DRAFT

DETAILED PROJECT REPORT

REJUVENATION OF RAVI RIVER THROUGH FORESTRY INTERVENTIONS

Overview

DETAILED PROJECT REPORT

Forestry Interventions for Ravi River

Overview

Rivers, particularly, large river systems, constitute one of the most fundamental life support systems that have sustained civilizations, and are projected to be a critical determinant for the future sustenance of human civilizations. River ecosystems are flowing waters that drain the landscape and include the biotic (living) interactions amongst plants, animals and micro-organisms, as well as abiotic (non-living) physical and chemical interactions of its many parts. In India, rivers are classified mainly of four types based on their geographical locations and origin i.e., (a) Himalayan Rivers (b) Peninsular Rivers, (c) Coastal Rivers, and (d) Inland Rivers. The Himalayan Rivers are glacier fed and perennial, while Peninsular Rivers are altogether monsoon fed. As far as the nature of Himalayan Rivers is concerned, these are antecedent rivers having deep gorges chasms. The trans-boundary Indus River Basin forms a part of the Himalayan River system and covers approx. area of 1.12 million km^2 is located in four countries, of which the largest part is distributed in Pakistan (47%), and substantial upstream parts in India (39%), China (8%) and Afghanistan (6%). In India, the Basin spreads over the Ladakh and Jammu and Kashmir Union Territories, Himachal Pradesh, Punjab, Rajasthan and Haryana; and Chandigarh Union Territory. The Ladakh and Jammu and Kashmir Union Territories share the highest extent of Basin area, being 1,93,762 km^2 (60%), followed by Himachal Pradesh (51,356 km^2 or 16%) and Punjab (50,304 km^2 or 15.96%). Rajasthan and Haryana States contribute nearly 5% and 3% extent of the Basin, respectively. Chandigarh UT has a minuscule extent of 114 km^2 or just 0.04% of the total Basin area. In India, Sutlej, Ravi, Beas, Chenab and Jhelum Rivers are the five principal tributaries of the Indus River Basin.

The Ravi River originates in the Lesser Himalaya in India, and is smallest river of all other trans-boundary rivers of India and Pakistan. In India, it is known as the river of Lahore. The total length of Ravi River is 720 km in both India and Pakistan. It runs almost along the India-Pakistan border. The length of Ravi River in India is 341 km and having catchment area of 11,706.41 km^2. Out of the total length of Ravi River, 168 km lies in Himachal Pradesh, 63 km in Jammu & Kashmir Union Terrotory (J&K UT) and 110 km in Punjab. Ravi River rises from the Bara Bhangal (A branch of Dhauladhar Range) area of Kangra district of Himachal Pradesh. The Bara Bhangal comprises of snow covered peaks at heights ranging from 3,000 - 6,000m amsl. Ravi River is formed by the confluence of Bhadal *Nallah* originating from Bhadal glacier, Rai *Nallah* originating from Rai Ghar glacier and Tantgari *Nallah* originating from Tantgari and Karu glaciers as a joint stream. The Ravi River has Budhil, Baira, Siul, Tant Giri, Sewa, Chirchind *Nallah*, Bhadal, Ujh, Bein and Basantar as major tributaries. The right bank tributaries of the Ravi River are Budhil, Tundahan Beljedi, Saho and Siul and its left bank tributary worth mentioning is Chirchind *Nallah*. Town Chamba is situated on the bank of the Ravi River. The Ravi River flows by the foot of Dalhousie hill, through the famous Chamba Valley. The Ravi River first flows westwards through a trough separating the Pir Panjal Range from Dhauladhar Range and then turns southward, cutting the deep

gorge through the Dhauladhar Range. It flows nearly 130 km in Chamba region, before leaving it finally at Kheri. The Ravi River forms the biggest sub-micro region of Chamba district. From Bara Bhangal of Kangra district, River flows through Bara Bansu, Tretha, Chanota and Ulhansa. After passing through the Chamba district, it leaves the Himalaya at Basholi and traverse close to Kathua. It makes a sudden westerly bend and enters the Punjab plains near Madhopur. Some distance below Madhopur, it demarks boundary between the two Punjab (West in Pakistan and East in India). The River flows through the border of J&K UT and Punjab State for approximately 60 km. It enters into Punjab near Pathankot, forms International boundary while passing through Gurdaspur and Amritsar districts of Punjab and finally leaves Indian Territory at Goina/ Kakarmani village some 80 km away from Lahore city. It then flows along the Indo–Pak border for 80 km before entering Pakistan and joining the Chenab River.

The Siul River is one of the major tributary of Ravi River in Himachal Pradesh with a catchment area of about 1500 km^2 and contributes a large amount of water to Ravi River. The major tributary of Ravi River in J&K UT is Ujh River which originates in Kailash Mountains near Bhaderwah hills, part of the Pir Panjal Range at an altitude of 4,300 m amsl. It flows a distance of nearly 100 km, some of it in Pakistan Punjab, before joining Ravi River near Chak Ram Sahai in Indian Punjab. The average width of the river in the plains is about 1.2 km. Ravi River flows through Kathua district of J&K UT. Basantar is another tributary of Ravi River which flows through Samba district of J&K UT. There are total 34,293 streams of Ravi River Basin in Himachal Pradesh and out of these, 27,701 streams are of first order, 5,162 of second order streams, 1,094 of third order, 253 of fourth order, 62 of fifth order, 17 of sixth order, 3 of seventh order, and 1 of eighth order streams. The well-known human settlements along the River are Bharmaur, Madhopur, Kathua, Samba, Basohli, Gurdaspur, Narot Jaimal Singh, Rakwal, Kamalpur, Sundergarh, Kassowala and Chamba town.

Ravi River

Restoration and Conservation Initiatives

Human induced degradation of River ecosystems and loss of aquatic biodiversity are continuing and widespread. Most of India's Rivers are in varying degrees of decline and distress. Human impacts, often involve changes in hydrologic activity and flow regimes. Deteriorating flow regimes and the discharge of organic and toxic effluents combine to affect a river's health adversely. The Ravi River shows ample signs of reduced environmental flow, declined water quality, damaged and mutilated 'Organs' – the tributaries, the riparian vegetation, the bed, the biota, and the floodplain; loss of ecological integrity, depleting ecosystem services, and overall poor health of the River.

Ecological restoration has become an important aspect of River Management. The term 'Restoration' usually implies the act of restoring to a former/ original state or position or to an unimpaired or perfect position. Thus, restoration has two implications i.e., Firstly, returning to an original state; and (ii) Returning to a state that is perfect or healthy.

‘Ecological River Restoration’ is specifically defined as ‘Assisting the recovery of ecological integrity in a degraded watershed system by reestablishing the processes necessary to support the natural ecosystem within a watershed. River restoration involves a wide range of stakeholders from the public and private sector including policy makers, practitioners, scientists and non-governmental organizations, as well as all citizen groups potentially impacted.

River Restoration is widely accepted by most National Governments and various stakeholders as an essential compliment to conservation and water management strategies. Despite legal mandate, huge investments, emergence of newer approaches, and fast developing industry of aquatic and Riparian Restoration, River ecosystems continue to deteriorate as a result of aggravated human influences.

The Government of India has recognized the concerns of growing water crisis as the main impediment in the country’s development and in the process of Nation building besides fulfilling various international obligations and commitments including the UN Agenda on Sustainable Development. Accordingly, the Government of India in recent decades has launched several countrywide priority programmes and initiated actions for sustainable management of water resources including restoration of major Indian River Systems vital for the maintenance of natural processes, healthy people and prosperous nation. The Government now aims for *Aviral Dhara* (uninterrupted flow), *Nirmal Dhara* (unpolluted flow), and ecological restoration. Current effort towards the preparation of present DPR on Forestry Intervention to Restore Ravi River is one such action.

Ravi River

Conservation Significance

According to ancient history traced to Vedas, the Ravi River was known as Iravati. The River was known as Parushani or Iravati to Indians in Vedic times and as Hydraotes to the Ancient Greeks. When the Indian National Congress changed its goals to ‘Purna Swaraj’ or Total Independence, President Jawaharlal Nehru unfurled the tricolor on the banks of Ravi River in the midnight hours of 31st December, 1929 amidst the slogans of ‘Inquilab Zindabad’ and ‘Bande Mataram’. The Ravi River was witness to the epic battle mentioned in the Rig Veda in which the Tribal kingdom of Bharata had emerged victorious. Not long after, the River saw the sage Valmiki compose the Ramayana while sitting on its banks, narrating the story of the ideal king Ram. The River was witness to the last seventeen years of Guru Nanak’s life, and how he performed ashnan (bath, as a purification process) every day before working in his fields. The River also cleansed the body of Guru Arjan after he was tortured on the orders of Emperor Jahangir, and it accepted the Guru in its embrace, providing him salvation from the Mughal forces. The Manimahesh Peak and the lake, which feeds the Budhil River - a tributary of the Ravi River, in Chamba is sacred lake and pilgrimage site of Hindus. The Majestic snow-peaked Himalayan Mountains and various natural ecosystems along the Ravi River and its tributaries, besides wide ranging religious, cultural and historic values, have enormous potential for recreation and tourism industry. The natural beauty

around this River is worth seeing and gives a great view at summer time. Moreover, the River is a great attraction for tourists and gives a notable place to local visitors. Water sports adventure (i.e., rafting and boating) and Pilgrimage (Mani Mahesh) are major attractions and constitute several circuits of tourism. Festivities and events like International Minjar Mela are associated with the worship of Ravi River.

The Ravi River provides subsistence fishery thereby nutritional security especially to people dwelling in interior areas along the International border and is a means of livelihood to local fisherman. The minor minerals (i.e., sand, boulders and concrete) are extracted in massive quantities from the river beds of Ravi River and its tributaries. This Basin has been heavily targeted for the hydro-electric power development since 1980s with the installation of NHPC's first hydro-electric power generation plant with the name of Baira Siul Hydro-electric power project. Hydro- Electric Projects (Commissioned, Under Construction & Planned) on Ravi River in Himachal Pradesh are 167 projects having hydro-power potential of 2835.12 MW, and having the potential capacity of 3237 MW.

The entire catchment comprises of mountainous terrain with steep hill slopes and is very thinly populated. Some areas in the upper catchment of the Basin remains frozen throughout the year. The main River as well as the tributaries are fed from snow/ glaciers which makes these rivers perennial. The average rainfall in the basin varies from 600 - 1,600 mm. Intensity of the rainfall is maximum in the region between the confluence of Siul and Thein Dam. While the upper reaches of Ravi River have low intensity of rainfall, the water availability due to snow/ glacier contribution is generally even. Due to high altitude and cold climate, there is hardly any vegetation in the upper reaches of the Basin. The area is not inhabited and the cultivation appears to be only on limited scale. Vegetation is mainly tropical, sub-tropical, temperate, sub-alpine and alpine types with a thick cover of reserve forests. The important species are Oak (*Quercus* spp.), Chestnut (*Aesculus indica*), Deodar (*Cedrus deodara*), Kail (*Pinus wallichiana*), Juniper (*Juniperus* spp.), The Himalayan *Yew* (*Taxus wallichiana*) and Birch (*Betula utilis*). The habitat areas of Musk Deer (*Moschus moschiferus* spp.), Snow Leopard *(Panthera uncia*), Himalayan Tahr (*Hemitragus jemlahicus*), Ibex (*Capra ibex*) and Serow (*Capricornis sumatraenus*) are restricted to the upper reaches of Ravi River catchment (2,800 – 4,000m amsl) and occupy the upper cold desert layer. Goral (*Naemorhaedus goral*) and Barking Deer *(Muntiacus muntjak*) are most common ungulates in this region. These animals are distributed in the temperate to sub-alpine forests between 2,400 - 2,800m amsl. Among the Primates, *Macaca mulatta* (Rhesus Macaque) and *Presbytis entellus* (Langur) apart from other animals like Squirrel (*Sciuridae* spp.), Jackal (*Canis* spp.), Leopard (*Panthera pardus*), Porcupine (*Hystrix indica*), etc. are found to inhabit the same ecological niche from the lower parts to upper parts of the hills i.e., from 1,400 to 3,400m amsl). Geologically, major portion of the Basin is composed of Jutogh Group / Vaikrita Group / Central Gneiss Formations while Blaini / Infra-Krol Formations are found in the bed of Ravi River. The soil of Ravi River Basin is Typic Cryorthents and Lithic Udorthents types.

Himachal Pradesh (HP), Punjab and J&K UT, which come under Ravi River Basin contributes 3,28,271 km^2 (9.99%) of total geographical area of India. These states collectively harbour 60,347 km^2 diverse forests (Recorded Forest Area (RFA)) or about

7.86% forests (RFA) of the country. Further, HP, Punjab and J&K UT have altogether 746.71 m cum growing stock of forests that constitute 12.75% of the total growing stock of the country. Forests in above mentioned States and UT harbor 6,55,899 million tons of carbon stock which contribute 9.206% of total estimated carbon stock of country which sequester carbon and also help in reduction of Greenhouse Gas emissions (FSI, 2019).

The Ravi River Basin is home to many threatened and sensitive ecosystems, *viz.*, glaciers, alpine meadows, grasslands, riparian forests, etc. along with a large variety of rare, endangered, and threatened species that inhabit them. The Ravi River Basin across two states (Himachal Pradesh and Punjab) and J&K UT harbours altogether 7 Wildlife Sanctuaries. These are Gamgul, Tundah, Kugti, Kalatop-Khajjiar, Dhauladhar, Jasrota and Kathlour Kushlian WLSs. In Ravi River Basin, two Wetlands of National importance i.e., Khajjiar Wetland and Ranjeet Sagar Wetlands occur. The prominent peaks in Ravi Riverscape are Pir Panjal (5,972 m amsl), Barakanda (5,860 m amsl), Manimahesh Kailash (5,660 m amsl) and Thamsar (5,080 m amsl). Recognizing conservation significance of Ravi River and responding to growing environmental concerns arising due to varied anthropocentric influences on the River, the Government of India, Ministry of Environment, Forest and Climate Change (MOEF&CC) has entrusted the task to HFRI, Shimla, one of the institutes of ICFRE to prepare the DPR on Forestry Interventions for River Restoration.

Forests and Rivers

Strong Linkages

Water is a vital element of all natural resources and essential to life. Forests have a close relationship to our water resources. Sustainable forest management is of vital importance for supply of good-quality freshwater, protection against natural hazards like floods or soil erosion, and for combating desertification. Forested Basins and catchments provides high proportion of freshwater to meet the basic requirements of domestic, agricultural, industrial and ecological needs in both upstream and downstream areas.

