# Participatory Forest Management Plan, (PFMP)

## Juniper Forests of Manna Valley, District Ziarat

**2022-2032**

**Forests and Wildlife Department Balochistan, Pakistan &**
**Village Community Organizations,**

**Manna, Ziarat Forests Division**

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# Participatory Forest Management Plan\ for Juniper Forests of Manna Valley, District Ziarat

## Endorsement

1. **Chairman, Village Community Organization**

2. **REDD+ Focal Person, Balochistan Forest Department**

**Disclaimer:**

This Participatory Forest Management Plan is not a funding commitment from Forests and Wildlife Department Balochistan. It is a proposal to be considered for future implementation of REDD+ Programme if funds are committed by the Balochistan government and/or any other donor(s). The success of this plan is contingent to the commitment of all stakeholders involved in the implementation of this plan. Benefit Sharing Mechanism and institutional setup for implementation of REDD+ approved by the Government of Balochistan will form the basis for implementing this Plan. Information on these aspects are suggestive and not binding on the Forests and Wildlife Department Balochistan and any other stakeholders mentioned in this document.

**وضاحت**

بلوچستان کا محکمہ جنگلات وجنگلی حیات اس منصوبے کے لیے مالی وسائل فراہم کرنے کا پابند نہیں ہوگا۔اس منصوبہ پر عمل درآمد کرنے کے لیے مالی اور انتظامی سفارشات دی گئی ہیں ۔تاہم ان پر عمل بلوچستان کے محکمہ جنگلات وجنگلی حیات کے بنائے گئے انتظامی و مالی رہنما اصولوں کے تحت ہوگا۔

Contents

## Acronyms

| | |
|---|---|
| AGB | Above Ground Carbon |
| BGB | Below Ground Carbon |
| ANR | Assisted Natural Regeneration |
| F&WD | Forestry & Wildlife Department |
| FCPF | Forest Carbon Partnership Facility |
| GIS | Geographic Information System |
| GOP | Government of Pakistan |
| LPG | Liquid Petroleum Gas |
| MW | Mega Watt |
| MoCC | Ministry of Climate Change |
| NCCP | National Climate Change Policy |
| NTFP | Non-Timber Forest Product |
| PFMP | Participatory Forest Management Plan |
| PFRA | Participatory Forest Resource Assessment |
| PSDP | Public Sector Development Programme |
| REDD+ | Reducing Emission from Deforestation and Forest Degradation |
| TFCC | Planning Commission Task Force on Climate Change |
| t $CO_2$-eq | Tonnes Carbon dioxide (Carbon credit) |
| VFP&CC | Village Forest Protection & Conservation Committee |
| 10 BTTP | 10 Billion Tree Tsunami Project |

## Executive Summary

Juniper Forests of Manna Valley are located in Union Council Manna of District Ziarat Balochistan. Manna Valley is one of the three sites selected by the Balochistan Forests and Wildlife Department in consultation with key stakeholders as a pilot site to demonstrate implementation of REDD$^+$ in the province. This is part of a larger project being implemented by the Ministry of Climate Change (MoCC), Government of Pakistan and the Provincial Forest departments in which a total of 15 Participatory Forest Management Plans are being developed for REDD$^+$ implementation in all six entities of Pakistan.

The Government of Pakistan has joined global efforts to address deforestation and forest degradation to mitigate climate change and its impact by initiating REDD$^+$ activities. REDD$^+$ has three phases; i. Readiness, ii. Demonstration through implementation, and iii. Result-based payments. The first two phases when combined are known as the readiness phase. Pakistan has made substantial progress in meeting REDD+ readiness requirements. Pakistan has developed a National REDD+ Strategy in 2021. Whereas Balochistan Forests and Wildlife Department has developed a Provincial REDD+ Action Plan. This action plan is a decentralized framework for Balochistan to proceed with REDD+ implementation. Preparation of Participatory Forest Management Plans is an important step to implement this action plan by integrating and implementing REDD+ activities in forest management in various socio-ecological systems.

The local stakeholders of Manna Valley were engaged in preparation of the present Participatory Forest Management Plan. Plan will guide the implementation process of REDD$^+$ by projecting business as usual and reduced emission scenarios derived from detailed participatory assessment of socio-economic circumstances, ecological condition, and challenges (drivers), and assessment of the forest resources which have been described in this plan. The plan also presents stakeholders' analysis with their roles and obligations use rights of forest dependent communities, conflict resolution and benefit-sharing mechanisms. This information is crucial for successful implementation of REDD$^+$.

The analysis of forest cover revealed that since 2010 Juniper forests in Manna Valley are decreasing at the rate of 0.71 hectares per year, causing 183 tonnes $CO_2$ eq emissions annually. This decrease in forest cover is clearly a case of great concern, particularly when the rest of the forest also faces severe degradation. Juniper forests in rest of the province are also decreasing and following the path of degradation. The essence of REDD+ intervention mentioned in this Participatory Forest Management Plan is expected to halt the decrease in forest cover and put it on path of improvement. This end of restoration and improvement would be achieved through collaborative forest management efforts of the stakeholders. This plan has proposed distribution of carbon and non-carbon benefits accrued by the implementation of plan according to which 80% benefits will go to the Government, and 20% will go equally to the customary right holders and users. These benefits will only be distributed if the planned emission targets are achieved. The plan provides scenarios so that the stakeholders can enjoy results-based payment and benefits. The success of this plan, therefore, is contingent to the commitment of all the stakeholders involved. A specific and definitive distribution of benefits in case of REDD+ programme is yet to be developed by the government, which will form basis for sharing of benefits in the case of private forests. This proposed ratio will be finalized or confirmed only after finalizing Balochistan's benefit sharing mechanism.

The initial period of this plan will be 10 years; however, the plan will be a living document and open for annual reviews. A budget forecast to implement activities mentioned is also provided in this plan. The major focus of the plan will be on enhancing forest cover by reforestation and regeneration of forest blanks and reducing the demand for fuel wood from the forest through promotion of energy efficiency and alternate sources of energy.

The implementation of activities described in the plan will be guided by annual operational plans to be developed by the Balochistan Forest and Wildlife Department in consultation with the relevant stakeholders. The plan will be implemented by Valley Level REDD+ Implementation Committee and District Level REDD$^+$ Implementation Committee to be notified by the Balochistan Forest and Wildlife Department in consultation with the relevant stakeholders.

## خلاصہ

بلوچستان ضلع زیارت کے وادی منا میں واقع جونیپر کے جنگلات محکمۂ جنگلات، جنگلی حیات کی جانب سے منتخب کردہ اُن تین مقامات میں سے ایک ہے جہاں ایک پائلٹ سائٹ کے طور پر اہم شراکت داروں سے مشاورت کے ساتھ ریڈ پلس کے نفاذ کا عملی مظاہرہ کیا جائے گا۔ یہ ایک بڑے منصوبے کا حصہ ہے جو وزارتِ موسمیاتی تبدیلی، حکومتِ پاکستان اور صوبائی محکمۂ جنگلات کے ذریعے لاگو کیا جا رہا ہے جس میں پاکستان کے تمام چھ علاقوں میں ریڈ پلس پر عمل درآمد کی غرض سے مجموعی طور پر جنگلات کے شراکتی انتظام کے لیے پندرہ منصوبے بنائے جا رہے ہیں۔

حکومتِ پاکستان نے جنگلات کی کٹائی اور تنزلی سے نمٹنے اور موسمیاتی تبدیلی کے اثرات کم کرنے کے لیے ریڈ پلس سرگرمیوں کا آغاز کر کے عالمی کوششوں میں شمولیت اختیار کی ہے ۔ ریڈ پلس کے تین مراحل ہیں۔ (i) تیاری (ii) عمل درآمد کے ذریعے مظاہرہ، اور (iii) نتائج پر مبنی ادائیگیاں۔ پہلے دو مراحل کو مشترکہ طور پر ریڈ پلس کی تیاری کا مرحلہ کہا جاتا ہے۔ پاکستان نے ریڈ پلس کی تیاری کی ضروریات کو پورا کرنے کے لیے خاطر خواہ پیش رفت کی ہے۔ پاکستان نے 2021ء میں ایک قومی ریڈ پلس حکمتِ عملی تیار کی ہے ۔ جب کہ بلوچستان کے جنگلات، جنگلی حیات کے محکمے نے صوبائی سطح پر ایک جامع ریڈ پلس ایکشن پلان تیار کیا ہے۔ بلوچستان میں ریڈ پلس پر عمل درآمد کو آگے بڑھانے کے لیے یہ ایکشن پلان ایک صوبائی فریم ورک ہے۔ مختلف سماجی ماحولیاتی نظاموں میں جنگل کے انتظام کے لیے ریڈ پلس سرگرمیوں کو مربوط اور لاگو کر کے جنگلات کے شراکتی انتظام کے منصوبوں کی تیاری اس ایکشن پلان پر عمل درآمد کے لیے ایک اہم قدم ہے۔

مقامی فریقین نے جنگلات کے شراکتی انتظام کے منصوبے کی تیاری میں حصہ لیا۔ ریڈ پلس پر عمل درآمد میں رہ نمائی کے لیے اس منصوبے کے تحت دو مختلف منظر ناموں یعنی موجودہ حالات اور اخراج میں کمی کا اندازہ لگایا جائے گا۔ اس مقصد کے لیے سماجی اقتصادی حالات کے تفصیلی شراکتی تجزیے، ماحولیاتی صورتِ حال اور چیلنجز اور منصوبے میں واضح کردہ جنگلاتی وسائل کا جائزہ لیا جائے گا۔ یہ منصوبہ فریقین کے کردار اور ذمّے داریوں کے ساتھ اُن کے تجزیے، جنگلات پر انحصار کرنے والی لوگوں کے حقوق کے استعمال، تنازعات کے حل اور مشترک فوائد کے حصول کا طریقۂ کار بھی پیش کرتا ہے۔ ریڈ پلس پر کامیاب عمل درآمد اور شراکتی سرگرمیوں کی تفصیلات کا تعیّن کرنے کے لیے یہ معلومات ضروری ہیں۔

جنگل کے رقبے کے تجزیے سے پتا چلتا ہے کہ 2010ء سے چلغوزہ جنگل میں 0.71 ہیکٹر سالانہ کی شرح سے کمی ہو رہی ہے جس سے سالانہ 183 ٹن کاربن ڈائی آکسائڈ کا اخراج عمل میں آ رہا ہے۔ ان جنگلات میں کمی ایسی صورت میں، جب باقی جنگلات بھی تنزلی کے شکار ہیں، انتہائی قابلِ غور ہے۔ جنگلات کے شراکتی انتظام کا اس منصوبے میں شامل اقدامات کے عملی اطلاق سے ان نقصانات میں کمی آئیگی۔

مجوزہ منصوبے کے مطابق اس منصوبے پر عمل درآمد سے حاصل ہونے والے کاربن اور نان کاربن محصولات میں سے 80 فی صد متعلقہ حکومت کو حاصل ہوں گے جب کہ باقی 20 فی صد جنگل کے حقوق رکھنے والوں اور صارفین کو ملیں گے۔ یہ فوائد صرف اہداف حاصل ہونے کی صورت میں تقسیم کیے جائیں گے اس لیے یہ منصوبہ فوائد میں کمی یا اضافے کا منظر نامہ پیش کرتا ہے تاکہ فریقین نتائج پر مبنی ادائیگی اور فوائد سے مستفید ہو سکیں۔ لہٰذا اِس منصوبے کی کامیابی اس میں شامل تمام فریقین کے عزم پر منحصر ہے۔

حکومت کی طرف سے ریڈ پلس پروگرام کے معاملے میں فوائد کی ایک مخصوص اور قطعی تقسیم فی الحال تیار نہیں ہوئی ہے جو جنگلات کے سلسلے میں فوائد کے اشتراک کی بنیاد بنائے گی ۔ مشترک فوائد پر مبنی بلوچستان کے طریقۂ کار کے طے ہونے کے بعد ہی اس مجوزہ تناسب کو حتمی شکل دی جائے گی یا اس کی تصدیق کی جائے گی۔

اس منصوبے کی ابتدائی مدّت دس سال ہوگی تاہم یہ منصوبہ ایک زندہ دستاویز ہوگا اور سالانہ جائزے کے لیے پیش ہوگا۔ اس منصوبے میں مذکورہ سرگرمیوں پر عمل درآمد کے لیے رہ نمائی متعلقہ فریقین کی مشاورت سے صوبائی محکمۂ جنگلات کی طرف سے تیار کیے جانے والے سالانہ آپریشنل منصوبوں کی مدد سے کی جائے گی۔ اس منصوبے کو گاؤں اور ضلعی کمیٹیوں کے ذریعے لاگو کیا جائے گا اور اس کے بارے میں متعلقہ فریقین کی مشاورت سے صوبائی محکمۂ جنگلات کے ذریعے مطلع کیا جائے گا۔

# CHAPTER I: Introduction

## 1.1. The Context of PFMP

Pakistan has been implementing REDD+ activities since 2010 to mitigate climate change through reduced carbon emissions from the forestry sector. The Government of Pakistan (GoP), Ministry of Climate Change (MOCC) is implementing a REED+ readiness programme funded by the Forest Carbon Partnership Facility (FCPF) of the World Bank. This Participatory Forest Management Plan (PFMP) is to demonstrate integration and implementation of REDD+ activities in forest management in various socio-ecological systems. The Participatory Forest Management Plans (PFMPs) translate REDD+ concepts and processes at practical level considering complex socio-economic conditions, burden of rights and concessions, as well as obligations in the forest. This is the reason that in addition to forest stock assessment, the preparation of PFMPs for REDD+ sites require a detailed assessment of the roles and rights of stakeholders in forest management and revenues so that trade-offs become clearer for redressal and communities are not deprived of their legitimate access to forest for their livelihoods. The core thrust of PFMPs in REDD+ perspective is to find contextually relevant options to address drivers of deforestation and forest degradation. REDD+ also provides mechanisms for the enhancement, measurement, and trade of carbon.

The present PFMP provides information including description of the site, GIS supported forest stock assessment, socio-economic situation, analysis of stakeholders with their interests and influences, emissions reduction scenarios, future interventions with estimated budget and implementation mechanism and key challenges for implementation. The activities that will maintain forest as carbon pool have also been explained in this plan giving a lead and support role to stakeholders, as well as the expected outputs. It is expected that the implementation of the PFMP will enable the stakeholders of Juniper Forest of Manna Valley to trade carbon credits in the national and international market in foreseeable future like any other product, by increasing and maintaining the carbon stock sequestered in the forest. The PFMP is envisaged to act as a road map towards implementation, monitoring, reporting and verification of resources improvement, and distribution of benefits among stakeholders.

