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Overview

Detailed Project Report

Forestry
Interventions for Rejuvenation of Chenab *River* Basin

Prepared by
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Detailed Project Report

Forestry Interventions for Chenab River

Overview

- Chenab River is one of the largest tributary of Indus River Basin which originates from the Chander Tal Lake, situated towards South-Easterly side of Bara Lacha Pass in Lahaul and Spiti district of Himachal Pradesh. Bhaga River, the major tributary of Chandra River originates from Suraj Tal, in the opposite direction of the Bara Lacha Pass. These two rivers join to each other at Tandi (Fig. 1.1), 8 km southwest of Keylong in Lahaul and Spiti district. From Tandi onwards, it flows through Lahaul Valley and enters in Pangi Valley of Chamba district near Bhujind and leaves the district at Sansari Nallah to enter Paddar Valley of Jammu and Kashmir Union Territory. The Chenab River traverses through the mountainous tract of Himachal Pradesh, and hilly and plain regions in J&K UT. It ultimately merges with the mighty Indus River in the form of Punjnad at Mithankot in Pakistan. Chenab River covers a distance of 453 km in India by meandering through narrow valleys, rugged terrain, steep slopes and deep gorges all along its course.
- Ptolemy, the noted Greek scholar described Chenab River in his travelogues as ‘Sandabal’ and it is mentioned as ‘Asikni’ in Hindu Vedic literature. The Chenab River is also known as Chandrabhaga, the name attributed to the confluence of two streams, Chandra and Bhaga at Tandi. The place is considered as very sacred by the main tribal communities due to its great mythological significance. Three mythological stories are connected with Tandi. First narrative is related to Draupadi, the wife of Pandavas. It is believed that Druapadi left her body at this place and the name Tandi has evolved from ‘Tan Dehi’ means giving up of the body. Second story described that Rishi Vashishtha who meditated near the hot water springs of Manali was cremated at this confluence. According to the third narrative, Chandra and Bhaga streams are symbolically considered to be son and daughter of the Moon and the Sun gods, respectively. It is held that the two divine entities fell in love with each other and decided to celebrate their heavenly marriage after starting their run from Bara Lacha Pass, in opposite directions. In doing so, they run down in South-east and South-west directions and after encircling an enormous expanse of Lahaul, ultimately met each other at Tandi to enter the wedlock.
- The Chenab Bridge - World’s highest Railway Bridge is under construction in Reasi district of J&K UT. This mega structure over Chenab River will be a kind of engineering marvel and connect enchanting Kashmir valley with Indian mainland by rail. Similarly, Akhnoor fort, on the bank of Chenab River is a monument of immense historical and archaeological significance. It was built by Raja Alam Singh in 1802, and is extremely important for reconstruction of the past history. It has been declared a national monument protected under the Monument Act, 1958.

- The Chenab River basin constitutes a major part of the Indus River Basin and covers a vast area of 29,326.47 km^2 in India, of which 73.55% area falls in the J&K UT, and 26.45% area occurs in Himachal Pradesh. From the management perspective, the Basin comes under the jurisdiction of the Lahaul and Pangi Forest Divisions of Himachal Pradesh and Kishtwar, Doda, Bhaderwah, Batote, Reasi, Ramban, Ramnagar, Udhampur, Jammu, Jammu Urban, Rajouri, Nowshera, Marwah and Mahore Forest Divisions of J&K UT.
- The majority of the catchment area of Chenab River in upper reaches abounds in snow, barren lands, glaciers and ice-fields. The basin is also characterized by varied geomorphic features including rugged terrains, steep slopes, rocky cliffs and narrow gorges. The drainage pattern is dendritic and radial with presence of many perennial tributaries/ small streams joining Chenab River from all directions.
- Appreciating ecological significance of Chenab River and recognizing the need of its conservation due to anthropocentric activities and environmental concerns, the Government of India through Ministry of Environment, Forest and Climate Change has entrusted the task to Himalayan Forest Research Institute (HFRI), Shimla, one of the Research Institutes under Indian Council of Forestry Research and Education (ICFRE), Dehradun to prepare the DPR on rejuvenation of Indus River Basin through Forestry Interventions.

Fig. 1.1 - Tandi - Confluence Point of Chandra and Bhaga

- The river restoration refers to a variety of ecological, physical, spatial and management measures, and practices aiming at reinstating the natural processes to restore biodiversity, providing benefits to both people and wildlife. Despite the absence of a rigorous scientific foundation and well-tested principles, river restoration is one of the most visible aspects of the hydrological science. Numerous studies over the past few years have been done with the issue of whether and to what extent large river floodplain systems are amenable for restoration. The studies have concluded that preservation should be the priority as far as possible so that rivers may retain much of their natural attributes. River restoration now accepted by government agencies and various stakeholders as an essential complement for conservation and natural resource management. Societal perceptions and expectations of an ecosystem performance ultimately determine whether restoration is a viable management option or not. The involvement of stakeholders in restoration decisions is growing and they have diverse preferences, institutional mandates, and expertise. The interactions between scientists and stakeholders involved in restoration of rivers are limited. The information in scientific language often leading to poor communication between scientists, stakeholders and decision makers. However, it is beyond any doubt that achievement of restoration goals always gets influenced by a large number of scientific and non-scientific factors. Scientific limitations include unavailable information on critical ecosystem conditions or processes, and inadequate synthesis of available information during model development. Non-scientific limitations include infeasibility of certain desired restorative actions (e.g., eradication of exotic species and reintroduction of extinct native species) and philosophical differences among different stakeholders and disagreements over who should bear the social and economic costs of restoration. Resolving resource management issues across entire river basins and resolving conflicting interests among various stakeholders requires a high degrees of coordination and synergy.
- 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* (continuous flow), *Nirmal Dhara* (clean flow), and ecological restoration of river basins. Current effort towards the preparation of present DPR on Forestry Interventions to restore the Chenab River is one such endeavour.

The Chenab River
Conservation Significance

- The Chenab River along with the Jhelum, Beas, Ravi and Sutlej rivers within the Indian Territory constitute five principal rivers of the trans-boundary Indus River System. Certainly, the Indus River and its tributaries have immense significance for two neighbouring and human dominated nations i.e., India and Pakistan. In the context of Indian sub-continent, three mighty rivers (i.e., Indus, Ganga and Brahmaputra) originating in the Himalaya not only form major river systems of the Hindu Kush Himalayan (HKH) Ranges, but also exceptionally important from ecological, economical, historical, cultural and mythological perspectives. The Indus Water Treaty (1960) grouped Chenab, Jhelum and Indus rivers as the 'Western Rivers' and the laid down provisions of the treaty allows India to use Chenab water for 'non-consumptive uses' including irrigation, storage and for electricity production.
- The Chenab River has vast catchment, which supports the livelihoods of human populace residing in geographically tough and hard areas of Himachal Pradesh and equally important for a sizeable population in J&K UT. The construction of weirs/ reservoirs/ barrages on the upstream tributaries and large dams on the main stem of river for hydro-power development affects the flow regime of river and reduce the supporting services provided by the river ecosystem to the dependent communities.
- The Chenab River basin has tremendous hydro-power potential and contributes significantly for generation of green energy. Several Hydro-electric power projects (HEPs) of different capacities have been commissioned on the Chenab River in J&K UT e.g., Dulhasti, Baglihaar, Salal, and Pakal Dul.
- The watershed of the Chenab River extends over the mountain ranges of the Pir Panjal, Great Himalaya, Lesser Himalaya, and Outer Himalaya or Shivaliks. Diverse forests along the vast altitudinal range are repository to a wide array of plant and animal diversity including several rare, threatened and endangered taxa. The Chenab River basin is important as it has a wide diversity of natural and manmade wetlands including three famous Ramsar sites (i.e., Chandertal Lake, Mansar Lake and Surinsar Lake). The Kishtwar High Altitude National Park located in the upper reaches of Chenab River basin represents pristine environment abounding in diverse forests, temperate grasslands, and several other ecosystems providing suitable habitats for important wildlife. (Fig. 1.2)

Fig. 1.2 – Human Settlement along Chenab River Basin

Forests and Rivers

Strong Linkages

Forests, water resources, and people are intensely interconnected, and have an intricate relationship among them. Both, quantity and quality of water are strongly influenced by forests. Forests form catchment of streams and rivers, absorb precipitation (i.e., rainfall and snow), slow runoff, reduce soil erosion, improve water infiltration and recharge groundwater and aquifers. Thus, forests have 'Sponge Effect'. Besides this, forests regulate the carbon, oxygen and hydrological cycles. Riparian forests are most complex ecological systems, disproportionately used by wide range of organisms, and are the interface between the terrestrial and aquatic ecosystems. Riparian forests serve as 'Natural Buffers' and 'Biological Filters', and have an ability to act as ecological machinery for self-regulation, self-purification and self-support for the dynamic flow of the river water and its quality. The Riparian forest buffers reduce the adverse impact of human activities on rivers. Forests help in sequestration of carbon and its storage and also act as rich repository of biodiversity. They are crucial for the sustainable management of freshwater resources, particularly river ecosystems, while water is essential for the sustainability of forest ecosystems. Humanity is strongly intertwined with forests as well as rivers, as both offer various ecosystem services to human kind. Since time immemorial, humanity has been using forests as well as rivers for multiple uses, benefits and values. The strong linkages and intricate interdependence between forests and rivers epitomises the significance of managing ecosystems in their entirety with the involvement of stakeholder and cooperation across a multitude of sectors concerned with the cause of land and aquatic resources.