To address challenges related to water security there is an urgent need for a better understanding of the interactions between forests and water, for awareness raising and capacity building in forest hydrology, embedding this knowledge and the research findings in policies. Similarly, there is a need to develop institutional mechanisms to enhance synergies in dealing with issues related to forests and water as well as to implement and enforce action programmes at the National and Regional Levels. In the past, forest and water policies were often based on the assumption that under any hydrological and ecological circumstance, forest is the best land cover to maximize water yield, regulate seasonal flows and ensure high water quality. Following this assumption, conserving (or extending) forest cover in upstream watersheds was deemed the most effective measure to enhance water availability for agriculture, industrial and domestic uses, as well as for preventing floods in downstream areas. Forest hydrology research conducted during the 1980s and 1990s suggests the role of upstream forests in maintaining water flows during the dry season; and water-quality preservation.

Interactions Between Forests and Rivers

Need for Closer Cooperation

Throughout its journey from source to sea, a river integrates all that happens in the basin landscapes, particularly the impact of human activities. Thus, rivers have been regarded as 'Arteries of the Catchment', 'Life blood', 'Highways', and even as the 'Sentinels'. Rivers provide early clues as special signals of human impact and associated risks. Hence, the society can take advantage of early warnings and plan mitigation strategies to deal with adverse human impacts and likely risks. Closer cooperation between the forest and water sectors is a precondition for sustainable development as interactions between forests and water (i.e., flow, yield, and quality) are complex. In recognition, there has been an increasing international action to address 'Forest Water' interactions.

Scientific Basis of River Management

Integrated Riverscape Approach to Restoration

Rivers are a dynamic combination of Water, Sediment, Aquatic Organisms, and Riparian Vegetation, all participating in a complex dance from the point of origin, or headwaters, toward the ocean or Basin where the journey ends. Rivers provide a multitude of services *viz*., water supply, waste assimilation, fisheries, energy production, flood attenuation, spiritual, cultural and recreational benefits, and the habitat that supports a wide range of ecosystems. It is precisely because rivers provide diverse services and performs various functions that planning for their use is so complex. During 1970s and 1980s, it became evident that engineering solutions alone are unable to provide solutions for the multifaceted problems of River Management, particularly the trades-off between competing interest and values and soon it was realized that an integrated approach to managing rivers and their River Basins is required. The approaches and practices of River Management of Basin Planning have evolved over time in response to changing and competing demands on river systems by societies as well as the significantly altered conditions of rivers. During the past four to five decades, the evolution in practices of river management and basin planning has witnessed a profound shift in focus from a narrow, engineering-focused approach, to a more complex process incorporating environmental sustainability, demand management, institutional development and economic and social analyses and trades-off. The need for multi-disciplinary i.e., geology, climatology, soil science, hydrology, ecology, forestry, engineering, environmental management, social sciences, etc. holistic approach to planning, assessment and management of river ecosystems arises due to the strong linkages between ecological interconnectedness of River Basins and the hydrology, upstream and downstream, and river and surrounding lands. The newer perspective of River Management and Basin Planning requires consideration of the following four broad groups of benefits.

- Environmental benefits to the River i.e., enhanced environmental flow, improved water quality, conserved biodiversity, and increased productivity

- Enhanced economic benefits from the river i.e., food, energy and manufacturing production
- Reduced costs of management i.e., flood control
- benefits beyond the River – eliciting wider cooperation and economic integration

The emerging need emphasizes to adopt a comprehensive approach to river management so as to understand the complex physical, chemical, biological, and even socio-economic processes that drive river health and for identifying the most effective and efficient restoration measures. Further, recent approaches to River Management stress upon to adopt the strategic approach focusing on the Riverine Landscape perspective, ecosystem based approach recognizing running waters are open ecosystems well connected with human systems. Their complex biotic and abiotic functions, processes and structures are largely the result of a system-inherent, dynamic genesis and development.

Preparation of DPR on Forestry Interventions

Restoration of Ravi River

Appreciating the occurrence and abundance of diverse forests/vegetation all along the River course from its origin to mouth; strong linkages between forests and rivers; intricacy of forest ecosystems; and critical functions performed by them, the recent focus of river restoration in India is on the Riverscape and the ecosystem based approaches. River restoration efforts are multifaceted in nature as they try to accomplish concurrently the broader goals of management of river ecosystem by ensuring multiple benefits and values to varied users, four dimensional connectivity of a river, enhanced e-flows, biodiversity conservation, improved ecosystem services, and sustainable livelihoods. River restoration incorporates a wide range of activities including policy and legal interventions and regulations; catchment management; forestry interventions including afforestation/ reforestation, soil and moisture conservation measures, wetland management, and biodiversity conservation; flow modification and retrofitting (i.e., engineering designs; structures and development;) floodplain reconnection; spring management and recharge of aquifers; bank stabilization; channel reconfiguration; instream species management; riparian management; treatment and appropriate disposal of sewage waste, industrial effluents and other pollutants; enhanced aesthetics and recreational facilities; and passive change of human behaviour. Thus, it is evident that forestry interventions are just one set of activities of a multipronged strategy aiming river restoration.

Vision, Aims and Objectives

The current project has been envisioned to achieve a future with clean and ample water for people and nature, where local caretakers are well-equipped, effective and courageous champions for rivers. Further, it envisages that everyone should have access to affordable, clean water and healthy rivers. The mission is to accomplish the above shared vision by adopting multi-pronged strategy and pursue of five specific strategic priorities i.e., (a) address drivers of environmental degradation and arrest biodiversity loss, (b) adopt integrated, innovative and nature based solutions, (c) enhance resilience and adaptation, (d) build

alliances and foster synergies, and (e) opt for the right influential models and interventions so as to achieve reduced pressure on biodiversity, restore degraded ecosystems, promote sustainable use of biological and water resources, enhance capacities, mainstream biodiversity, augment policy and law support, and facilitate science based efficient decision making.

In view of the above and in accordance with the National and Global level priorities, commitments, agendas, strategies, and approaches, the Implementation Plan on proposed forestry interventions seeks to address the following focal areas or goals in an integrated manner:

(a) Riverscape Management: Aiming a holistic Riverine Landscape (Riverscape) approach for sustainable management of Ravi River, its banks, or its Riparian areas, within its fluvial system.

(b) *Aviral Dhara, Nirmal Dhara,* Ecological Rejuvenation and Biodiversity Conservation: Aim to address the drivers and stressors of river ecosystem and promote sustainable use by balancing ecological requirements with the needs of sustainable livelihoods.

(c) Improved Ecosystem Services and Sustainable Livelihoods: This goal aims to specifically seek enhanced ecosystem services so as to maintain sustainable livelihoods.

(d) Effective Implementation, Knowledge Management and Innovative Approaches: This goal aims to ensure effective implementation of the project, knowledge management, development of innovative approaches (i.e., nursery techniques, afforestation, bio-filters and bio-remediation), and adoption of appropriate modern technologies.

Project Objectives, Outputs and Outcomes: This Plan aims to fulfill the requirements of above stated four focal areas in a phased manner and visualizes specific outputs and outcomes. Hence, the following objectives are envisaged.

Project Objectives

1. To promote an environment conducive to sustainable land and river eco-based management approaches focusing on reduced soil erosion and to conserve the representative biodiversity of the Ravi Riverscape.
2. To carry out appropriate forestry interventions to restore river connectivity, enhance e-flow, improve water quality, and conserve the terrestrial and aquatic biota within the Ravi Riverscape.
3. To promote improved ecosystem services and support sustainable livelihood opportunities for local communities, particularly forest dwellers, fishermen and other vulnerable groups.

4. To adopt, integrate and implement innovative approaches and modern technology aiming knowledge management, enhancing capacity along with proper monitoring and evaluation for rejuvenation of the Ravi River and its tributaries.

Above objectives will be achieved through the following outcomes.

1. Creation of an enabling environment for climate resilient, sustainable terrestrial, aquatic (river and wetlands) and floodplain ecosystem management.
2. Inter-agency and civil society driven, climate resilient approaches for appropriate forestry and other allied interventions demonstrated in adequate extent(s) of natural, Agriculture and Urban Landscapes of the Riverscape.
3. Enhanced ecosystem services from Natural (i.e., forest, grassland, river and wetland) ecosystems, agro-ecosystems and Urban Landscapes.
4. Sustainable livelihoods, particularly of forest dwellers, fishermen and other vulnerable groups.

Capacities for adaptive management, learning and replication of project lessons are developed.

Ravi Riverscape

The Ravi River Basin in India spreads over two States i.e., Himachal Pradesh and Punjab and one Union Territory i.e., Jammu & Kashmir. The largest part of the Basin lies within Himachal Pradesh (5,041 km^2) constituting 43.06% of Ravi River Basin. For the present assignment, on the basis of directions from the MoEF&CC and consensus emerged in the extensive consultative process with various stakeholders out of 11,706.41 km^2 basin area, 9,173.61 km^2 area has been included in the Riverscape delineated for the purpose of planning, assessment and proposed management by way of Forestry Interventions in the context of Ravi River whereas 2,532.8 km^2 area of Basin has been excluded. All tributaries have been included as a part of the Riverscape. In short, the entire catchment in the mountainous states forms part of the Riverscape while once the river descends in the alluvial plains of Punjab State, only effective areas of micro-watersheds influenced.

Table 1- Riverscape area of Ravi River

Sr. No.	**Ravi River**	**Area ($km^{2)}$**	**Percentage (%)**	**Coverage Area (States and UT)**
1	**Ravi Riverscape**	9173.61	78.36	Himachal Pradesh, Jammu and Kashmir UT and Punjab
2	**Catchment beyond Ravi Riverscape**	2532.8	21.64	Himachal Pradesh, Jammu and Kashmir UT and Punjab
Total		11706.41	100	

Table 2 - Details of the Geographical Area of States and UT concerning Ravi River Basin

Sr. No.	State and UT	Geographical Area of State and UT (km^2)	Catchment Area	Representative Area included in Riverscape (km^2)	Geographical Coordinates		Representative Area of Riverscape (%)
					Latitude N	Longitude E	
1	**Himachal Pradesh**	55,673**	5,041.00	5,041.00	32°10’ 31" to 33°01 ' 25"	75° 47 '51" to 77° 4 '44"	54.95
2	**Jammu and Kashmir UT**	53,258*	2,970.91	2,970.91	32°16’34" to 32°56 '44"	75° 4 '11" to 75° 56 '6"	32.39
3	**Punjab**	50,362*	3,694.5	1,161.70	31°46 '10" to 32°30 ' 42"	74° 3 '8" to 75° 54 '1"	12.66
	Total =	**1,59,293**	**11706.41**	**9,173.61**			**100.00**

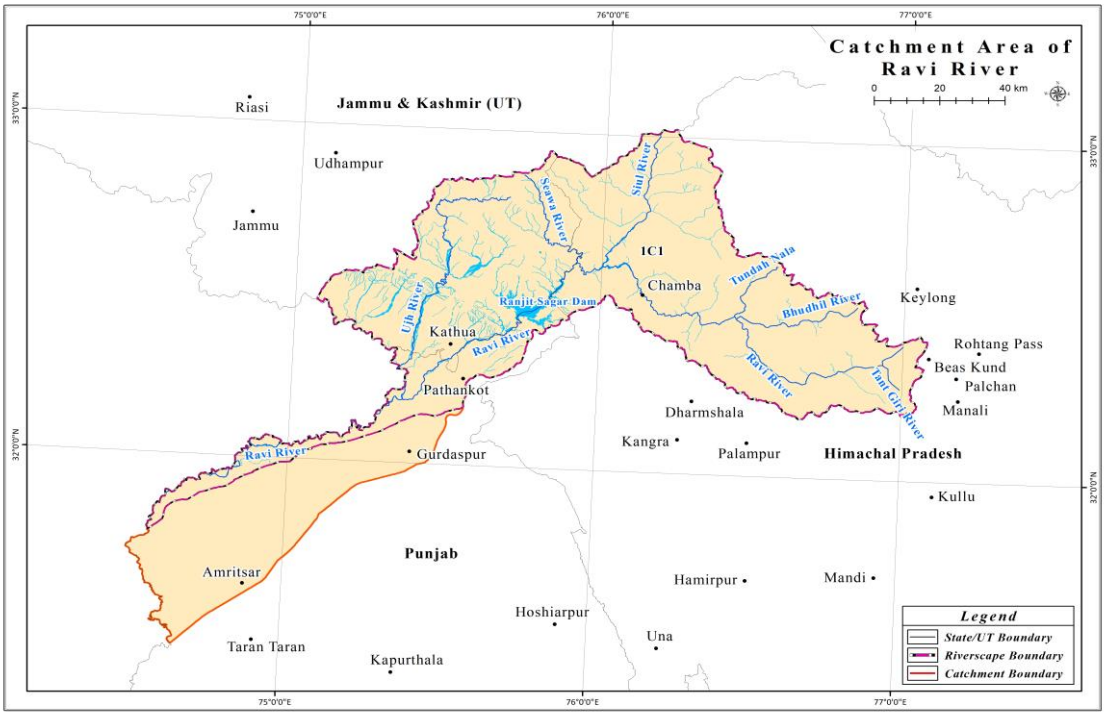

Fig.1 – Catchment Area of Ravi River

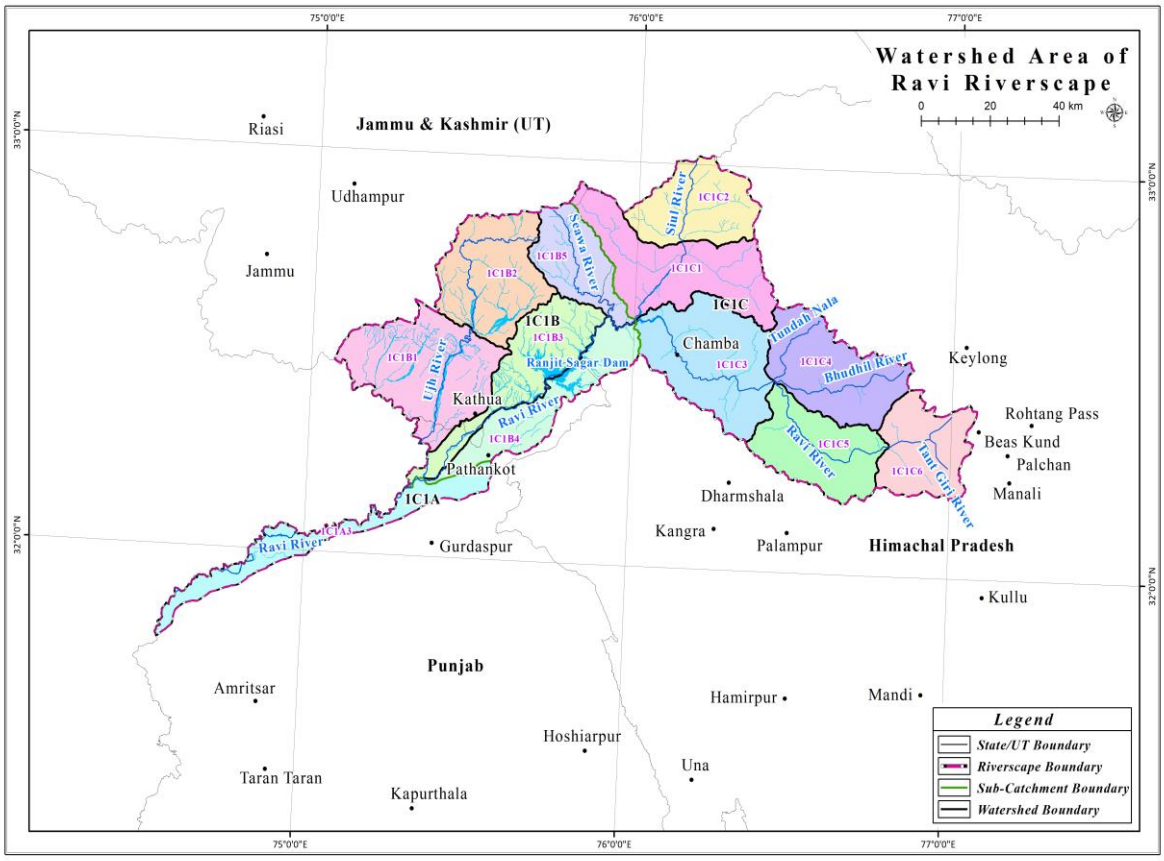

Fig. 2 – Watershed Area of Ravi Riverscape

Land Use Land Cover (LULC) Analysis

Land information is important to a wide variety of human activities such as agriculture, forestry, water resources, as well as other types of land resource management. The preprocessed geometrically and radio-metrically corrected PAN merged satellite datasets were displayed on screen for attempting visual interpretation of various land use classes: (a) Agricultural Land; (b) Natural/Semi-natural Grassland; (c) Barren; (d) Water bodies; (e) Forest; (f) Scrub; (g) Built-up/Settlement; and (h) Snow covered/Glacial area.