These proposed activities will not only benefit the Juniper Forests of Manna Valley but will also benefit the inhabitants of more than 20 other villages residing in the forest. In addition, to the resident community members residing in the Juniper forests, the proposed activities will also prove very useful to the inhabitants of Manna and Zindra Towns. As compared to the past, Juniper forests in the Manna Valley have been seen more protected. Awareness raising among the community members on the importance of Juniper forests especially on water conservation/availability has played a key role in the protection of these forests.

## 1.2. Objectives of PFMP

Taking into account the Global, National and Provincial objectives and priorities that have been reflected in the Section 1.4, the plan has been formulated to achieve the following specific objectives for undertaking interventions through the Participatory Forest Management Plan in Juniper Forests of Manna Valley:

1. To promote sustainable forest management in Juniper Forests of Ziarat.
2. To protect, improve forest health and enhance Carbon stocks in Juniper forests while addressing drivers of deforestation and forest degradation.
3. To enable the Ziarat forest community and Forest Department staff to manage forests jointly and efficiently for multiple uses.

## 1.3. Methodology

A team of experts comprising 3 members was constituted to collect the socio-economic data and simultaneously register the views of community members towards participatory forest management. While collecting the socio-economic data, the local communities, which are the major stakeholders in this entire process, were given the lead role while the team of experts intervened only where the need was felt. For materialization of this entire process, a meeting of the community members and village elders was scheduled on June 27, 2021, in the Forest Office. In the meeting, besides the experts, resident community members, Deputy Conservator of Forests, Range Forest Officer and Forester also participated. In this regard, the meeting began with an introductory session, wherein the expert's team, officers/officials of Balochistan Forest and Wildlife Department and community members introduced themselves to each other. This was followed by a briefing session, wherein the experts explained the aims and objectives of the entire exercised and briefed the community members on the importance of preparation of participatory forest management plans for the Juniper forests of Sasnamanna, in the aftermath of climate change and $REDD^{+}$. This was followed by a discussion session wherein the community members were allowed to identify their needs and problems related to the forest use. Once these needs and problems related to forests were identified by the community members, they were asked to provide the best possible solution under the prevailing situation for conservation of Juniper forest ecosystem of Sasnamanna area. Community members came up with different sets of solutions for these problems. Team of experts also helped them in identification of the possible solutions keeping in view the long-term sustainability of the Juniper forest resources. During this process, community members were asked for provision of data related to Sasnamanna area. On the completion of process, it was once again explained in detail to the community members that the purpose of present initiative is to prepare participatory forest management plan for Juniper forests under the REDD+ Project so that these forest resources could be conserved/protected as Carbon Stocks.

The overall methodology for preparation of the plan has been guided by PFMP Manual (version 1.0, 2021) for practitioners prepared under Forest Carbon Partnership Facility (FPCF) of the Ministry of Climate Change (MOCC), Islamabad. A multi-layered methodology was adapted for the preparation of PFMP, which includes the following steps:

i. Selection of site in light of the REDD+ guidelines and procedure. Juniper forests was one of the three potential sites selected for preparation of PFMP.
ii. Participatory data collection. Local community of Sasnamanna participated in providing socio-economic data and sharing details on forest-community interaction. They also participated in collecting forest resource assessment data. They also participated in identifying forest management activities and implementation mechanism. Under the Free Prior Informed Consent (FPIC), the community was briefed on relevant concepts, causes and effects of activities. They participated in identifying drivers of deforestation and forest degradation and demand of timber and firewood. The solutions to problems and demands of community were translated into interventions in prioritised order and listed. The exercise was conducted through PRA using spot observations, Focused Group Discussion, mapping, semi-structure interviews, transect walk and ranking.
iii. Participator Forest Inventory was conducted to collect data from 11 sample plots selected in Juniper Forests. The location of sample plots is provided in following map (**Figure 1**). The sample plots were chosen through stratified random sampling among each forest stratum. The soil, topography, water availability, and status of vegetation vary spatially within a land-use category and the overall area proposed for the site. Trees, biomass stock, and growth rate are not distributed uniformly in a site. Therefore, a sampling design is followed for locating the sample plots in each of the selected forest strata. The location of sampling plots could

determine the biomass stock or growth rate estimates. Based on forest type and forest density, three forest stratum (>70%, 40%-70%, 10%-40% tree canopy cover) were formed to carry out the systematic stratified sample on the map.

iv. Sample points were nested circular plots of 17.64 m, 5.64 m, and 0.56 m radius. All living trees and standing dead woods with DBH above 5cm, and stumps were measured from the full plot of 17.84 meters (~1000 $m^2$). Fallen trees and stumps, dead wood with diameter above 5cm were also recorded from the plot. The plot included two subplots; 5.64 meters (~100 $m^2$) for collecting data of seedlings and shrubs and 0.56-meter plots (~1 $m^2$) for data on litter, leaves, grasses, etc. From a plot of 5.64 m, all seedlings were counted, and shrubs were cut down and fresh weight of the sample was recorded. This sample was clipped and collected in the bags to find out oven dried biomass in the lab. The above-ground non-tree biomass including leaves, litter, grasses, etc. collected from 0.56 m radius sub-plot and weighed. Soil organic carbon values were taken from the national forest inventory, carried out in 2018. The data from these samples was analysed for estimation of carbon stock. The coordinates of each sample plot were noted, and fixed-point photos were taken during the inventory.

v. Data analysis and development of PFMP: The data were analysed, GIS map prepared and put together in the form of PFMP with a 10-year perspective including an annual forestry operational plan. The plan was reviewed individually, jointly and sent to experts for peer review.

vi. The plan was sent for endorsement by the Balochistan Forest Department and relevant community.

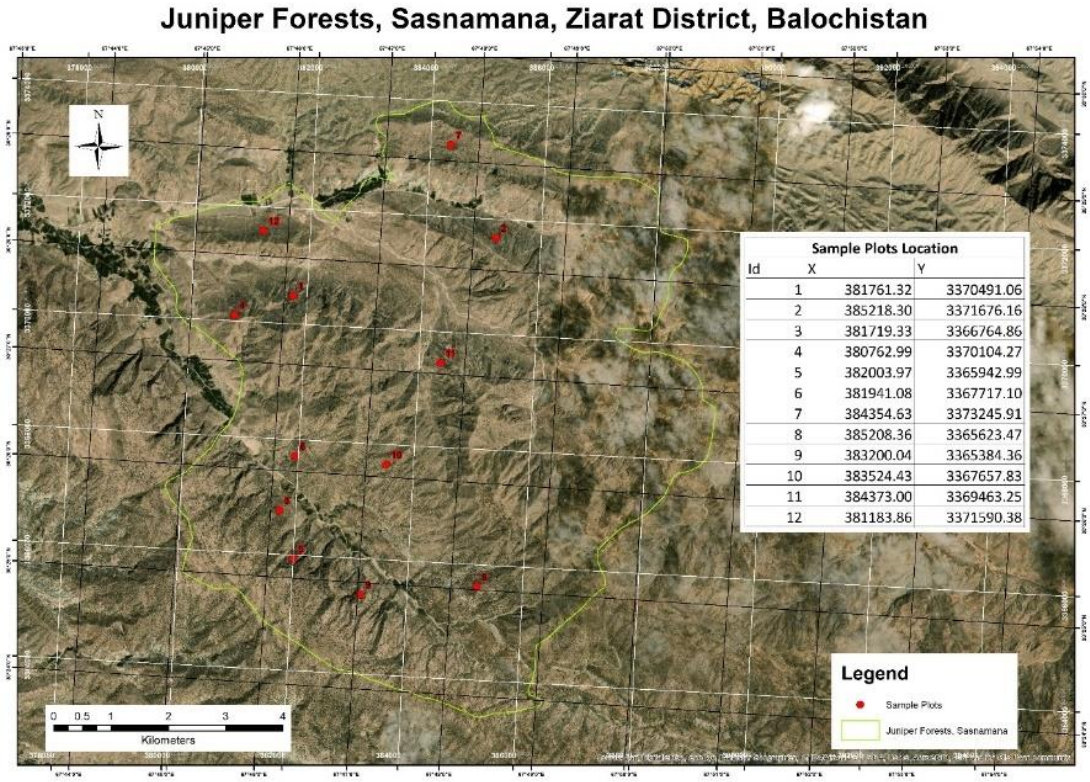



Figure - 1: Location of sample plots

## 1.4 Policy Alignment

The objectives of the Participatory Forest Management Plan of Juniper Forests of Sasnamanna were aligned with the following provincial, national, and global policies/strategies/commitments related to REDD+.

### 1.4.1. Global Commitment

To reduce current global 23% carbon emission contributed from AFOLU sector (IPCC 6th Assessment Report, 2021, p245).

### 1.4.2. National Policies/commitments

Pakistan's report on intended Nationally Determined Contributions (NDCs) seeks 20% reduction of the current national GHG emissions (GOP, 2017). The National Climate Change Policy (NCCP) 2012 under Section 4.4 on Forestry Sector states that the climate change is likely to have multi-faceted adverse effects on the ecosystem as a whole, particularly on the already vulnerable forestry sector in Pakistan. Mitigations in the forestry sector entail restoration of Pakistan's forests through sustainable forest management, with particular focus on how these are affected by climate change. This will not only benefit state forests but forests dependent communities and the whole society in general. The most likely impacts of climate change will be decreased productivity, changes in species composition, reduced forest area, unfavourable conditions for biodiversity, higher flood risks and the like, as portrayed in the Planning Commission Task Force on Climate Change (TFCC) Report (GoP, 2008).

### 1.4.3. Provincial Policies/commitments

Balochistan as such has not formulated the Climate Change Policy yet, and similar is the case with the Forest and allied resources i.e. rangelands and watershed management. Due to this very reason, Balochistan Forest and Wildlife Department seeks guidance from the policies formulated at the federal level in both, climate change as well as in forestry sectors. However, besides the Balochistan Forest and Wildlife Department also seeks guidance from the Rules of Business formulated at the provincial level. The activities reflected in this PFMP to manage Juniper forests, District Ziarat, are in full alignment with the actions suggested in the national climate change and forest policy of Government of Pakistan as well as with the Rules of Business of Forest and Wildlife Department for managing forest and allied resources at the provincial level. In addition to the above-mentioned documents, the activities included in the current Participatory Forest Management Plan for the Juniper Forests of Ziarat are also in alignment with the guidance provided in the Balochistan Conservation Strategy (BCS) and Balochistan Comprehensive Development Strategy (BCDS).

# CHAPTER II: PARTICIPATORY FOREST MANAGEMENT PLANNING

The data and information gathered during PFMP survey through, participatory planning with communities were analysed, results compiled, and interventions identified **(Annex 1, data)**. The results are presented in the following sections.

## 2.1 Ecological

### 2.1.1 Site description

Manna valley is located at a distance of 35 Km in the north of Ziarat Town which is the famous as tourist resort. From the district headquarter Ziarat town, Manna valley is located in the north. Manna valley falls in the administrative jurisdiction of Manna Union Council. Socio-economic, climatic and geographic conditions of the village follow those prevailing in the district Ziarat. Here it is worth mentioning that Ziarat is one of the 33 districts of the province. It was elevated to the status of district on July 1, 1986. Ziarat is located in the north-east of provincial capital Quetta at distance of 127 Km. Total area of the district is 1487 sq. km. Manna valley, being part of district Ziarat, is one of the major valleys of the district running east – west. The geographical location of village determined through GPS is produced below:

**Table 1: Geographical location of Manna Valley district Ziarat**

| S. No: | Description | |
|---|---|---|
| 1 | Latitude: | 30°.27.7’ |
| 2 | Longitude: | 067°.46.1’ |

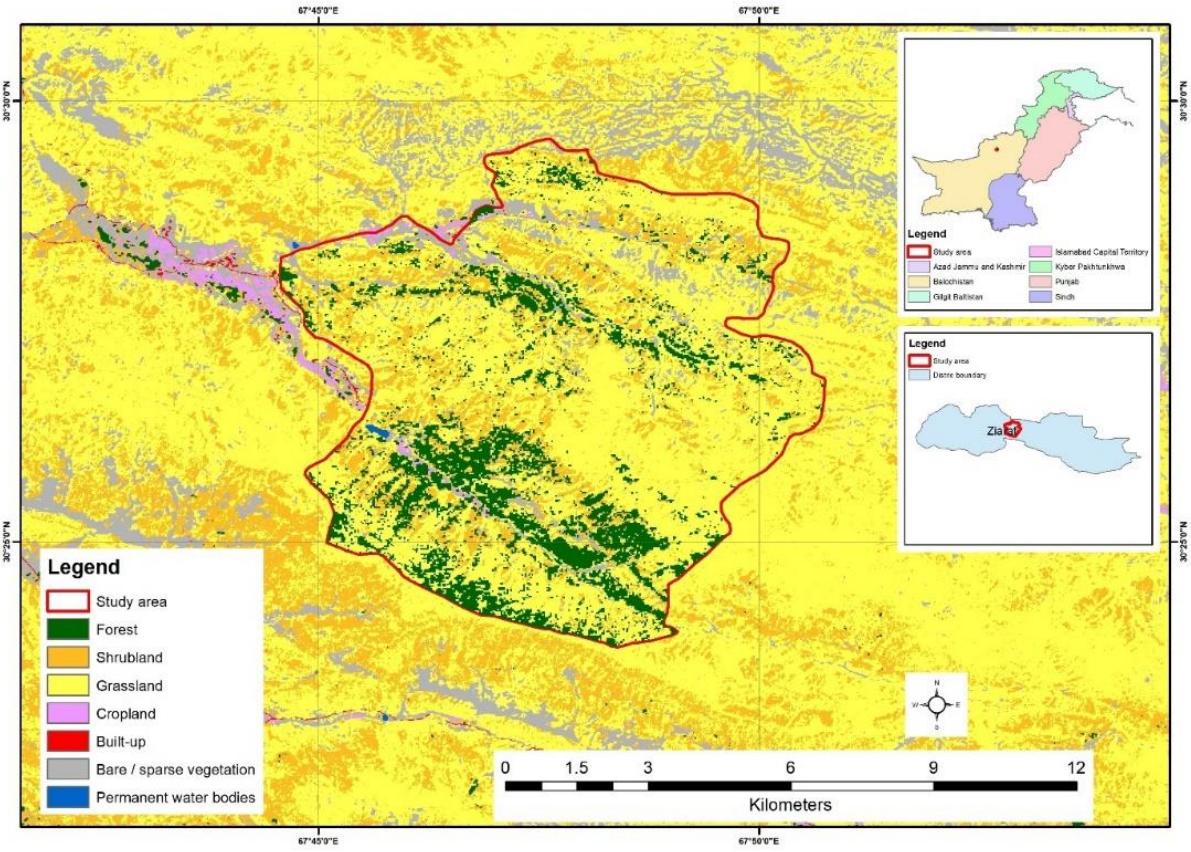



**Figure – 2: Map of District Ziarat showing Juniper forests**

The above map shows that the dominant land cover in the PFMP site is Grassland followed by Forest and shrublands. Concentration of forests is more in the south. The PFMP site is completely surrounded by grass lands whereas the croplands are visible outside the western boundary of the site. Some cropland is also visible in the west and south of PFMP site even in the forest patches which indicates conversion of forest land into cropland.

