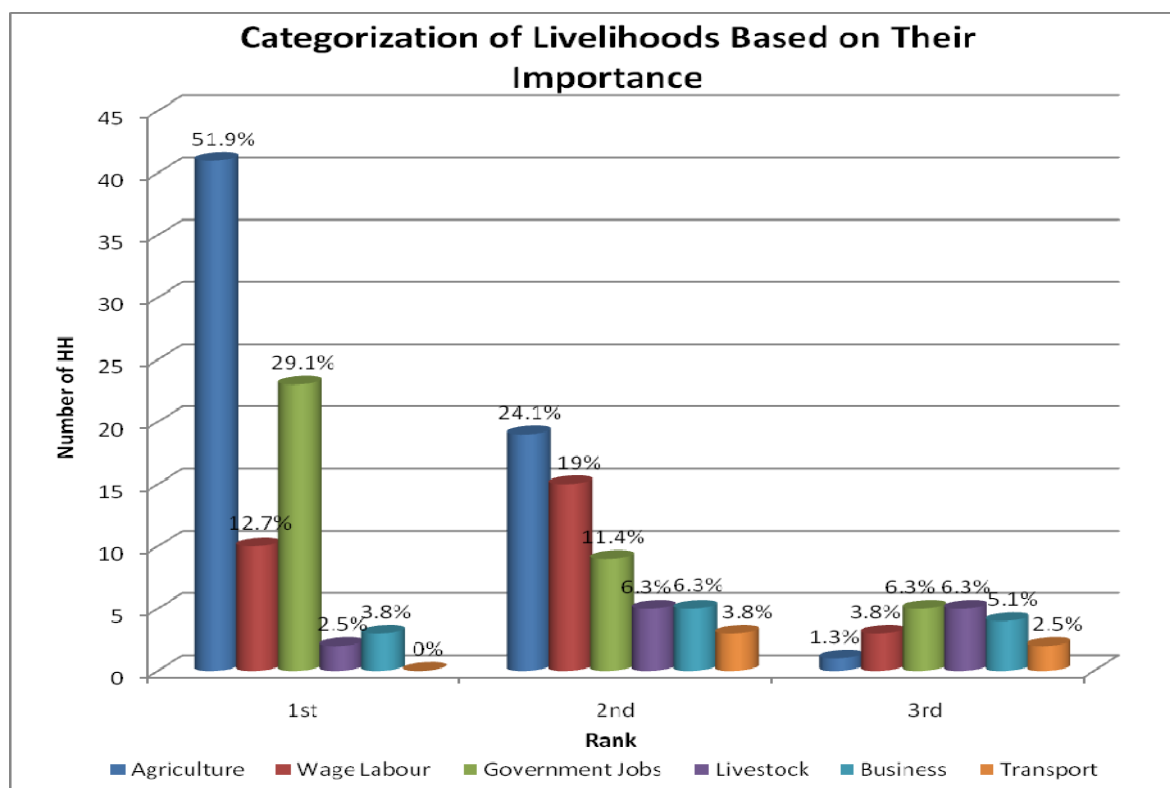
The most widely accepted definition of livelihoods is “a livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living”<sup>xxxiii</sup>. Natural resources play a key role in sustaining livelihoods of communities. This relationship between ecosystem services and livelihoods is very strong if the community has low development indicators such as per capita income, level of education, availability of common facilities and access, such as the case in Ziarat District. The socio-economic status of the communities in the area is a good example of the relationship between natural ecosystem services and livelihoods of the remote communities. This section analyzes livelihoods strategies of the communities living around the Juniper forest in Ziarat and quantifies the cash and in-kind income from different activities. Basically the intention is to show the economic contribution of Juniper services to livelihoods at a very broad level.

Household income is defined broadly in this study to include cash income, subsistence values, non-market income and asset sales. Non-market income refers to the incomes received in-kind from ecosystems. In the case of a forest such as Juniper, non-market income accrues through fuel wood, poles, barks and non-timber forest products such as herbs and medicinal plants etc. Non-market income is also received from forest ecosystem services. Asset sales refer to the role that is played by transferable assets, such as livestock, both in normal situations and at times of shocks or special occasions. Non-market income may also serve the strategy of coping with stress, and certain types of forest products which are not generally harvested may be exploited or used when market and subsistence incomes are lower than normal.