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/surrounding landscapes, particularly the impact of human activities. Thus, rivers have been regarded as 'Arteries of the Catchment', 'Lifeblood', 'Highways', 'Pantries of the world' and even as the 'sentinels'. The 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

For a long, humans have altered rivers for multiple uses and benefits. The alteration of rivers has been carried out with the best of intention, but without knowledge of the potential implications and repercussions for the diversity, connectivity and ecological integrity of the river ecosystem. The complex subject of 'River Science' has emerged, especially in light of anthropogenic disturbances and regulations which have simplified most rivers and resulted into adverse consequences for structure, composition and functions of a river. The earlier interventions towards river management were mainly small scale interventions, piecemeal, fragmentary in nature, focused on isolationist scientific approaches for management of river degradation and attempted to tackle the symptoms rather than the causative factors.

The complex and dynamic nature of river ecosystems require a comprehensive strategy following a system-based approach, recognizing physical, biological, ecological, socio-economic, and political aspects of the river and human systems which are intricately interconnected. The newer science of river management calls for integration and involvement of allied multidisciplinary subjects *viz*., geomorphology, hydrology, climatology, landscape ecology, hydraulic engineering, forestry, and aquatic and terrestrial ecology besides social sciences. 'River Restoration' is now a common response to declining river health and its importance to water resource management can only be expected to grow. River restoration has been defined as 'assisting the recovery of the ecological structure and function in a degraded ecosystem by replacing lost, damaged or compromised components and re-establishing the processes necessary to support the natural ecosystem and to improve the ecosystem services it offers'. The concept of river restoration has been evolved over the time and it is different than other terms *viz.,* 'Rehabilitation', 'Remediation', 'Reclamation', 'Replacement', 'Rejuvenation', 'Mitigation', etc. used in the context of river management.

Rivers are complex mosaic of habitat types and environmental gradients and characterized by spatial complexity and four types of connectivity (i.e., longitudinal, vertical, lateral and temporal). Hence, rivers are increasingly investigated from a landscape perspective, both as 'landscapes' in their own right and as 'ecosystems'. A landscape perspective of streams and rivers has emerged and the riverine landscapes are viewed as 'Riverscapes'. The concept of riverscape is used to describe the broad scale physical, biological and aesthetic nature of rivers as the riverscape approach integrates the elements of flowing water and surrounding lands those have been imperiled by human activities. The notion of riverscape is applied across multiple hierarchical scales as it recognizes a stream or river, its floodplain, and riparian area as an integrated ecological unit.

Preparation of DPR on Forestry Interventions

Restoration of Chenab 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.

The 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 the larger objectives of management of river ecosystems considering the criss-cross linkages between aquatic, biological and physical environments. The project basically aims at improving the aims of the river flow regime, increase in the environment flow (i.e., e-flows), habitat enrichment, biodiversity conservation, and improvement of the ecological and aesthetic attributes and generation of more avenues and opportunities for sustainable livelihoods. The project is set to adopt a multi-sectoral, multi-pronged, inclusive and holistic approach for proposed Forestry Interventions to fulfil the twin objectives of maintaining the constant and clean flow of water in the rivers as per the *Aviral dhara* and *Nirmal dhara* concepts under *Namami Gange* programme of NMCG.

Goals and Objectives

1. To review and assess the existing situation of river basin, past river management and implications and lessons learned,
2. To identify and involve stakeholders and build consensus for design and development of strategies and approaches,

3. To assess ongoing forestry activities of the state/UT engaged in the river management programme(s).
4. To assess potential and possibilities for regeneration, improvement, and restoration of forest catchments,
5. To assess the conditions of riparian forests and potential of biological filters,
6. To examine the possibility of allied and other income generation activities,
7. To assess the potential of cultivation of medicinal plants and restoration of conservation areas and identify appropriate species and suitable sites,
8. To identify research and monitoring needs and develop a strategy for future research and monitoring, and
9. To formulate strategies, develop approaches, and plan activities for project implementation.

The Chenab Riverscape

Nature is complex to comprehend and so are the interrelationships which exist between the different ecosystems. Rivers not only represent the most diverse ecosystems right from their origin up to the merger with the ocean, but also exhibit tremendous heterogeneity and complexity with the surrounding environments all along its course. The rivers passing through the terrestrial landscape displays longitudinal, lateral, hyporheic and temporal dimensions. Rivers and streams are like long ribbons of aquatic habitat, and inherently difficult to study. It is quite essential to have a continuous view of entire spatially heterogeneous scene of the river environment for effective research and conservation of river ecosystems. Any attempt aiming at the river conservation and restoration of river needs to appreciate and comprehend the river ecosystem in its entirety, and also requires to take into consideration the interconnectedness between the river with its surrounding lands as well as impacts of human influences on the river ecosystems. The quantity, function and ecology of water changes as it move from watershed to river. Riverscapes are interactive and open systems which are characterized by high levels of natural disturbances and interconnected ecotones. The riverscape and river share the sheet of water which covers the land in whole or in part, permanently or intermittently. The riverscape is that part of a landscape where the runoff water erodes the soil of the catchment and leads to sedimentation in river bed and sea. Thus, Potamology -The science of rivers underpin the various fluvial and ecological processes and emphasize on the riverine landscape perspective of rivers. Thus, the concept of riverscape indicates a holistic approach linking the rivers and its banks, or the riparian areas. Consequently, the 'Chenab Riverscape' area has been selected on a scientific basis and boundaries of the riverscape have been delineated for the purpose of planning, assessment and proposed Forestry Interventions.

The Chenab River is a trans boundary River and its catchment area/basin is spread across the state of Himachal Pradesh and J&K UT and extended up to Pakistan (Fig. 1.3). As far as the

mountainous state of Himachal Pradesh and the newly created J&K UT are concerned, the catchment area of Chenab is 7755.44 km^2 and 21571.03 km^2, respectively. The entire catchment area of the Chenab River and its tributaries falling in the state of Himachal Pradesh and J&K UT has been included for delineation of the riverscape (Fig. 1.4). Thus, the larger portion of the delineated Chenab River i.e., 73.55 % lies in the J&K UT and 26.45 % area of the riverscape falls in Himachal Pradesh (Table - 1.1).

Table: 1.1 - Riverscape Area of Chenab River

STATE/UT	**Geographical Area (Km^2)**	**Geographical Geocordinates of Delineated Chenab Riverscape**		**Area Included in the Chenab Riverscape (Km^2)**	**Representative Area in the Riverscape (%)**
		Latitude N	**Longitude E**		
Himachal Pradesh	55,673	32° 02' 41.741" N to 33° 17' 00.592" N	76° 16' 50.347" E to 77° 46' 35.393" E	7755.44	26.45
Jammu and Kashmir UT	55,258	32° 24' 08.143" N to 34° 15' 04.169" N	74° 06' 21.099" E to 76° 44' 08.721" E	21571.03	73.55
Total	**1,08,931**	--	--	**29326.47**	**100**