### 2.1.2 Geology and soil

Most of the Juniper forests in Ziarat and surrounding areas occupy rugged mountainous topography. In the forested area topography ranges from small hills in Surghund area to steep and precipitous slopes towards Mount Khalifat. Rocks of area are of Siwalik Conglomerate, Sand stone, Jurassic, Kirthar and Pahr limestone and Ghazij Shales formations. Generally the area is hilly with valley bottoms which not only serve as drainage for the watershed but are important from agricultural point of view. Local communities through construction of terraces, grow orchard and other agriculture crops in these valley bottoms.

Soils in the Juniper forests are poorly developed and are, therefore, present in thin and shallow layer. Colour ranges from light grey to dark brown (where humus is present). Soils are mostly gravelly clay loam with surface covering of gravels and stones. Due to thin and shallow layer, soil water holding capacities are low. However, due to presence of gravels in the soils, water is stored in crevices from where it is accessed by the tree and shrub roots. In many patches of the forests, shale is present as an impervious layer preventing the soil infiltration and storage. In such areas, tree and shrub growth is seriously affected which is reflected by a die back and low and stunted growth.

### 2.1.3 Climatic Conditions

Junipers grow in dry temperate zone, where temperatures are extremely cold during winters and mild in summers with most of the precipitation received during winters. Growing season starts in early April and prevails until mid-October, providing about 180 - 200 days for growth in a normal year. During winters, temperatures mostly fall below freezing point, while some time the maximum temperatures are also below freezing point. In summers the maximum temperature does not exceed 30 $C^0$. Major portion of the precipitation is received in the form of snow with some early and late winter showers. Due to low temperatures during the winters, snow remains on the ground for a long time affecting the infiltration of rainwater in the soils. Average annual precipitation in the Juniper forests zone varies from 8 to 13 inches with maximum received in the form of snow.

In terms of climatic conditions, drought is one of the important problems Juniper forests are faced with. In area supporting Juniper forests, every third year is considered as droughts. Although Juniper trees have adapted to this natural condition, sometimes drought gets severe and prolong, in such case the forest suffers in terms of drying up of trees. Recently a severe and prolong drought from 1998 to 2004, adversely affected the health of Juniper forests. In many areas of the forests, especially on southern aspect and shallow soils, trees got dried due to non-availability of enough moisture to support tree survival, while in other portions they were under stress, which made them vulnerable to attack by insects and diseases.

For Manna valley no separate data in terms of precipitation, temperature, wind speed and other climatic variables is available. Therefore, the climatic data collected for district Ziarat applies to the village with no major variations. Generally, the area falls in the dry temperate zone with most of precipitation received during winters from November to March in the form of rain and snow. Monsoon showers are also common that are received during late June to September. Winters in the village are harsh with temperatures falling below freezing point during December to February. Soils also freeze during this period and most of the vegetation undergoes dormancy starting late October. Summers are pleasant with day temperatures going high only for a short period during noon to after-noon. For

the maximum and minimum temperatures and mean annual rainfall the data available for the district Ziarat has been used and reflected below. This data can also be applied to the Manna valley. The combined effect of climatic and edaphic conditions prevailing in Manna valley makes the area suitable for growing deciduous fruits and cultivation of both Kharif and Rabi crops. To have an idea about the maximum and minimum temperatures prevailing during the different months of the year, data of district Ziarat is produced below in Table 1:

**Table 1: Mean Annual Temperature, Relative Humidity and Precipitation in District Ziarat**

| Mean Temperature C° | Mean Relative Humidity (%) | Mean Lowest Temperature C° | Mean highest Temperature C° | Mean Precipitation(mm) |
|---|---|---|---|---|
| 10 | **20** | **-10** | **22** | **290** |

As far as the precipitation is concerned, Manna valley follows the same pattern as prevailing in district Ziarat, i.e. dry temperate. In Manna valley, following the data recorded for district Ziarat, is used, where the mean annual rainfall received is 308.18 mm. The data for the rainfall received during the different months of the year is produced below:

| **Table 2:** | **Annual precipitation regime of district Ziarat** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Months of the year** | | | | | | | | | | | |
| | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
| **Mean Rainfall in mm** | 51.8 | 53.8 | 50.8 | 21.6 | 7.4 | 4.1 | 13.7 | 7.6 | 1.3 | 1.8 | 6.4 | 26.9 |

Average precipitation received during the year in the district Ziarat was calculated to 20.6 mm per annum, with the major share received during the winters in the form of snow and rain. Monsoon showers are also received occasionally during July to September. While the total precipitation received in district Ziarat has been calculated to 247 mm.

### 2.1.5 Vegetation

Vegetation in the Juniper Forests of the Manna Valley is typical of Dry Temperate Zone. Vegetation of Juniper forests of Manna Valley has been produced in Table 3 below:

| **Table 3:** | **Forest, Rangeland and Wildlife Data of Manna Valley** | | |
|---|---|---|---|
| **Type** | **Classification** | **Major Species** | **Status** |
| Forest trees | Balochistan Dry Temperate Scrub (Steppe) | Obusht (*Juniperus excelsa*), Shana (*Pistacia khinjak*), Shang (*Fraxinus xanthoxyloides*). | Historically it was dry temperate climax formation of juniper and wild pistachio; as a remnant, few isolated trees of wild Ash/wild pistachio still surviving. Overall the climax formation reduced to scrub condition due to grazing and fuel wood pressures. Presently it is with very open cover and a fair amount of grasses and herbs. |

| | | | |
|---|---|---|---|
| Shrubs | Central Balochistan Rangelands | Zarga (*Prunus eburnea*), Makhai (*Caragan ambigua*), Zaralg (*Berberis Balochistanica*), Ghureza (*Sophora lopcuroides*), Tharkha (*Artemisia maritime*), Zawal (*Achillea santolina*), Spanda (*Peganum harmala*), *Stipa pennata Pennisetum orientale Cymbopogan* | Rangelands seem degraded as evident from presence of less palatable plants. The degradation is caused by fuel wood collection and the area is in the route of nomadic migrants. |
| Wildlife Habitat | Dry Steppe | Mammals: Hill fox (*Vulpes vulpes griffithi*), Cape hare (*Lepus capensis*), Porcupine (*Hystrix indica*), Afghan Hedgehog (*Hemiechinus auritus megalotis*) Birds: Chukar (*Alectoris chukar*), See see (*Ammoperdix griseogularis*), Kestrel (*Falco tinnunculus*), Magpie (*Pica pica*) Reptiles: tortoise (*Agrionemys horsfieldii*), Saw-scale viper (*Echis carinatus*), Levantine viper (*Macrovipera lebetina*). | There are no historical benchmarks to determine the status of wildlife in the area. However, the community informs that the number of wildlife species has declined; which could aptly be attributed to casual attitude for hunting and habitat degradation. |
| Planted species | Amenity and Farm forestry | Safida (*Poplus spp.),* Toot (*Morus alba*), American Saru (*Cupressus arizonica*), *Salix spp*. | Planted along water channels, water storage ponds, round Farmlands and household compounds. |

### 2.1.6 Juniper forests

Balochistan is home of the worlds' second largest and perhaps oldest Juniper forests tracts, covering approximately 86000 ha in the mountains that surround Ziarat, Zarghoon, and Surghund areas. Juniper trees naturally occur between elevations of 1980 and 3350 meters where precipitation averages 324 mm annually. Soils in the area poorly developed and are therefore thin with an underlying layer of shale. Juniper forests of Ziarat have long been source of attraction both to the elites and general public for recreational purposes. Beside recreation, these forests also serve as a source for a number of tangible and intangible goods and services. Due to this very reason, the most important role played by these forests is as source of livelihood for the communities living in and around them. This has made these forests an invaluable asset for the entire area. Recently the awareness about the environmental issues and the resultant hue and cry for the conservation of these forests has added a new dimension to their importance. Looking at this newly developed scenario, many national and international NGOs have also joined the horses for conservation of these forests with those already present in the field. Joint efforts, therefore, have been put up for the conservation of these forests but with little attention paid to the communities living in and around, who are the main resource users and stakeholders. As a result most of these endeavours have succeeded in achieving the objectives aimed at the biological and physical components of the ecosystem. The human (anthropological) aspect has remained unattended.

Taking a look at the details of rights, reveals that Juniper forests are burdened with rights and privileges of local communities provided to them under the forest regulations/forest acts. These rights and privileges include: rights of water, collection of dead and dry fuel wood, timber for hutment construction and grazing livestock. Forests provided sustainable yield of these products until the populations were low and the communities were following the traditional migration patterns during

winters to lowlands. With the explosion of human and livestock populations in the area, pressure on forests has increased tremendously leading to the overuse of the resource. This has resulted in degradation of the forests in some portions, raising eyebrows of both local communities and conservationists. Apart from the human use, Juniper forests have also suffered natural decays through attack of mistletoe (a semi-parasitic plant), fungal infestations, and natural die back. Among these natural calamities, mistletoe has inflicted heavy damage. Severe infestation of mistletoe in Manna valley of forests has caused immense damage to the trees. The infestation has also spread to six new sites entering the main Ziarat valley, which has raised the concern for many conservationists.

## 2.2 Socio-economic data

### 2.2.1 Demography

In Manna valley, there are 1250 households residing in more than 20 villages each with an area of around 40 to 50 acres on an average. Total population of valley has been calculated to 1766 individuals. Most of the families in the village live in joint family system wherein the entire family comprising 4 to 6 brothers with their families, live in single compound with each family having its own kitchen arrangement. The social structure of Manna valley like most of the villages of district Ziarat is tribal. Valley is inhabited by Sarangzai, a sub-tribe of Kakar tribe in Pashtoons. Most of the families live in a joint family system, due to this reason a strong social bonding is prevalent in the valley.

### 2.2.2 Health and education

Manna valley is located at 35 km from the Ziarat town and due to this reason the number of educational institutions is low in the valley. It is because of this very reason the literacy rate is low in Manna valley. In the villages, High, Middle school and primary schools for boys were present. However, for girls only primary schools were present in these villages. Besides the schooling, most of the male and female of the villages in the valley also get the religious education in the Mosques. This has enabled them to read the Quraan.

At present, there are Eight schools in the Manna valley. In all of these schools teaching facilities are available up to the primary level. All of these schools are exclusively for boys. However, in the boy's primary schools, girls are also enrolled for getting education. Present enrollment is low in the schools.

In Manna valley, a Civil Dispensary/Basic Health Unit (BHU) is present in Manna town. Except for this no other basic healthcare facilities are available for the inhabitants of the villages. Patients are taken to Zindra and Ziarat for treatment, where Basic Health Unit (BHU) and District Headquarter hospitals are available for treatment. However, serious patients are taken to Quetta for treatment.

### 2.2.3 Livelihood sources

As mentioned above, Manna valley is located at a distance of 35 Km from the Ziarat town. Due to arid climatic condition and non-availability of any flow water, the entire area offers very limited opportunities for livelihoods. In Manna valley major livelihood sources include agriculture and livestock rearing with some members busy in daily wage labour and government/private services. Community members informed that majority of the inhabitants of Manna valley are dependent on the daily wage labour for their livelihoods. However, agriculture along with livestock provides livelihoods to about 50% of population.

In the agriculture sector, the major emphasizes upon raising orchards of apple and cherry. The dominant crop is apple, which is liked for its high price fetching capacities. Among the field crops, sweet pea, potatoes and vegetables are grown but not on a larger scale as compared to orchards. Most of the vegetables grown are used for household consumption.

In Manna valley both type of crops i.e. field crops as well as orchards are being grown for earing livelihoods. Major portion of the cultivated land has been grown with orchards, while on a smaller portion field crops are raised. In the orchards of the village apple trees are the dominant tree species, which is followed by Cherries. Other fruit species trees such as apricots and peaches are also present in scattered form among the apple trees. In apple orchards, Red Delicious and Golden Delicious varieties the most common ones, however, recently a new variety with the name of Gaja is also being introduced in the orchards. Among the field crops, mostly sweet pea and potatoes are grown. Season for growing of general agricultural crops in Manna valley extends from April to October.

Although both horticultural and field crops are grown by the inhabitants of Manna Valley, still there are no arrangements for reducing the post-harvest losses. In the agriculture sector the following issues were being faced by the resident community members of Manna Valley:

Livestock, which used to be the second important source of livelihood for the inhabitants of Manna Valley, however, severe drought of 1998 – 2004 and the trend of raising orchard in agriculture adversely affected animal husbandry. In the valley now only small ruminant i.e. sheep and goats are being raised by the inhabitants but on a limited scale only for household consumption purposes. Sheep and goats are raised by the resident community members due to hilly/mountainous topography and presence of shrubby vegetation in the forested area. At present the total population of these small ruminants recorded in the villages of Manna valley was 1395 heads, with majority of goats. At the household level, women are also engaging in backyard poultry. Backyard poultry not only helps women in improving the nutrition level of households, but the eggs are sold out by the women folk to meet to earn hard cash.

At present, as such no conflicts exist over the land/forest resources in the Manna Valley. In the valley all cultivable land is being cultivated by the owners/resident community members. However, during discussion with the resident community members in Manna Valley, some of the problems faced by the inhabitants included:

1. Accelerated depletion of water table that is posing danger to the very existence of apple orchards of village
2. Seepage losses due to Kaccha or unlined water channels
3. No concept of water storage in reservoirs for irrigation of crops
4. Lack of awareness on the agricultural practices especially cultivation of low delta crops.
5. Lack of water conservation structures in the village to improve recharge.

Here it is worth mentioning that during the meeting with the community members, it was observed that minor rift prevailed among two sub clans that resulted in demarcation of land between them. This has contributed towards conservation of forest because both clans strictly protected forest under their territory.

### 2.2.4 Legal Position

For management and protection of Juniper forests in Ziarat and other districts in Balochistan, Government has assumed the responsibility through declaring these as State Forests through Government Notifications issued from 1911 to 1953 under the Balochistan Forest Regulation, 1890 (Regulation V of 1890). However, in these notifications local inhabitants have been allowed some rights which include the rights for collection of dry firewood, timber for hutments, use of tree branches for construction of hedges around agriculture fields. Besides these rights, other uses by the local communities include the rights of livestock grazing and cultivation of crops on agricultural lands. Management of the Juniper forests now lies with the Balochistan Forest and Wildlife Department, who is responsible for conducting all the protection and improvement activities in these forests. For management purposes of these forests a separate Deputy Conservator of Forests (DCF) along with

support staff is present in Ziarat. All the forestry related activities, both development and non-development, are conducted by the DCF, while the Conservator of Forests, Sibi Circle supervises and provides necessary guidance on important issues.