Livelihood strategies of the Juniper communities indicate that they have a limited number of options, exacerbated in part by their lack of education and skills. The available resource base and traditional practices of the nomad tribal communities have motivated them to select natural resources based livelihood activities for the majority of the households living around the Juniper forest.

Figure 2 shows the number of livelihood options available in the area and the level of their importance for the interviewed households. According to the household survey results, there are six categories of livelihood activities: agriculture, wage labour, government jobs, livestock, small business and work in private businesses and transportation. Out of the six categories of livelihood activities agriculture, livestock and wage labour are directly related to the natural resources and ecosystem services from the Juniper forests. Most of the inputs for agriculture and livestock related livelihood activities are provided by the ecosystem.

**Figure 2: Categorization of livelihoods based on their importance**



Diversification of livelihoods activities is a very important factor in reducing vulnerability and increasing resilience. According to the analysis, 29% of the sample households have only one livelihood activity, about 75% do not have more than two livelihood activities, 95% of the sample households do not have a fourth livelihood activity and none of them have more than four livelihood activities. This indicates that only 5% (4) of the households have more than three diversified revenue sources. Agriculture is the first **and** second most important livelihood activity of 52% and 24% households respectively. Since agriculture is very sensitive to sudden shocks, the households that ranked agriculture as their main livelihood are thus more vulnerable to such shocks if they do not have other livelihood or revenue sources or high liquidity assets.

None of the sample households has mentioned the collection of non timber forest products (NTFP) or any other Juniper forest goods as a source of livelihoods. This indicates that although they collect Juniper forest products for subsistence use, they have not recognized it as a part of their livelihood strategy. Table 3 below shows the different goods and services used by the communities. Almost all of the households interviewed use at least three Juniper goods for their household needs.

**Table 3: Ranking of Juniper forest goods and services based on their importance**

Goods and services	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	Total	%
<b>Fuel wood</b>	46	18	10	1	0	0	75	95
<b>Medicinal plants</b>	0	22	23	14	12	0	71	90
<b>Construction Materials</b>	6	6	18	17	7	0	54	68
<b>Timber</b>	18	21	10	1	1	0	51	65
<b>Grazing &amp; fodder</b>	3	3	8	7	2	8	31	39
<b>Bark</b>	0	7	2	10	2	0	21	27
<b>Berries</b>	0	1	2	0	3	2	8	10
<b>Indirect services</b>								
<b>Flood protection</b>	4	0	3	3	0	1	11	14
<b>Water</b>	1	0	0	1	0	0	2	3
<b>Soil fertilization</b>	1	0	1	0	0	0	2	3

The above table indicates that almost 95% of the sample households extract fuel wood from the Juniper forest to fulfill their energy requirement. Almost 90% of households collect medicinal plants, while 68% use wood as construction material and 65% use the wood for timber. Almost all the households use at least three Juniper products or services. Only 2 households mentioned water services from Juniper, which may be because of a lack of understanding about the Juniper forests' role as a watershed to regulate water supply.

The assessment indicates that while the respondents are clear on the goods they obtain directly from the forest, their understanding of indirect services such as water provision etc. is limited. This may be due to the lack of awareness on the ecosystem services provide by the Juniper.

The following section looks at the income and expenditure of the households from the goods and services provided by the Juniper forest. Average values are calculated across different activities and are used for the analysis. However, in order to provide a broader perspective minimum and maximum figures are also indicated.

### 5.2. Income sources and annual income per household

The Table 4 shows that 75% of the sample households are engaged in agriculture, 76% engaged in livestock related activities, 41% are employed in government jobs, 33% work as laborers and 15% engage in private business. The average income from agriculture is approximately PKR 500,000, which is the highest income level among all the activities, followed by private employment and government jobs.

**Table 4: Income sources and annual income per household**

Source	No HH	No Persons	Min (PKR)	Avg (PKR)	Max (PKR)
<b>Agriculture</b>	59	279	6,300	502,300	4,557,000
<b>Livestock</b>	60	77	6,000	179,751	1,378,800
<b>Private sector &amp; Personal Employment</b>	12	25	42,000	240,857	1,200,000
<b>Government Jobs</b>	32	47	56,000	200,688	840,000
<b>Labour</b>	26	52	1,800	74,569	210,000

### 5.3. Expenditure Pattern per household per Year

The expenditure pattern shows that the largest amount of income is spent on essential items such as food and clothing at an average of PKR 187,000 per household per year. Expenditure on water is also indicated to be quite high at PKR 55,000 per household per year. It is interesting to note the category “other” combined gives an amount of approximately PKR 80,000 per household per year and this is expenditure on festivals such as religious festivals and weddings.