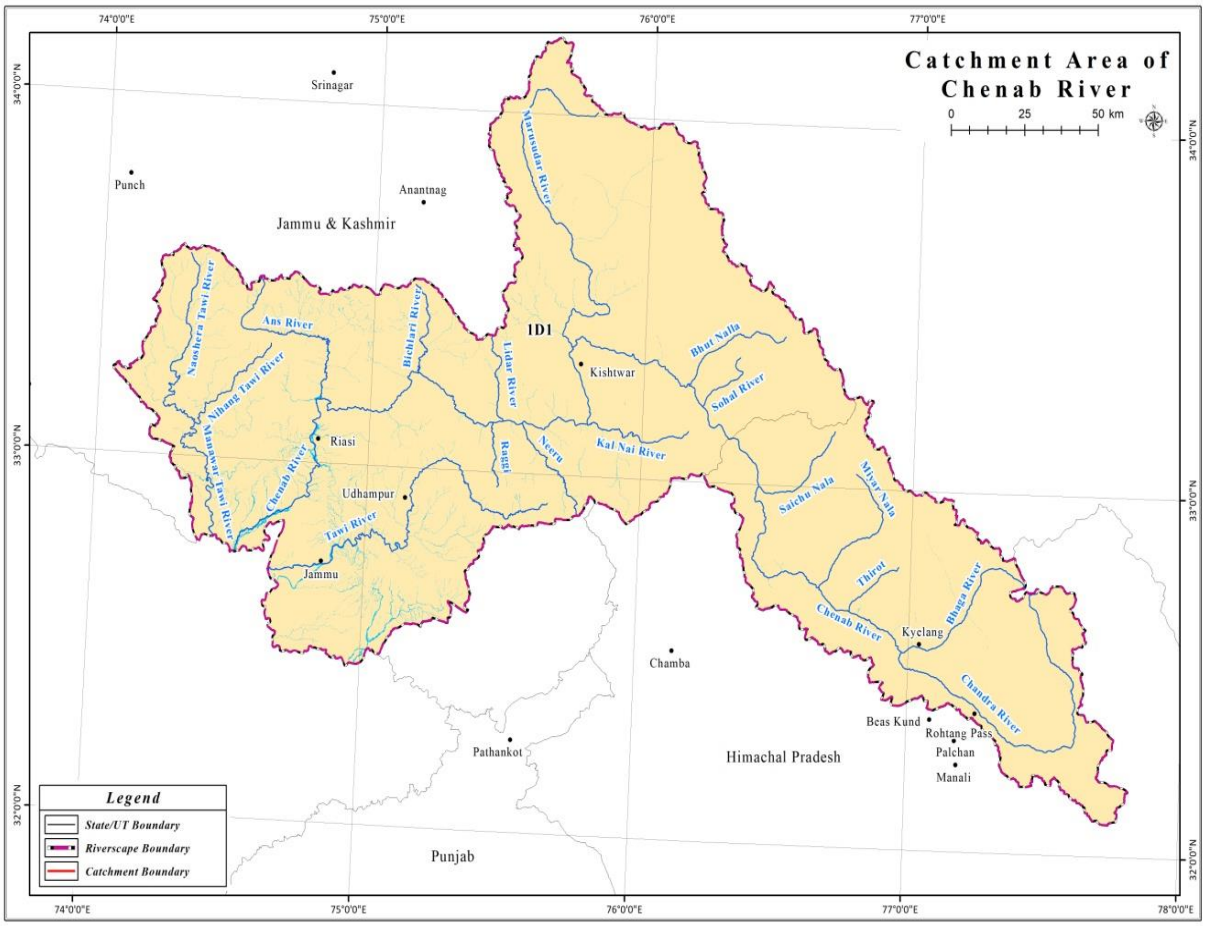

Fig. – 1.3 Catchment Area of Chenab River

Fig. – 1.4 Chenab Riverscape (Pangi Valley), Himachal Pradesh

The management of water resources or more specifically river management is a herculean task shrouded with many ambiguities and uncertainties. River managers face a wide array of challenges and multiple problems posed by multiple stakeholders with competing needs and variety of issues. Thus, river management involves the interdisciplinary approach seeking collaboration from multiple sectors and pooling of individual knowledge/ skills for the overall benefit of the river ecosystems. The multidisciplinary approach recognises the past management practices, drivers of change in flow regime, factors responsible for ecological decline, and strengthening of the legal framework for restoration of rivers. Thus, the important integrated approach of river management entails the interplay of various traditional disciplines e.g. hydrology, fluvial geomorpholgy, and aquatic ecology with the river science. As the river act as a system of strongly connected components, so the more sophisticated and complex discipline of river management involve both active and passive management measures/practices including the physical changes in the natural infrastructure (riverine corridors and catchments) and policy level interventions for restoration of rivers.

Preparation of Detailed Project Report (DPR)

The Approach

During field level investigation of the project, HFRI followed a multi prolonged and multi-stakeholder oriented extensive consultative approach for preparing the DPRs of the five tributaries of Indus River Basin (i.e., Chenab, Jhelum, Ravi, Beas and Sutlej). The preparatory phase included review of literature, primary and secondary data collection and analysis. Expert consultations and inputs from the wide range of stakeholders (policy and decision makers; relevant authorities; scientific organizations dealing with environment, forestry, wildlife; civil society; non-governmental organizations and related interest groups) were recorded (Fig. 1.5).

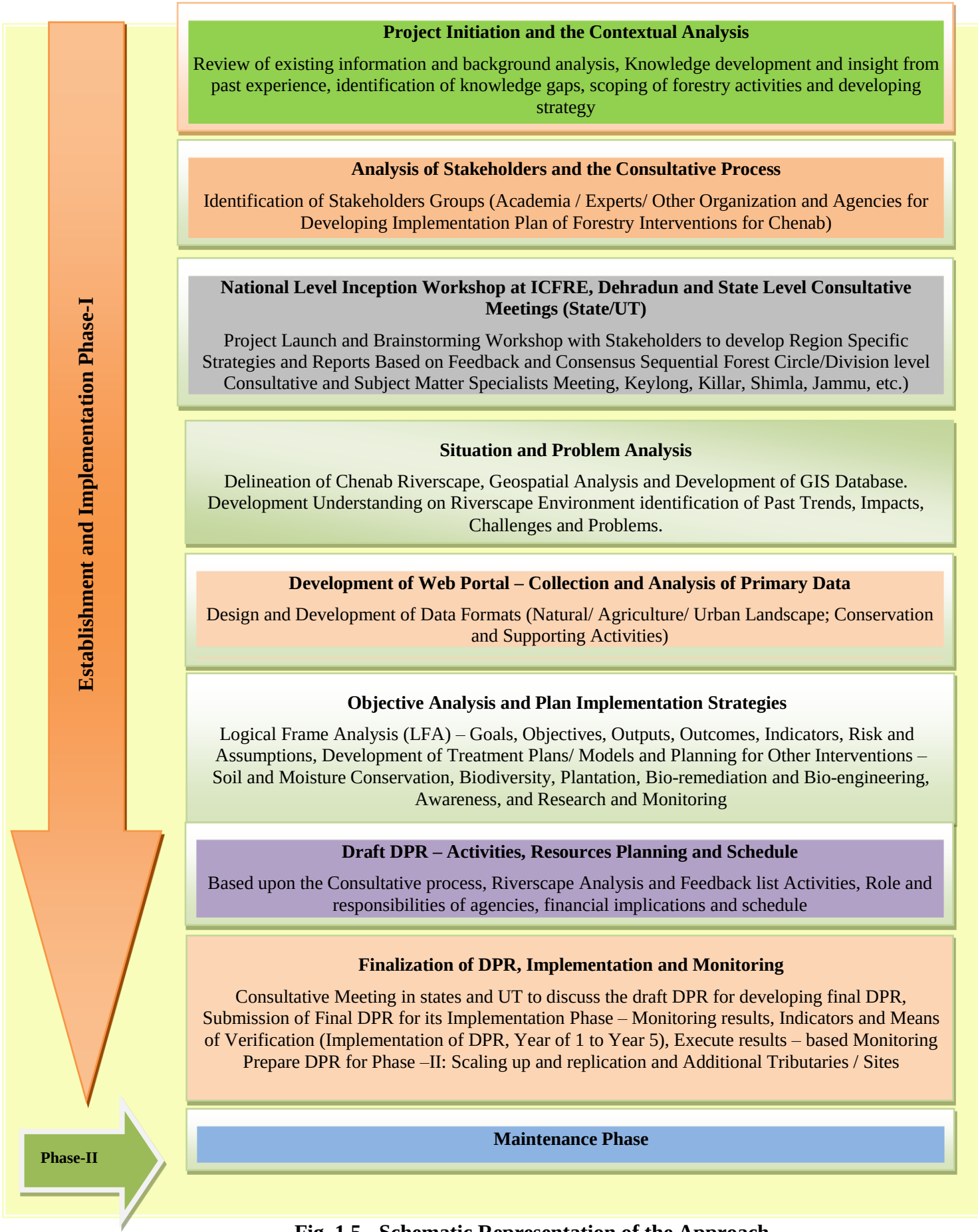

Fig. 1.5 - Schematic Representation of the Approach

Contextual Analysis: All 'Change processes' of the exercise formed a part of wider context impinging upon the very objectives of the project itself. As per the issues highlighted, the project on Forestry Interventions for rejuvenation of the Chenab River is constantly influenced by economic, social and political processes otherwise forming an integral part of the society also. The project planners and implementers accordingly sought inputs/information about the overall picture or the environment, including technical, national and sectoral information. Activities under the said project started with an overall preliminary study (pre-study), and feasibility study forming its inception phase. The pre-study involved the understanding and assessment of project's external environment by collecting information about various related sectors, states and organization's involved as well as the primary data that existed about the target disciplines, sectors, themes, etc.