### 2.2.5 Dependence on forests

In the past trees were cut down for obtaining timber for personal uses but this practice has been abandoned. No timber for commercial selling is extracted from Juniper forests of Manna Valley. Local community members get their fuel wood from the Juniper forests but many households in the villages are also getting firewood from their orchards and farmlands. Due prevalence of orchards in the valley, number of livestock by community members has been greatly reduced. Grazing pressure from the livestock of resident community members is low. Although not very common, however, at the beginning of slack season and during drought, grass from the forested areas is cut down and stored for feeding livestock. Medicinal plants and Juniper berries are collected all over the forests and there is no area specifically demarcated for this purpose. For cutting of mistletoe infested trees, construction of check dams etc. labour is employed by the Forest Department. Manna valley is visited by tourists, but no facilities are available. So, tourism is not taking place on an organized level. The community members have now also raised Poplar trees in the valley in and around their farmlands that are not only providing them with hard cash but also timber for construction. However, there are no alternatives for the grazing lands in the valley. Some of the community members have raised fodder crops on their lands but due to scarcity of cultivable land, fodder production is not given priority among crops. Similarly, no alternatives exist for the locally produced medicinal plants such as berries of Junipers, *Artemisia spp* and *Zizyphora tenure.*

In the Valley except for the Manna Town, where natural gas is available for cooking and heating, rest of the rural population is dependent upon Juniper forests for fulfilling their fuel wood requirements for cooking and heating. However, recently the pruning material from the orchards has also helped in reducing the pressure on Juniper forests for fuel wood provision. Besides, Juniper trees, community members also cut down the associated shrubs, bushes and sometimes even the herbaceous vegetation for this purpose. This uprooting of bushes and shrubs from the forested area has caused the deterioration of forests by paving the way for accelerated erosion. It is estimated that an average family/household of 10 members utilizes half a donkey load (weighing 50 kg) of wood per day during summers, while during winter months the consumption goes 3 times high. In terms of monetary value, one donkey load usually, costs from Rs. 500/- to 600/- depending on the load of bushes/wood that has been cut and carried to the village. Total population of project area is 1766 individuals. As per estimates, the per capital fuel consumption per person has been calculated to 3300 kg per annum by taking 5kg/person/day for 7 months of summer and 15kg/person/day for 5 winter months.

As far as timber is concerned, none of the community member is extracting Juniper timber. Most of the community members are now raising *Populus spp* on their farmlands and using its timber/wood for household consumption.

### 2.2.6 Forest rights

For management and protection of Juniper forests in Ziarat and other districts in Balochistan, Government has assumed the responsibility through declaring these as State Forests through Government Notifications issued from 1911 to 1953 under the Balochistan Forest Regulation, 1890 (Regulation V of 1890). However, in these notifications local inhabitants have been allowed some rights which include the rights for collection of dry firewood, timber for hutments, use of tree branches for construction of hedges around agriculture fields. Besides these rights, others use by the local communities include the rights of livestock grazing and cultivation of crops on agricultural lands. Management of the Juniper forests now lies with the Balochistan Forest and Wildlife Department, who is responsible for conducting all the protection and improvement activities in these forests. For

management purposes of these forests a separate Deputy Conservator of Forests (DCF) along with support staff is present in Ziarat. All the forestry related activities, both development and non-development, are conducted by the DCF, while the Conservator of Forests, Sibi Circle supervises and provides necessary guidance on important issues.

### 2.2.7 Changes in forests over time

During visit to Manna valley, it was observed that forest degradation is present. It was observed that due to previous years long grazing and high stocking rate the understory vegetation cover of shrubs and bushes has been adversely affected. Besides, the grubbing of shrubs and small trees growing in the forested area for heating and cooking purposes by resident community members has also contributed to removal of vegetation. As a result of this vegetation removal not only the grazing/carrying capacity of forested land in the valley has been reduced in terms of livestock raising in the area, but it has also led to soil erosion at many places as a result of increased amount of run off that is generated after high intensity spring and monsoon rainfalls. Decrease in vegetation cover has also caused reduction in infiltration rate/capacity and water holding capacity of soils. Therefore, the regeneration of *Juniperus excelsa*, and other species of trees and shrubs/bushes/herbs is very low in the Manna area due to low soil moisture availability for germination and growth of plants. As forested land of the valley serves as major watersheds, which contribute towards recharge of grounds for replenishing ground water table, their degradation is directly affecting the recharging of water table and, therefore, water availability in Manna Valley has decrease substantially.

Another important cause of land degradation in Manna Valley was present in the form of heavy soil erosion caused by the mountain streams. During spring and monsoon seasons, mountain streams present in Manna Valley carry runoff water from the upper mountainous areas that serve as watersheds/catchments for these channels. Due to non-availability of vegetation cover, usually large amount of run off is generated that passes through these streams in the form of flash floods. During water flow in rainy season, banks erosion and sometime soils from valuable croplands are also eroded that leaves large areas unsuitable for cultivation. Although farmers and local community members are trying their best to reduce such erosions in the area, their efforts in the face of such havoc are peanuts.

### 2.2.8 Stakeholders

Stakeholder analysis is given in **Annex 2** and description of the main stakeholders is given below. In Manna valley for resolution of conflicts, a social organization exists in the form of a 5-five members committee. This organization is active at the local level in the valley and resolves all such issues and conflicts that pop up among the residents of villages.

In Manna valley, formal organizations in the form of Community/Village Organizations are present in some of the village. These Community/Village Organizations have been formed by the Taraqee Foundation for implementation of Physical Infrastructure Schemes in the valley. Other than the Taraqee Foundation, no other NGO has worked in the valley.

The key stakeholders in the preparation of Participatory Forest Management Plan include Resident Communities of Manna Valley, Balochistan Forest and Wildlife Department, Agriculture and Cooperative Department, Livestock and Dairy Development Department, District Administration, Local market suppliers, Commission Agents, Transporters, Non-Government Organizations working in the valley, donor agencies interested in management of Juniper forests, tourists. The Manna Valley has high eco-tourism potential as comprised of unique Juniper Forest, scenic beauty, springs, dam and Shrine of pious ancestor of inhabitants:

**Forest institutions**

The socioeconomic data of Juniper forests of Manna Valley (Annex 1) reflects the institutional dimensions that may be relevant in management of drivers of deforestation and maintaining future trend in favour of REDD+. The following institutions are relevant to the management of Juniper Forests of Manna Valley.

**A. Balochistan Forest and Wildlife Department**

Juniper forests of Manna Valley, being the State Forests, are protected and managed by the Balochistan Forest and Wildlife Department. These and other Juniper Forests are managed under the Balochistan Forest Regulation, 1890. Juniper Forest Division headed by a Deputy Conservator of Forests, who is stationed at Ziarat town is responsible for the overall management of these forests. In implementation of management and protection activities he is supported by Range Forest Officer, Deputy Rangers, Foresters, Forest Guards and Game Watchers. In Manna Valley, for management and protection purposes, Deputy Ranger, Forester, Forest Guards and Game Watchers have been deployed by the Balochistan Forest and Wildlife Department. Besides, all the development related to forests, rangelands and watershed management are also implemented by these staff members. In the past, infested Mistletoe trees were also treated i.e. trimmed and cut down by the staff of Forest and Wildlife Department.

**B. Conservation Committee**

In Manna Valley, a Conservation Committee comprising 5-five members has been constituted for forest conservation and resolving other such issues. This committee has proved very effective in dealing with issues of deforestation and grazing. For disputes and issues related to the forests are presented to the committee and by looking into the nature of challenge, it decides for a date and venue. On the specific date all the concerned with the issue get together at a pre-decided venue. The issues/problems are discussed in detail and finally the committee through a consensus comes up with a decision which is then implemented with letter and spirit. Due to the presence of this committee, the deforestation and other such activities have greatly reduced. It is worth mentioning here that since the Conservation Committee has been constituted through a consensus building process in which all the resident community members have taken part. Due to this very reason, all the decision made by the Conservation Committee are implemented in letter and spirit.

### 2.2.9 Stakeholders Analysis

The key stakeholders in the preparation of Participatory Forest Management Plan include: Resident Communities of Manna Valley, Balochistan Forest and Wildlife Department, Agriculture and Cooperative Department, Livestock and Dairy Development Department, District Administration, Local market suppliers, Commission Agents, Transporters, BRSP and Non-Government Organizations working in the valley and donor agencies. Details of stakeholders' interactions with the forest management and carbon pools with respect to their interest and influence are available in Annex 2.

**Table 4: Influence and interest matrix of forest management and carbon pool**

| | **Neglected players:** Need special attention to safeguard their interests | **Major players:** Need to be fully involved |
|---|---|---|
| **INTEREST High** Score 2 and 3 | Local Market Suppliers, Non-Governmental Organizations (NGOs) | Local Community Members, Balochistan Forest and Wildlife Department, |
| | **Marginal players** Low priority | **Risk factors** Need to be addressed |
| **INTEREST Low** Score 0 and 1 | Agriculture and Cooperative Department, Livestock and Dairy Development Department, Transporters, Local Market Suppliers, Commission Agents | Balochistan Forest and Wildlife Department, Local Communities and District Administration |
| | **INFLUENCE Low** Score 0 and 1 | **INFLUENCE High** Score 2 and 3 |

While analyzing the data of the stakeholders for the Juniper Forests of Manna Valley, it came up that the major players in forest management and relevant carbon pools are the same. Although the stakeholders themselves may not be aware of this fact since the concepts are new. However, they may need to be made aware about this, especially of the importance and benefits of management of carbon pools. In terms of interest and influence on forest management the major players are communities and Forest department particularly the local communities demand for more land to grow orchards.

## 2.3 Analysis of drivers of deforestation, forest degradation and barriers to enhancement

As indicated in socioeconomic data (**Annex 1**), residents of villages in Manna Valley depend upon Juniper Forest resources for their **domestic needs for firewood and grazing** their livestock and other forest products. Juniper Forests of Manna Valley, as mentioned earlier, fall in Protected Forest category owned by the provincial government where the local community has use rights unless restricted by the government. In these forests, except for small quantities of firewood, no timber is harvested either.

During late 1970's and early 1980's, **infestation of Mistletoe** was discovered by the scientists of Pakistan Forest Institute, Peshawar. This led to the intensive survey of the valley for Mistletoe infestation. As a result of survey, a large number of trees, which were heavily infested, were cut down, while others with low level infestations, were trimmed down. This deforestation caused by the cutting down of heavily infested trees and trimming of others led to forest degradation. In addition to this, the removal of ground vegetation i.e. associate shrubs and bushes has resulted in reduction of ground cover that is now contributing to soil erosion.

Another important factor that is leading to deforestation and forest degradation is the **change of land use to agriculture**. Where possible, the community members specially in the Sasnak and Chasnak valleys are converting the valley bottoms and mountain streams to agricultural land. Although so far this practice is confined to mountain streams and valley bottoms, with increase in land hunger, it can also encroach upon the forested areas present in these valleys. The major drivers of deforestation and forest degradation include:

**Drivers of Deforestation:**

- Change of land use to Agriculture.
- Mistletoe infestation.

**Drivers of Forest degradation:**

- Firewood collection for cooking and heating, area being very cold during winters
- Uncontrolled Livestock grazing

**Barriers to Forest Restoration:**

- Uncontrolled grazing
- Very slow growing indigenous species i.e. Juniper
- Hyper aridity and frequent droughts

## 2.4 Carbon stock assessment of Manna Forests

### 2.4.1 Plot level Carbon Stock Estimation

Based on the field data carbon stock (tons per hectares) for Above Ground Carbon (AGB) and Below Ground Carbon (BGB) was worked out using the standard sets for tree species, tree DBH and height, and dry biomass of shrubs and litter (**Table 5**). The tree species level carbon stock is given in Annex 3. Based on this data individual plots level carbon stock values are given in Table 5. The estimated stock of carbon per hectares (ha) was then used to estimate the total carbon stock in the selected site of Manna Forest.

**Table 5: Plot level above and below ground carbon stock**

| Plot No. | Average of AGC (tonne /ha) | Average of BGC (tonne /ha) |
|---|---|---|
| 1 | 0.769623 | 0.19240575 |
| 2 | 0.882001974 | 0.220500493 |
| 3 | 2.385507134 | 0.596376783 |
| 4 | 1.944369311 | 0.486092328 |
| 5 | 1.946978148 | 0.486744537 |
| 6 | 1.593643749 | 0.398410937 |
| 7 | 0.365441697 | 0.091360424 |
| 8 | 1.369023014 | 0.342255753 |
| 9 | 1.618243724 | 0.404560931 |
| 10 | 2.304165193 | 0.576041298 |
| 12 | 0.856238891 | 0.214059723 |
| **Average** | **1.454682427** | **0.363670607** |

### 2.4.2. Forest Cover Assessment

The change in forest cover was assessed by using Landsat multispectral 30m spatial resolution satellite images on the path (150) and row (36) and google Earth Engine Cloud Computing platform for the classification of forest cover by applying Random Forest Machine Learning Algorithm. The analysis indicates decrease of 7.51 ha in forest cover in the past 10 years at an average rate of 0.71 hectare (ha) per year (**Table 6**).

