GOVERNMENT OF BIHAR

WATER RESOURCES DEPARTMENT

ENVIRONMENTAL IMPACT ASSESSMENT
AND
ENVIRONMENTAL MANAGEMENT PLAN
FOR
KOSI-MECHI INTRASTATE LINK PROJECT

JANUARY-2019

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TOR COMPLIANCE

COMPLIANCE TO TERMS OF REFERENCE ISSUED BY MoEF&CC

Sl. No.	TOR Conditions	Remarks
1.	**Scope of EIA Study**	
	The EIA Report should identify the relevant environment concerns and focus on potential impacts that may change due to the construction of proposed project. Based on the baseline data collected for three (3) seasons (Pre-monsoon, Monsoon and Winter seasons), the status of the existing environment in the area and capacity to bear the impact on this should be analysed. Based on this analysis, the mitigation measures for minimizing the impact shall be suggested in the EIA/EMP study.	Agreed. The baseline data was collected for one (1) season only as per section 3 of ToR and accordingly the environmental study has been done.
2.	**DETAILS OF THE PROJECT AND SITE**	
i.	General introduction about the proposed project	General Introduction of proposed project is given in Page No. C1-1 of Chapter-1 of EIA/EMP Report.
ii.	Details of project and site giving L-sections of all U/S and D/S projects with all relevant maps and figures. Connect such information as to establish the total length of interference of Natural River and the committed unrestricted release from the site of Dam/Barrage into the main river.	L-sections of Kosi–Mechi link canal is furnished in Fig.No. C2.2 of Chapter-2. This is an extension of existing canal project. The barrage is already built and river flow is not affected.
iii.	A map of boundary of the project site giving details of protected areas in the vicinity of 25 km of project location	Location (Vicinity) Map of ayacut is given in Fig.No. C3-1, as Annexure-4.
iv.	Location details and map of the project area with contours indicating main project features. The project layout shall be superimposed on a contour map of ground elevation showing main project features (viz. location of dam, Head works, main canal, branch canals, quarrying etc.) shall be depicted in a scaled map.	Location details & map of the project area indicating main project features are given in Fig.No. C2-1 of Chapter-2.
v.	Layout details and map of the project along with contours with project components clearly marked with proper scale maps of at least 1:50,000 scale and printed at least on A3 scale	Layout Plan is given in Fig.No.C2-2, in Chapter-2 of EIA/EMP Report.

	for clarity.	
vi.	Existence of National park, Sanctuary, Biosphere reserve etc. in the study area, if any should be detailed and presented on map with distinct distances from the project components. Drainage pattern and of the river catchment up to the proposed project site. Delineation of critically degraded areas in the directly draining catchment on the basis of silt yield index as per the methodology of soil and land use survey of India.	No forest land is involved in this existing project. The map showing existence of National park, Sanctuary, Biosphere reserve etc. are given in Fig.No.C3-14. in Chapter-3 of EIA/EMP Report. This is an extension of canal project. The catchment study is not linked with this project.
vii.	Soil characteristics and map of the project area	Soil Characteristics is given in section 3.9.4 in Chapter-3,
viii.	Geological and Seismo-tectonic details and maps of the area surrounding the proposed project site showing location of dam site and canal sites	Geology, seismicity & seismic map is given in section 3.7 & 3.8 and fig.No. C3.4 of chapter-3.
ix.	Remote sensing studies, interpretation of satellite imagery, topographic sheets along with ground verification shall be used to develop the land use/land cover pattern of the study using overlaying mapping techniques viz. Geographic information system (GIS), False Color Composite (FCC) generated from satellite data of project area.	Remote sensing studies with interpretation of satellite imagery and topographic sheets along with ground verification have been used for preparation of all GIS maps.
x.	Land details including forests, private and other land.	No forest land is involved in this existing project. Total land required for canal system 1396.9 ha & 632.23 ha land has been acquired and Additional land to be acquired is 764.58 ha. Details are described in section 2.8.7, in Chapter-2.
xi.	Demarcation of snow fed and rain fed areas for a realistic estimate of the water availability.	Not Applicable
xii.	Different riverine habitats like rapids, pools, side pools and variations in the river substratum-bedrocks, rocks, boulders, sand/silt or clay etc. need to be covered under the study.	As this is a canal project, no river characteristics comes under the scope of this study.
3.	**DESCRIPTION OF ENVIRONMENT AND BASELINE DATA**	
i.	To know the present status of environment in the area, base line data with respect to environmental components air, water, noise, soil, land and biology & biodiversity (flora &	The baseline data was collected for 1 season that is pre-monsoon (Mar- May, 2017) and is given in