**Table 5: Annual expenditure per household**

Item	Min (PKRs)	Avg (PKRs)	Max (PKRs)
<b>Foods and clothing etc</b>	18,000	186,731	1,500,000
<b>Education</b>	2,000	48,615	420,000
<b>Health</b>	1,000	28,884	600,000
<b>Energy</b>	1,000	22,759	360,000
<b>Water</b>	2,500	54,827	360,000
<b>Transport</b>	1,000	28,193	200,000
<b>Other (Eid festival)</b>	5,000	23,333	60,000
<b>Other (Weddings)</b>	25,000	55,000	100,000

#### 5.4. Crop production and income for the producing households

In terms of agricultural production, fruit plantations/ orchards are the main sources of income. The Table 6 shows the annual average crop production by the sample households and its value. The income per year per households includes both the subsistence as well as cash incomes from crops.

**Table 6: Annual crop production per producing household and income**

Crop	# of HH	Avg Production Kg	Income/year/HH (PKR)
Wheat	5 (6%)	3,384	84,600
Potato	16 (20%)	2,433	44,781
Tomato	5 (6%)	892	35,400
Pumpkin	1 (1%)	120	4,200
Peas	4 (5%)	710	7,100
Onion	17 (22%)	6,285	86,056
Garlic	1 (1%)	2,400	60,000
Apple	44 (56%)	8,551	579,310
Cherry	11 (14%)	540	115,818

Out of the total sample 24% (19 households) do not engage in agriculture. Only 6% of the households cultivated wheat during the previous year, and the average yield was about 3,384 kg per household. The total wheat production was sold. Fruits and vegetables showed a higher cultivation level and 20% of the households cultivated potatoes during the year, with an average yield estimated at 2,433 kg per producing household. Most of the households produced potatoes for sale, with very few using them for own consumption.

Apple seems to be the highest and most lucrative crop cultivated. According to the estimates, apple is the highest income earning agricultural crop for the households engaged in agriculture as a livelihood activity. About 56% of the sampled households have engaged in cultivation of apple in the study area. On average, 8,551 kg of apple have been produced by each producing household during the particular year. About 14% of the sampled households produce cherries and per household yield was estimated at 540 kg for the year. It is the second highest income earning agricultural crop. Both apple and cherries are produced only for income purpose. It was observed that the prices variation for apple and cherries is high. This is probably because of the quality of the products and the access to markets. Finally, 22% of the interviewed households have grown onion and average yield for the particular year per producing household was estimated at 6,285 kg. About 99% of the onion production has been sold and the rest has been consumed by the producing households. Market access is a determining factor to get a good price for the agricultural products. Due to the lack of transport facilities the producers may have to sell their products to intermediate collectors for a lower price. Some of the households who had market access would have been able to get a higher price for their products.

### 5.5. Livestock income for producing households

Livestock is entirely dependent on the ecosystem services from the Juniper forest. Grazing in the Juniper area is a common practice and fodder is also extracted. Table 7 below shows the average livestock income per household. It depicts livestock products and their values, and revenue from live animal sales for the livestock producing households per year. The maximum number of livestock per household was recorded at 60 cattle, 110 goat, 200 sheep and 20 chickens. Although it was observed that most of the households use some form of livestock products (milk, meat etc), there was some hesitation on their part to provide this information. Therefore these livestock product values should be considered as the minimum values per producing households. Although the households in the study area consume meat, the information on the meat production by the households was not provided by the interviewed households. Almost all of the livestock products have been consumed and not produced for cash income. About 11% of the sample (9 households do not have any type of livestock mentioned below in the table.