**Table 6: Forest cover assessment (2011 -2021)**

| No | Landsat Satellite Sensor | Landsat data acquisition | Forest Cover (ha) |
|---|---|---|---|
| 1 | Landsat-8 | 2021-04-02 | 1116.69 |
| 2 | Landsat-5 | 2011-04-23 | 1123.84 |
| Change in Forest Cover in last 10 years | | | - 7.15 |
| Per year change in forest cover | | | - 0.71 |

Table 7: provides **three scenarios** of forest cover in the coming ten years that can be followed:

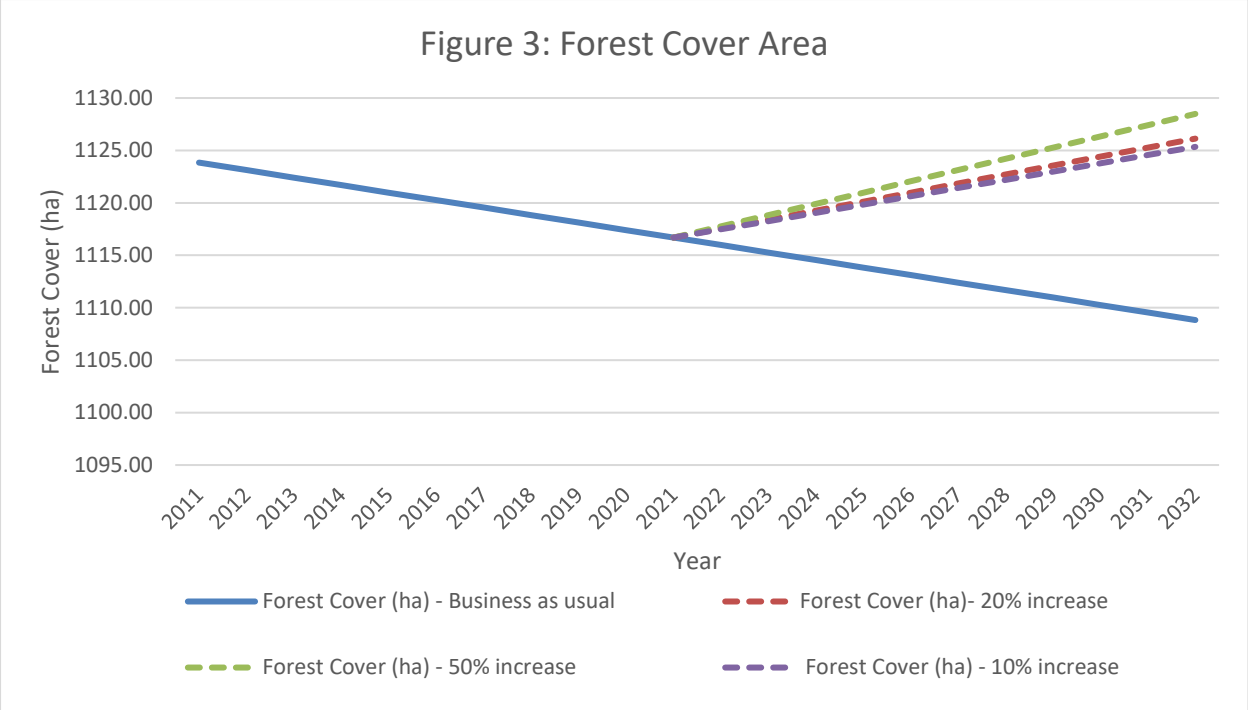
1. Adding 10% forest cover in addition to reversing the current average annual reduction of 0.71 ha.
2. Adding 20% forest cover in addition to reversing the current average annual reduction of 0.71 ha.
3. Adding 50% forest cover in addition to reversing the current average annual reduction of 0.71 ha.

The above scenarios mean that for the forest cover to recover from the current annual loss of 0.71 ha (as observed in the last 10 years) and enhancing it by 10%, 16.52 ha of forest cover in total would be required to be added, which will increase the forest cover to 1125.34 ha instead of 1108.83 ha in the business-as-usual scenario by the year 2032. Similarly, in 20% and 50% scenarios the forest cover over an area of 17.30 ha and 19.66 ha would have to be added, respectively. Since the total area of the forest is 6,782 ha, even higher target of forest cover increase is possible than these scenarios.

**Table 7: Forest Cover Scenarios based on trend in the past 10 years**

| **Rate of change per year** | -0.71 | -0.07 | -0.14 | -0.36 |
|---|---|---|---|---|
| **Year** | **Forest Cover (ha) - Business as usual** | **Forest Cover (ha) - 10% increase** | **Forest Cover (ha)- 20% increase** | **Forest Cover (ha) - 50% increase** |
| 2011 | 1123.84 | | | |
| 2012 | 1123.13 | | | |
| 2013 | 1122.41 | | | |
| 2014 | 1121.70 | | | |
| 2015 | 1120.98 | | | |
| 2016 | 1120.27 | | | |
| 2017 | 1119.55 | | | |
| 2018 | 1118.84 | | | |
| 2019 | 1118.12 | | | |
| 2020 | 1117.41 | | | |
| 2021 | 1116.69 | 1116.69 | 1116.69 | 1116.69 |
| 2022 | 1115.98 | 1117.48 | 1117.55 | 1117.76 |
| 2023 | 1115.26 | 1118.26 | 1118.41 | 1118.84 |
| 2024 | 1114.55 | 1119.05 | 1119.26 | 1119.91 |
| 2025 | 1113.83 | 1119.84 | 1120.12 | 1120.98 |
| 2026 | 1113.12 | 1120.62 | 1120.98 | 1122.05 |
| 2027 | 1112.40 | 1121.41 | 1121.84 | 1123.13 |
| 2028 | 1111.69 | 1122.20 | 1122.70 | 1124.20 |
| 2029 | 1110.97 | 1122.98 | 1123.55 | 1125.27 |
| 2030 | 1110.26 | 1123.77 | 1124.41 | 1126.34 |
| 2031 | 1109.54 | 1124.56 | 1125.27 | 1127.42 |
| 2032 | 1108.83 | 1125.34 | 1126.13 | 1128.49 |
| Total Forest Cover to be added in ten years | | 16.52 | 17.30 | 19.66 |

These scenarios are presented visually in **Figure-3** (Forest cover Scenarios)




### 2.4.3 Carbon stock estimation and CO2 emissions

The field data and biomass collected from 11 samples was used to calculate Above Ground Biomass (AGB) using locally developed allometric equations (Ismail et al, 2018) for 2011-2021 (**Table 8**). In Manna Forest, the cumulative carbon stock in the carbon pools (above, below, deadwood, litter and soil) was estimated to as 78,601 tonnes back in 2011 which decreased to 78,101 tonnes in 2021. This change corresponds to the decrease in forest cover from 1123.84 ha in 2011 to 1116.69 ha in year 2021 causing $CO_2$ emissions at the rate of 183 tonnes of $CO_2$ eq. per annum (see Table 8 and Figure 4).

Figure 4: Forest Cover Maps used for Change Analysis

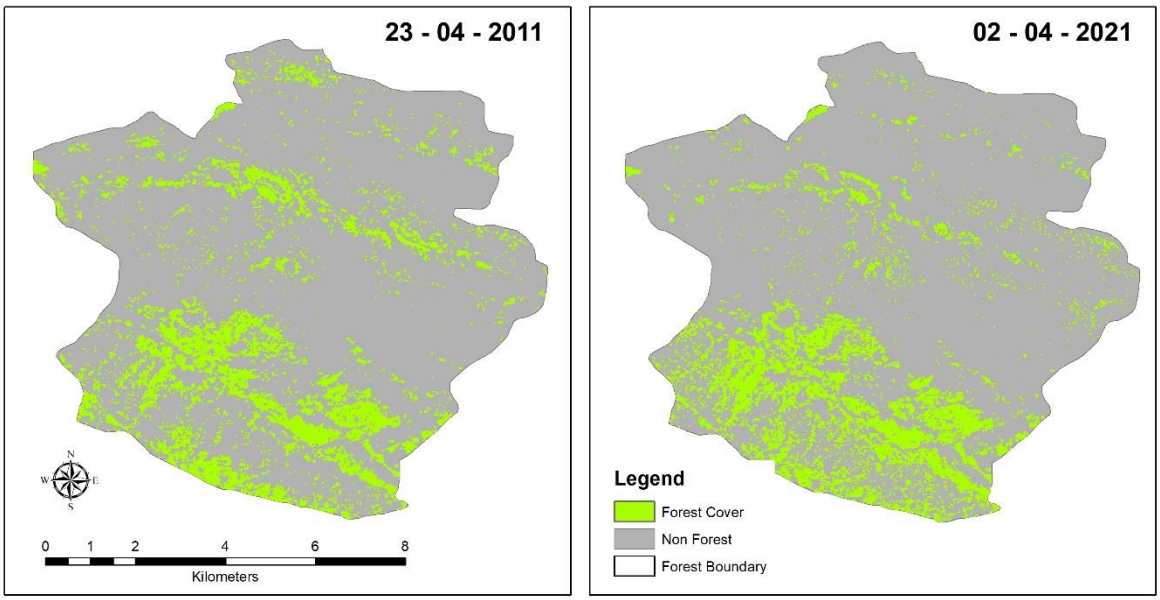



**Table 8: Carbon stock estimation (2011-2021)**

| Carbon pool | Mean carbon stock (tonnes C stock per hectare) | Forest Cover (ha) | Total stock (tonnes C stock) | $CO_2$ (tonnes $CO_2$ eq) |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **2011 (2011-04-23)** | | | | |
| Above | 1.45 | | 1,634.83 | |
| Below | 0.36 | | 408.71 | |
| Deadwood | 0.00 | 1123.84 | - | |
| Litter | 0.22 | | 248.34 | |
| Soil* | 67.9 | | 76,308.74 | |
| **Cumulative** | | | 78,601 | 288,202.24 |
| **2021 (2021-04-02)** | | | | |
| Above | 1.45 | | 1,624.43 | |
| Below | 0.36 | | 406.11 | |
| Deadwood | 0.00 | 1116.69 | - | |
| Litter | 0.22 | | 246.76 | |
| Soil | 67.9 | | 75,823.25 | |
| **Cumulative** | | | 78,101 | 286,368.67 |
| Rate of change per year | | | | |
| **2021-2011** | | **-0.71** | **-50.01** | **183** |

* Soil Carbon Value taken from NRO Inventory

### 2.4.4 $CO_2$ emissions reduction Scenarios for deforestation

This section presents the future $CO_2$ emissions reduction scenarios applying 10%, 20% and 50% reduction to current emissions rate over the past 10 years due to deforestation (As per definition of forest adopted by Pakistan for REDD+). The current $CO_2$ emissions rate is 183 tones $CO_2$ eq per annum because of deforestation. In case of 10% emissions reduction scenario by increasing forest cover the emissions from the forest will reduce by 18 tonnes $CO_2$ eq: per annum, while with 20% and 50% emissions reduction scenario the emissions will reduce by 37 and 92 tones $CO_2$ eq annually.

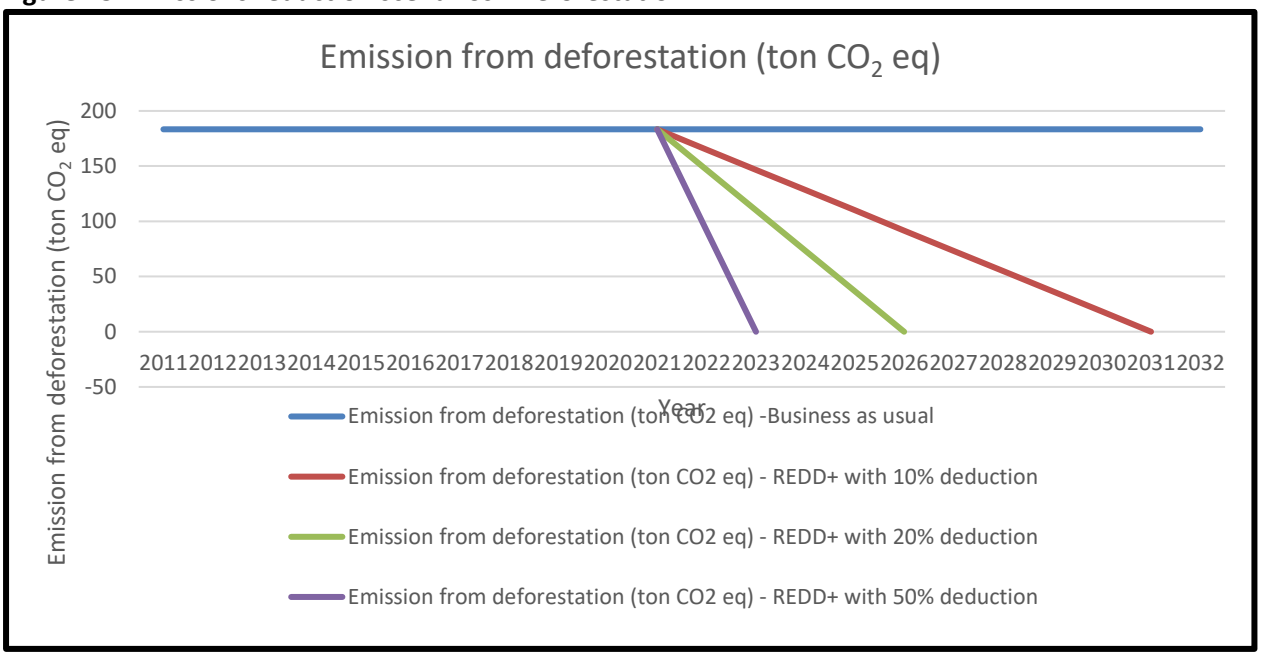
**Table 9: Deforestation Emissions trend and Different Emissions reduction scenarios**

| **Rate of change per year** | 183 | -18 | -37 | -92 |
|---|---|---|---|---|
| **Year** | **Emissions from deforestation (tonnes $CO_2$ eq) - Business as usual** | **Emissions from deforestation (tonnes $CO_2$ eq) - REDD+ with 10% reduction** | **Emissions from deforestation (tonnes $CO_2$ eq) - REDD+ with 20% reduction** | **Emissions from deforestation (tonnes $CO_2$ eq) - REDD+ with 50% reduction** |
| 2011 | 183 | | | |
| 2012 | 183 | | | |
| 2013 | 183 | | | |
| 2014 | 183 | | | |
| 2015 | 183 | | | |
| 2016 | 183 | | | |
| 2017 | 183 | | | |
| 2018 | 183 | | | |
| 2019 | 183 | | | |
| 2020 | 183 | | | |
| 2021 | 183 | 183 | 183 | 183 |
| 2022 | 183 | 165 | 147 | 92 |
| 2023 | 183 | 147 | 110 | 0 |

| | | | | |
|---|---|---|---|---|
| 2024 | 183 | 128 | 73 | |
| 2025 | 183 | 110 | 37 | |
| 2026 | 183 | 92 | 0 | |
| 2027 | 183 | 73 | | |
| 2028 | 183 | 55 | | |
| 2029 | 183 | 37 | | |
| 2030 | 183 | 18 | | |
| 2031 | 183 | 0 | | |
| 2032 | 183 | | | |

The table 9 produced above shows that under REDD+ implementation if the deforestation trend is reversed at a rate of 10% then the forest will stop $CO_2$ emissions due to deforestation by the 10th year, if the deforestation rate is reduced by 20% then the deforestation will be controlled by the 5$^{th}$ year and at 50% reduction the $CO_2$ emissions because of deforestation can be set aside by the end of 2$^{nd}$ year as shown in the Figure - 5 below.

**Figure - 5: Emissions reduction scenarios - Deforestation**




### 2.4.5 $CO_2$ Emissions Trend – forest degradation:

Fuelwood and Timber consumption for the pilot site was estimated based on population of the area, population growth rate and per capita fuelwood and timber consumption statistics collected during the field survey. The total population of the pilot site in 2017 was 4140 with a growth rate of 3.66 per annum. The fuelwood and timber consumption per capita per annum was calculated as 0.92 $m^3$ and 0.25 $m^3$, respectively. Based on this data emissions from forest degradation are calculated and presented in the Table 10.