	fauna), wildlife, socioeconomic status etc. should be collected within 10 km radius of the main components of the project/site etc i.e. dam site & house power site. The air quality and noise are to be monitored at such locations which are environmentally & ecologically more sensitive in study area. **The baseline data should be collected for 1 season.** The old data available for the existing shall be used preparation of EIA/EMP report of the project. Flora-fauna in the catchment and command area should be documented. The study area should comprise of the following: • Catchment area up to the dam/barrage site. • Submergence area. • Project area or the direct impact area should comprise of area within 10 km radius of the main project components like dam, canals etc. • Dow stream up to 10 km from the tip of the reservoir.	Chapter-3. This is an extension of canal project. The barrage of this project was completed in 1963. There is no increase in water storage or extension of water spread area. The study of project is limited to extension of canal from 41.30 km to 117.50 km. The entire scope of storage, utilisation of water and its effect on downstream remains unaltered.
4.	**DETAILS OF THE METHODOLOGY**	
i.	The methodology followed for collection of base line data along with details of number of samples and their locations in the map should be included. Study Area should be demarcated properly on the appropriate scale map. sampling sites should be depicted on map for each parameter with proper legends. For Forest classification, champion and seth (1968) methodology should be followed.	Different methodologies of sampling and analysis for various environmental parameters were given in Chapter-3. The study area also properly demarcated with sampling sites & proper legends. The sampling locations are shown in maps.
5.	**METHODOLGY FOR COLLECTION OF BIODIVERSITY DATA**	
i.	The number of sampling locations should be adequate to get a reasonable idea of diversity and other attributes of flora and fauna. The guiding principles should be the size of the study of the area (larger should have larger number of sampling locations)and inherent diversity at the location, as known from secondary sources (e.g. eastern Himalayan and low altitude sites should have a larger no of sampling locations owing to higher diversity)	The Ecology & Biodiversity study was carried out during the pre-monsoon season of 2017 and the details of the study is given in section 3.16, Chapter-3.
ii.	The entire area should be divided in grids of	The technique used for data

	5kmx5km preferably on a GIS domain. There are after 25% of the grids should be randomly selected for sampling of which half should be in the directly affected area (grids including project components such as reservoir, dam, powerhouse, tunnel, cannel etc.) and the remaining in the rest of the area (areas of influence in 10km radius from project components). At such chosen location the size and number of sampling units (e.g. quadrates in case of flora/transects in case of fauna) must be decided by species area curves and the details of the same (graphs and cumulative number of species in a tabulated form) should be provided in the EIA report. Some of the girds on the edges may not be completely overlapping with the study area selecting 25% of the grids. The number of grids to be surveyed may come out as decimal number (i.e. it has an integral and a fractional part) which should be rounded to the next whole number.	collection was a proportionate stratified random sampling method involving the use of various size of quadrants for various growth forms and life forms of plants which is furnished in section 3.16.4, Chapter-3.
iii.	The conventional sampling is likely to miss the presence of rare, endangered and threatened (r.e.t) species since they often occur in low densities and in case of faunal species are usually secretive in behaviour. Reaching the conclusion about the absence of such species in the study area based on such methodology is misleading. It is very important to document the status of such species owoing to their high conservation value. Hence likely presence of such species should be ascertained from secondary sources by a proper literature survey for the said area including referring to field guides which are now available for many taxonomic groups in India. Even literature from studies/surveys in the larger landscapes which include the study area for the concerned project must be referred to, since most species from adjoining catchments is likely to be present in the catchments in question. In fact such literature from the entire state can be referred to. Once a listing of possible R.E.T. species from the said area is developed, species specific methodologies should be adopted to ascertain	The result of the study indicates a total 8 species of mammals, 8 species of reptiles 6 species of amphibians, 43 species of birds and 44 species of butterflies were recorded. During the survey, no endemic plant species were observed from study area. As such from floristic stand point, the study area cannot be considered as unique site. As per the IUCN red list of threatened species 2016, no species were found to be listed as R.E.T (Rare, Endangered & Threaten) category. There are 12 species of Schedule II, 01 species of Schedule III, 49 species of Schedule IV and 3 species of Schedule V were recorded which also indicates that no such rare endangered species