**Table 7: Annual livestock income per producing household**

Type	# HH	Avg # of Animals/HH	Livestock products				Sales of Live animals		
			Milk		Dung		# HH	Avg Unit sold (number)	Value
			Avg production (Ltr)	Value	Avg production (Kg)	Value			
<b>Cattle</b>	14	9	-	-	800	1,000	5	5	125,000
<b>Goat</b>	59	16	1,207	46,739	8,000	10,000	19	4	17,868
<b>Sheep</b>	60	20	10,380	415,200	3,560	4,450	25	5	31,840
<b>Chicken</b>	6	12	-	-	-	-	-	-	-



### 5.6. Juniper forest products

The Table 8 below depicts the different Juniper forest products collected by the households around the forest and the value generated from the different products per collecting household per year. Almost all of the products have been collected only for household consumption and not for selling purposes. Some households have harvested Juniper trees to construct houses, flood protection barriers and use as supporters to stabilize the walls of the dug wells.

**Table 8: Juniper forest products and value per producing household<sup>4</sup>**

Products	# collecting HH	Avg amount/H H	Unit	Min value/HH (PKR)	Avg value/HH (PKR)	Max value/HH (PKR)
Fuel wood	73	213	Maunds <sup>5</sup>	2,700	63,343	190,500
Medicinal plants	63	4.27	Kg	150	640	2,250
Juniper Bark	29	17	Maunds	400	6,759	48,000
Fodder	15	114	Maunds	900	17,150	40,500
Grazing	60	1,341	Maunds	1,500	87,514	1,080,000
Timber	15	33	Maunds	900	14,790	54,000
Berries	6	4	kg	25	100	250

Approximately 80% of sampled households collect more than 27 species of medicinal plants from the Juniper forest area<sup>xxxiv</sup>. Although the contribution in economic terms is only PKR 640 per household per year, there is a strong link between the conservation of medicinal plants and well-being of the population because 80% of the households interviewed collect medicinal plants for their own household use for different health purposes. Health care of the rural tribal population in an area where there is limited access to the modern western medicines and related services is entirely dependent on the medicinal plants extracted from the Juniper forest. Approximately 40% of collectors are female.

Over 90% of the households collect fuel wood and 40% of collectors are female and 60% male, which on average contributes PKR 63,343 to the income of per household per year. Around 37% of sample households collect Juniper barks for their household needs and all the collectors are male. Fodder is collected by 20% of the households and 25% female and 75% male engage in fodder collection. 20% of the households have extracted timber during the given year and the extraction has been done by the males of the households, contributing approximately PKR 15,000 to per household income per year.

<sup>4</sup> There is a difference in the number of households that ranked the Juniper products and those that responded to questions regarding collection. Not all of the households that ranked them responded to engaging in collection.

<sup>5</sup> 1 maund = 40 kg

Only 8% of the sampled households collect berries from the forest, mostly for their own consumption and this activity is usually undertaken by females and children. Grazing of livestock in the Juniper forest is one of the main uses of Juniper forest resources. Both male and female are engaged in livestock grazing and 25% of them are female and 75% male.

Some households collect more than 50 maunds (1 maund = 40 kg) of fuel wood per month and this may be to store fuel wood for the winter season for heating and cooking purposes. The capacity of the forest to provide fuel wood needs to be assessed in order to determine the level of threat to the forest from fuel wood collection.

## 5.7. Water services

Water delivered from the Juniper forest is currently used for a variety of purposes, including irrigated agriculture, livestock production and domestic consumption. Each of these water uses generates both financial revenues and economic benefits. The land use information provided earlier indicates the extent of crop cultivations. The main sources of water in the Juniper area are rainfall, snow, ground water and springs and streams. During the dry period requirement is met from water flows from the Juniper watershed and ground water. Water is a scarce resource in this area.

### 5.7.1. Personal and household water consumption

The value of water for household use per year is estimated in Table 9 below. Data was gathered on use of water for drinking, cooking and washing purposes. The minimum, average and maximum amounts and values per household per year were estimated. Some households purchase water from vendors and they pay PKR 500 per 1,000 liters of water. Using this information, the price of the water for household use was assumed to be PKR 0.50 per liter.