**Table 10: Forest Degradation Emissions trend**

| Year | Population | Fuelwood Consumption (FC) ($m^3$/year) | Timber Consumption (TC) (m3/year) | Fuelwood Emissions[1] (FC*D*BEF2*CF*44/12) (tones $CO_2$ eq) | Timber Emission (TC*D*BEF2*CF*44/12) (tones $CO_2$ eq) | Emission from Forest Degradation (tones $CO_2$ eq) -Business as usual |
|---|---|---|---|---|---|---|
| 2011 | 3310 | 3045 | 828 | 3730 | 1014 | 4744 |
| 2012 | 3436 | 3161 | 859 | 3872 | 1052 | 4924 |
| 2013 | 3566 | 3281 | 892 | 4019 | 1092 | 5111 |
| 2014 | 3702 | 3406 | 925 | 4172 | 1134 | 5306 |
| 2015 | 3842 | 3535 | 961 | 4330 | 1177 | 5507 |
| 2016 | 3988 | 3669 | 997 | 4495 | 1221 | 5716 |
| 2017 | 4140 | 3809 | 1035 | 4666 | 1268 | 5933 |
| 2018 | 4292 | 3948 | 1073 | 4836 | 1314 | 6151 |
| 2019 | 4449 | 4093 | 1112 | 5013 | 1362 | 6376 |
| 2020 | 4611 | 4242 | 1153 | 5197 | 1412 | 6609 |
| 2021 | 4780 | 4398 | 1195 | 5387 | 1464 | 6851 |
| 2022 | 4955 | 4559 | 1239 | 5584 | 1517 | 7102 |
| 2023 | 5137 | 4726 | 1284 | 5789 | 1573 | 7362 |
| 2024 | 5324 | 4899 | 1331 | 6001 | 1631 | 7631 |
| 2025 | 5519 | 5078 | 1380 | 6220 | 1690 | 7910 |
| 2026 | 5721 | 5264 | 1430 | 6448 | 1752 | 8200 |
| 2027 | 5931 | 5456 | 1483 | 6684 | 1816 | 8500 |
| 2028 | 6148 | 5656 | 1537 | 6928 | 1883 | 8811 |
| 2029 | 6373 | 5863 | 1593 | 7182 | 1952 | 9134 |
| 2030 | 6606 | 6078 | 1652 | 7445 | 2023 | 9468 |
| 2031 | 6848 | 6300 | 1712 | 7717 | 2097 | 9814 |
| 2032 | 7099 | 6531 | 1775 | 8000 | 2174 | 10174 |

[1] Wood Density (D)

| | |
|---|---|
| *Juniperus excelsa* | *0.5041* |
| *Average* | *0.5041* |
| Biomass Expansion Factor: BEF2 | 1.35 (IPCC Table 3A.1.10) |
| CF = carbon fraction of dry matter | 0.5 |

### 2.4.6 Net Emissions from Deforestation and Forest Degradation

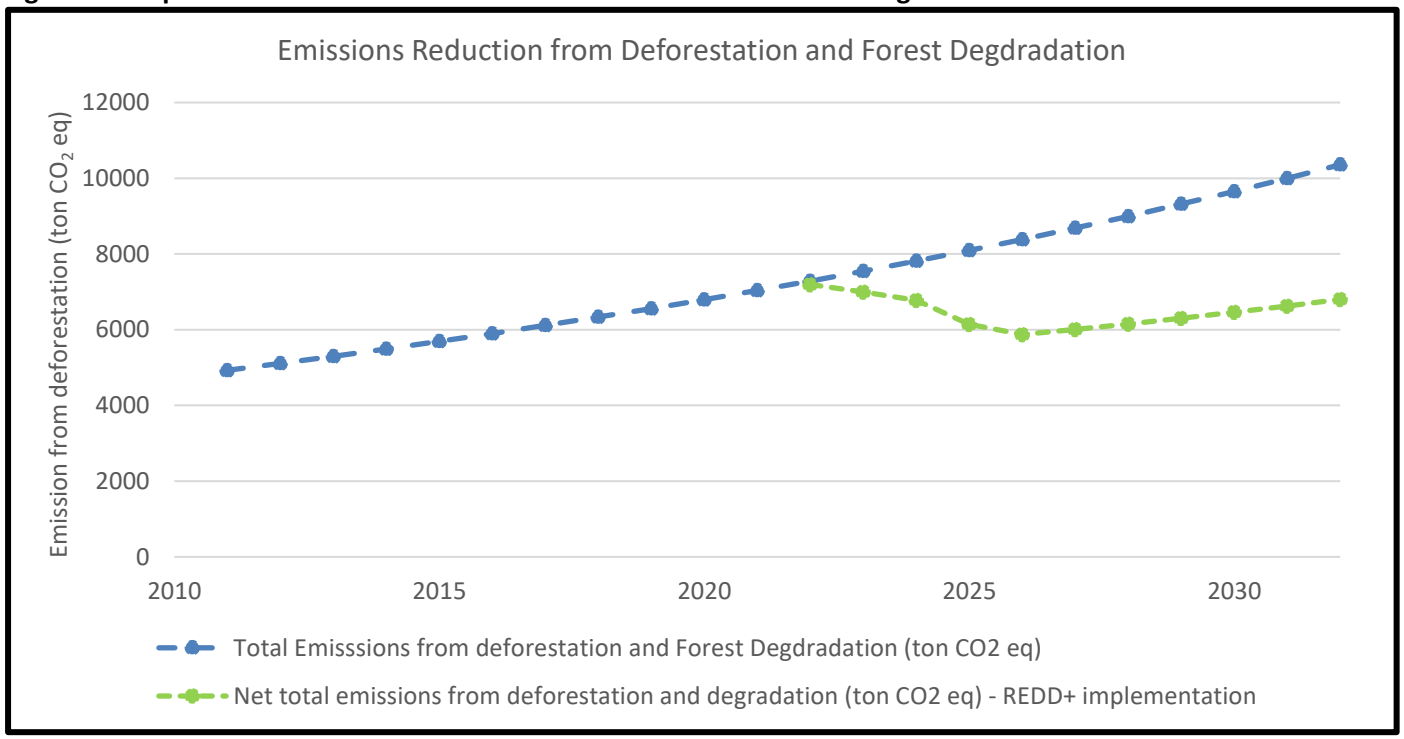
The Table 11 below provides a net $CO_2$ sequestration scenario based on 50% forest cover enhancement in addition to addressing existing negative trend and reducing emissions from forest degradation in an incremental manner annually from 5% to 25% with REDD+ activity. In this scenario, the net emissions from the forest will continue declining till 2026 due to cumulative effect of increasing forest cover and reduction in forest degradation due to REDD+ implementation but will again start climbing due to increasing population resulting in increase in demand for fuel and local use timber. Even with the effort of 50% enhancement and reversing existing deforestation rate the forest cover will increase to 1128.49 ha out of the total forest area of 6782 ha. So, combination of activities to increase forest cover and reducing pressure on forest for fuel should be undertaken so that the emissions from forest degradation could be reduced.

**Table 11: Sequestration Scenario from Forest Enhancement and Reducing degradation**

| **Rate of change per year** | 183 | | | | | -92 | |
|---|---|---|---|---|---|---|---|
| **Year** | **Emission from deforestation (tonnes $CO_2$ eq) -Business as usual** | **Emission from Forest Degradation (tonnes $CO_2$ eq) -Business as usual** | **Total Emissions from deforestation and Forest Degradation (tonnes $CO_2$ eq)** | **5-25% Reduction in Degradation emissions** | **Net emissions from degradation** | **Emission from deforestation (tonnes $CO_2$ eq) - REDD+ with 50% reduction** | **Net total emissions from deforestation and degradation (tonnes $CO_2$ eq) - REDD+ implementation** |
| 2011 | 183 | 4744 | 4927 | | | | |
| 2012 | 183 | 4924 | 5108 | | | | |
| 2013 | 183 | 5111 | 5295 | | | | |
| 2014 | 183 | 5306 | 5489 | | | | |
| 2015 | 183 | 5507 | 5690 | | | | |
| 2016 | 183 | 5716 | 5900 | | | | |
| 2017 | 183 | 5933 | 6117 | | | | |
| 2018 | 183 | 6151 | 6334 | | | | |
| 2019 | 183 | 6376 | 6559 | | | | |
| 2020 | 183 | 6609 | 6792 | | | | |
| 2021 | 183 | 6851 | 7034 | | | 183 | |
| 2022 | 183 | 7102 | 7285 | | 7102 | 92 | 7193 |
| 2023 | 183 | 7362 | 7545 | 368 | 6994 | 0 | 6994 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2024 | 183 | 7631 | 7814 | 763 | 6868 | -92 | 6776 |
| 2025 | 183 | 7910 | 8094 | 1582 | 6328 | -183 | 6145 |
| 2026 | 183 | 8200 | 8383 | 2050 | 6150 | -275 | 5875 |
| 2027 | 183 | 8500 | 8683 | 2125 | 6375 | -367 | 6008 |
| 2028 | 183 | 8811 | 8995 | 2203 | 6608 | -458 | 6150 |
| 2029 | 183 | 9134 | 9317 | 2283 | 6850 | -550 | 6300 |
| 2030 | 183 | 9468 | 9651 | 2367 | 7101 | -642 | 6459 |
| 2031 | 183 | 9814 | 9998 | 2454 | 7361 | -733 | 6627 |
| 2032 | 183 | 10174 | 10357 | 2543 | 7630 | -825 | 6805 |

**Figure -6: Sequestration scenarios – Forest Enhancement and Reduced degradation**



## CHAPTER III: PROPOSED INTERVENTIONS

Juniper is one of the most important ecosystems in the dry temperate zone. Due to population explosion, change of forest land use to agriculture at an accelerated pace and infestation of Mistletoe in Manna Valley, an integrated approach has been adopted in recommending interventions/activities through Participatory Forests Management Planning. Besides, it is also very important to mention over here that most of population/individuals of Manna Valley fall in the class "poorest of the poor". Community members have very little livelihood sources, most of them are engage in daily wage labour. For undertaking interventions in the Manna Valley, it is important that interventions should be implemented in all the natural resource sectors i.e. forestry, agriculture, livestock and water. Undertaking activities either in forestry or livestock or any other natural resource sector in STAND ALONE MODE is not going to achieve the desires results of reducing/controlling deforestation and forest degradation. By taking into consideration this very fact into account and integrated approach towards natural resource management has been recommended in the Participatory Forest Management Plan of Juniper Forests of Manna Valley. All the interventions have been, therefore, grouped under the different outcomes and outputs. Detail of these interventions follows:

**Interventions addressing Drivers of Deforestation**

**Change of Land Use to Agriculture**

- Community Organizations at tribal level in Sasnamanna to engage local stakeholders in forest management and protection.
- Creating awareness among the people on the importance of these forests and potential revenues to be generated through REDD+ implementation.
- Mobilize communities to control land use change and empower forest department to enforce laws to curb land use changes.

**Mistletoe infestation.**

- Assessment of die back and Mistletoe problems in Juniper forests of Manna valley

**Interventions addressing Drivers of forest degradation**

**Firewood collection for cooking and heating, area being very cold during winters**

- Establishment of nurseries for planting in the forest and on rangelands to improve fodder and firewood availability for the local population.
- Supporting energy plantations
- Watershed rehabilitation and improvement initiatives
- Explore and promote alternate energy sources
- Pilot testing of Solar Systems as domestic energy alternative
- Capacity building of communities in energy conservation technologies

**Uncontrolled Livestock grazing**

- Capacity building of communities in grazing management, livestock management and fodder production
- Introduction of appropriate grazing systems and range restoration and improvement measures
- Involving women in livestock production initiatives

- Increasing fodder crops production on agricultural lands

**Interventions addressing Barriers to forest restoration**

**Uncontrolled grazing**

- Develop participatory grazing management plans for regulating grazing in regeneration areas

**Very slow growing indigenous species i.e. Juniper**

- Promote natural and artificial regeneration in Juniper forests
- Facilitate promotion and development of ecotourism in Juniper forest areas of Manna valley and create awareness on importance of juniper species

The total indicative budget of the PFMP implementation is PKR 196,600,000 over the ten years period.

Ten years budgeting and operational planning of the PFMP is given in Table 12.

**Table 12. Indicative operational plan and Estimated budget of PFMP for 10 years**

| | | | | Operational Plan | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S. N0.** | **Activity** | **Unit** | **Unit cost** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total units** | **Total cost** |
| **A** | **Participatory Forest Management** | | | | | | | | | | | | | | |
| 1 | Community Organizations at tribal level in Sasnamanna to engage local stakeholders in forest management, address forest land conversion issues and protection to the forest. | No | 500,000 | 5 | 5 | 5 | | | | | | | | 15 | 7,500,000 |
| 2 | Creating awareness among the people on the importance of these forests and potential revenues to be generated through REDD+ implementation. | No | 100,000 | 1 | 1 | 1 | | | | | | | | 3 | 300,000 |
| 3 | Plantation in Juniper forests | ha | 1,000,000 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 100 | 100,000,000 |
| 4 | Assessment of die back and Mistletoe problems in Juniper forests of Manna valley | LS | 3,000,000 | 1 | | | | | | | | | | 1 | 3,000,000 |
| 5 | Establishment of enclosures to assist natural regeneration in Juniper patches | LS | 20,000 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 60 | 1,200,000 |
| **B** | **Forest Regeneration** | | | | | | | | | | | | | | |
| 1 | Establishment of nurseries for planting in the forest and on rangelands to improve fodder and firewood availability for the local population | No | 500,000 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | 70 | 35,000,000 |
| 2 | Supporting energy plantations | ha | 200,000 | 10 | 10 | 10 | 10 | 10 | 10 | | | | | 60 | 12,000,000 |
| 3 | Watershed rehabilitation and improvement initiatives | No | 500,000 | 1 | 1 | 1 | 1 | | | | | | | 4 | 2,000,000 |
| **C** | **Managed Rotational Grazing and Livestock Management** | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Capacity building of communities including women in grazing management, livestock management and fodder production | No. of events | 500,000 | 5 | 5 | 5 | 5 | | | | | | | 20 | 10,000,000 |
| 2 | Introduction of appropriate grazing systems and range restoration and improvement measures | Herdsman | 500,000 | | 3 | 3 | 3 | 3 | 3 | | | | | 15 | 7,500,000 |
| **D** | **Promotion of Sustainable Energy Technology** | | | | | | | | | | | | | | |
| 1 | Pilot testing of Solar Systems as domestic energy alternative | No | 500,000 | | 5 | 5 | 5 | 5 | | | | | | 20 | 10,000,000 |
| 2 | Explore and promote alternate energy sources like bio-briquettes, etc. | No | 100,000 | | 5 | 5 | 5 | | | | | | | 15 | 1,500,000 |
| 3 | Capacity building of communities in energy conservation technologies (Energy Efficient stoves, etc.) | No. of persons | 3000 | | 200 | 200 | 200 | 200 | 200 | 200 | | | | 1200 | 3,600,000 |
| **E** | **Promotion & Value Addition of Non-Timber Forest Products (Trainings/Equipment's)** | | | | | | | | | | | | | | |
| 1 | Facilitate promotion and development of ecotourism in Juniper forest areas of Manna valley | No | 500,000 | 2 | 2 | 2 | | | | | | | | 6 | 3,000,000 |
| | **Total** | | | | | | | | | | | | | | **196,600,000** |

# CHAPTER IV: IMPLEMENTATION MECHANISM FOR THE PFMP

## 4.1. Resources for implementation of interventions/activities

Balochistan Forest and Wildlife Department is the custodian institution of all the Juniper forests in the province including the Juniper forests of Manna valley. The department has already implemented many donor and Public Sector Development Programme funded projects in the valley for conservation of Juniper forests. Balochistan Forest and Wildlife Department has also undertaken survey and treatment of Mistletoe infested trees through various projects. Taking into consideration the importance of Juniper forests, Balochistan Forest and Wildlife Department will take a lead role towards securing necessary financial and human resources for the project. Besides, the Balochistan Forest and Wildlife Department, other key stakeholders identified in this plan will also put up efforts towards resource mobilization.