Table 3 - Distribution of area under different Land Use and Land Cover categories

Sr.No.	Land Use and Land Cover	Area (in km^2)	Percentage of Total Area (%)
1.	Agriculture	2318.27	25.27
2.	Alpine Pastures	0.99	0.01
3.	Barren	1014.89	11.06
4.	Canal	5	0.05
5.	Cloud	135.63	1.48
6.	Cloud Shadow	0.81	0.01
7.	Dense Forest	1063.45	11.59
8.	Moderately Dense Forest	1083.63	11.81

Sr.No.	Land Use and Land Cover	Area (in km^2)	Percentage of Total Area (%)
9.	Open Forest	946.18	10.31
10.	Plantation	39.68	0.43
11.	River (Dry)/River Sand	119.73	1.31
12.	River (Perennial)	134.04	1.46
13.	Scrub	473.09	5.16
14.	Settlement	100.96	1.1
15.	Snow/Glaciers	1736.54	18.93
16.	Waterbody	0.72	0.01
Total		**9173.61**	**100**

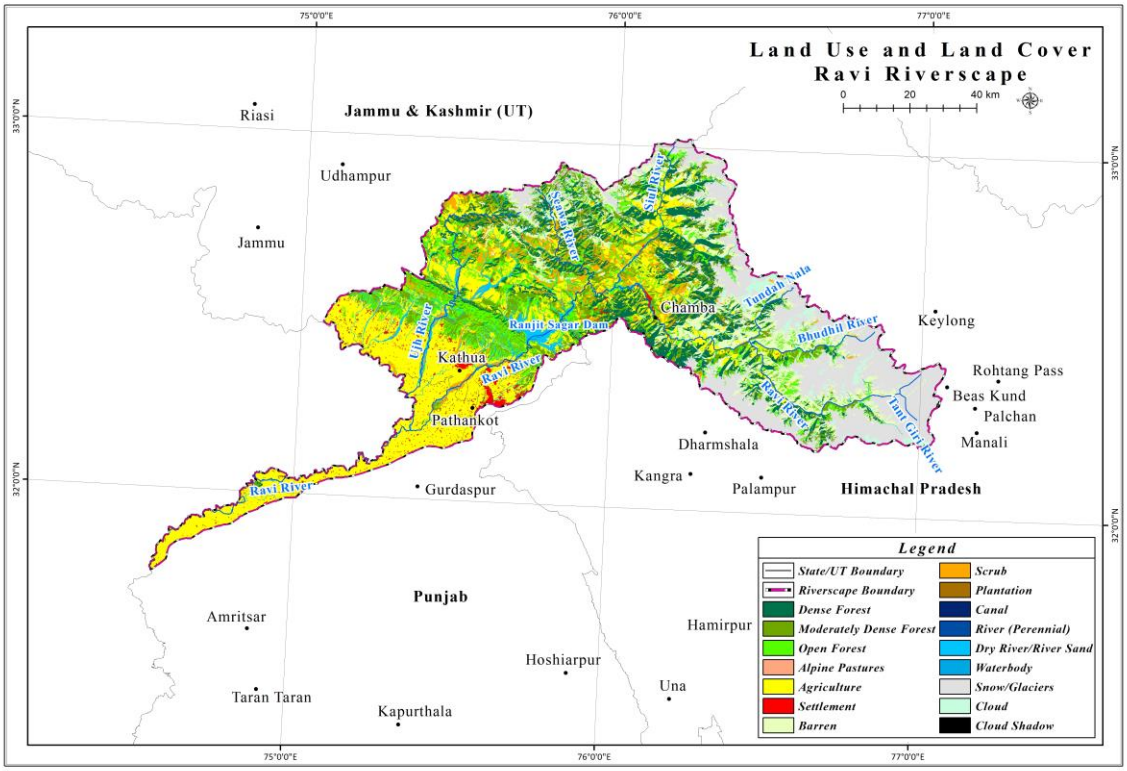

Fig. 3 - The Ravi Riverscape Land Use and Land Cover Categories

Prioritization of Suitable Areas for Proposed Forestry Interventions

For the purpose of preparation of DPR and for identification of priority areas for the proposed treatment/forestry interventions in the Ravi Riverscape, GIS-assisted decision making process by way of geospatial analysis and modeling was used. GIS was used to generate different layers within the Riverscape like land use, soil erosion rates, and slope of the topography. The following shape files were superimposed to obtain a combination-matrix of various layers that revealed the prevalent features of any area within the Riverscape with regard to

vegetation, land use, erosion, and degree of slope. The Land Use and Land Cover classes were merged in to 7 classes *viz.*, Dense Forest, Alpine Pastures, Open Forest, Agriculture, Barren, Settlement, and Others. A weightage from 1 to 6 scale was given to the above Land Use and Land Cover classes. Further, the slope layer was categorized into three categories and each category was assigned a weightage of 1 to 3 based on the degree of slope. The erosion layer received from Institute of Water and Soil Conservation (IWSC) had 5 major categories of erosion *viz.*, <5, 5 to <10, 10<20, 20-<40, and ≥40 (erosion in t/ha/year). Each category of erosion was given a weightage in multiples of 1.5. GIS overlay operations were carried out on the above three layers and the weighages for various combinations were combined together by means of addition to arrive at summed weightage for each combination. These values were then categorized in to Low, Medium and High based on statistical quartile. For example, an open forest area is classified as 'High Priority' if it has an erosion 20 to <40 t/ha/year to ≥ 40 t/ha/year devoid of any slope class. Likewise, the agriculture area having slope 0-30 and erosion rate <5 t/ha/year has been classified as 'low priority'. The priority information for Ravi Riverscape is given in Fig. 4.

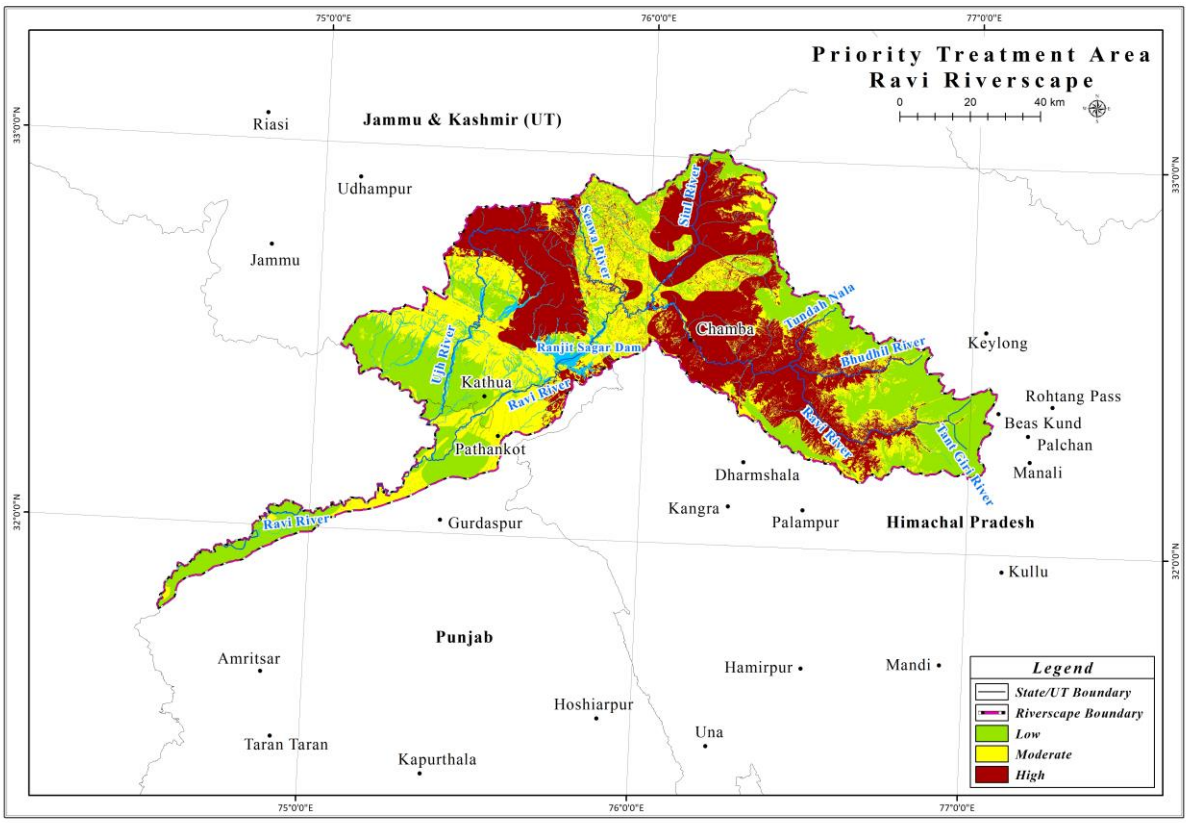

Fig. 4 - Priority Zones for Forestry Interventions in Ravi Riverscape

Table 4: Prioritized Areas in Concerned States and UT

Sr. No	States and UT	High Priority Area (km^2)	Medium Priority Area km^2 (%)	Low Priority Area km^2 (%)	State Area in three Prioritized categories(km^2)
1	**Himachal Pradesh**	2247.93 (24.50%)	1204.66 (13.13%)	1588.41 (17.31%)	5041.00 (54.95%)
2	**Jammu & Kashmir UT**	927.99 (10.11%)	1079.91 (154.59%)	963.01 (10.50%)	2970.91 (32.39%)
3	**Punjab**	73.77 (0.80%)	464.98 (5.07%)	622.95 (6.79%)	1161.70 (12.66%)
Grand Total		**3249.69 (35.42%)**	**2749.55 (29.97%)**	**3174.37 (34.60%)**	**9173.61 (100%)**

Preparation of Detailed Project Report (DPR)

The Approach

The HFRI has followed the broad framework of DPR as adopted in the context of Forestry Interventions for Rejuvenation of Ganga River. Long field based experience, existing scientific knowledge and multi-disciplinary expertise available at the Institute have been optimally utilized for planning, assessment and development of suitable approach and strategies in the case of Ravi River. The Ravi River originates in the state Himachal Pradesh and flows in the plains of Punjab before its confluence with Chenab River in Pakistan. In short, concerned two states i.e., Himachal Pradesh and Punjab and one Union Territory i.e., J&K were involved in the extensive consultative process, planning and assessment. The Project Launch Workshop and Sequential Consultative Meetings organized in concerned States and Union Territory included policy and decision makers, representatives of State Forest Department and various Line Agencies – Agriculture, Horticulture, Animal Husbandry, Mining, Irrigation, Hydroelectric Projects; State/National Level Scientific or Specialized Organizations i.e., Soil and Water Conservation, Hydrology, Forestry, Wildlife, Environmental Management, Central Water Commission, Groundwater, Remote Sensing and GIS; Universities; Civil Society; and Non-Governmental Organizations besides conservationists and field practitioners. The well planned consultative process and feedback from various stakeholders have been the key step in the formulation of strategies and preparation of present DPR. Constant persuasion, guidance and support at all stages by the Hon'ble Union Environment and Forest Minister, Hon'ble Forest Ministers of concerned States, senior officials of the MoEF&CC, ICFRE, SFDs, HFRI Team were instrumental throughout the process of planning and finalization of the DPR.