	their presence in the study area which would be far more conclusive as compared to the conventional sampling. If the need be, methods like camera trapping can be restored to, particularly for areas in the eastern Himalayas and for secretive/nocturnal species. A detailed listing of the literature referred to, for developing lists of R.E.T. species should be provided in the EIA reports.	were present in the study area. Details are given in section 3.16.5 and 3.16.12 of Chapter-3.
iv.	The R.E.T. species referred to in this point should include species listed in schedule I and II of wildlife (protection) Act,1972 and those listed in the red data books (BSI,ZSI and IUCN).	The RET status of fauna species are given in Table No. C3-27 to C3-32, of Chapter-3.
6.	**COMPONENTS OF THE EIA STUDY**	
	Various aspects to be studied and provided in the EIA/EMP report are as follows:	
A.	**Physical and chemical Environment**	
	Geological & Geophysical Aspects and Seismo-Tectonics	
	• Physical geography, Topography, Regional Geological aspects and structure of the catchment • Tectonics, seismicity and history of past earthquakes in the area. A site specific study of the earthquake parameters will be done. The results of the site specific earthquake design shall be sent for approval of the NCSDP (National Committee of schematic Design Parameters, central Water Commission, New Delhi for large dams. • Land slide Zone or area prone to landslide existing in the study area should be examined. • Presence of important economic mineral deposit, if any • Justification for location & execution of the project in relation to structural components (dam/barrage height) • Impact of project on geological environment	Topography and Regional Geological aspects are given in section 3.6 and 3.7 in Chapter-3. Seismicity is briefed in section 3.8 in Chapter-3. The most advantage of this project is that no storage facility is required because there already exists a barrage and 40 km long canal namely EKMC and it is a contour canal, there is an advantage of gravity flow. The proposed project is site specific. Hence there is no viable alternative for this project**.**
	Meteorology, Air and Noise	
	• Meteorology (viz. Temperature, Relative humidity, wind speed/direction etc.) to be collected from nearest IMD station of Ambient Air Quality, all the parameters vide	Meteorological parameters were collected during the study period from the nearest IMD station, Purnia. (1961-1990).

	Notification dated 18.09.2009 CPCB, in the study area at 6 locations. • Existing Noise Levels and traffic density in the study area at 5-6 locations.	Ambient Air Quality, all the parameters vide Notification dated 18.09.2009 CPCB, are measured in 10 stations and provided in section 3.12 of chapter-3 Similarly noise levels are measured in 10 locations and details are furnished in section 3.15 of chapter-3
	Soil Characteristics	
	Soil classification, physical parameters (viz. texture, porosity, bulk Density and water holding capacity) and chemical parameters (viz. Ph, sodium, potassium, organic, carbon, available potassium, available phosphorus, SAR, Nitrogen and salinity etc.) at @ one sample/ha of command area.	Soil samples from 11 sites were analysed and the results are listed in Table No.C3-5 of chapter-3.
	Remote sensing and GIS studies	
	• Generation of thematic maps viz, slope map, drainage map, soil map, land use and land cover map, etc. Based on these, thematic maps, an erosion intensity map should be prepared. • New configuration map to be given in the EIA Report	Slope map, drainage map, soil map, land use and land cover map are furnished in Fig.No.C3-2, Fig.No.C3-9, Fig.No.C3-5, Fig.No.C3-3 of Chapter-3 respectively.