Further, it was also realized that understanding the complex and dynamic nature of a river ecosystem and its linkages with the forests and other surrounding lands requires adequate knowledge of relevant multi-disciplinary subjects and application of various technologies. It is beyond any doubt that there is a lot of literature on the wider subject of river ecology and management besides a long historical perspective on the management of the Chenab River. Thus, the foremost and 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 consultations. The websites of prominent international, national, state level agencies and organizations dealing with any of the aspects related to river resources and conservation approaches 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 efforts 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 Chenab Riverscape and its physical, biological and socio-economic sub-environments.

Consultative Process: The second vital step for planning, assessment and preparation of DPR required broader participation of stakeholders at all stages of planning of the project activities. Broadly five groups of stakeholders were identified: (a) the Target group (i.e., primary and secondary target groups and beneficiaries); (b) Project owners; (c) Decision makers; (d) Experts and subject matter specialists; and (e) Financing agencies. The preparatory phase included the extensive consultative process with identified groups of stakeholders right from the beginning. The Inception Workshop, Project Launch and Brainstorming Workshop, sequential Consultative Meetings and Subject Matter Specialist (SMS) were organized at the State, Forest Circle/ Division level in concerned State and UT so as to make the State and UT Forest Departments, other line agencies and other stakeholders aware about the project, the approach, field data formats and support required from them so as to achieve the objectives of the preparatory phase. During the Consultative Meetings, a wide range of themes *viz*., the concept of riverscape, delineation of riverscape boundaries, strategies for project implementation, collection of primary field data, data formats, geospatial analysis of riverscape, prioritization of sites, potential plantation and

treatment models, monitoring, etc. were deliberated. Field functionaries were provided adequate trainings on collection of field data and filling of prescribed formats during sequential Consultative Meetings.

Situation and Problem Analysis: The third key step in the process of preparation of DPR was to delineate the Chenab Riverscape for the purpose of planning, situation and problem analysis thereby, 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/UT and Forest Circle levels provided the much desired insight on the issues pertaining to the Chenab River basin and its tributaries, terrestrial and aquatic biodiversity, past management, associated states, 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 Chenab Riverscape. 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/ State level agencies/ Departments, Scientific Organizations and Universities) allowed developing an understanding on the riverscape environment (i.e., physical, biological, and socio-economic) and identification of challenges, constraints, problems, and threats in river conservation. The situation analysis facilitated developing an insight on state specific challenges and threats for Himachal Pradesh and J&K UT wherein the river flows which depicted contrasting situation owing to large variations in the physical, biological and socio-economic sub-environments. In fact, the extensive consultative process and the sequential meetings with varied stakeholders definitely helped in the identification and focusing on the main problems in the concerned State and UT in context with the Chenab River, besides comprehending the varied reasons/ causes, and effects or implications of river degradation on the surrounding lands.

Development of Web Portal - Collection and Analysis of Primary Field Data: Outcome of the Consultative Meetings in the concerned State and UT, developed an insight into the hierarchical organizational structure of the State and UT, and river basin including the Forest Department, which has also been identified as the Nodal Agency for the purpose of planning and implementation of DPR. The present project has envisaged collection of primary field data for the entire Chenab Riverscape course with the support and involvement of Forest Department, Agriculture Department and other Line Agencies of concerned State and UT. Prior to the collection of primary field data, the essential requirements revolved around the development of plantation and treatment models, design of field data formats and software for analysis of the field data.

Plantation and Treatment Models: The multi-disciplinary expertise available at HFRI, Shimla became quite useful to the executing team, and was utilized in developing suitable plantation and treatment models for the proposed forestry and other conservation interventions in three types of landscapes visualized in the Chenab Riverscape. These interventions included the relevant natural, agricultural and urban landscapes. Considering

the kind of natural ecosystems, local flora, soil conditions and agro-climatic zones, and models of various kinds of plantations have been recognized, designed and developed by the institute professionally for implementation under the DPR. The process behind the various models proposed within the natural landscapes primarily revolved around protection, eco-restoration and conservation. Thus, applicable activities have been planned and proposed with equally diverse models.

Details of those potential models on Forestry Interventions and particular treatment plans were also sent to the concerned State and UT for selection and to propose suitable changes and adjustments, if necessary, based totally on the relevant information, and experience. Total 21 different treatment models applicable to the natural landscapes have been developed and recommended to the concerned State and UT of Chenab River, out of which 8 treatment models are for the Himachal Pradesh and the remaining 13 models are for the J&K UT for field application in the respective region.

Similarly, 4 treatment models (boundary plantation and block plantations) have been envisaged for Agricultural Landscapes in the concerned State and UT. Likewise, considering Urban Landscapes all along the Chenab and its tributaries, two treatment models *viz.*, (i) River front development; (ii) Institutional plantation have been for Himachal Pradesh State and four models focusing on (i) Bio-remediation and Bio-filteration; (ii) River front development; (iii) Institutional plantation, and (iv) Eco-park development for the Urban landscapes under Chenab Riverscape in the J&K UT.

Design of Field Data Formats: The Institute adopted and modified five field data formats earlier designed and developed for the Ganga River DPR. Modified data formats were used in the present exercise for collection of primary field data required for the preparation of DPR. The details of five data formats, and the procedure to be adopted were shared with stakeholders, particularly the forest officials and frontline staff during the consultative process, so as to seek their valuable contribution in collection of primary field data, a prerequisite for the preparation of DPR.

Development of Software and Web Portal: In order to handle a large and voluminous data sets efficiently, better collation, analysis, and synthesis of the required information for report generation and preparation of DPR in a short time available, development of a desired software and web portal were considered essential. The software was developed in PHP/ Mysql, server Linux based that works on Codeigniter Framework basis. It is web based and easily accessed via internet. The software can compute cost calculations according to selected specified models for unlimited created models. In the software, field data can be entered as per the five specified types of models, *viz*., natural landscape, agricultural landscape, urban landscape, 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 and UT 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.

The Forest Departments (FDs) of concerned State/UT provided a total of 1169 data sets. The State Forest Department (SFD), Himachal Pradesh provided in all 149 formats belonging to two Forest Divisions while the Forest Department of J&K UT provided 1020 data formats represented by fourteen Forest Divisions. Out of total received formats, nearly 19.16 % datasheets were meant for proposed interventions in natural landscapes while 8.21 % data forms were proposed for plantation activities and other treatments in agricultural landscapes. Rest of 72.63 % data forms were meant for proposed activities in urban landscapes, conservation interventions and supporting activities.

Objective Analysis and Strategic Planning: The extensive consultative process 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 in the project can contribute to in the longer term and why is the project important for the society, biodiversity and the river ecosystem. In the process, the HFRI team was able to decide the goals, objectives, outputs and outcomes that can be attained. The consultative process gave desired insights on the problems in achieving various objectives and identification of priority actions for restoration of the river. The process also facilitated in formulation of the strategies for programme implementation. Accordingly, it was decided that the programme implementation has to be concurrent in natural, agricultural and urban landscapes within the riverscape. Further, a variety of conservation 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 the HFRI in the preparation of DPR presenting the details of proposed activities, resource planning and year-wise schedule of operations. The DPR (Vol. I and II) was shared with the concerned State and UT, FDs, line agencies and other stakeholders in the State and UT through the National Level Consultation Meetings seeking their feedback and valuable inputs. Copies of the draft DPR were also submitted to the ICFRE, Dehradun 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 concerned State and UT, FDs, ICFRE and the MoEF&CC. The Phase I – i.e., Project implementation has been planned for duration of five years by respective State and UT and FDs 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 – 'Maintenance Phase' of five years duration would be executed after the implementation of Phase I, primarily with the objective to maintain plantations raised in three types of landscapes and planning for scaling up the replication of activities in the left over tributaries.

Organization of DPR

The DPR for Chenab River is presented in two Volumes i.e., Volume I and Volume II. The Volume-I deals with the main DPR while the Volume-II provides summary of Concerned State and UT (i.e., Himachal Pradesh and Jammu and Kashmir UT) located along the course of the river.