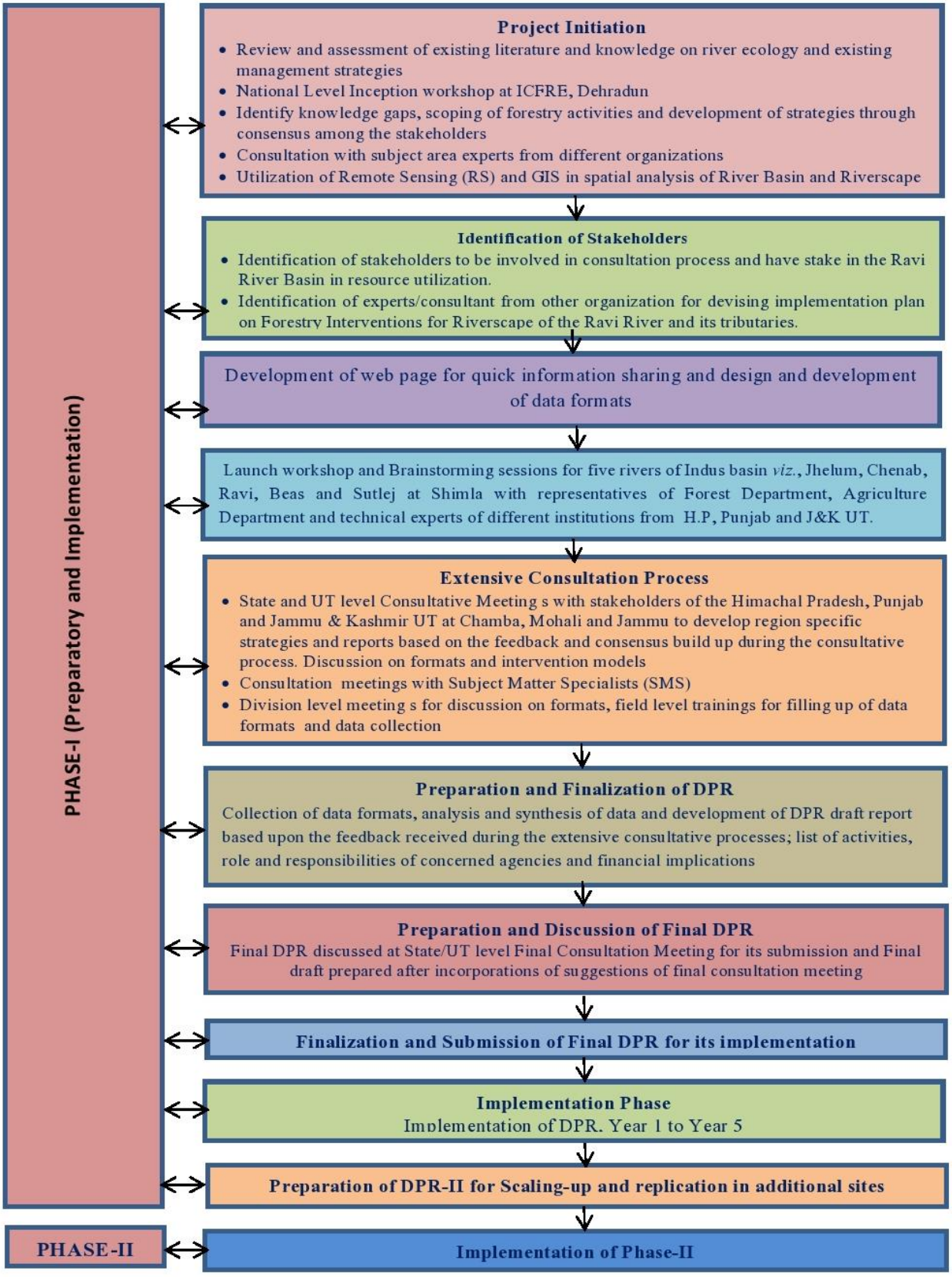

Fig. 5 – Schematic Representation of the Approach

Detailed Project Report (DPR) - Approach

Contextual Analysis: Ecology of the Ravi River is constantly influenced by economic, social and political processes that take place in society. The project planners and implementers thus seek information about the overall picture on the environment, including technical national and sectoral information. Project activities started off by performing an overall preliminary study (*Pre-study*), feasibility study or the inception phase. The pre-study involved the collection and compilation of information related to external environment of Ravi Riverscape by consulting various related sectors, agencies, states and organizations involved as well as any data that existed about the target disciplines, sectors, themes, etc.

The river is a complex and dynamic ecosystem and it is strongly linked with varied forests and its surroundings. To understand linkages of river with its surroundings, an adequate knowledge of relevant multi-disciplinary subjects and application of various technologies are essentially required. There is a growing literature on the wider subject of river ecology and management besides a long historical perspective on the management of the each of the major river including the Ravi River. Thus, the foremost key step in the present planning exercise on the preparation of DPR was a systematic review of vast available literature on the subject through internet surfing and library consultation. The websites of prominent International, National, State Level Agencies and Organizations dealing with any of the aspects related to river resources and conservation were extensively searched and required information was downloaded for developing the desired insight. The relevant secondary information from related organizations was also collected. The combined effort on the review of literature and collection of background information immensely helped in the contextual analysis. The contextual analysis also provided desired insight on the Ravi Riverscape and its three sub-environments (i.e., physical, biological and socio-economics).

Consultative Process: The second vital step for successful planning and implementation required broader participation of stakeholders at all stages of planning of the project activities. The assignment envisaged stakeholder consultations at the National and State levels at the time of launch of entrusted task and also after the preparation of draft DPR. Hence, it was essential to first identify which individuals and stakeholders affect and are affected by the project and which ones should be involved in the planning process. Likewise, it was critical to identify which stakeholders should be informed and involved during and after the project implementation. Accordingly, prominent consultations for the preparation of DPR were held at the National and State Levels. In the context of present assignment, broad five groups of stakeholders were identified as a part of the Step 1 on the contextual analysis. These five stakeholder groups included: (a) Target Group (i.e., Primary and Secondary Target Groups and Beneficiaries); (b) Project owners and project groups; (c) Decision makers (at different levels, in organizations, at authorities and agencies, local politicians); (d) Experts and subject matter specialists; and (e) Financing agencies (those who sponsored/ finance the project as well as State/ National or International financiers who shall support and fund the project implementation (FRI, 2016). The one- year duration Project's preparatory phase included the extensive consultative process with identified groups of stakeholders right from the beginning. Chapter-3 provides a broad-based list of stakeholders in five identified groups,

highlighting the prominent Central/ State Governments Ministries, Departments, Agencies, Organizations besides Civil Agencies and NGOs that were consulted or their representatives participated in Project Launch and Brainstorming Workshop and subsequent Sequential Consultative Meetings organized for the purpose at the Forest Circle/ Division level in Himachal Pradesh and Punjab and Jammu & Kashmir UT lying along the main River course. List of Consultative Meetings is given in Table 5.

Table 5 -Consultative Meetings at the National and State Levels for the Preparation of DPR

Sr. No.	Consultation Event	Date and Venue	No. of Participant
1	National Level Inception Workshop on Preparation of DPRs of Indian Major Rivers	24-25 April, 2019 ICFRE, Dehradun	61
2	State Level Project Launch and Brainstorming Workshop	28-29 June, 2019 Hotel Holiday Home, Shimla	178
3	First Consultation Meeting for Chamba Forest Circle, Himachal Pradesh	2 August, 2019; DRDA Hall, Hardaspura, Chamba	77
4	First State Level Consultative Meeting – Punjab	21 August, 2019 Forest Complex, Mohali, Punjab	65
5	First State Level Consultation Meeting - Jammu & Kashmir	12 October, 2019 Forest Information Centre, Vikram Chowk, Jammu (J&K)	50
6	Field training in HP (Chamba, Churah, Dalhousie etc)	Oct.2019 to Dec., 2019	Concerned field staff
7	Field training in Punjab (Amritsar, Gurdaspur, Pathankot)UT	Oct. 2019 to Dec., 2019	Concerned field staff
8	Field training in J&K UT (Kathua, Samba, Billawar, Basohli, Ramnagar and Bhaderwah)	Dec. 2019	Concerned field staff
9	Second State Level Consultation Meeting - Jammu & Kashmir UT	25 February, 2020 Convention Center, Jammu	116
10	Second State Level Consultation Meeting - Punjab	12 March, 2020 Forest Complex, Mohali	75
11	Second Consultative Meeting-Himachal Pradesh	26 June, 2020 HFRI (Through Video Conference)	55

Recommendations

- The sites proposed and prioritized for Forestry Interventions should be on the basis of the various parameters in context with the respective river basins e.g. soil characteristics, pH, slope, gradient, forest canopy and forest density, land use land cover, hydrological data (i.e., snow melt, COD and BOD of water quality, ground water, lakes and wetlands) and meteorological data (rainfall, snowfall, temperature, evaporation, wind speed, relative humidity). The data collected with substantial application of the GIS should be tailored to locate the pin point locations for interventions.

- Role of various land management agencies like Soil and Water Conservation Department, Agriculture Department, Horticulture Department must be clearly identified and an integrated and multi-sectoral approach should be adopted in the DPR.
- The DPR should be well documented and free of any ambiguities so that it can be implementable straightway.
- For suggesting the soil and moisture conservations measures spur to bottom and against the slope approach should be adopted and provisions of drain line treatment, nallah treatment and minor engineering works and treatment of micro shed areas should be included in the DPR proposals.
- For suggesting the plantations models on the Agriculture Landscapes across the Riverscape, agro-forestry and integrated models should be proposed and there should be some provisions for drought management, more water for cropping, recharging of aquifers and emphasis on the micro-watersheds.
- There should be ample provisions for the skill development, capacity building of the local inhabitants in the DPR.
- There should be provisions of the livelihood enhancement to check the migration of people from the rural areas.
- Suitable workable strategies should be suggested for tackling the monkey menace.
- Because wood is a versatile material and it also helps in mitigation of climate. So suitable clones of the fast growing wood species should be suggested in the plantations models for Natural Landscapes.
- More emphasis should be laid on the treatment of the catchments of tributaries of the rivers.
- Urban bodies like Municipal corporations and Municipal Committees should be actively involved in the formulation of the DPR.
- Plantations models should include the species like Apricot and Seabuckthorn (SBT) and there should be greater emphasis on the production of the quality planting material (QPM).
- Ways and means should be suggested for improvement of the traditional ponds in the Kandi areas.
- There should be provisions of livestock improvement in the DPR.
- There should be provisions for development of the wood based industries.
- SKUAST (Sher-e- Kashmir- University of Agriculture Science and Technology) should be involved as a partner in the DPR.
- High altitude wetlands should also be treated as part of the DPR.
- Sharing of the existing information between the various agencies and stakeholders e.g., National Institute of Hydrology (NIH), Pollution Control Board (PCB), Photo Interpretation Department (PI), SKUAST, Agriculture Department, Horticulture Department, Forest Department, Urban Bodies and Municipal Corporation is necessary.
- There should be provision for the replacement of the Pine forests in the riverine zone of the Ravi River.

Situation and Problem Analysis: Preparation of DPR involves delineation the Ravi Riverscape for the purpose of planning, situation and problem analysis, developing an insight on the Riverscape environment, and prioritization of areas for proposed forestry interventions. The background analysis/ contextual analysis and the consultative process adopted at the National, State and Forest Circle levels provided the much desired insight on the Ravi River, its Basin and tributaries, terrestrial and aquatic biodiversity, past management, associated States, Union Territory and developmental activities. A Riverscape within the larger River Basin was delineated. Detailed geospatial analysis of the Riverscape using remote sensing and GIS technologies was carried out. The approach adopted for application of remote sensing and GIS for geospatial analysis for the Ravi Riverscape is described in Chapter-2. It provided an understanding on the situation of physical attributes i.e., land use and land cover, altitudinal variation, slope, aspect, soil, erosion, forest types and forest cover, fragmentation, etc. The review of secondary information from a variety of sources (i.e., National and State Level Agencies/Departments, Scientific Organizations and Universities) allowed developing an understanding on the Riverscape environment (i.e., physical, biological and socio-economics) and identification of challenges, constraints, problems, and threats in river conservation. The situation analysis facilitated developing an insight on the state specific challenges and threats as two States (i.e., HP and Punjab) and J&K UT wherein the river flows depicts contrasting situation owing to large variations in the physical, biological and socio-economic sub-environments. The consultative process and the sequential meetings with varied stakeholders definitely helped in the identification of focal problems in both the States and J&K UT, understanding their reasons/ causes, and effects or implications on the river itself and surrounding lands. Every effort must be made to make the project successful. Hence, careful planning for DPR based on extensive consultations and scientific facts and principles is required. Regular flow of funds at all stages of the implementation phase should be ensured to carry out the project activities effectively.

Development of Web Portal - Collection and Analysis of Primary Field Data: The present project has envisaged collection of primary field data for the entire Riverscape with the support of concerned State Forest Department (SFD), Agriculture Department and other Line agencies. Prior to the collection of primary field data, the essential requirement was on the development of plantation and treatment models, design of field data formats and software for analysis of field data. The team preparing this DPR may visit sites from where the river flows and so as to develop successful wetland models to critically evaluate them for use in this project.

Plantation and Treatment Models: The multi-disciplinary expertise available at HFRI was used in developing potential plantation and treatment models for the proposed forestry and other conservation interventions in major three type of Landscape- components visualized in the Ravi Riverscape. These were; (i) Natural, (ii) Agriculture, and (iii) Urban Landscapes. The purpose of various models planned in the Natural Landscapes is primarily protection, eco-restoration and conservation. Details of potential models were sent to the concerned States and UT for selection and to recommend appropriate modifications, if necessary based on local knowledge, expertise, and experience.

In this multi-level plantations of trees, herbs, shrubs, grasses and important medicinal plants may be included. More and more medicinal plants should be grown in the nurseries of concerned department and it should be on the priority list to cultivate more medicinal plants in the hills of Himachal Pradesh and J&K UT. While selecting species for planting, ability of plants to tolerate the temperature and other factors of that area should also be considered. In the upper areas of Himalaya, the species which are planted should be useful in conserving soil and also provide the shade for aquatic animals in the river in hot days. Grasses and other ground cover must be kept intact during plantation and other activities. It is important to ensure the planting stock needs and the quality with the help of research nurseries and other quantity planting stock production units of the State Forest Research Institutes or the Research Wings of the SFDs. Grasses Plantation activities for monsoon should be planned carefully, so that, these activities are in harmony with the overall project for which DPR is being prepared. In the three-tier models of plantation emphasis will be given to indigenous species of fodder, fruits, medicinal and other values which would include bamboos, grasses, shrubs, medicinal plants, trees and horticulture species.

Design of Field Data Formats: The HFRI has adopted and modified five formats earlier developed and prescribed in the context of Ganga River by FRI, Dehra Dun (Annexure 2). Five elaborate formats were meant for the collection of primary field data. Various efforts should be taken for the collection of correct information and data in a uniform template for all the States and UT which comes under the DPR project. The data formats are very useful for preparing the DPR. Details of these five data formats, types of information required, and the procedure to collect desired information were shared with stakeholders, particularly the forest officials and frontline staff during the consultative process and specific training sessions organized. Adequate soft and hard copies of formats were made and widely distributed to forest officials and other stakeholders during the consultative process.

Development of Software and Web Portal: The State Forest Department of Himachal Pradesh, Jammu & Kashmir UT and Punjab returned a large number of duly filled in field data forms to HFRI which contributed voluminous information and it was difficult to handle such large data sets manually in a short time available for the preparation of DPR. Hence, it necessitated to take help of software so as to effectively collate, analyze, synthesize, and interpret the voluminous data sets and retrieval of desired information relevant to each of the involved States/ Forest Divisions/ Forest Ranges and the three pre-defined landscapes within the Riverscape. For this purpose, HFRI engaged a commercial vendor – Sh. Sudhir, M/s Reckon Web Developer, Dehra Dun to develop a web based software.

The firm developed software in PHP/ Mysql, server Linux based and that works on Code igniter Framework basis. It is a web based and easily accessed via internet. The software can compute cost calculations according to selected specified models for unlimited created models and is password protected. In the software, filed data was entered as per the five specified models, *viz*., Natural, Agriculture and Urban Landscapes, Conservation Interventions and supporting activities and can be saved in digital format. The software is capable of generating reports in the desired formats e.g., State-wise, District-wise, Division-wise, Model-wise and Activity-wise, and Annual Consolidated Reports can be generated to

obtain insight on year-wise areas under different landscapes to be treated and corresponding costs.