**Table 9: Water consumption and value per household for the period they live in Ziarat**

Water use	Min (ltr)	Avg (ltr)	Max (ltr)	Price/ltr	Min Value (PKR)	Avg Value (PKR)	Max Value (PKR)
Drinking	720	13,502	99,000	0.5	360	6,751	49,500
Cooking	720	8,109	43,200	0.5	360	4,054	21,600
Washing	3,600	32,147	288,000	0.5	1,800	16,074	144,000

On average, approximately 54,000 liters of water are used by each household during the period of time that they live in Ziarat. This amounts to an average value of PKR 27,000 per household per year. Out of the sample households 68% of the water is collected by females, 28% by males and 4% purchase water from vendors. This information can be used to calculate per person drinking water consumption per day assuming that average household size is 10 persons per household. As such a person drinks around 4 liters of water per day and uses 9 liters of water for washing purposes. Compared to the basic standard minimum water requirement to have a healthy life of 50 liters per person per day<sup>xxxv</sup> this estimated value is significantly low.

### 5.7.2. Crop water consumption

The water footprint of an individual or community is defined as “the total volume of freshwater that is used to produce the goods and services consumed by the individual or community” (Hoekstra and Chapagain 2008)<sup>xxxvi</sup>. “The water footprint is an indicator of water use that looks at both direct and indirect water use and is the total volume of fresh water used to produce the product, summed over the various steps of the production chain”<sup>xxxvii</sup>.

Following are the estimated values of water for crop production, based on average production and the estimated water footprint (per kilogram global average).

**Table 10: Value of water for agricultural crop production**

Crop	Avg Production Kg	Water/liters/ Per Kg <sup>6</sup>	Average water consumption (Li) / crop/HH	Value per crop/HH (PKR)
Wheat	3,384	1,300	4,399,200	175,968
Potato	2,433	250	608,250	24,330
Tomato	892	180	160,560	6,422
Pumpkin	120	240	28,800	1,152
Peas	710	700	497,000	19,880
Onion	6,285	374	2,350,590	94,024
Garlic	2,400	374	897,600	35,904
Apple	8,551	700	5,985,700	239,428
Cherry	540	700	378,000	15,120

The values were estimated assuming that the 50% water footprint is from the Juniper and price per liter is PKRS 0.08 per liter as explained in the methodology. Per kilogram global average was multiplied with the average production of the particular product to get values per household. The table indicates that apple has the highest water consumption with an average of about PKR 7 million liters per household per year. The second is wheat which uses water at a value of over PKR 4 million, followed by onion with PKR 2 million per household per year.

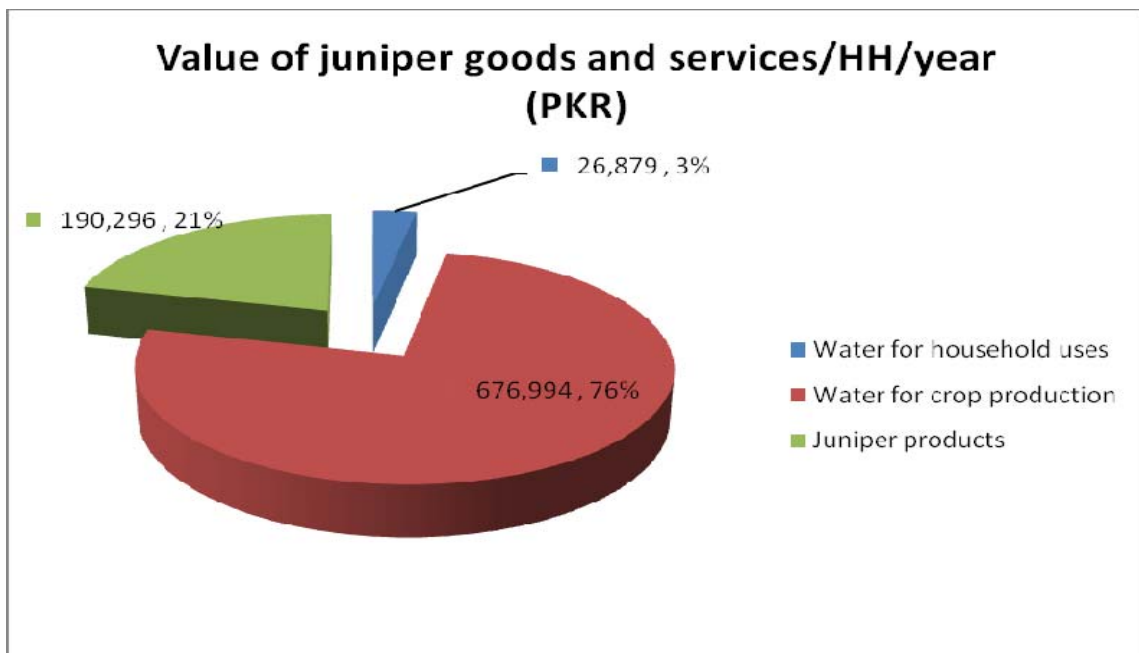
Wheat and orchards (apple, peas and cherry) are the highest water consuming crops cultivated in the area.