The Volume-I comprised of total 8 chapters. The first two chapters provide detailed insight about multi-dimensional river ecosystems highlighting the evolving concepts of river ecology, past conservation and management initiatives, existing problems of river ecosystem and needs of river restoration, riverine landscape or 'riverscape', and linkages between forests and water/ river. In addition to this, the chapters also give a broad idea about the basis of the DPR preparation, Logical Framework Approach (LFA), vision, goals, objectives, and expected outcomes of the project. The remaining six chapters emphasizes upon the policy, legal and institutional context, exhaustive consultative process undertaken during the preparatory phase, role of Implementing Agencies (IA)s and stakeholders, approach and methodologies, proposed Forestry Interventions, implementation mechanism, project budget, and potential benefits of envisaged Forestry Interventions. More precisely, these chapters include detailed account of envisaged Forestry Interventions by highlighting proposed plantation and treatment models, conservation interventions and supporting activities; project management, partner organizations and implementation mechanism; project budget outlay, extent of proposed activities and schedule; and potential benefits of planned Forestry Interventions. The Volume II incorporates summary of concerned State and UT.

Chenab Riverscape and its Environment

A river is more than just the water inside it and water is only one component of the intricate and dynamic river ecosystem. The overall environment of a river is sum reflection of physical regime-climate, geology, topography and land cover; biological attributes- (i.e., terrestrial and aquatic biodiversity); and the socio-economic conditions in the surrounding lands of the river or beyond in its catchment.

The ecosystem based approach to river management as a prerequisite seeks appreciation and understanding of the physical, biological and socio-economic sub-environments of the river. The fluvial processes, hydrological regimes, and ecological processes are vital driving forces of the river ecology. Four types of connectivity are of paramount importance for the sustainability of river ecosystem. A dynamic river from source to sea reflects varied interconnectedness, intricacies, heterogeneity, and channel dynamics besides longitudinal changes, vertical interactions, lateral exchange processes, temporal variations, and the resultant spatial patterns in the overall environment in the river and its surrounding lands.

The Chenab Riverscape has been delineated or selected for the purpose of proposed Forestry Interventions on the basis of consensus emerged from the exhaustive and extensive consultations with various stakeholders. An area of 29,326.47 km^2 falling in the State of Himachal Pradesh and J&K UT has been selected for the purpose of proposed Forestry

Interventions. Thus, the area under consideration of this delineated Riverscape constitutes the total catchment area of the Chenab River Basin within India.

Presently, the Chenab River reflects fragmentation, decreased connectivity, reduced e-flow, enhanced pollution, and declined aquatic and terrestrial biota, diminished ecosystem services, and overall poor health of the river.

Legislative and Policy Context

The rivers are inherently and intricately linked with forests, wildlife, surrounding lands, and people. Hence, the subject of conservation and restoration of river ecosystem is quite complex. In the 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. Despite considerable concerted efforts made, much needs to be done so as to effectively and efficiently manage rivers and other freshwater resources pivotal for human well-being and sustainable development. The cumulative environmental impact assessment and carrying capacity studies commissioned in the context of prominent rivers are a welcome step. However, maintaining essential e-flow and four types of connectivity in the context of a river are challenging tasks.

Certainly, the Indian Forest Act, 1927; Wildlife (Protection) Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act, 1980; Environment (Protection) Act, 1986; and Biological Diversity Act, 2002 besides some of the provisions – namely, 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 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 Chenab River from the perspective of river water settlement, use and obligations as it is one of the 'Western Rivers' listed under the Treaty.

Implementing Agencies and Institutional Context

It is important to comprehend the various accountable institutions and agencies controlling the land, the protection of forests and wildlife. This helps in the engagement of right authorities or agencies in conservation of the rivers. Comprehensive information have been

given in the particular sections of the DPR about the different Government and Non-Governmental Agencies at the Centre and State levels besides diverse stakeholders and the Civil Society which are involved with the prominent disciplines/ sectors of forest management, wildlife conservation, environmental management, water resource management, river development and restoration of rivers in the country. The Chapter 3 - on the Chenab riverscape and its environment of the DPR elaborately describes the composition and complexities of sub-environments and delineates the various factors directly or indirectly involved for keeping the river clean and healthy. The Union Ministry of Jal Shakti (MoJS) and the Ministry of Environment, Forest and Climate Change (MoEF&CC) at the centre are the two prominent ministries which are directly concerned with the restoration of rivers and water resources of the country. The present DPR has envisaged the Ministry of Environment, Forest and Climate Change (MoEF&CC) as the Nodal Agency for overseeing and steering the programme implementation; the ICFRE, Dehra Dun and its institute i.e., HFRI, Shimla as the National Partner Organization for capacity development and monitoring; and the crucial role is to be performed by the concerned Forest Departments of the State and UT as the Primary Implementing Agencies.

The MoEF&CC at the centre is the Nodal Ministry responsible for the planning, promotion, coordination and overseeing the implementation of country's environmental and forestry policies and programmes aiming for sustainable management of wide range of natural ecosystems (i.e., forests, grasslands, wetlands including lakes and rivers, coastal, and marine), associated biodiversity, ensuring the welfare of animals, and the prevention and abatement of pollution. While implementing various policies and programmes related to forests, environment and wildlife, the Ministry is guided by the principle of sustainable development and enhancement of human well-being. The Ministry also serves as the Nodal Agency in the country for the United Nations Environment Programme (UNEP), South Asia Cooperative Environment Programme (SACEP), and International Centre for Integrated Mountain Development (ICMOD), and for the follow up of the strategies and programmes of the United Nations Conference on Environment and Development (UNCED). The Ministry is also interested in the important tasks related to; multilateral bodies such as the Commission on Sustainable Development (CSD), Global Environmental Facility (GEF), and of regional bodies like the Economic and Social Council for Asia and Pacific (ESCAP) and the South Asian Association for Regional Cooperation (SAARC) on matters related to the environment, and implement programmes related to various international conventions *viz*., the United Nations Convention on Biological Diversity (UNCBD), United Nations Convention on Combat of Desertification (UNCCD), United Nations Framework on Climate Change (UNFCC), Ramsar Convention on Wetlands, Convention on Control of International Trade in Endangered Species of Wild Fauna and Flora (CITES), etc. for which the country is signatory and thus, committed. Till recent past the MoEF&CC also dealt with the various programmes and activities related to river Ganga *viz*., the Ganga Action Plan, National Ganga River Basin Authority (NGBRA), and National Mission for Clean Ganga. These subjects and activities were transferred to the Ministry of Water Resources (presently Ministry of Jal Shakti) with its broad mandate. The MoEF&CC is supported in its mandate, functions and responsibilities by wide range of Authorities, Agencies, Organizations/ Institutions and Sub-ordinate offices.

The Indian Council for Forestry Research and Education (ICFRE), an autonomous council under the MoEF&CC is supported by nine institutes and six advanced Research centres in performing the wide range of forestry related activities across the country which include conduct of research; transfer of innovative technologies in the field of forestry relevant to the different biogeographic regions of the country to the States and UTs and other agencies; and to impart forestry education. The Himalayan Forest Research Institute (HFRI), Shimla is one of the institutions under the umbrella of ICFRE and mandated to generate, preserve, disseminate advance knowledge, technologies and solutions for addressing issues arising out of interactions between people, forests and environment on a sustained basis through research, education and outreach and the specific goal of contributing research relevant to the conservation of North Western and Western Himalayan forests and forest ecosystems. The HFRI has been working in Himachal Pradesh State and UTs of Jammu & Kashmir and Ladakh. The MoEF&CC has entrusted a major task to ICFRE on the preparation of DPRs on Forestry Interventions for rejuvenation of major Indian rivers. Considering the expertise and appropriate location of HFRI in the Himalayan State of Himachal Pradesh, the ICFRE assigned the responsibility of preparing the DPR on the Chenab River along with DPRs of four other rivers of the Indus River system. The HFRI with its expertise in the field of forestry relevant to the Trans, North western and western Himalaya, multi-disciplinary scientific staff including practising professional foresters, well-placed vast campus amidst deodar forests and adequately equipped various laboratories and other physical infrastructure is the most appropriate scientific agency not only for the preparation of present DPR, but for its effective implementation, capacity development and monitoring through the Forest Department(s).

River Conservation and Restoration

Need for Research, Monitoring and Knowledge Management Centre

The subject of river conservation and restoration is multifaceted. A large number of organizations at the National and State levels are responsible for river management. Often, they work in isolation. Available research and monitoring information on rivers is widely scattered and in several instances obsolete and archival in nature, piecemeal, relevant to specific tributaries/ segments/ stretches of a river. Under the stated situation, it is difficult to develop a comprehensive understanding of complex inter-relationships of dynamic river ecosystems. The review of available literature highlighted that there are substantial gaps in the information and overall understanding on the river complexities. Several agencies are involved in diverse monitoring activities concerning river ecology. In spite of notable efforts made for quite some time, India faces enormous challenges in the field of river conservation and restoration. Certainly, the formidable task of restoration of major Indian rivers is challenging. It essentially requires the desired knowledge and technical know how to deal with the intricate discipline of river ecosystem. There is a felt need to improve, strengthen, and augment knowledge. Research and monitoring are pivotal to develop the desired information base for evolving strategies besides facilitating policy and decision making.