Objective Analysis and Strategic Planning: The consultative process with stakeholders allowed an understanding to develop the long-term vision and goals that indicate the desired direction or pathways for actions and activities. In the process, it was also understood which changes the project can contribute to in the longer term and why is the project important for the society, biodiversity and the river ecosystem. The multi-disciplinary team of HFRI with resource inputs form wide-range of stakeholders was able to decide the goals, objectives, outputs and outcomes that can be attained. The consultative process gave desired insight on the problems in achieving various objectives and identification of priority actions for rejuvenation of the river. Ultimately, the process also immensely helped in firming up the strategies for implementation of the project.

Accordingly, it was decided that the strategies are required to be formulated for: (1) Sustainable land and ecosystem management, (2) Conservation of biodiversity, and (3) Improvement of livelihood and Programme implementation has to be concurrent in Natural, Agriculture and Urban Landscapes within the Riverscape. Further, a variety of 'conservation interventions and supporting activities' would also be required for effective implementation, knowledge management and sharing, capacity development, monitoring, and adaptive management.

Preparation of Draft DPR – Activities, Resource Planning and Schedule: The aforesaid key steps and the process adopted ultimately helped HFRI in the preparation of draft DPR presenting the background information, situation analysis and environment of the delineated Ravi Riverscape, formulation of strategies, planning of specific activities, resource planning (i.e., manpower, equipment and the finances), and year-wise schedule of operations. Draft DPR (Vol. I and II) was shared with HP, Punjab and one J&K UT, SFDs and other stakeholders in the State/UT as well as the National Level Consultation Meetings seeking their feedback and valuable inputs. Copies of the draft DPR were also submitted to the ICFRE, Dehra Dun and the MoEF&CC, New Delhi and comments were invited. Necessary presentations were also made at ICFRE and MoEF&CC.

Finalization of DPR, Implementation and Monitoring: The draft DPR was finalized incorporating the feedback and specific comments received from the respective States and UT, SFDs, ICFRE and the MoEF&CC. Initially, the project implementation during Phase 1 has been planned for duration of five years by respective States and UT and concerned SFDs as the implementing agencies. A provision for inbuilt, Results-Based Monitoring has been made for continuous monitoring, organizational learning and adaptive management. The Phase II after five year implementation would deal with maintenance phase of plantations raised during the phase I, scaling up of the activities and covering of the left over tributaries.

Organization of DPR

The present DPR is prepared in two Volumes. Volume I deals with the main DPR while the Volume II contains summaries of HP, Punjab and J&K UT along the course of the Ravi River. Volume I has two parts (Part I and Part II). Part I has altogether four Chapters dealing

with the existing situation of the Ravi Riverscape while Part II with four Chapters deals with the proposed plans. Chapter 1 - 'Introduction highlights the complexity and dynamic nature of rivers and its linkages with forests, other lands, and human well-being, past and present river management, evolving concepts and holistic approach of basin management and Riverscape, current task on forestry interventions, logical framework, and the organization of the DPR. Chapter 2 highlights the existing environment (i.e., physical, biological, and socio-economic) in the broader context of Ravi River Basin, in particular the Riverscape under consideration along the course of Ravi River. This Chapter emphasizes the details of biodiversity in terms of diverse forests, grasslands, wetlands, and associated threatened species besides the physical and the socio-economic environment. Chapter 3 describes the approach and methodologies, i.e., the planning and assessment area for DPR and the approach adopted. Chapter 4 deals with the details of various Central and State Government-level Agencies and Organizations that are directly responsible for the policy and decision making, over-seeing and implementation of various activities relevant to water resources, environment, forest management, biodiversity conservation, river management, etc. This Chapter critically examines the existing policies, conventions, treaties and laws pertaining to the themes of the DPR, identifies gaps, imperatives and future needs from the perspective of various users and those who either influence/impact or are responsible for the management of water resources. Chapter 4 also provides an insight into various civil society organizations Nehru Yuva Kendra Sangathan (NYKS), Indian Armed Forces (Eco-Task Force), and Central Armed Police Forces (i.e., Indo-Tibetan Border Police-ITBP that can either undertake activities relevant to Forestry Interventions or assist and facilitates in various supporting activities. Chapter 5 under Part II describes the goals, objectives and treatment models for various models of Forestry Interventions and the adopted strategies for implementation. This is followed by Chapter 6 which specifically narrates institutional arrangements and mechanisms for project implementation besides aspects of sustainability. Chapter-7 provides details on the overall project budget, cost tables and the schedule of operations. The last Chapter-8 describes the potential benefits of proposed Forestry interventions. References are provided at the end. As already stated, Volume II incorporates details of States and U.T. summaries concerning HP, Punjab and J&K UT relevant to the Ravi Riverscape that have been included for implementation during the Phase-1 and phase-II of the Project.

Ravi Riverscape and its Environment

River ecosystems are part of larger watershed networks or catchments, where smaller headwater streams drain into mid-size streams, which progressively drain into larger river networks. The river ecosystem is a complex mosaic of interaction and interrelationship of the biotic (i.e., flora and fauna) and abiotic (i.e., hydrological, geomorphic, etc.) components in dynamic equilibrium. A River is the ultimate sink for surface runoff in its basin. Due to the diversion of river water for agricultural, industrial, and domestic uses of the natural and freshwater flow in the rivers has been exploited. The overexploitation of river resource is manifested mostly by lack of longitudinal, lateral and vertical connectivity in the river system and poor flow in the river. Contamination of the rivers by domestic and industrial liquid waste results in the deterioration of river health. The encroachment on river

space, obstruction of water ways in the drainage basin, excessive sand mining and deforestation in the catchment has further aggravated the problem. The poor health of rivers has adversely impacted the complex dynamic equilibrium in the river basin. It raises question about sustainable use of river resource. The present synthesis is based on the review of secondary information because it was neither aimed to make enormous efforts to come up with mammoth information nor it had been possible within the scope of the short period (one year) assigned for the preparation of present DPR. Thus, synthesis on the environment of the River basin/ Riverscape is solely based on review and an effort has been made to summarize and highlight the vital aspects of three sub-environments from the perspective of DPR and restoration of Ravi River through Forestry Interventions.

The rhitherone zone of Ravi River within the Himalaya has been maneuvered extensively for generation of power by formulation of many dams, Chamera I, II, III and Ranjitsagar/Thein. Like any river, the Ravi River is also under immense human influence as it is one of the principal rivers of the Indus River System and trans-boundary river between India and Pakistan. Construction of dams/ reservoirs/ barrages/ canals/ establishment of hydroelectric projects, expansion of agriculture/ horticulture, development of fisheries, urbanization, industrialization, and enhanced tourism activities. Certainly, rapid and unplanned development activities have not only severely impacted the natural ecosystems (i.e., forests, grasslands and wetlands) along the river course, but also imperiled the river itself and its tributaries.

Socio-Economic Environment

A large proportion of the population in the Ravi River Basin inhabiting villages in proximity to forests depends upon forest resources for their subsistence, livestock or labour-oriented works mainly in fast expanding agriculture or neighbouring towns/cities. Agriculture is the main source of livelihood. The Ravi River provides subsistence fishery thereby nutritional security especially to people dwelling in interior areas along the International border and is a means of livelihood to local fishermen. People in the hill district (i.e., Chamba) of Himachal Pradesh and parts of Jammu chiefly depend on forest resources and pastorals practice transhumance livestock rearing. The tribal inhabitants in Ravi River Basin are ‘Gaddis’and ‘Gujjar’ tribes in Himachal Pradesh and ‘Bakarwals’ in Jammu and Kashmir UT. These tribes depend on the forests for food, fodder, medicines, agriculture implements, handicrafts, social and religious ceremonies, etc.

Chamba and Kangra districts of Himachal Pradesh; Amritsar, Gurdaspur, and Pathankot districts of Punjab and Kathua and Samba districts of Jammu and Kashmir UT fall in Ravi Riverscape. According to the Census 2011, the total population of Chamba district of Himachal Pradesh which comes under Ravi Riverscape is 5,19,080 persons comprising 2,61,320 males and 2,57,760 females. Kangra district have a total population of 15,10,075, with 7,50,591 male and 7,59,484 female populations. The total population of Gurdaspur Amritsar and Pathankot, according to Census 2011 is 22,98,323, 11,59,227, 1,56,306, respectively. Male and Female population of Gurdaspur is 12,12,617 and 10,85,706; Amritsar is 6,15,417 and 5,43,810; Pathankot is 82,045 and 74,261. Population of Kathua and Samba districts of J&K UT is 6,16,435 and 3,18,898, respectively. Kathua district has male and

female population of 3,26,109 and 2,90,326, respectively. Samba district has 1,69,124 males and 1,49,774 females population, according to census 2011.

The values of literacy in HP, Punjab and J&K UT ranged from 72.17% to 81.41% against the country's average of 74.04%. The lowest literacy rate among these concerned States and UT was in J&K UT, while the highest literacy was in Himachal Pradesh.

Table 6 -Census 2011 data of Himachal Pradesh, Punjab and J&K UT

Sr. No.	Variables	Himachal Pradesh		Punjab			Jammu & Kashmir UT	
		Kangra	Chamba	Gurdaspur	Amritsar	Pathankot	Kathua	Samba
1	Geographical Area in km^2	5,739	6,522	3,551	2,683	2,502	2,651	1,002
2	Population as per census 2011	15,10,075	5,19,080	22,98,323	11,59,227	1,56,306	6,16,435	3,18,898
3	Average population density	263	80	647	928	246	232	318
4	Sex ratio	1,012	986	895	889	890	877	886
5	Literacy	85.67%	72.17%	79.95%	76.27%	73.09%	73.09%	81.41%

Legislative and Policy Context

The Ravi River flows through Himachal Pradesh, parts of the newly formed J&K UT and Punjab before flowing into Pakistan. Thus, it is not just an Inter-State River, but also a trans-boundary river whose waters are shared between India and Pakistan (IWT, 1960). In Himachal Pradesh and J&K UT, the biggest collective, threat to the Ravi River Basin is from the Hydropower Sector. Other threats include illegal sand and boulder extraction and related activities including operation of stone crushing units, road construction, illegal waste and untreated effluents dumping, etc. Real estate and tourism related construction activities have also started to prove disastrous to Basin as floodplains are getting exploited by these sectors increasing flood risk. In the State of Punjab, the issues relate to over extraction of water for the purpose of irrigation, commercial and industrial purpose as well as dumping of industrial waste into the River. Most importantly, the Ravi River Basin has already started witnessing climate change related impacts including glacial melt and increasing threat of Glacial Lake Outburst Floods (GLOF). Therefore, the law and institutions need to gear itself to the realities of climate change. India’s law on natural resources have focused on meeting mostly the developmental needs of the nation to a large extent and meeting local aspirations to a very limited extent. In past five decades or so the Central and State Governments have enacted various legislations related to forests, wildlife, environment, river, etc. and formulated relevant policies. The DPR enumerates and reviews various legal and policy foundations relevant to River ecosystem and conservation those exist in the country and also highlights

that how various prominent judgments, directives and other interventions by different Hon'ble Courts including the National Green Tribunal have helped in safeguarding interests of forests, wildlife, rivers, and wetlands besides protection of the environment.

Certainly, the Indian Forest Act, 1927; Wildlife (Protection) Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act, 1980; Air (Prevention and Control of Pollution) Act, 1981; Environment (Protection) Act, 1986; and Biological Diversity Act, 2002; Forest Rights Act, 2006; Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; The Compensatory Afforestation Fund Act, 2016; Indus Water Treaty, 1960: Jammu and Kashmir Re-organization Act, 2019 besides some of the provisions - Article 48A and Article 51A (g) of the Constitution of India are pertinent from the perspective of river conservation. The National Forest Policy, 1988; Environment Impact Assessment Notification, 2006; Municipal Solid Waste (Management and Handling) Rules, 2000; National Water Policy, 2012; and Wetland (Conservation and Management) Rules, 2017; Guidelines on Sustainable Sand- mining, 2015; MoUD Guidelines on Urban Greening, 2014; Himachal Pradesh Participatory Forest Management Regulations, 2001; Himachal Pradesh Non Bio-degradable Garbage (Control) Act,1995; Forest (Conservation) Amendment Rules, 2014 are some of the prominent policies and legal instruments applicable in case of river conservation. The agreement made and provisions incorporated as per the Indus Water Treaty, 1960 are of utmost importance in the context of Ravi River from the perspective of river water settlement, use and obligations as it is one of the 'Eastern Rivers' listed under the Treaty.

Implementing Agencies, Institutional Context

From the perspective of proposed Forestry Interventions, details of the Implementing Agencies at the National and State levels are much desirable. The HFRI in the DPR has proposed the MoEF&CC as the Nodal Agency for overseeing and steering the programme implementation; the ICFRE, Dehra Dun and its institute i.e., the HFRI, Shimla as the National Partner Organization for Capacity Development and Monitoring; and the pivotal role of the concerned Forest Departments of H.P. , Punjab and J&K UT as the Implementing Agencies.

The Civil Society represents the collective group of individuals, Non-Governmental Organizations and Institutions in a society that mark interests and will of citizens, and also referred as the 'Third Sector' of the society, distinct from the government and corporate. Since, the Ravi River flows through cities and towns. The river and its tributaries throughout their journey from origin to confluence are surrounded by densely populated human habitations. The Civil Society can play vital role in creation of mass awareness, protection of river and river resources, and allied activities. The religious bodies (e.g., village devta, temples, gurdwaras, Radha Soami Satsang, etc.) can also play vital role in efforts towards river restoration. Likewise, numerous organizations and institutions (e.g., Panchayats, JFMCS, Eco-development Committees, Biodiversity Management Committees (BMCs), Aanganwari Workers, Nehru Yuva Kendras (NYKs), National Service Scheme (NSS), etc.) can be of utmost importance and they can be involved in awareness campaigns, cleaning

drives for river and surrounding lands, protection and monitoring, and also implementation of proposed Forestry Interventions.

The mechanism of implementation at the National State and Field levels and constitution of National State Level Project Steering Committee (PSC) in each of the two pilot States and one Union Territory are described below.

River Conservation and Restoration

Need for Research, Monitoring and Knowledge Management Center

The research and monitoring activities are vital to develop the information base, setting goals and objectives and evolving strategies besides facilitating policy and decision making. Considering the complex and dynamic nature of river ecosystem, and the fact that the vast area is covered within the Riverscape and much of the area is in difficult terrain and inaccessible, it is essential to adopt various concurrent monitoring mechanisms and relevant tools for carrying out envisaged monitoring activities. Thus, concurrent monitoring mechanisms include: (a) IT enabled monitoring, (b) RS and GIS based monitoring, (c) Online monitoring through Web portal, (d) On ground monitoring, and (e) participatory monitoring. In recent times, increasingly mobile app based monitoring on real time basis in a much more transparent manner is possible. Thus, it is proposed to incorporate IT/ mobile app based monitoring. Since large, difficult and inaccessible areas form the major part of the River Basin/ Riverscape, optimal use of RS and GIS technologies, particularly for monitoring glaciers; sedimentation in reservoirs; and changes in channel morphology, land use and land cover, snow cover, forest cover, wetlands, cropping pattern, etc.