<sup>6</sup> Based on the global average estimates by Hoekstra, 2008 and IFC 2010

Figure 3 below explains the value of provisioning services from Juniper (water and Juniper goods) per household per year. On average each sample household gets economic benefits from the forest as:

- **Water for crop production is almost PKR 700,000 per household annually<sup>7</sup>**
- **Water for household use is approximately PKR 27,000 per household annually**
- **Livelihoods contribution from Juniper products is PKR 190,269 per household annually<sup>8</sup>**

**Figure 3: Value of Juniper provisioning services**



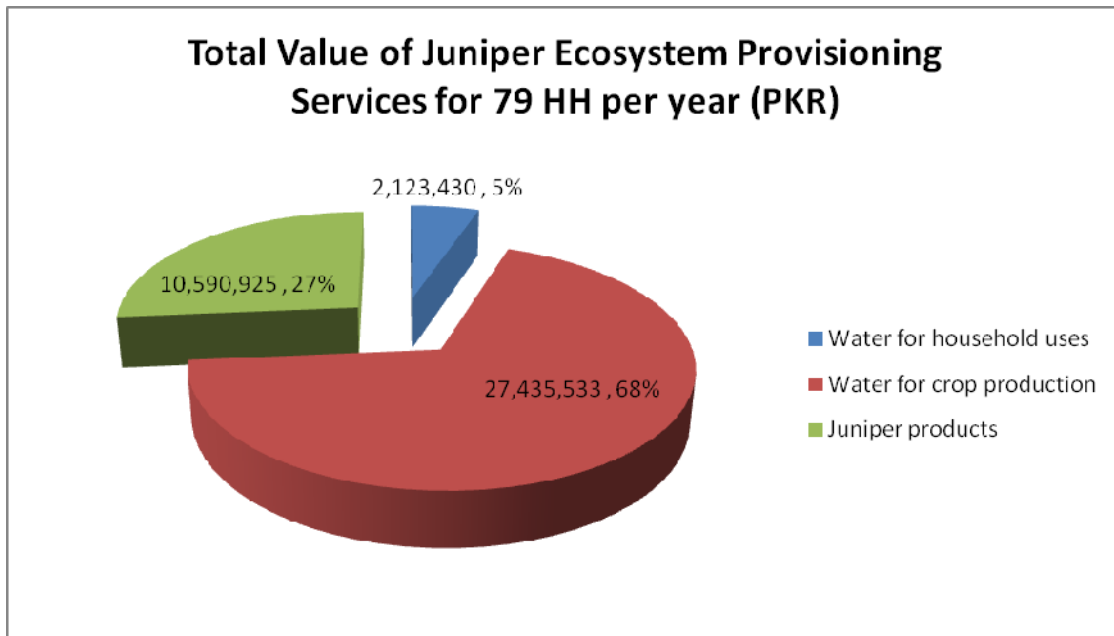
The above graph indicates that 87% of value from Juniper is from watershed services, while approximately 13% of value comes from the contribution of Juniper goods such as fuel wood, medicinal plants, and timber to local incomes. Water is used mainly for household requirements and to produce crops such as apple, pears, cherries and wheat.

<sup>7</sup> Each household means each household in the sampled areas that engage in agriculture

<sup>8</sup> Each household means each household in the sampled areas that engage in collecting agriculture

The total value of water for household use and crop production, and total value of Juniper products such as fuel wood, medicinal plants, timber, fodder is also estimated for the 79 households interviewed (Figure 4). According to this, the total value of water for household use for all the sampled household is estimated at over PKR 2 million per year; for crop production it is estimated at over PKR 27 million per year<sup>9</sup>; and total value of Juniper products for the sampled households is estimated at over PKR 10 million per year<sup>10</sup>. The total of Juniper ecosystem provisioning services for the 79 households altogether per year is thus estimated at over PKR 40 million per year.