Regrettably, understanding on interrelationships and dynamic linkages between forests/ forestry with hydrology and river ecology has been ignored in a populous country wherein more than a dozen major river systems including mighty Himalayan Rivers exist. There is an urgent need to develop a knowledge management centre in the fields of forest hydrology, river conservation and river restoration. Numerous rivulets, tributaries, and rivers suffer on account of pollution. Several countries have taken a lead in developing appropriate tools and techniques such as bio-remediation and bio-filters so as to treat polluted waters. However, much needs to be done in India in this grossly neglected field. In view of this, the present DPR envisages establishing a Knowledge Management Centre in the fields of forest hydrology, river conservation and river restoration besides support for multidisciplinary researches and monitoring activities relevant to priority disciplines/ fields.

The HFRI, Shimla with its long standing, multidisciplinary team, well laid infrastructure and expertise in the field of Himalayan environment, forestry, natural resource management, climate change, etc. is suitably placed and visualized to develop as the Knowledge Management Centre for the above stated purpose.

Project Components and Proposed Interventions

The Plan envisages four broad goals

- **Riverscape Management:** Aims a holistic riverine landscape (riverscape) approach for sustainable management of the Chenab River, its banks, or its riparian areas, within its fluvial system.
- ***Aviral Dhara, Nirmal Dhara,* Ecological Restoration 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.
- **Improved Ecosystem Services and Sustainable Livelihoods:** This goal aims to specifically seek enhanced ecosystem services so as to maintain sustainable livelihoods.
- **Effective Implementation, Knowledge Management, and Innovative Approaches:** This goal aims to ensure effective implementation of the project, knowledge management, development of innovative approaches, and adoption of appropriate modern technologies.

The Project Components and Proposed Interventions

Component 1: Implementation of Forestry Interventions in the Concerned State and UT along the Riverscape - The Component 1 of the Project deals with the proposed Forestry Interventions in concerned State and UT along the course of river and includes three sub-components: (i) Forestry Interventions in three lower order sub-zones *viz*., (a) Natural Landscape (NL), (b) Agricultural Landscape (AL), and (c) Urban Landscape (UL) adopting appropriate plantation treatment models; (ii) Conservation Interventions; and (iii) Supporting Activities.

Component 2: Strengthening Knowledge Management and Capacity Development for Forestry Interventions and Conservation of Riverscape - India lacks desired experience in restoration of rivers as it is relatively an emerging discipline for the country. However, efforts

are on in this direction. Positive outcomes from any such efforts aiming towards river restoration or river conservation are unlikely unless evidence and science based holistic strategies are actively involved in planning, assessment, management and development of rivers and policies relevant to river conservation and restoration. Thus, this component 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 approach involving active participation of stakeholders. The HFRI, a reputed and established learning seat is envisaged to serve as the Knowledge Management/ Learning Centre and to undertake concurrent research related activities essential for conservation and restoration of the Himalayan Rivers. It also plays a pivotal role in building desired national capacity for demonstrating the strong linkages between diverse forests in the Himalaya and rivers ecosystems. This component specifically seeks activities relevant to policy, advocacy, outreach, monitoring, evaluation, and capacity development.

Component 3: Scaling Up, Replication in Additional Sites and Maintenance Phase - The present DPR focuses on the programme implementation on the select tributaries, particularly once the river descends in the plains. This component plans to support the scaling up and replication of planned efforts in additional sites/ tributaries besides primarily supporting the maintenance phase of plantations raised during the Phase I – i.e., Implementation Phase.

Component 4: National Coordination for Forestry Interventions and Riverscape Conservations - In general, a major river involves two or more States and UTs in its basin. Thus, programmes related to river management and restoration requires National level coordination for proposed Forestry Interventions and various conservation efforts among the participating State and UT located along the course of the river. As such, the MoJS is the Central Nodal Ministry for all aspects of management of water resources including river development and restoration of the rivers. However, several other Ministries are also involved for specific components/ needs. This component envisages National level coordination for Forestry Interventions and river restoration and visualizes varied activities *viz*., policy and legal interventions, riverscape level coordination, programme implementation, monitoring and impact evaluation besides extending support for the finances required for the project execution.

Strategies

The riverscape is a mosaic of varied land uses and it includes: (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 situations, and varied use patterns, ownerships and management needs. Hence, three broad land use categories within the riverscape have been referred as the ‘Natural’, ‘Agricultural’, and the ‘Urban’ landscapes. These three landscapes immensely influence the intricate and vibrant nature of the Chenab River ecosystem, especially the environmental flow, water quality, and aquatic biota besides terrestrial biodiversity in surrounding lands, and the various ecological processes of the *lotic*

system. Thus, 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 execution. As a part of the broader strategy, zoning within the Riverscape is visualized keeping in view three distinct landscape categories and specific targeted Forestry Interventions are being planned in each of the zone.

- **Natural Landscapes –** The 'Natural Landscapes' constituted the largest zone as various categories of land use/ land cover of the natural environment. Altogether, 21 models/ treatment plans focusing on forests, grasslands and wetlands have been proposed in various prioritized sites based on geospatial analysis. Proposed interventions focus on protection, soil and moisture conservation works, control of invasive and alien species, plantations, eco-restoration, etc.
- **Agricultural Landscapes –** The second lower order zone (the Agricultural Landscapes) largely in the rural environment all along the main channel and its tributaries constitutes the matrix of the Riverscape, predominated by agriculture and horticulture crops mainly on private lands. The purpose of this zone is to promote planting of economic and fruit trees so as to enhance the overall conservation values, and other expected ecological functions and ecosystem services. In all, different 04 models in Agricultural Landscapes have been proposed.
- **Urban and Peri-urban Landscapes –** A large number of settlements, towns and cities exist all along the course of the main river and its tributaries. A substantial proportion of the Riverscape is thus constituted by the urban/ built-up environment. Proposed interventions in the third lower order zone i.e., the urban landscape include activities related to development of riverfront, eco-park, institutional plantations and avenue plantations. Altogether, 06 models in the concerned State and UT have been proposed for the stated purpose.

Theme Plans: In addition to the above**,** the activities common to two or lower order zones are being referred as the Theme Plans. The theme based activities are broadly grouped in 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 agency 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 I deals with project implementation while the Phase II primarily focuses on the maintenance of plantations established during the Phase I. 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.1.6).

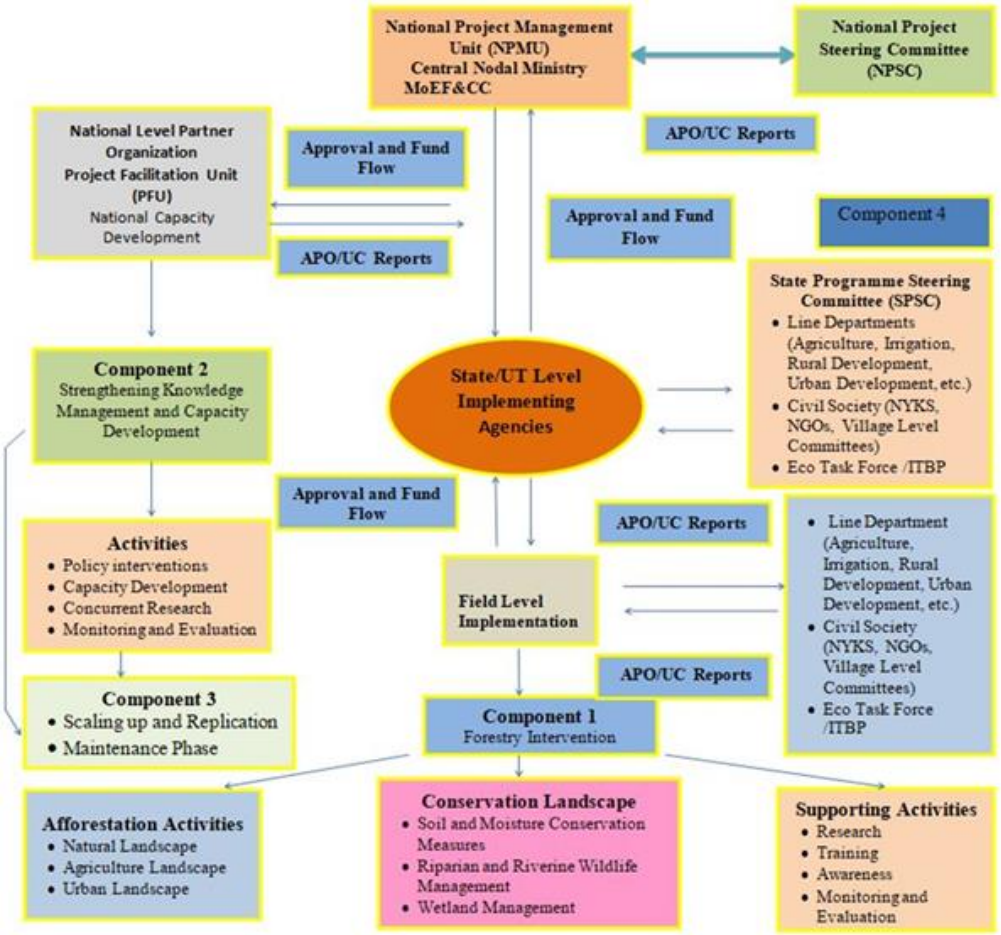

Fig. 1.6-Schematic Representation of the Project Implementation

Project Budget

The projected financial outlay of the Phase I on Project Implementation of five-years duration is Rs. 318.17 Crore. The projected budget outlay of Phase II (i.e., Maintenance Phase) of five-years duration is Rs. 58.10 Crore. As stated earlier, the project included four broad based components. Accordingly, financial cost of each of these four components is summarized below:

Principal Component - A on 'Implementation of Forestry Interventions' in concerned State/UT of the riverscape amounts to Rs. 310.77 Crore or represents 82.59 % of the overall project budget.