Over the years, The HFRI has developed as a Knowledge Management Centre in the field of Himalaya ecology including Trans-Himalayan region and conservation of diverse temperate forest ecosystems and privilege to have essential ingredients i.e., (a) Professionals and expertise, (b) State of the art laboratories and other physical infrastructure, and (c) Processes and innovative technologies. Since its establishment, HFRI has made significant contributions towards the forestry research, development of suitable nursery techniques, propagation of native plant species, and eco-restoration of mined areas and cold desert and having long experience in dealing with cumulative environmental impact assessments of Himalayan Rivers and well-laid infrastructure has been proposed to undertake the major responsibility as the National Level Partner Organization for effective implementation of this priority project on river restoration (i.e., forestry and conservation interventions aiming for *aviral dhara* and *nirmal dhara*, ecological integrity and restoration of river health), liaisoning with Central Nodal ministry and Implementing Agencies at the State level, concurrent research and development, science and technology based back-stopping, capacity development, monitoring, and evaluation.

For this purpose, the HFRI would need to establish a Project Facilitation Unit (PFU), headed by the Nodal Officer (NO) of the project at a senior level (Scientist – G or CCF Level Officer). He/ she will be supported by River Coordinator (RC)/SPS (Senior Project Scientist), one Junior Project Scientist (for Forest Biodiversity/ Bio-remediation and Bio-filteration/

Aquatic Ecology/ Remote Sensing and GIS/ Agroforestry/ SMC and Bio-engineering), two Project Associate (for Forestry Research/ Communication and Conservation Education/ Ecosystem Monitoring/ Forestry Training), one Project Manager (for IT and National River Database/ Administration/ Procurement/ Finance and Audit), one Office Assistant, and one MTS.

Project Components and Proposed Interventions

The project envisages the following four Components for implementation.

Component 1: Implementation of Forestry Interventions in concerned States and UT along the Riverscape - Implementation of Forestry Interventions in concerned States and UT is deal with the course of main stem of Ravi River and all its tributaries in hilly states/UT. The Component 1 includes three sub-components: (i) the proposed 'Forestry Interventions in Natural Landscape (NL), Agriculture Landscape (AL) and Urban Landscape (UL) adopting appropriate plantation treatment models; (ii) 'Conservation Interventions'; and (iii) 'Supporting Activities'. Besides proposed extensive plantations in three types of Landscapes within the Riverscape, the significant inputs under the sub-components on Conservation Interventions by way of soil and water conservation, riparian and riverine wildlife management, and wetland management have been envisaged.

For the overall success of project on Forestry Interventions, it is important that in concerned participating States and UT, will carry out 'Supporting Activities' referred as 'Themes' at the State and Local levels. These activities include: (a) Policy level interventions; (b) Concurrent research and development; (c) Participatory monitoring; (d) Capacity development; (e) Awareness; and (f) Evaluation.

Further, in order to ensure effective implementation, coordination and monitoring of the state-wide project activities, support for the establishment and smooth running of the State level Project Management Units (SPMUs) in two concerned States and one UT is also provisioned as a part of this Component.

Component 2: Strengthening Knowledge Management and Capacity Development for Forestry Interventions and Conservation of Riverscape - In the management of River ecosystem, there is an evident paradigm shift from river development to River conservation and then River restoration. Obviously, India lacks desired experience in restoration of rivers as relatively it is a new discipline for the country. However, efforts are on in this direction. For successful river conservation and restoration, holistic strategies should be adopted in policy and planning for better understanding of forest-river linkages and their intricacies, and successful river conservation needs. Moreover, in the emerging scenario of transparency in public policy, and essential requirements of comprehensive environmental impact assessment, and integrated planning for conservation of water resources, there are several expectations from multidisciplinary sciences. These expectations can vary based on the political climate, objectives of different (and often competing) government agencies, spatial and temporal scales of river resources and resultant complexity of the issues. The Best Available Science in river management and restoration should be based on six broad criteria

of: (a) Relevance, (b) Inclusiveness, (c) Objectivity, (d) Transparency and openness, (e) Timeliness, and (f) Peer review. In view of the above stated facts, the component two of the project aims to incorporate science into policy, planning and management for informed decision making that can facilitate positive outcomes of concerted efforts towards sustainable management of rivers and River restoration in particular in India.

The HFRI, Shimla has taken a lead in the preparation of present DPR adopting a multistep holistic approach based on exhaustive consultations and stakeholder participation while following a scientific planning process using RS and GIS based geospatial analysis for the Riverscape, multidisciplinary review on the Riverscape environment, and extensive field data collection by the concerned SFDs in the data formats prescribed by the Institute. The HFRI is a reputed and well known established learning centre in the fields of natural resource management and forestry, particularly relevant to the Himalayan environment; those have direct relevance to the River ecosystems. Thus, it is of utmost importance that HFRI is not only involved as a National Level Partner Organization for facilitating monitoring, evaluation, and capacity development as proposed in the present DPR, but also be entrusted the responsibility of major task to serve as the Knowledge Management/ Learning Center and to undertake concurrent research related activities essential for conservation and restoration of the Himalayan Rivers. The HFRI also plays a pivotal role in building desired National capacity for demonstrating the strong linkages between diverse forests in the Himalaya and Rivers ecosystems.

The Component 2 will seek to support improved knowledge by strengthening the Knowledge Management Center and Capacity Building on learning and experience required for conservation of Himalayan Riverscapes within the country by offering best practices for Forestry Interventions and various activities like conservation measures as envisaged in the DPR.

Component 3: Scaling Up, Replication of Successful Models in Additional Sites and Maintenance Phase - The present implementation plan of DPR focuses on implementation in whole catchment area in concerned hilly state (Himachal Pradesh) and UT (J&K) and on the selected tributaries, particularly once the river descends in the plains of Punjab. The Component 3 plans to support the scaling up and replication of planned efforts in additional sites / tributaries of Ravi River besides primarily, supporting the maintenance phase of various types of plantations raised in later years (3rd, 4th and 5th years) of the Phase I – Implementation Phase.

Component 4: National Coordination for Forestry Interventions and Riverscape Conservations - River management and restoration programmes require National level Coordination for proposed Forestry Interventions and various conservation efforts among the participating States or located along the course of main channel and its tributaries because major Indian River systems involve two or more States as the basin of the river and its tributaries are spread over multiple States. So, MoJS is the Central Nodal Ministry for all aspects of management of water resources including River Development and Restoration of Rivers, but several other Ministries are also involved for specific components/needs.

Thus, for National Level Coordination, an appropriate mechanism is vital for Forestry Interventions and River Restoration at the level of Central Nodal Ministry. The Component 4, therefore, visualizes activities for: (a) establishment of the River Decision Support and Management Information System (RDS & MIS); (b) facilitating activities relevant to policy and legal interventions, Riverscape level coordination, monitoring and impact evaluation; and (c) administering the implementation of major project on Forestry Interventions. In order to accomplish this, the Component 4 specifically envisages the establishment of a Project Management Unit (PMU) at the Nodal Ministry level. The PMU at the Nodal Ministry would handle the programme implementation, coordination among participatory States, Partner Organizations at the National and State level besides extending support for the finances required for the project execution.

Strategies

The developed understanding on the Riverscape environment has amply revealed that the Riverscape is a mosaic of varied land uses and it includes the: (a) Natural ecosystems, (b) Rural system predominated by agro-ecosystems, and (c) Built-up urban environment represented by cities and towns. Each of these broad land use category represents significant area of the Riverscape with unique conditions and situation, and varied use patterns, ownerships and management needs. Hereafter, three broad land use categories within the Riverscape are being referred as the 'Natural', 'Agriculture', and the 'Urban' Landscapes. These three Landscapes immensely influence the intricate and vibrant nature of Ravi River ecosystem, especially the environmental flow, water quality, and aquatic biota besides terrestrial biodiversity in surrounding lands, and the various ecological and fluvial processes of the *lotic* system. Hence, in view of the prominence of three types of Landscape elements within the Riverscape, a multipronged strategy for proposed Forestry Interventions addressing specific requirements of each of the land use type/ landscape category has been planned for the execution.

Table 7 – List of Models Proposed for Restoration of Ravi Riverscape

Sr No.	Model Type	Model Number
I	**Natural Landscape (NL)**	
A	**Hills - Himachal Pradesh**	
1	Sub-Alpine Conservation	RV/HP/NL/01
2	Sub-Alpine Enrichment	RV/HP/NL/02
3	Temperate Conifer Forest	RV/HP/NL/03
4	Temperate Mixed Forest	RV/HP/NL/04
5	Pasture and Grazing Land Development	RV/HP/NL/05
6	Himalayan Chir Pine Forest	RV/HP/NL/06
7	Himalayan Mixed Forest	RV/HP/NL/07
8	Sub-Tropical Dry Deciduous Forest	RV/HP/NL/08

Sr No.	Model Type	Model Number
9	Eradication of *Lantana* (> 50%)	RV/HP/NL/09
10	Control/ Removal of Invasive Species or <50% *Lantana*	RV/HP/NL/10
11	Protection Model for Natural Regeneration	RV/HP/NL/11
12	Fire Protection Model	RV/HP/NL/12
13	Plantation by Eco-Task Force in Temperate Forests	RV/HP/NL/13
B	**Jammu and Kashmir UT**	
14	Alpine Conservation	RV/JK/NL/01
15	Sub- Alpine Enrichment	RV/JK/NL/02
16	Temperate Conifer Forest	RV/JK /NL/03
17	Temperate Mixed Forest	RV/JK/NL/04
18	Pasture and Grazing Land Development	RV/JK/NL/05
19	Himalayan Chir Pine Forest	RV/JK/NL/06
20	Himalayan Mixed Forest	RV/JK/NL/07
21	Sub-Tropical Dry Deciduous Forest	RV/JK/NL/08
22	Eradication of *Lantana* (> 50%)	RV/JK/NL/09
23	Control/ Removal of Invasive Species or <50% *Lantana*	RV/JK/NL/10
24	Protection Model for Natural Regeneration	RV/JK/NL/11
25	Fire Protection Model	RV/JK/NL/12
26	Plantation by Eco-Task Force in Temperate Forests	RV/JK/NL/13
C	**Alluvial Plains – Punjab**	
27	Restoration of Degraded Forests Model	RV/PB/NL/01
28	Road Side Plantation	RV/PB/NL/02
II	**Agriculture Landscape (AL)**	
A	**Hills-Himachal Pradesh**	
29	Boundary Plantations	RV/HP/AL/01
30	Planting of Economic Trees in Block Plantations	RV /HP/AL/02
B	**Jammu and Kashmir UT**	
31	Planting of Economic Trees	RV/JK/AL/01
32	Planting of Economic Trees in Block plantation	RV/JK/AL/02
C	**Alluvials Punjab**	

Sr No.	Model Type	Model Number
33	Boundary Plantations	RV /PB/AL/01
34	Block Plantations	RV/PB/AL/02
III	**Urban Landscape (UL)**	
A	**Hills – Himachal Pradesh**	
35	Riverfront Development	RV/HP/ UL/01
36	Institutional and Industrial Estate Plantation	RV /HP/ UL/02
37	Eco-Park Development	RV/HP/UL/03
B	**Jammu and Kashmir UT**	
38	Riverfront Development	RV /JK/ UL/01
39	Institutional and Industrial Estate Plantation	RV /JK/ UL/02
40	Eco-park Development	RV / JK/UL /03
C	**Alluvial-Punjab**	
41	Bio-remediation and Bio-filtration	RV/PB/UL/01
42	Riverfront Development	RV/ PB/UL/02
43	Institution Plantation	RV/PB/UL/03
44	Eco-Park Development	RV/PB/UL/04

Natural Landscape (NL) - For developing treatment models, insight obtained from the consultative process, field acquaintance, professional judgment, forest working plans, and CAT plans was optimally used. Suggested models for the Natural Landscape are segregated into two broad groups: (a) Models for the Himalayan Mountainous tract in Himachal Pradesh and Jammu and Kashmir UT, and (b) Models for the alluvial plains of Punjab. Each recommended treatment model includes background information on site characteristics, recommended plant species for the proposed plantation besides details on spacing, quantity of different activities and man days of work during the establishment year as well as in subsequent years of maintenance. Details of potential treatment models (44 Nos) were shared with SFDs of concerned States and UT seeking feedback for appropriate finalization of 44 models in three types of Landscapes (NL, AL and UL), and incorporated in the present DPR. Altogether, 13 models selected for Natural Landscape in the hilly region of Himachal Pradesh were numbered from RV/HP/NL/01 to RV/HP/NL/13; and 13 models were selected for Natural Landscape in the hilly region of Jammu and Kashmir UT; and named as RV/JK/NL/01 to RV/JK/NL/13 while 02 models for Natural Landscape in alluvial plains of Punjab State, numbered from RV/PB/NL/01 to RV/PB/NL/02 were included.

Agriculture Landscape (AL) - The second lower order zone *i.e.*, the Agriculture Landscapes largely in the rural environment constitutes the matrix of the Riverscape. The activities in this zone mainly seek enhanced agricultural production. Within the Ravi Riverscape, in terms of

extent the Agriculture Landscape was widely distributed; firstly, along the altitudinal gradient in Himachal Pradesh and Jammu and Kashmir UT; secondly, in the vast expanse of alluvial plains of Punjab along the main channel. The primary activity in this zone is agriculture and horticulture production. A wide range of agricultural and horticulture crops are being undertaken by farmers on their private lands. The purpose of this lower order zone (i.e., Agriculture Landscape) is to enhance productivity of agricultural lands by appropriate Soil and Moisture Conservation measures and planting of economic and fruit trees so as to support the overall conservation values and other expected ecological functions and ecosystem services. Two models for the Agriculture Landscape in the hill State of Himachal Pradesh are proposed. These are: (a) model RV/HP/AL/01, and (b) model RV/HP/AL/02 relevant to boundary plantations and Planting of Economic Trees in Block plantation, respectively. In case of Jammu and Kashmir Union Territory, 2 models: RV /JK/AL/01 and RV /JK/AL/02 are proposed. In alluvial plains of Punjab, 2 models (RV/PB/AL/01 and RV/PB/AL/02) specifically designed for plantations along the boundaries of crop fields and plantations in blocks, respectively have been proposed.