A total of Rs. 47.35 million is required for implementation of activities contained in the Participatory Forest Management Plan of Manna Valley. Arranging this amount is not an easy task in view of the availability of resources with the Balochistan Forest and Wildlife Department and Community Conservation Organizations (CCOs) especially under prevailing poverty in the communities. However, for provision of this very amount a number of other options would also be explored to support the activities included in the plan for conservation of Juniper forests, rehabilitation of natural resources present in the valley, increasing productivity of productive sectors such as agriculture and livestock and strengthening village infrastructures. Through implementation of the Participatory Forest Management Plan, it is expected that it will not only contribute towards Juniper forest conservation but would also help in reducing poverty level in the villages of valley as a result of increased productivity in agriculture and livestock sectors and generation of alternate income earning opportunities. Besides, the Participatory Forests Management Plan will also pave the way towards sustainable resource use. In the long run the implementation of activities through Participatory Forests Management Plan will help in improving the standard of living of the village inhabitants.

For implementation of the activities outlined in the plan, initially a donor conference would be called, where besides inviting the local donor agencies, the International NGOs especially those working in Balochistan would also be requested to participate. This will provide an opportunity for getting the funding for implementation of activities in different sectors. Another important area, which would be explored for the implementation of the Participatory Forests Management Plan of Manna Valley, is through arranging coordination meetings with all those partner agencies that are already working in tehsil Ziarat, such as Balochistan Rural Support Programme (BRSP), Taraqee Foundation (TF), Water and United Nations Development Programme (UNDP). Besides, the Food and Agriculture Organization (FAO) working in the province would also be approached for securing financial support. In these meetings, the plan will be shared with these partners and the sectors where these organizations/agencies are working would be identified for future partnerships. This will provide a very conducive environment for partnerships among the different agencies working in the area of community/rural development and natural resource management/conservation. Another most important avenue for the implementation of activities is through the Ten Billion Tree Tsunami Project (TBTTP).

As inhabitants of villages of Manna valley would be forming a Community Conservation Organizations (CCOs) through/under the project, therefore, they would be working very closely with the project management. They would very actively participate in the preparation of annual/quarterly work plans. It would be thus an excellent opportunity for the project to implement the planned activities on

ground that has been identified in the CCOs meeting. Taking these facts into consideration, it would be to the great advantage of the Participatory Forests Management Plan to use the CCOs forum for implementation of the planned activities. Similarly, the Balochistan Forest and Wildlife Department will also play key role in arranging for funding through the Public Sector Development Programme (PSDP) of Balochistan. As the provincial Government of Balochistan has now got many opportunities available to it for natural resource management and rural/community development, therefore, it would not be a difficult task to get their consent for funding a plan where a lot of inputs in terms of survey and preparation of plan have already been added. In terms of resource mobilization for the plan, here it is very important to indicate here that as the plan has taken up an integrated approach towards the sustainable management of natural resources and community/rural development, therefore, a multi-dimension approach should be sought for securing funding/sponsoring purposes. In this mechanism, efforts would be put up to secure funding for implementation process from different organizations working in different sectors.

## 4.2. Suggested institutional mechanism for implementation of activities

Balochistan Forest and Wildlife Department in consultation with the Community Conservation Organizations will decide on formation/notification of suitable institutional mechanism for implementation of this plan. It is proposed d that valley and district level REDD+ implementation committees may be notified by the Balochistan Forest and Wildlife Department that will oversee implementation of activities. The notifications will include description of responsibilities of Balochistan Forest and Wildlife Department, the respective CCOs, and any other relevant stakeholders.

### 4.2.1. Valley Level REDD+ Implementation Committee (VLRIC):

Balochistan Forest and Wildlife Department in consultation with the CCOs, would notify two committees viz.: A Valley Level REDD$^+$ Implementation Committee (VLRIC) and the District Level REDD$^+$ Implementation Committee (DLRIC). The VLRIC will comprise representative from the CCOs and the Balochistan Forest and Wildlife Department. The community will nominate representatives for the VLRIC to represent them. The representatives of the CCOs will be responsible to mobilize and ensure community support for implementation of activities contained in the Participatory Forest Management Plan. The Balochistan Forest and Wildlife Department will implement the plan activities through the Deputy Conservator of Forests Ziarat and Rang Forest Officer Ziarat/Manna Valley. These officers will be supported by the Deputy Ranger Forest, Foresters and Forest Guard in implementation process. The VLRIC will be Co-chaired by a CCOs member nominated by the communities.

### 4.2.2. District Level REDD+ Implementation Committee (DLRIC):

The VLRIC in implementation of its activities will be supported by a District Level REDD$^+$ Implementation Committee (DRIC). This committee will be chaired by the Deputy Conservator of Forests, while Divisional Forest Officer Ecotourism, District Livestock Officer, District Agriculture Officer and Sub-Divisional Officer Irrigation, a representative of CCO would be members of the committee. The responsibility of the DLRIC will be to monitor progress on implementation of activities and secure/extend support from the relevant actors including the government departments.

## 4.3 Benefit Distribution Mechanism

The implementation of the REDD$^+$ interventions package and other support activities will increase the volume of carbon stock in the forest. The increase in carbon stock in the forest pool measured by variable means and the trade of carbon will generate substantial income for the stakeholders of Manna Valley Juniper Forests in due course of time. The income earned by trading carbon stock will be distributed in proportions as per the use rights held by stakeholders in the State Forest. The

increase in income from the Carbon Trading would serve for stakeholders to place standing trees at a higher value than to cut for other uses. Since the community will be reducing harvest of fuel wood, restrict grazing for encouraging regeneration and voluntarily participate in restocking of forest, they will expect a major share from results base payments from reduced carbon emissions. An example is the 80:20 benefit sharing mechanism between the community and the Balochistan Forest and Wildlife Department from trophy hunting programme in Torghar, Dureiji and Shah Noorani areas of the province. A specific distribution of benefits in case of REDD$^{+}$ programme will be developed by the Balochistan Forest and Wildlife Department in due course of time which will form basis for sharing of benefits in the Juniper Forests of Manna Valley.

This plan has proposed distribution of carbon and non-carbon benefits accrued by the implementation of plan according to which 80% benefits will go to the Government, and 20% will go equally to the customary right holders and users. These benefits will only be distributed if the targets are achieved. The plan therefore provides scenarios to reduce or increase benefits so that the stakeholders can enjoy results-based payment and benefits. The success of this plan, therefore, is contingent to the commitment of all the stakeholders involved. A specific and definitive distribution of benefits in case of REDD+ programme is yet to be developed by the government, which will form basis for sharing of benefits in the case of private forests. This proposed ratio will be finalized or confirmed only after finalizing Balochistan's benefit sharing mechanism.

# CHAPTER V: CONFLICTS AND GRIEVANCES REDRESSAL MECHANISM

## 5.1 Conflict within the community

Traditionally, a jirga system resolves conflicts within the community in Manna Valley and the decisions taken are acceptable to all the parties. Under REDD+ redressal, it is proposed that the same jirga should take lead role for resolving conflicts arising among the communities/villages regarding implementation of REDD+ activities. The structure and function of jirga system has been described in earlier section in this document.

## 5.2 Conflict between the two villages

The CCOs formed under/through the project with the help of jirgas/committee will settle any disputes between the two villages. Any unsettled disputes will be referred to the District Level REDD+ Implementation Committee (DLRIC). If conflicts are still not resolved, the matter will be taken up to the court of the formal judicial system.

## 5.3 Community's grievance towards Balochistan Forest and Wildlife Department

The REDD+ is a new mechanism for communities as well as for the Balochistan Forest and Wildlife Department, therefore both partners (Community and the Balochistan Forest and Wildlife Department) may be facing some conflict of interests in due course of time. In case of any such grievances arises, these will be dealt through the grievance redressal mechanism developed under the REDD+ obligation. This mechanism is also reflected well in Provincial REDD+ Action Plan.

## References: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## Annex 1: Socio-economic data of Juniper Forests of Manna Valley

| | |
|---|---|
| **I. Stakeholder group (name)** | Stakeholder Analysis of Manna Valley, District Ziarat |
| **II. General information** | |
| Location of stakeholder groups (e.g., different villages/hamlets in and outside forest area) and names and indicate on map if possible | Manna valley, Union Council Manna, District Ziarat. |
| | |
| **III. Social organization in the forest area** | |
| *2. Traditional organizations (e.g., jirga)* | |
| 2.1. Organization (name; purpose; membership) | A 5-five-member committee constituted by the village residents of Manna valley for conflict resolution |
| 2.2. Organization (name; purpose; membership | |
| 2.3. Organization (name; purpose; membership | |
| 3. Formal organization (e.g., social; welfare organization or village development committee | Formal Organizations have been formed by the Taraqee Foundation at the village level for organizing village inhabitants into formal organizations and implementation of community development activities and interventions. |
| **IV. Use of forest and forest area** | |
| **4.** For what are you using the forest area? | |
| Timber for personal use like house construction, etc. (where; locate on the map) | In the past trees were cut down for obtaining timber for personal uses but this practice has been abandoned. |
| Timber for commercial selling (where; locate on the map) | No timber for commercial selling is extracted from Juniper forests of Manna Valley. |
| Firewood (where; locate on the map) | Local community members get their fuel wood from the Juniper forests but many households in the villages are also getting firewood from their orchards and farmlands. |
| Grazing | Due prevalence of orchards in the valley, number of livestock by community members has been greatly reduced. Grazing pressure from the livestock of resident community members is low. |
| Grass cutting | This practice is not very common in the Juniper forests. However, at the beginning of slack season and during drought, grass from the forested areas is cut down and stored for feeding livestock. |

| | |
|---|---|
| Other products, e.g., mushroom, pine nuts, pine needles, vegetables, stones, minerals, medicinal plants | Medicinal plants and Juniper berries are collected all over the forests and there is no area specifically demarcated for this purposes. |
| Forest areas related daily labor/employment (employed by whom; for what?) | For cutting of mistletoe infested trees, construction of check dams etc. labour is employed by the Forest Department. |
| Tourism (what; where; locate on the map) | Manna valley is visited by tourists, but no facilities are available. So tourism is not taking place on an organized level |
| Hunting/Fishing | Not reported |
| What would it mean if you had no access to these forest products? (Any alternatives? Threat to livelihood?) | Although communities are now using Iron Girder and similar alternatives. Besides the community members have now also raised Poplar trees in the valley in and around their farmlands that are not only providing them with hard cash but also timber for construction. However, there are no alternatives for the grazing lands in the valley. Some of the community members have raised fodder crops on their lands but due to scarcity of cultivable land, fodder production is not given priority among crops. Similarly, no alternatives exist for the locally produced medicinal plants such as berries of Junipers, *Artemisia spp* and *Zizyphora tenure* |
| **5. Rights and concessions in forest area** | |
| 6. Do you have formal, legal, or traditional, customary rights on forest products (use)? Which ones? If documented rights, where? | In the notification of state forests, local community members have been given the rights for dead, dry and fallen wood. Besides, the priority for the contract and labour in the forestry activities. |
| Timber (shares) | As explained above |
| Fodder: grass cutting/grazing | As explained above |
| Firewood | As explained above |
| Other products: | As explained above |

## Annex 2: Participatory Stakeholder Analysis

| STAKEHOLDER | INTEREST in Forest Management | | INFLUENCE on Forest mgt. | | Relevant forest carbon pools | | Influence on forest carbon pools | |
|---|---|---|---|---|---|---|---|---|
| | Type of interest | Level of interest | Type of Influence | Level of influence | Type of carbon Pool | Level of interest | Type of influence | Level of influence |
| Local Community | Fuel wood, Timber, grazing, water, medicinal plants | 3 | Decision on use of forest resources i.e. Timber, fuel wood, medicinal plants | 2 | Above and below ground | 3 | Use of carbon pools | 2 |
| Forest and Wildlife Department | Forest Management, Conservation of Biodiversity, Watershed Management | 3 | Controlling management prescriptions, Decision on use | 1 | All five carbon pools | 3 | Legal framework and control mechanism | 3 |
| Agriculture and Cooperative Department | Water and soil conservation | 2 | Good relationships with community and BFWD, | 1 | Above and below ground | 1 | Lobbying | 1 |
| Livestock and Dairy Development Department | Grazing/Forage and water | 1 | Good relationships with community and BFWD | 1 | Above ground | 1 | Lobbying | 1 |
| District Administration | Forest Management | 2 | Good relationships with community and BFWD | 2 | All five carbon pools | 2 | Influence on use of carbon pools | 2 |
| Local Market Suppliers | Water and soil conservation | 1 | Good relationship with community | 1 | Above ground | 1 | Lobbying | 1 |
| Commission Agents | Water and soil conservation | 1 | Political Lobbyist | 1 | Above ground | 1 | Lobbying | 1 |
| Transporters | Water and soil conservation | 1 | Political Lobbyist | 1 | Above ground | 1 | Lobbying | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BRSP and other Non-Governmental Organizations (NGOs) | Forest conservation including water and soil conservation | 2 | Lobbyist | 1 | All five carbon pools | 2 | Lobbying | 1 |
| Donor Agencies | Forest management and biodiversity conservation | 2 | Lobbyist | 1 | All five carbon pools | 2 | Lobbying | 2 |

| ***Scale** | **Level of interest** | **level of influence** |
|---|---|---|
| 0 | None | Negligible or ignored |
| 1 | Little | Little |
| 2 | Significant | Significant |
| 3 | High/vital for existence | Controller |