Component – A, the Sub-component 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. Amongst three landscapes, the obvious emphasis is on Natural Landscapes. Thus, a sum of Rs. 144.10 Crore has been provisioned for proposed afforestation/ reforestation activities in Natural Landscapes, both in the mountainous State of Himachal Pradesh as well as in hilly and plain regions in Jammu region of J&K UT, under the delineated Chenab Riverscape. The projected budget outlay for proposed plantations in Natural Landscapes accounts for 72.45 % of the Sub-component or 38.30 % of the overall project cost. The projected budget outlays for Agriculture and Urban Landscapes are of the tune of Rs. 2.71 Crore and Rs. 52.86 Crore or 1.36 % and 26.58 %, respectively of the envisaged cost of the Sub-component. The second Sub-component on 'Conservation Interventions' includes four major types of interventions/activities. These are: (a) soil and moisture conservation measures, (b) moraine management, (c) riverine and riparian wildlife management, and (d) wetland management. The budget outlay for this Sub-component is Rs. 73.71 Crore and this would amount to 19.59 % allocation of the funds provisioned for implementation of Forestry Interventions in the concerned State and UT. The third Sub-component pertaining to 'Supporting Activities' is to be executed by the two State and UT level's IAs. This Sub-component includes six 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 16.92 Crore or 4.50 % of total funds proposed to involved State/UT has been provisioned for carrying out various supporting activities for five-years period.

Component - B on '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 10.45 Crore or 2.78 % of the overall project outlay. The highest budget amounting Rs. 4.49 Crore has been provisioned for cost of PFU, while budget of Rs. 3.16 Crore has been provisioned for Research and Development, while 1.18 Crores, 1.26 Crore, 1.26 Crore, 0.45 Crore, 0.46 Crore, 0.99 have been envisaged for policy level

interventions, capacity development, Scientific exchange, awareness, Monitoring and Evaluation respectively.

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. 58.10 Crore or 15.44% of the total project financial outlay has been envisaged specifically for the Component – C on 'Maintenance Phase'.

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. 18.20 Crore, representing 4.84 % of the overall budget over a period of five-year during the Phase I has 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 and UT.

Thus, it is amply clear that the major chunk (~82.59%) of project budget outlay is meant for field level activities incorporating proposed Forestry Interventions, conservation interventions and supporting activities to be implemented by involving State and UT Forest Department (HP and J&K UT). The higher proportion of budget allocation to the extent of Rs. 288.06 Crore or 87.39 % of overall budget is meant for the UT of J&K UT considering the fact that a larger extent of the riverscape is located in this mountainous state while a budget of Rs. 41.58 Crore or 12.61% of the total budget has been provisioned for the State of Himachal Pradesh. Altogether, 16 Forest Divisions in participating State and UT will carry out proposed activities relevant to Forestry Interventions within the Riverscape. A total of 16 Territorial Forest Divisions and 4 Wildlife Divisions in the Chenab Riverscape will carry out proposed activities relevant to Forestry Interventions within the Riverscape. A total of 8872.2 ha area of three landscapes, 235 ha area of Riverine and Riparian wildlife management and wetland management and 620860 m^3 extent of soil and moisture conservation in the Chenab Riverscape is envisioned to be treated under the various Forestry Interventions.

Project Budget Outlay - Component/ Activity Wise Budget Allocation

Sr. No.	**Component/ Activity**	**Amount**	**Allocation**
		(Rs. in Crore)	**(%)**
	Implementation of Forestry Interventions in Two States of Riverscape (A1+A2+C1+C3)	310.77	**82.59**
A.1	**Plantations and Treatment Models in Three Categories of Landscape**	**198.89**	
A.1.1	Natural Landscapes	144.10	
A.1.2	Agriculture Landscapes	2.71	52.86

A.1.3	Urban Landscapes	52.08	
A.2	**Conservation Interventions**	**73.71**	
A.2.1	Soil and Moisture Conservation	51.87	
A.2.2	Riverine and Riparian Wildlife Management	19.73	
A.2.3	Wetland Management (Natural and Artificial)	2.11	19.59
A.3	**Supporting Activities**	**16.92**	
A.3.1	Policy Level Interventions	0.16	
A.3.2	Research Activities	1.15	
A.3.3	Capacity Development	5.05	
A.3.4	Awareness	1.77	4.50
A.3.5	Participatory Monitoring	0.74	
A.3.6	Cost of PMUs of Two State Level Implementing Agencies	7.56	
A.3.7	Evaluation	0.45	
A.3.8	Contingency and Miscellaneous Activities	0.04	
B.	**Strengthening Knowledge Management and National Capacity for Forestry Interventions and Conservation of Riverscapes**	**10.45**	**2.78**
C.	**DPR – Phase II (Maintenance phase) Including Scaling Up and Replication of Successful Models of Forestry Interventions**	**58.10**	**15.44**
C.1	Maintenance Cost of A.1 and A.2 (Cost of Phase II)	24.54	6.52
C.2	Maintenance Cost of A.3, B and D	19.93	5.30
C.3	Scaling Up and Replication of Successful Models of Forestry Interventions (5% of A.1 & A.2)	13.63	3.62
D.	**National Coordination for Forestry Interventions and Riverscape Conservation**	**18.20**	**4.84**
	Total Phase I (A+B+D)	**318.17**	
	Total Project Cost (Phase I+II) (A+B+C+D)	**376.27**	**100.00**

Note: In the proposed budget for H P 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 case. 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 Benefit

The potential benefits anticipated from the Forestry Interventions in different Landscapes and Soil and Moisture Conservation measures envisaged in the Chenab Riverscape across Himachal Pradesh and Jammu and Kashmir UT can be projected as given below (Table 1.2).

Table: 1.2 - Potential Benefits from Proposed Forestry Interventions in Chenab Riverscape

Sr. No.	Potential Benefits	Quantity (in 20yrs)	Quantity (in 10yrs)
A)	**Biomass, Carbon Stock, CO_2 Reduction and Carbon Credit**		
1	Biomass Production in Natural, Agriculture and Urban Landscapes (t/ha/year)	2.15	1.72
2	Total Biomass Production from 8,101.40 ha areas of three Landscapes (Tonnes)	17,418.01	13,934.40
3	Contribution to Carbon Stock from 8,101.40 ha areas of three Landscapes (Tonnes)	8,186.46	6,549.16
4	Estimated CO_2 Reduction from Forestry Interventions in three Landscapes (8,101.40 ha) (Metric tonnes CO_2 eq/ha/year)	7.43	5.94
5	Estimated CO_2 Reduction from Forestry Interventions in three Landscapes (8,101.40 ha) (Metric tonnes CO_2 eq/ year)	11,42,537.32	91,4,029.85
6	CO_2 Captured by the three landscapes (8101.40 ha) capable of capturing metric tonnes of CO_2 eq /ha/year	7.43	5.94
7	The expected CO_2 reduction from plantation in (Million tonnes of CO_2 eq.)	1.14	0.91
8	Potential to generate carbon credit from plantation in three Landscapes (Million tonnes)	1.14	0.91
B)	**Water Quality and Quantity**		
9	Water Quantity: Conservation of water through Forestry Interventions (Million Cubic Meter/year)	18.69	
10	Water Quality: Estimated sediment reduction through Forestry Interventions ('000 m^3/Year)	11.59	
C)	**Income generated through NTFPs (in Lakhs)**		
11	The estimated benefit from NTFP's i.e., herbaceous medicinal plants from 8,101.40 ha area of Natural Landscape in Chenab Riverscape after ten years (Rs. in Lakhs) 106.52		
D.	**Man-Days to be Generated**		
12	Generation of Employment from Plantation Activities and Other Conservation Interventions (Total man days in Phase I and Phase II)		92,87,717