Urban Landscape (UL) - Proposed Forestry Interventions in the third lower order zone i.e., the Urban Landscapes. The built up environment represented by the Land Use and Land Cover category of 'Settlement' of the Riverscape. This category of Land Use and Land Cover was widely distributed throughout the Riverscape, predominantly all along the main channel and its tributaries and formed the third lower order zone referred as the 'Urban Landscape (UL)'. Under this lower order zone, altogether 3 models (RV/HP/UL/01 to RV/HP/UL/03) focusing on Riverfront development, Plantations in Institutional and Industrial Estates, Eco-park development, have been proposed in the mountainous tract of Himachal Pradesh. Likewise, for Jammu and Kashmir, UT, 3 models have been proposed viz., Riverfront development (RV /JK/ UL/01), Institutional and Industrial Estate Plantations (RV /JK/ UL/02) and Eco-park Development (RV / JK/UL /03). Within the alluvial plains of Punjab, 4 models *viz*., bio-remediation and bio-filtration (RV/PB/UL/01), Riverfront development (RV/ PB/UL/02), Institutional and Industrial Estate Plantations (RV/PB/UL/03), Eco-Park Development (RV/PB/UL/04) are proposed in Urban Landscape.

Theme Plans: In addition to the above, the activities common to two or lower order zones are being referred as the Theme Plans. Theme based activities are broadly grouped into two categories: (i) 'Conservation Interventions' including Soil and Moisture Conservation, Riverine and Riparian Wildlife Management, and Wetland Management; and (ii) 'Supporting Activities' including policy and legal interventions, concurrent action research, capacity development, awareness, participatory monitoring, and project management and evaluation. The theme based activities have been planned and proposed at the National, State and Local field levels. The State and UT level Implementing Agencies i.e., the State and UT Forest Department will be responsible for execution of activities proposed as theme plans while the National Partner Organization (HFRI, Shimla) will concurrently carry out these activities at the National Level. Some of the supporting activities such as project management will be undertaken simultaneously by the Central Nodal Ministry and the State Project Management Unit (SPMU) based at the Headquarters of the concerned FD/ IA.

Implementation Mechanism

The programme implementation has been planned in two phases of five years duration each. The Phase 1 deals with project implementation while the Phase II primarily focuses on the maintenance of plantations established during the Phase 1. The project visualizes constitution of two Programme Steering Committees (PSCs), one at the National level in the Central Nodal Ministry being referred as the 'National Programme Steering Committee (NPSC)' while the other one at the State/UT level in the concerned FD/ IA, and being referred as the 'State Programme Steering Committee (SPSC)'. The NPSC and SPSC would be responsible for the efficient execution of the project at the National and State/UT level, respectively. The NPSC would be responsible for approving the APOs submitted by participating State/UT and a National Level Partner Organization (NPO) in addition to primary functions of overseeing and steering the execution of the implementation plan. The NPMU at the Central Nodal Ministry will be responsible for the release of funds to IAs and the NPO once the APOs have been approved by the NPSC. The Project Facilitation Unit (PFU) at the NPO will follow its own mechanism of governance and will constitute its own Monitoring and Steering Committee for overseeing the project.

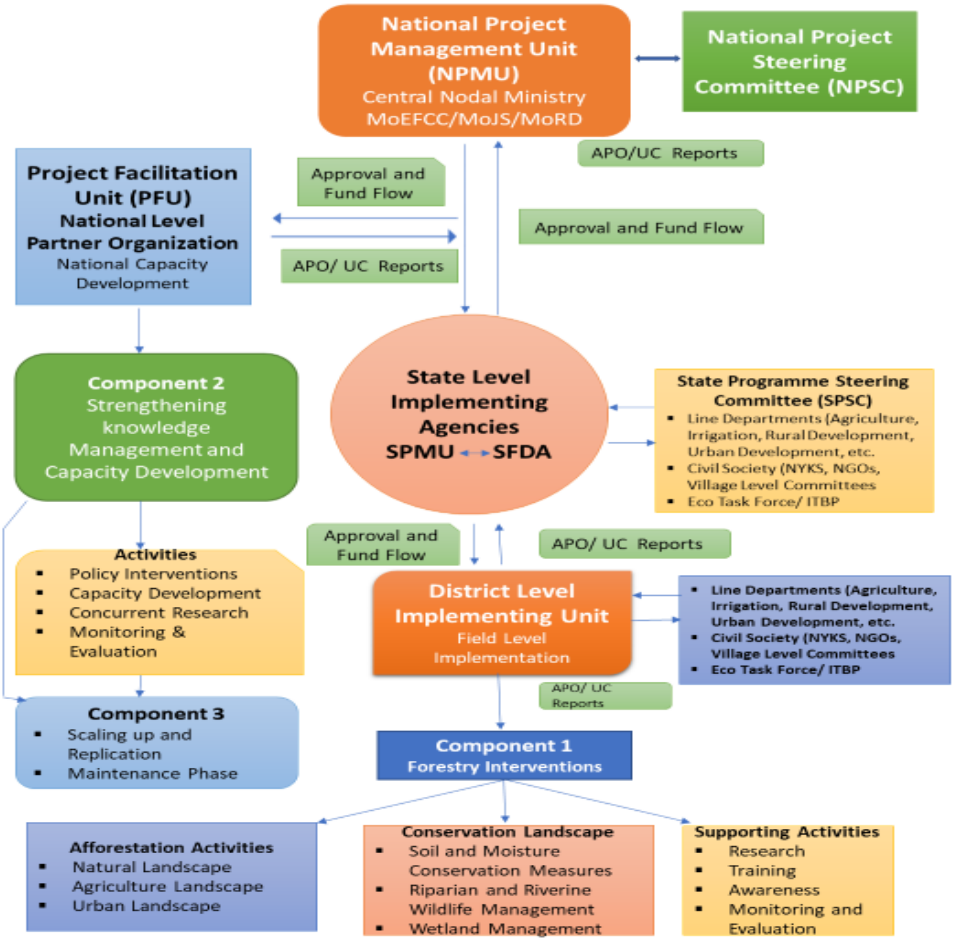

Fig. 6 – Proposed Hierarchical Institutional Arrangement and Mechanism for Project Implementation

Project Budget

The total financial outlay for phase I and phase II for detailed project report of Ravi River through Forestry Intervention is Rs. 498.77 Crores. The projected financial outlay of the Phase 1 on Project Implementation of five-year duration is Rs. 395.95 Crores. The projected budget outlay of Phase II (Maintenance Phase) of five-year duration is Rs. 102.79 Crores. As mentioned above, the project includes four broad based components. Accordingly, financial cost of each of these four components is summarized below:

Project Outlay: Component and Activity Wise

Principal Component-A: Implementation of Forestry Interventions in Ravi Riverscape

An amount of Rs 359.33 Crores, which is 72.04 % of the overall project budget, is provisioned for principal component A. This includes total Rs. 333.69 Crores for Forestry Interventions in three Landscapes (Sub-component A.1) and Conservation intervention (Sub-component A.2) and Rs. 25.64 crores provisioned for supporting activities (Sub-component A.3).

Component -A: The Component - A on plantations and various treatment models in three types of Landscapes within the Riverscape is the largest in terms of its spread, extent and quantum of funds provisioned. The component A, being the predominant component of the overall project, have envisaged three sub-compenents.

Sub-Component–A.1 the predominant sub-component (A.1) emphasizes on extensive plantation in three types of Landscapes (Natural, Agriculture and Urban) and Plantations under Eco-Task Force (ETF) within the Riverscape. Among three Landscapes, the highest predominance of proposed activity is in Natural Landscapes within the Riverscape i.e., Rs. 105.47 Crores. Two Battalions of Eco-Task Force will also carry out plantation (2,000 ha) activities in the Natural Landscape in Hiamchal Pradesh and Jammu & Kashmir UT at a projected cost of Rs. 45.34 Crores. Plantations and other appropriate treatment models have also been planned for Agriculture Landscape and Urban Landscape within the Riverscape and budget provision to the tune of Rs. 4.81 Crores and Rs.67.22, Crores respectively of the sub-component (A.1) have been made.

Second Sub-component on 'Conservation Interventions' (**A.2**) includes three major types of interventions/activities. These are: (a) Soil and Moisture Conservation measures, (b) Riverine and Riparian Wildlife Management, and (c) Wetland Management. Rs. 110.85 Crores are provisioned for this sub-component, which is 22.22 % of total budget outlay. Out of this, the budget outlay for SMC is Rs. 73.21 Crores, which is 20.37 % allocation of the funds provisioned for Component A. Budget outlay provisioned for Riverine, Riparian Wildlife Management and Wetland Management is Rs. 37.64 Crores, which is 10.48 % of total budget of component A.

Third Sub-component (**A.3**) pertaining to 'Supporting Activities' is to be executed by concerned States/UT level IAs. This Sub-component includes seven broad based activities viz., (a) policy and legal interventions, (b) participatory monitoring, (c) adaptive research, (d) capacity development, (e) awareness, (f) project management, and (g) evaluation. A budget

of 25.64 Crores or 5.14% of total budget proposed to the concerned States/UT has been provisioned for carrying out various supporting activities for five-year period.

Component-B: The component B specifically pertains to the National Partner Orgnization (NPO) responsible for carrying out priority activities relevant to the strengthening of knowledge management, enhacement of capacity for Forestry Interventions and River Conservation. Strengthening Knowledge Management and enhancement of National capacity for forest hydrology, Forestry Interventions, and conservation and restoration of rivers would require a sum of Rs. 18.53 Crores or 3.72% of the overall project outlay. The highest budget amounting Rs. 4.89 Crores have been provisioned for cost of PFU, while budget of Rs. 3.93 Crores have been provisioned for Research and Development, while Rs. 1.12 Crores, Rs. 1.69 Crore, Rs. 2.25 Crore, Rs. 0.92 Crore, Rs. 0.42 Crore and Rs. 0.29 Crores have been envisaged for policy level interventions, capacity development, scientific exchange, awareness, Monitoring and Evaluation, respectively.

Component – C: The component C on the Phase II of the project of five-year duration for maintenance of plantations raised during Phase I of the project has also been planned. The Phase II would also include limited activities related to replication of efforts in additional tributaries/areas and scaling up of the planned effort. A sum of Rs. 102.81 Crores or 20.61 % of the total project financial outlay have been envisaged specifically for the Component – C on 'Maintenance Phase'.

Component – D: The component D pertains to project management at the national level which would include the establishment of National Project Management Unit (NPMU) at the Central Nodal Ministry with the responsibility to oversee, steer and manage this priority project. A sum of Rs. 18.09 Crores, representing 3.63 % of the overall budget over a period of five-year during the Phase I have been provisioned. Thus, it is clear that the major portion of project budget outlay is meant for field level activities incorporating proposed forestry interventions, conservation interventions and supporting activities to be implemented in concerned States/UT.

A total of 12 Territorial Forest Divisions and 4 Wildlife Divisions in Ravi Riverscape, will carry out proposed activities relevant to Forestry Interventions within the Riverscape. A total of 6401.54 ha area of three Landscapes, 421 ha area of Riverine and Riparian Wildlife Management and Wetland Management and 452920.5 m^3 extent of Soil and Moisture Conservation in Ravi Riverscape is envisioned to be treated under the various Forestry Interventions. Overall budget outlay for 16 Forest Divisions of Ravi Riverscape has been given in State and UT summaries of Himachal Pradesh, Punjab and J&K UT i.e., Vol. II of the Ravi River DPR. The range of budget allocation among 12 Forest Territorial Divisions varies from Rs. 2.34 Crores to Rs. 77.87 Crores over a period of five years of Establishment (Phase –I) and next five years of maintenance (Phase –II.) Whereas, the budget range for 4 Wildlife Divisions range from Rs. 2.00 Crores to Rs. 18.27 Crores over a period of 10 years (i.e., Phase I and II).

Cost Indexing: The project costs have been worked out on the basis of rate prevalent during year 2019-20 in the respective State/UTs and 7% escalation in the project cost during the subsequent years has been incorporated in anticipation of the cost escalation in future.

However, actual project cost at the time of implementation on yearly basis shall need revision as per the change in Wholesale Price Index (WPI) on year to year basis. The Conservator of Forest may be empowered to revise the project cost accordingly for the quality desired output of the project.

Table 8 – Project Budget Outlay - Component/ Activity Wise Budget Allocation for Ravi Riverscape

Sr. No.	Component/ Activity	Amount (Rs. in Crore)	Allocation Total (%)	Allocation Phase I (%)
	Implementation of Forestry Interventions in Two States and one UT of Riverscape (A.1+A.2+C1+C3)	**410.34**	82.27	84.27
A.1	**Plantations and Treatment Models in Three Categories of Landscapes**	**222.84**	44.68	56.28
A.1.1	Natural Landscapes	105.47		
A.1.2	Eco Task Force	45.34		
A.1.3	Agriculture Landscapes	4.81		
A.1.4	Urban Landscapes	67.22		
A.2	**Conservation Interventions**	**110.85**	22.22	27.99
A.2.1	Soil and Moisture Conservation	73.21		
A.2.2	Riverine and Riparian Wildlife Management and Wetland Management (Natural and Artificial)	37.64		
A.3	**Supporting Activities**	**25.64**	5.14	6.48
A.3.1	Policy Level Interventions	0.19		
A.3.2	Research Activities	2.44		
A.3.3	Capacity Development	7.54		
A.3.4	Awareness	4.64		
A.3.5	Participatory Monitoring	0.90		
A.3.6	Cost of PMUs of Two State Level Implementing Agencies	9.33		
A.3.7	Evaluation	0.56		
A.3.8	Contingency and Miscellaneous Activities	0.05		
Total Budget of Component A (A1+A2+A3)		**359.33**		
B.	**Strengthening Knowledge Management and National Capacity for Forestry Interventions and Conservation of Riverscapes**	**18.53**	3.72	4.68
C.	**DPR – Phase II (Maintenance phase) Including Scaling Up and Replication of Successful Models of Forestry Interventions**	**102.81**	20.61	

C.1	Maintenance Cost of A.1 and A.2 (Cost of Phase II)+ Est. of Phase II ETF	59.97		
C.2	Maintenance Cost of A.3, B and D	26.169	5.24	
C.3	Scaling Up and Replication of Successful Models of Forestry Interventions (5% of A.1 & A.2)	16.68		
D.	**National Coordination for Forestry Interventions and Riverscape Conservation**	**18.09**	3.63	4.57
	Total Phase I (A+B+D)	**395.95**		100.00
	Total Project Cost (Phase I+II) (A+B+C+D)	498.769 or say **498.77**	**100.00**	

C.1 Maintenance Cost in Crore [(NL)16.04+(ETF)36.48+(Est. of Phase II ETF)1.80 + (AL) 0.33 + (UL)1.95 = 56.6]+[(SMC) 0+ (Riparian & Wetland)3.37]= 59.97

Note: In the proposed budget of Ravi River for HP, Punjab and J & K UT Implementing Agencies, 5% of total budget of phase I will be added in phase II for Scaling Up and Replication of Successful Models.