## Annex 3: Plot level Carbon stocks

| Plot No. | Latitude | Longitude | Species Name | DBH (cm) | Tree height (m) | AGB (kg) | AGB (ton/ha) | AGC (ton/ha) | BGC (ton/ha) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 30.27 | 67.46 | *Juniperus excelsa* | 43 | 7.9 | 295.8189693 | 2.96 | 1.39 | 0.35 |
| 1 | 30.27 | 67.46 | *Juniperus excelsa* | 40 | 6.9 | 261.5414612 | 2.62 | 1.23 | 0.31 |
| 1 | 30.27 | 67.46 | *Juniperus excelsa* | 43 | 5.7 | 295.8189693 | 2.96 | 1.39 | 0.35 |
| 1 | 30.27 | 67.46 | *Juniperus excelsa* | 23 | 9.1 | 101.9245772 | 1.02 | 0.48 | 0.12 |
| 1 | 30.27 | 67.46 | *Juniperus excelsa* | 32 | 6.2 | 178.8596945 | 1.79 | 0.84 | 0.21 |
| 1 | 30.27 | 67.46 | *Juniperus excelsa* | 9 | 5.4 | 20.62396466 | 0.21 | 0.10 | 0.02 |
| 1 | 30.27 | 67.46 | *Juniperus excelsa* | 17 | 6.7 | 60.91497282 | 0.61 | 0.29 | 0.07 |
| 1 | 30.27 | 67.46 | *Juniperus excelsa* | 22 | 11.0 | 94.49398615 | 0.94 | 0.44 | 0.11 |
| 2 | 30.28 | 67.48.2 | *Juniperus excelsa* | 23 | 5.4 | 101.9245772 | 1.02 | 0.48 | 0.12 |
| 2 | 30.28 | 67.48.2 | *Juniperus excelsa* | 21 | 4.7 | 87.29710137 | 0.87 | 0.41 | 0.10 |
| 2 | 30.28 | 67.48.2 | *Juniperus excelsa* | 36 | 8.8 | 218.5848788 | 2.19 | 1.03 | 0.26 |
| 2 | 30.28 | 67.48.2 | *Juniperus excelsa* | 54 | 1.6 | 435.9994286 | 4.36 | 2.05 | 0.51 |
| 2 | 30.28 | 67.48.2 | *Juniperus excelsa* | 22 | 4.2 | 94.49398615 | 0.94 | 0.44 | 0.11 |
| 3 | 30.25 | 67.46 | *Juniperus excelsa* | 46 | 4.6 | 331.8202591 | 3.32 | 1.56 | 0.39 |
| 3 | 30.25 | 67.46 | *Juniperus excelsa* | 83 | 7.5 | 906.5477202 | 9.07 | 4.26 | 1.07 |
| 3 | 30.25 | 67.46 | *Juniperus excelsa* | 53 | 11.0 | 422.3397562 | 4.22 | 1.98 | 0.50 |
| 3 | 30.25 | 67.46 | *Juniperus excelsa* | 49 | 9.0 | 369.5111019 | 3.70 | 1.74 | 0.43 |
| 4 | 30.25.7 | 67.46.1 | *Juniperus excelsa* | 57 | 6.5 | 478.0484102 | 4.78 | 2.25 | 0.56 |
| 4 | 30.25.7 | 67.46.1 | *Juniperus excelsa* | 37 | 2.5 | 229.0252166 | 2.29 | 1.08 | 0.27 |
| 4 | 30.25.7 | 67.46.1 | *Juniperus excelsa* | 51 | 2.0 | 395.56134 | 3.96 | 1.86 | 0.46 |
| 4 | 30.25.7 | 67.46.1 | *Juniperus excelsa* | 39 | 58.0 | 250.5050618 | 2.51 | 1.18 | 0.29 |
| 4 | 30.25.7 | 67.46.1 | *Juniperus excelsa* | 23 | 8.8 | 101.9245772 | 1.02 | 0.48 | 0.12 |
| 4 | 30.25.7 | 67.46.1 | *Juniperus excelsa* | 81 | 12.4 | 869.6644656 | 8.70 | 4.09 | 1.02 |
| 4 | 30.25.7 | 67.46.1 | *Juniperus excelsa* | 67 | 5.5 | 629.5284591 | 6.30 | 2.96 | 0.74 |
| 4 | 30.25.7 | 67.46.1 | *Juniperus excelsa* | 72 | 5.6 | 711.6133628 | 7.12 | 3.34 | 0.84 |
| 4 | 30.25.7 | 67.46.1 | *Juniperus excelsa* | 34 | 4.7 | 198.3115616 | 1.98 | 0.93 | 0.23 |
| 4 | 30.25.7 | 67.46.1 | *Juniperus excelsa* | 41 | 5.1 | 272.7735251 | 2.73 | 1.28 | 0.32 |
| 5 | 30.28 | | *Juniperus excelsa* | 94 | 16.9 | 1120.551983 | 11.21 | 5.27 | 1.32 |
| 5 | 30.28 | | *Juniperus excelsa* | 5.14 | 2.4 | 7.944959393 | 0.08 | 0.04 | 0.01 |
| 5 | 30.28 | | *Juniperus excelsa* | 54 | 17.0 | 435.9994286 | 4.36 | 2.05 | 0.51 |

| Plot No. | Latitude | Longitude | Species Name | DBH (cm) | Tree height (m) | AGB (kg) | AGB (ton/ha) | AGC (ton/ha) | BGC (ton/ha) |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 30.28 | | *Juniperus excelsa* | 45 | 3.5 | 319.6304721 | 3.20 | 1.50 | 0.38 |
| 5 | 30.28 | | *Juniperus excelsa* | 50 | 4.5 | 382.4446649 | 3.82 | 1.80 | 0.45 |
| 5 | 30.28 | | *Juniperus excelsa* | 41 | 8.5 | 272.7735251 | 2.73 | 1.28 | 0.32 |
| 5 | 30.28 | | *Juniperus excelsa* | 20 | 6.8 | 80.33717688 | 0.80 | 0.38 | 0.09 |
| 5 | 30.28 | | *Juniperus excelsa* | 87 | 11.6 | 982.199982 | 9.82 | 4.62 | 1.15 |
| 5 | 30.28 | | *Juniperus excelsa* | 12 | 11.0 | 33.66125706 | 0.34 | 0.16 | 0.04 |
| 5 | 30.28 | | *Juniperus excelsa* | 59 | 12.0 | 506.9632487 | 5.07 | 2.38 | 0.60 |
| 6 | 30.26.1 | 67.46.2 | *Juniperus excelsa* | 57 | 6.6 | 478.0484102 | 4.78 | 2.25 | 0.56 |
| 6 | 30.26.1 | 67.46.2 | *Juniperus excelsa* | 78 | 9.1 | 815.5310213 | 8.16 | 3.83 | 0.96 |
| 6 | 30.26.1 | 67.46.2 | *Juniperus excelsa* | 46 | 8.7 | 331.8202591 | 3.32 | 1.56 | 0.39 |
| 6 | 30.26.1 | 67.46.2 | *Juniperus excelsa* | 57 | 13.1 | 478.0484102 | 4.78 | 2.25 | 0.56 |
| 6 | 30.26.1 | 67.46.2 | *Juniperus excelsa* | 48 | 10.1 | 356.7617534 | 3.57 | 1.68 | 0.42 |
| 6 | 30.26.1 | 67.46.2 | *Juniperus excelsa* | 41 | 10.5 | 272.7735251 | 2.73 | 1.28 | 0.32 |
| 6 | 30.26.1 | 67.46.2 | *Juniperus excelsa* | 41 | 9.6 | 272.7735251 | 2.73 | 1.28 | 0.32 |
| 6 | 30.26.1 | 67.46.2 | *Juniperus excelsa* | 11 | 6.2 | 29.0255321 | 0.29 | 0.14 | 0.03 |
| 6 | 30.26.1 | 67.46.2 | *Juniperus excelsa* | 8 | 4.0 | 16.87580605 | 0.17 | 0.08 | 0.02 |
| 7 | 30.29.2 | 67.47.8 | *Juniperus excelsa* | 22 | 5.2 | 94.49398615 | 0.94 | 0.44 | 0.11 |
| 7 | 30.29.2 | 67.47.8 | *Juniperus excelsa* | 13 | 4.3 | 38.57684634 | 0.39 | 0.18 | 0.05 |
| 7 | 30.29.2 | 67.47.8 | *Juniperus excelsa* | 36 | 4.0 | 218.5848788 | 2.19 | 1.03 | 0.26 |
| 7 | 30.29.2 | 67.47.8 | *Juniperus excelsa* | 9 | 5.6 | 20.62396466 | 0.21 | 0.10 | 0.02 |
| 7 | 30.29.2 | 67.47.8 | *Juniperus excelsa* | 19 | 6.9 | 73.61767436 | 0.74 | 0.35 | 0.09 |
| 7 | 30.29.2 | 67.47.8 | *Juniperus excelsa* | 9 | 5.1 | 20.62396466 | 0.21 | 0.10 | 0.02 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 56 | 6.5 | 463.8547174 | 4.64 | 2.18 | 0.55 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 8 | 2.0 | 16.87580605 | 0.17 | 0.08 | 0.02 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 10 | 3.0 | 24.67701281 | 0.25 | 0.12 | 0.03 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 26 | 6.6 | 125.5887393 | 1.26 | 0.59 | 0.15 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 35 | 6.1 | 208.3464281 | 2.08 | 0.98 | 0.24 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 61 | 9.5 | 536.5754057 | 5.37 | 2.52 | 0.63 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 87 | 8.0 | 982.199982 | 9.82 | 4.62 | 1.15 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 45 | 9.1 | 319.6304721 | 3.20 | 1.50 | 0.38 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 41 | 5.9 | 272.7735251 | 2.73 | 1.28 | 0.32 |

| Plot No. | Latitude | Longitude | Species Name | DBH (cm) | Tree height (m) | AGB (kg) | AGB (ton/ha) | AGC (ton/ha) | BGC (ton/ha) |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 47 | 6.1 | 344.1977514 | 3.44 | 1.62 | 0.40 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 39 | 7.5 | 250.5050618 | 2.51 | 1.18 | 0.29 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 38 | 5.9 | 239.6658044 | 2.40 | 1.13 | 0.28 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 28 | 5.1 | 142.4813424 | 1.42 | 0.67 | 0.17 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 54 | 4.5 | 435.9994286 | 4.36 | 2.05 | 0.51 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 32 | 5.6 | 178.8596945 | 1.79 | 0.84 | 0.21 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 44 | 7.7 | 307.6296202 | 3.08 | 1.45 | 0.36 |
| 8 | 30.25 | 67.48.3 | *Juniperus excelsa* | 23 | 5.3 | 101.9245772 | 1.02 | 0.48 | 0.12 |
| 9 |  | 67 | *Juniperus excelsa* | 40 | 6.0 | 261.5414612 | 2.62 | 1.23 | 0.31 |
| 9 |  | 67 | *Juniperus excelsa* | 49 | 4.5 | 369.5111019 | 3.70 | 1.74 | 0.43 |
| 9 |  | 67 | *Juniperus excelsa* | 70 | 11.0 | 678.2816046 | 6.78 | 3.19 | 0.80 |
| 9 |  | 67 | *Juniperus excelsa* | 23 | 10.3 | 101.9245772 | 1.02 | 0.48 | 0.12 |
| 9 |  | 67 | *Juniperus excelsa* | 36 | 8.8 | 218.5848788 | 2.19 | 1.03 | 0.26 |
| 9 |  | 67 | *Juniperus excelsa* | 54 | 3.8 | 435.9994286 | 4.36 | 2.05 | 0.51 |
| 10 | 30.26.1 | 67.47.2 | *Juniperus excelsa* | 80 | 6.3 | 851.4605391 | 8.51 | 4.00 | 1.00 |
| 10 | 30.26.1 | 67.47.2 | *Juniperus excelsa* | 61 | 7.6 | 536.5754057 | 5.37 | 2.52 | 0.63 |
| 10 | 30.26.1 | 67.47.2 | *Juniperus excelsa* | 34 | 3.0 | 198.3115616 | 1.98 | 0.93 | 0.23 |
| 10 | 30.26.1 | 67.47.2 | *Juniperus excelsa* | 78 | 5.3 | 815.5310213 | 8.16 | 3.83 | 0.96 |
| 10 | 30.26.1 | 67.47.2 | *Juniperus excelsa* | 43 | 7.8 | 295.8189693 | 2.96 | 1.39 | 0.35 |
| 10 | 30.26.1 | 67.47.2 | *Juniperus excelsa* | 42 | 8.5 | 284.199823 | 2.84 | 1.34 | 0.33 |
| 10 | 30.26.1 | 67.47.2 | *Juniperus excelsa* | 55 | 9.2 | 449.8380734 | 4.50 | 2.11 | 0.53 |
| 12 | 30.28.3 | 67.45.8 | *Juniperus excelsa* | 17 | 3.0 | 60.91497282 | 0.61 | 0.29 | 0.07 |
| 12 | 30.28.3 | 67.45.8 | *Juniperus excelsa* | 53 | 7.1 | 422.3397562 | 4.22 | 1.98 | 0.50 |
| 12 | 30.28.3 | 67.45.8 | *Juniperus excelsa* | 13 | 3.2 | 38.57684634 | 0.39 | 0.18 | 0.05 |
| 12 | 30.28.3 | 67.45.8 | *Juniperus excelsa* | 19 | 4.2 | 73.61767436 | 0.74 | 0.35 | 0.09 |
| 12 | 30.28.3 | 67.45.8 | *Juniperus excelsa* | 43 | 8.8 | 295.8189693 | 2.96 | 1.39 | 0.35 |
| 12 | 30.28.3 | 67.45.8 | *Juniperus excelsa* | 60 | 9.7 | 521.682599 | 5.22 | 2.45 | 0.61 |
| 12 | 30.28.3 | 67.45.8 | *Juniperus excelsa* | 31 | 7.4 | 169.4464268 | 1.69 | 0.80 | 0.20 |
| 12 | 30.28.3 | 67.45.8 | *Juniperus excelsa* | 7 | 3.0 | 13.44342841 | 0.13 | 0.06 | 0.02 |
| 12 | 30.28.3 | 67.45.8 | *Juniperus excelsa* | 14 | 4.2 | 43.76571405 | 0.44 | 0.21 | 0.05 |