**Figure 4: Total value of Juniper provisioning services for the sample households per year**



<sup>9</sup> Only households engaged in crop production were accounted for i.e 75% of the sampled household

<sup>10</sup> Only households engaged in Juniper product collection were accounted for i.e 76% of the sampled households

## 6. Conclusion

It is impossible to recreate an old growth forest and the Juniper forest in Ziarat District in Pakistan is an old growth forest. Not only does it have value in terms of the longevity of each tree and its natural beauty, it provides undeniable services to human wellbeing in the area. These services provide economic benefits to the communities both directly and indirectly.

This study was an attempt to broadly quantify some of these economic benefits, in order to make the case to policy makers that conservation of these forests is not only crucial to the livelihoods of local populations but can also be a source of income at the provincial and national levels.

The study presents the economic and livelihood arguments for conserving Juniper ecosystems for increased economic growth and human well-being. It does this by undertaking a rapid ecological-socio-economic assessment of the Juniper forests in Ziarat District, and thus determining the relationship between the ecological values of these ecosystems with socio-economic values. Juniper forests - it is found – have an integral role to play in the provision of products and services that have a demonstrable value at least to local livelihoods. The study has been broad due to the lack of available data and the remoteness of the valleys, but the main idea has been to provide indicative figures of the economic value of the forest.

It looked at three main services in four valleys, that are used by surrounding households, and their values were estimated to show that on average the forest the value of water for crop production is almost PKR 700,000 per household annually, the value of water for household use is approximately PKR 27,000 per household annually and the value of livelihoods contribution from Juniper products is PKR 190,000 per household annually.

For all the sampled households, the total value of water for household use for all the sampled household is over PKR 2 million per year; for crop production is over PKR 27 million per year<sup>11</sup>; and total value of Juniper products for the sampled households is over PKR 10 million per year. These figures indicate that the forest has direct economic value to the people of the area. As such their conservation is essential to their continued well being.

Moving further however, the potential of Juniper forests is also apparent at the provincial and national levels. They can be explored to expand ecotourism in the area. This part of Pakistan has beautiful mountains and is culturally rich. The added attraction of these “living fossils” can further boost the tourism potential in the future.

There is thus a need for a shift in policy by looking at these very broad values, and thus understanding the value of conserving these forests. Further research on other benefits can additionally strengthen the economic case for conservation and encourage policy making.

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<sup>11</sup> Only households engaged in crop production were accounted for i.e 75% of the sampled household

## References

- <sup>i</sup> For details about the study area please refer to *Assessment Study of Juniper Forest 2009, prepared by Pakistan EcoConsult (Pvt) Ltd for IUCN Pakistan*. Available with IUCN Pakistan Quetta Office....
- <sup>ii</sup> IUCN 2006. *Investigating the delivery of ecosystem economic benefits for upland livelihoods and downstream water users in Nepal*, Policy brief one.
- <sup>iii</sup> <http://encyclopedia2.thefreedictionary.com/Juniper+species>
- <sup>iv</sup> Diamond, David D. 1997. *An old-growth definition for western Juniper woodlands: Texas Ashe Juniper dominated or codominated communities*. Gen. Tech. Rep. SRS-15. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 10 p.
- <sup>v</sup> <http://www.khyber.org/places/2005/ZiaratDistrict.shtml> ;  
[http://www.pakistanpaedia.com/land/GEO\\_7.html](http://www.pakistanpaedia.com/land/GEO_7.html); <http://www.heritage.com.pk/travel-guide/ziarat/> ;  
<http://www.pakistaneconomist.com/database2/Updated-information/Quetta.asp>
- <sup>vi</sup> *Assessment Study of Juniper Forest 2009*, prepared by Pakistan EcoConsult (Pvt) Ltd for IUCN Pakistan.
- <sup>vii</sup> Mudassir Asrar Zaidi et al 2006. *Pharmacological Screening of Arceuthobium oxycedri (Dwarf Mistletoe) of Juniper Forest of Pakistan*. Online Journal of Biological Sciences 6 (2): 67-70, 2006.
- <sup>viii</sup> IUCN. *Flora of Ziarat; Ethnobotanic and Medicinal Importance*. Government of Balochistan, UNDP, GEF and IUCN. Available with IUCN Quetta Office
- <sup>ix</sup> Government of Balochistan and IUCN. *Ziarat District: Integrated District Development Vision (draft)*
- <sup>x</sup> *ibid*
- <sup>xi</sup> IUCN. *Flora of Ziarat; Ethnobotanic and Medicinal Importance*. Government of Balochistan, UNDP, GEF and IUCN. Available with IUCN Quetta Office
- <sup>xii</sup> IUCN 2009: *Mainstreaming Biodiversity Conservation into production systems in the Juniper Forest Ecosystems*. Project document. Available with IUCN Pakistan Quetta Office....
- <sup>xiii</sup> Government of Balochistan and IUCN. *Ziarat District: Integrated District Development Vision (draft)*
- <sup>xiv</sup> Government of Pakistan. *First National report of Pakistan to the Convention of Biological Diversity*
- <sup>xv</sup> *ibid*
- <sup>xvi</sup> Government of Pakistan. *First National report of Pakistan to the Convention of Biological Diversity*
- <sup>xvii</sup> *ibid*
- <sup>xviii</sup> Government of Pakistan. *First National report of Pakistan to the Convention of Biological Diversity*
- <sup>xix</sup> Development Statistics of Balochistan (2008)
- <sup>xx</sup> Agricultural Statistics of Balochistan (2007-2008)
- <sup>xxi</sup> For details about the study area please refer to *Assessment Study of Juniper Forest 2009, prepared by Pakistan EcoConsult (Pvt) Ltd for IUCN Pakistan*. Available with IUCN Pakistan Quetta Office....