*One tones of CO_2eq is one credit or 1 CER. Therefore, the estimated Carbon credit potential for 20 years will be 11,20,000 CER (CER=Certified Emission Reductions) and 8,96,000 CER (Certified Emission Reductions) over a span of 10 Years. ** Assuming 80% of the potential productivity in 10 years

Annexure-I

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

Introduction

The Chenab is a transboundary river and one of the principal tributaries of Indus River System which originates from the Chandertal Lake, situated towards south-easterly side of Bara Lacha Pass at an altitude of 4,891 m amsl in Lahaul and Spiti district of Himachal Pradesh. The Bhaga River, the major tributary of Chandra River originates from Surajtal Lake, in the opposite direction of the Bara Lacha Pass. These two rivers join at Tandi in Lahaul and Spiti, H.P. The Chenab River is also known as Chandrabhaga, the name attributed to the confluence of two streams i.e., Chandra and Bhaga. Chenab is the largest river of Himachal Pradesh in terms of volume of water. From Tandi onwards, Chenab River flows through Lahaul Valley and enters into Pangi Valley of Chamba district near Bhujind and leaves the district at Sansari *Nallah* to enter Paddar Valley of Jammu and Kashmir Union Territory (J&K UT). The Chenab River traverses through the mountainous tract of Himachal Pradesh and J&K UT before it flows out in plains of Punjab in Pakistan. The Chenab River covers a distance of 453 km in India by meandering through narrow valleys, rugged terrain, steep slopes and deep gorges all along its course, and ultimately merges with the mighty Indus River in the form of Punjnad (confluence of five rivers) at Mithankot in Pakistan.

The Chenab River Basin constitutes a major part of the Indus River Basin and covers a vast area of 29,326.47 km^2 in India, of which 26.45% area occurs in Himachal Pradesh (32°05' to 34°15' N Latitudes and 76°13' to 77°48' E Longitudes), and 73.55% area lies in the J&K UT (32°26' to 34°12' N Latitudes and 74°03' to 76°46' E Longitudes). The 'DPR on Rejuvenation of Chenab River through Forestry Interventions' will be implemented by forest department in 20 Forest Divisions (2 Territorial, 2 Wildlife in Himachal Pradesh and 14 Territorial, 2 Wildlife in Jammu & Kashmir UT).

The guidelines for implementation of the DPR are as follows:

- 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 (NPMU).
- State Forest Department (SFD) of Himachal Pradesh and Forest Department (FD) of Jammu & Kashmir UT are the primary Implementing Agencies (IAs). State/ UT Project Management Unit (SPMU) shall be at the Headquarters of SFD/ UTFD headed by Additional Principal Chief Conservator of Forests (APCCF) level official. Implementation will be through the hierarchical structure of Chief Conservator of Forests (CCF) - Conservator of Forests (CF) - Divisional Forest Officer (DFO) of SFDs/UTFDs.
- Other Departments such as Agriculture, Horticulture, Soil Conservation, Revenue, etc.; groups such as Gram Panchayat, Van Panchayat, Non-Government Organizations (NGOs), etc.; and public representatives should be suitably involved in steering, execution and monitoring of the project.
- Separate bank account should be maintained to operate the DPR at divisional level. General Financial Rules (GFRs), other rules/guidelines of government to be followed strictly during implementation.

- A Steering Committee and a Monitoring Committee shall be constituted at National and State/ UT levels.
- The State/ UT level Steering Committee shall meet at least twice a year for approving the (Annual Plan of Operations) APOs and discussing other related issues.
- The SFD/ UTFD would dovetail activities with similar ongoing/ future schemes of various departments through appropriate Memorandum of Understandings (MoUs) for synergy and avoiding duplication.
- Incentives (free quality planting material of fruit or forestry plants and maintenance cost) already provisioned for farmers. Explore possibility of providing more incentives from other schemes in the State/ UT.
- An Execution Manual would be prepared by the SFD of Himachal Pradesh and UTFD of J&K UT in local official language at the start of project implementation in line with DPR recommendations with participation of all line departments specifying roles and responsibilities.
- Native species of trees, shrubs, herbs and grasses will be selected for the proposed treatment models/ plantations. Mixed plantations will be adopted as far as possible instead of monoculture for enhancing plant diversity and greater ecosystem services.
- 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 mycorrhizae 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, NGOs, Institutions and progressive farmers for supply of best quality planting material.
- The budget will be provided after submission of Annual Plan Operations (APOs) for each year. So the prevailing wage rate will be applicable whenever DPR is implemented. Also site can be changed as per the availability of land at the time of implementation wherever required with the permission from the Competent Authority.
- The fencing cost has been calculated on average basis of enclosure of area to the extent of 5 hectare and average carriage lead is taken as 1 km (up & down). Adjustments need to be done in case of variable planting areas and carriage leads.
- 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 Departments of Himachal Pradesh and J&K UT.
- The cost Norms proposed in treatment models 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 State/UT and will not exceed these

Departmental Norms. The suggestive cost models are to create multistoried forest cover for improving the bio-diversity of the area which in turn conserve the water and soil in-situ.

- In *Lantana* eradication models or wherever *Lantana* removal is involved, the Cut Root Stock (CRS) method should be adopted.
- The fencing such as stone wall, barbed wire fencing and bio-fencing must be ensured before planting activities.
- In Fire Protection Model, the area is virtually targeted, 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 State and UT.
- Under Urban Landscapes, 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 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 micro plan and estimates.
- The suggested interventions are to be considered flexible and not rigid, in terms of changing the site location, area, species and minor changes in the models and the applicable schedule rates if the circumstances demand so while implementation of the Chenab DPR and the concerned Conservator of Forests shall exercise the power to approve such changes as and when required.
- The project costs have been worked out on the basis of rate prevalent during 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 Forests may be empowered to revise the project cost accordingly for the quality output of the project.
- Soil Moisture Conservation (SMC) measures and grasses would be given high priority for enhancement of ground water recharge and promotion of favourable conditions for rejuvenation of the entire ecosystem.
- Flexibility is allowed to address the changing stakeholder needs, national, regional or local priorities, and learnings from local knowledge, concurrent experiences and research.
- Best practices of site selection (such as Decision Support System) and treatment of the site shall be adopted. ‘Ridge to Valley’ approach would be followed for treatment of sites in the riverscape of Chenab and its tributaries.

- Divisional Forest Officers (DFOs) will have flexibility on choice of species, site, model, quantity of work, specifications and timing of activities within the total budget proposed in the DPR for the Division.
- APO shall serve as the standard document for Global Positioning System (GPS) location and extent of treatment site for Chenab DPR.
- The cost estimates in models are for guidance and not serve as actual budget for treatment of a site. The rates in force at the time and place would be applicable and reflected in the APO.
- Cost of the project would be adjusted for the actual date of implementation of the project based on Wholesale Price Index (WPI). The expenditure must be restricted to the actual amount sanctioned to the State/UT. In Himachal Pradesh, further 25% hike in wage rates would be applied for Tribal Areas.
- Services of suitable Experts may be used for bio-remediation, eco-park development, river front development, etc. and also for designing SMC structures.
- 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 Department.
- Indigenous species recommended for the Forest Divisions in the DPR in the divisions Working Plan should be used in the natural landscape. Non-timber Forest Products (NTFPs) and other species that support livelihood would be given priority.
- Inhospitable and difficult areas would be identified by SFD/UTFD and assigned to Eco Task Force for treatment as sufficient budget provision is there in the DPR.
- The areas infested with invasive species should be promptly planted with economically useful species.
- Public awareness and participation should be ensured.
- Capacity building activities should be planned for the staff during first year of implementation and there should be continuous skill up-gradation on subsequent years.
- There should be proper Grievance Redress Mechanism (GRM) in place.
- The regular monitoring of project activities should be ensured. Monitoring shall have two dimensions: (i) monitoring of project activities and (ii) monitoring for ecological and socio-economic indicators.

Don’ts

- Without the use of Geographical Information System (GIS) tool no field work should be executed.
- The plantation work should not be undertaken before imparting training to the field staff.
- No work should be undertaken which has negative impacts on environment and society.
- No work should be done which is contrary to environmental laws and policies at National and International levels.
- Invasive species on fragile slopes and extremely harsh sites not be removed *en masse.*
- Exotics should not be planted in natural landscape. If it is very urgent to plant an exotic species, the consent of Competent Authority may be taken.
- Species known to consume large amount of water should be avoided.
- Planting should not be restricted to the listed species in order in the DPR.

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