Project Schedule

The execution period of Phase I and Phase II of the project has been designed and incorporated in the present DPR is of 5-years duration in each phase. Thus, the total duration for programme implementation including the maintenance phase is of 10-years. At this juncture, it is not clear when the project would commence and which will be the first year of programme implementation during Phase I. The Government of India may take its own time to decide the Central Nodal Ministry responsible for the implementation of the project and to allocate required funds for the execution of plan. Various proposed activities have been staggered over five years of the Phase I. The experience illustrates that once the Government of India has accorded its approval for the project and earmarked required funds, the first year by IAs would be largely devoted for project initiation, preparatory works, particularly the establishment of nurseries and commencement of various activities related to conservation interventions and supporting activities. The planting material meant for high altitude Himalayan part of the Riverscape would be ready in nurseries and earliest available by the end of second year of project implementation. Thus, the earliest effective establishment year of plantations would be the third year of Phase I in high altitude areas. Establishment of plantations is proposed in third, fourth and fifth years of Phase I. The Phase II of five years duration is specifically designed and incorporated for the purpose of maintenance of plantations and other activities. Considering the fact that most proposed activities are time bound and seasonal in nature, ideally the project initiation after all approvals, budget allocation, etc. should commence in April–May so as to allow adequate time for preparatory works, establishment of nurseries, development of planting material for afforestation/

reforestation in lower reaches of the Riverscape before the onset of monsoon season in the month of June or so in the next year. Thus, careful scheduling of project commencement would be vital for the overall success and effective implementation of envisaged activities. The quantum of activities is expected to be at its peak in third and fourth years of Phase-I. The Mid-Term Review (MTR) is proposed in the last quarter of third financial year of the project execution while the Terminal Evaluation (TE) is being envisaged in the third year of the Phase II.

Potential Benefits of Forestry Intervention

The proposed efforts towards River restoration are confined exclusively to Forestry Interventions aiming for enhancement of forest cover, grassland and wetland management, reduction in soil erosion, riparian management, and in stream/aquatic habitat and species management. Certainly, several other measures of engineering, hydrological, mechanical, agricultural, bio-technological nature aiming channel and flow modification, dam removal or retrofitting, bank stabilization, storm water management and flood control, spring/aquifer management, floodplain reconnection and channelization, channel reconfiguration, management of industrial effluents and urban waste and sewage, climate smart agriculture, management of toxins, etc. are out of purview of the present DPR.

In view of the above, various potential socio-economic benefits and improved ecological functions expected as a result of proposed wide-ranging Forestry Interventions are summarized in Table 9.

Table 9 - Consolidated Accrued Potential Benefits from Proposed Forestry Interventions in Ravi Riverscape

Sr. No.	Potential Benefits	Quantity (20 Years)	Quantity (10 Years)
A	**Biomass, Carbon stock, CO_2 reduction and Carbon Credit**		
1	Biomass Production in Natural, Agriculture and Urban Landscape (t/ha/year) after 20 year	2.66	-
2	Total Biomass Production from 7995.84 ha area of three landscapes (Tonnes)	21268.93	17015.14
3	Contribution to Carbon Stock from 7995.84 ha area of three landscapes (Tonnes) i.e, 47% of biomass (tonnes)	9996.40	7997.12
4	Estimated Carbon Reduction from forestry interventions in three landscapes (7995.84) (metric tonnes CO_2 eq/ha/year) (Here all components i.e., bole, leaf, twigs branches, roots are accounted)	8.97	7.176
5	Estimated Carbon reduction from forestry interventions in three landscapes (7995.84 ha) (metric tonnes CO_2 eq/year)	68368.99	54695.19
6	The expected CO_2 reduction (million tonnes of CO_2 eq.)	1.37	1.096

7	Potential to generate Carbon Credit from plantation in three landscapes (million tonnes) **(CER=**Certified Emission Reductions**)**	1.37	1.096
B	**Water Quality and Quantity**		
8	Water Quantity: Conservation of water through forestry interventions (million Cubic Meter/year)	17.95	
9	Water Quality: Estimated sediment reduction through forestry interventions (‘000 m^3/year)	146.78	
C	**NTFP’s**		
10	The estimated benefit from NTFPs i.e., herbaceous medicinal plants from **2602.35** ha area of Natural Landscape in Ravi Riverscape after ten years (Rs in Lakhs)	540.58	
D	**Mandays to be generated**		
11	Generation of Employment from Plantation Activities and Other Conservation Interventions (Total man days in Phase I and Phase II)	78,50,783	

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ANNEXURE-1

Guidelines for Implementation of Detailed Project Report (DPR) for Rejuvenation of Ravi River through Forestry Interventions

The Ravi River is a transboundary Himalayan River traversing through the northwestern India and eastern Pakistan. It is one of six principal rivers of the Indus River System. It originates in the Lesser Himalaya in India from Bara-Bhangal area of Kangra district of Himachal Pradesh. Flowing westward, it is hemmed by the Pir Panjal and Dhauladhar Ranges, forming a triangular zone. After passing through the Chamba district, it leaves the Himalaya at Basohli and traverse through Kathua district in Jammu region of the Jammu and Kashmir Union Territory (J&K UT). It makes a sudden westerly bend and enters the Punjab Plains near Madhopur. Some distance below Madhopur, it demarks boundary between the two Punjab (West in Pakistan and East in India). It joins the Chenab River at Trimb (Pakistan). The Ravi River is the smallest river of all other transboundary rivers of India and Pakistan. It runs almost along the India-Pakistan border. The total length of Ravi River both in India and Pakistan is 720 km while the length of Ravi River in India is 341 km. Out of the total length of 341km, 168 km lies in Himachal Pradesh, 63 km in J&K UT and 110 km in Punjab. The entire Ravi River Basin in the Indian Territory spreads over an extent of 11,706.41 km^2. The DPR covers total 16 Forest Divisions i.e., 6 in Himachal Pradesh, 4 in Punjab and 6 in J&K UT. The Detailed Project Report on Rejuvenation of Ravi River through Forestry Interventions will be implemented by the concerned States/UT Forest Departments i.e. Himachal Pradesh, Jammu and Kashmir UT and Punjab with following guidelines within the Riverscape:

- The existing framework within the Ministry of Environment, Forest and Climate Change (MoEF&CC), GoI shall implement the DPR. National Afforestation and Eco-Development Board (NAEB) will be the national Project management Unit.
- Forest Departments of the Himachal Pradesh, Punjab and J&K UT are the primary Implementing Agencies (IAs). State Project Management Unit (SPMU) at the headquarters of Forest Department (FD) headed by Additional Principal Chief Conservator of Forests(APCCF) level official. Implement through the hierarchical structure of Chief Conservator of Forests (CCF) to Conservator of Forests (CF) to Divisional Forest Officer(DFO).
- Local community and other departments such as Agriculture, Horticulture, Soil Conservation, Revenue, *Gram Panchayats*, Non-Governmental Organizations (NGOs), etc. shall be suitably involved in steering, execution and monitoring committees of the project.
- There should be separate bank account to operate the DPR at division level. General Financial Rules (GFRs) and other rules/guidelines of Government are to be followed.
- A Steering Committee and a Monitoring Committee shall be created at national and state levels.
- The State level Steering Committee shall meet at least twice a year for approving the APOs and discussing other related issues. There should be provision of regular financial

reporting of the project at all levels and compilation of quarterly financial reports and annual financial statements of the project. Also provision of internal and external audit should be ensured.

- The FDs would dovetail activities with similar ongoing/future schemes of various departments through appropriate Memorandum of Understandings (MoUs) for synergy and avoiding duplication.
- Incentives such as free quality planting material of fruit or forestry plants and maintenance cost are already provisioned for farmers. Also, explore possibilities of providing more incentives from other schemes in the State/UT.
- An execution manual would be prepared by the concerned FDs of Ravi Riverscape in local language at the start of the project implementation in line with DPR recommendations with participation of all line departments specifying roles and responsibilities.
- Adopt best practices of site selection and treatment of the site. Generally, adopt Ridge to Valley approach for finalizing and implementation of Soil and Moisture Conservation (SMC) works in Riverscape area.
- Flexibility is allowed to address the changing stakeholder needs, National, Regional or local priorities, and learning from local knowledge, concurrent experiences and research.
- Divisional Forest Officers (DFOs) will have flexibility of choice of species, site, model, quantity of work, specifications and timing of activities within the total budget proposed in the DPR for the division.
- The cost estimates in models are for guidance and not serve as actual budget for the treatment of a site. The rate in force at that time and place would be applicable and reflected in APO.
- Native species of trees, shrubs, herbs and grasses as given in the DPR/Working Plan would be selected for plantation in the proposed treatment models. Non-timber forest products (NTFPs) and other species that support livelihood would be given priority.
- The suggestive cost models are to create multistoried forest cover for improving the biodiversity of the area which in turn conserve the water and soil in-situ.
- Traditional and prominent horticultural and ornamental species those under cultivation in the region for quite some time, should be planted in the Agriculture and Urban Landscapes.
- Adopt mixed plantations as far as possible instead of monoculture for enhancing plant diversity and greater ecosystem services. The species are proposed according to their occurrence in the altitudinal zones however, Implementing Agencies may plant site specific species also.
- Suitable native species suggested for different plantation models are finalized after due consultation with Forest Department and other stakeholders of concerned States/UT. The details of native species proposed for plantation under each treatment model are provided in the chapter-5 of Vol. 1 of DPR Ravi River.
- The necessary preparations for planting works including digging of pits would be completed two-three months before the onset of monsoon or planting season. However, the period between pit digging and scheduled planting time would not be more than four months so that run-off of soil by wind and water could be minimized.

- Appropriate quantity of farmyard or organic manure or mycorrhiza would be applied to boost plant growth in nurseries and plantation sites. Eco-friendly measures (i.e., physical or mechanical methods, use of natural products, etc.) for weed and pest control would be adopted without resorting to the use of synthetic chemicals
- Plantation sites would be protected against all types of biotic disturbances and abiotic stresses so as to effectively safeguard planted material for three years through fence, watch and ward, as well as local public awareness programmes and their active involvement.
- The Implementing Agency should either develop modern and centralized nurseries or identify various certified Research Institutes, Universities, Non-Governmental Organizations (NGOs), Institutions and progressive farmers for supply of best quality planting material.
- The budget will be provided after submission of Annual Plan Operations (APO) for each year. So the prevailing wage rate will be applicable whenever DPR is implemented. Also site can be changed as per the availability at the time of implementation wherever required.
- In Himachal Pradesh, further 25% hike in wage rates would be applied for Tribal Areas in the high altitude.
- The fencing cost has been calculated on average basis of enclosure of area to the extent of 5 hectare and average carriage leeds is taken as 1 km (up & down).
- Start nursery activities/sowing of species those are require in plantation activities well in advance i.e., 3-4 years before for conifers and one year before for other plants and well developed plants should be planted.
- The nursery time for plants in multitier model is taken on average basis i.e., 1.5 – 4.5 years so average is 3 years, for calculating the norm. Also the plant cost is taken from the norm prescribed by the Forest Department of respective States and UT.
- The cost norms indicate the upper limits. The expenditure will be booked under various items shown in the detailed models as per actual work done in the field as per Schedule of Labour rates of the respective States/UT and will not exceed these Departmental Norms.
- In *Lantana* eradication models or wherever *Lantana* removal is involved, the Cut Root Stock (CRS) method should be adopted.
- The fencing work includes the 4-strands of barbered wire with interlacing of thorny bushes.
- In Fire Protection Model, as area is virtually targeted, hence Implementing Agency should rotate fire protection operations in areas of the Division so that each selected area takes operations after 3 years.
- In Agriculture models, the guidelines of Sub-Mission on Agroforestry (SMAF) of Central Government should be considered as being adopted in States and UT.
- Under Urban Landscape, the Seechewal Model (Punjab) for bio-remediation and bio-filtration may be taken into consideration.
- Also in Urban Landscape, Eco-Park Development, Institutional Plantation and Riverfront Development models can be converged with Nagar Van Yojna as launched by Government of India (GoI).

- In Soil and Water Conservation Models, the watershed approach and techniques should be adopted for desired results. For this intervention, the Annual Plan Operation (APO) should be submitted each year with the proposal of micro-plan of specific sites with detailed estimates.
- In Riverine and Riparian Management and Wetland Management models, areas shown in budgetary provisions are virtual and concerned Implementing Agency (IA) should clearly mention the proposed activities in Annual Plan Operation (APO) to be taken up in particular area with detailed plan and estimates.
- The prescribed models, identified sites, area of the sites, species and rates may be modified to suit local conditions at the time of implementation of project and the concerned Conservator of Forests shall exercise the power to approve such changes as and when requires.
- The project costs have been worked out on the basis of rate prevalent during the year 2019-20 in the respective State/UT and 7% escalation in the project cost during the subsequent years has been incorporated in anticipation of the cost escalation in future. However, actual project cost at the time of implementation on yearly basis shall need revision as per the change in Wholesale Price Index (WPI) on year to year basis. The Conservator of Forest may be empowered to revise the project cost accordingly for the quality desired output of the project.
- Services of suitable Experts may be used for Bio-remediation, Eco-park development, Riverfront Development, etc. and also for designing Soil and Moisture Conservation (SMC) structures.
- Capacity building/Awareness activities should be planned for the involvement of local people, NGOs and other organization involved in plantation activities.
- Geographic Information System (GIS) tools should be used necessarily for the works to be implemented. The APO shall serve as the Standard document for the Global Positioning System (GPS) location and extent of treatment site for the Ravi River DPR.
- Protection against all the biotic and abiotic pressures should be effectively managed.
- In Agriculture landscape, farmers should be trained and their capacity building should be done before taking up the activities.
- Farmers would be allowed to choose species for plantation. Quality Planting Material (QPM) of superior varieties of fruit species should be supplied in consultation with the Horticulture Departments.
- Supporting activities regarding policy level intervention and monitoring and evaluation be implemented seriously.
- Inhospitable and difficult areas would be identified by the FDs and, if available, assigned to Eco- Task Force for treatment with provision of sufficient budget.
- Invasive species areas are to be planted with economically important species.
- The frequency of meeting of Monitoring Committees shall be same as Steering Committees. In-house monitoring will be done by the Implementing Agency and third party monitoring will be done by the external agency.

Don’ts

- Avoid to plant Exotics in natural landscape. If absolutely essential to plant an exotic, the consent of Steering Committee may be taken.
- Don’t remove *Lantana camara* en masse from fragile slopes and extremely harsh sites.
- Avoid plantation of large water consuming species.
- No work should be started without training/capacity building of frontline staff.
- Any work which exerts negative impact on the environment and social intricacies should not be undertaken.
- No work should be implemented which do not comply with the environmental laws and policies at National and State levels.
- No work should be carried without taking GPS location of the site.

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