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- <sup>xxii</sup> For details about the study area please refer to *Assessment Study of Juniper Forest 2009, prepared by Pakistan EcoConsult (Pvt) Ltd for IUCN Pakistan*. Available with IUCN Pakistan Quetta Office....
- <sup>xxiii</sup> MA 2003. *Ecosystems and human well-being: A framework for assessment*. World Resources Institute
- <sup>xxiv</sup> MA 2005. Ecosystem Conditions and Human Well-being, Chapter 5. *Ecosystems and Human Well-being: Current State and Trends*, Volume 1
- <sup>xxv</sup> *ibid*
- <sup>xxvi</sup> MA 2005. Ecosystem Conditions and Human Well-being, Chapter 5. *Ecosystems and Human Well-being: Current State and Trends*, Volume 1
- <sup>xxvii</sup> *ibid*
- <sup>xxviii</sup> MA 2005. Ecosystem Conditions and Human Well-being, Chapter 5. *Ecosystems and Human Well-being: Current State and Trends*, Volume 1
- <sup>xxix</sup> Losey J. E and Vaughan M. 2006. The Economic Value of Ecological Services Provided by Insects. *Bioscience* Vol. 56 No. 4. [www.bioscience.org](http://www.bioscience.org)
- <sup>xxx</sup> Hoekstra, A. Y. 2008. *Water footprint of food*. Twente water centre, University of Twente, The Netherlands
- <sup>xxxi</sup> *ibid*
- <sup>xxxii</sup> IFC 2010. *Water Footprint Assessments: dehydrated onion products micro irrigation systems*
- <sup>xxxiii</sup> Chambers, R. and Conway, G.R. 1992. *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century, Discussion Paper 296*. Brighton, UK: Institute of Development Studies.
- <sup>xxxiv</sup> For further information on Medicinal Plants in Juniper Forests please see IUCN. *Flora of Ziarat: Ethnobotanic and Medicinal Importance*. Government of Balochistan, UNDP, GEF and IUCN. Available with IUCN Quetta Office
- <sup>xxxv</sup> Gleick, P.M. 1996. *Basic Water Requirement for Human Activities: Meeting Basic Needs*. Pacific Institute for Studies in Development, Environment, and Security. [www.bvsde.paho.org/bvsacd/cd17/basic\\_wate.pdf](http://www.bvsde.paho.org/bvsacd/cd17/basic_wate.pdf).
- <sup>xxxvi</sup> Hoekstra, A.Y., Chapagain, A.K. 2008. *Globalization of Water: Sharing the Planet's Fresh Water Resources*. Blackwell Publishing, Oxford UK.
- <sup>xxxvii</sup> Hoekstra, A. Y. 2008. *Water footprint of food*. Twente water centre, University of Twente, The Netherlands



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