	• **Water Quality**	
	• History of the ground water table fluctuation in the study area. • Water Quality for both surface water and ground water for [i] physical parameters (pH, Temperature, Electrical conductivity, TSS); [ii] chemical parameters (Alkalinity, Hardness, BOD, COD, NO_3, PO_4, Cl, SO_4, Na, K, Ca, Mg, Sillica, Oil & Grease, Phenolic compounds, Residual sodium carbonate); [iii] Bacteriological parameter (MPN, Total coli form); and [iv] Heavy metals (pb, As, Hg, cd, Cr^{-6}, Total cr, cu, Zn, Fe) at minimum 10 locations, however, the sampling numbers should be increased depending on the command area. • Declination of sub and micro watersheds, their locations and extent based on the soil and Land use survey of India (SLUSOI), Department of Agriculture, Government of India. Erosion levels in each micro-watershed and prioritization of micro-watershed and prioritization of micro-watershed through silt yield index (SYI) Method of SLUSOI.	• Water level fluctuation in the study area is discussed in section 3.13.5 of Chapter-3. • Water Quality both surface & ground water were analysed and presented in Table No.C3-16 and Table No.C3-17 of Chapter-3. This project is an extension of canal from 41.30 km to 117.50 km. The details of micro watershed are not coming under the purview of this project.

B.	**Water Environment & Hydrology**	
	• Hydro-Meteorology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-meteorological studies in the catchment area should be established along-with real time telemetry and data acquisition system for inflows monitoring. • Run off, discharge, water availability for the project, sedimentation rate, etc. • Basin characteristics • Catastrophic events like cloud bursts and flash floods, if any, should be documented. • For estimation of sedimentation Rate, direct sampling of river flow is to be done during the study. The study should be conducted foe minimum one year. Actual silt flow rate to be expressed in ha-m km-2 year-1. • Set-up a G&D monitoring station and a few rain gauge stations in the catchment area for collecting data during the investigation. • Flow series, 10 daily with 90%, 75% and 50% dependable years discharges • Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of monsoon flow during monsoon season. For remaining months, the flow shall be decided by the committee based on the hydrology and available discharge. • A site specific study on minimum environment flow should be carried out	The details of flow series for 50% and 75% dependable years are given in Annexure-3. The Environmental Flow is discussed in section 2.9.3 of chapter 2 and as per the guidelines of environmental flow is fully assured

C.	**Biological Environment**	
	Besides primary studies, review of secondary data/ literature published for project area on flora & fauna including RET Species shall be reported in EIA/EMP report. **FLORA**	
	• Characterization of forest types (as per champion and seth method) in the study area and extent of each forest type as per the forest working plan. • General vegetation profile and floral diversity covering all groups of flora including Bryophytes, pteridophytes, lichens and orchids. A species wise list may be provided. • Assessment of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index [IVI], Shannon Weiner index etc. of the species to be provided. Methodology used for calculating various diversity indices along with details of location of quadrates, size of quadrates etc. to be reported within the study area in different eco systems. • Existence of National park, sanctuary, Biosphere Reserve etc in the study area, if any, should be detailed • Economically important species like medicinal plants, timber, fuel wood etc. • Details of endemic species found in the project area. • Flora under RET categories should be documented using international Union for the Conservation of Nature and Natural Resources (IUCN) Criteria and botanical survey of India's Red Data list along with economic significance. Species diversity curve for RET species should be given. • Cropping pattern and horticultural practices in the study area. • Biodiversity study shall be carried out by associating a reputed organization as per the list of such institutes is available on MoEFCC website.	The forest type in the region is mostly tropical dry deciduous type with low density of tree Floral diversity and Density, Frequency, Basal Area & Importance Value Index (IVI)) etc. are discussed in section 3.16.5 of Chapter-3 Existence of National park, sanctuary, Biosphere Reserve etc around the study area is given in Fig.No. C3-14 in Chapter-3. As per the IUCN red list of threatened species 2016, no species were found to be listed as R.E.T (Rare, Endangered & Threaten) category. Cropping pattern is briefly described in section 3.16.9 of Chapter-3.

	FAUNA	
	• Fauna study and inventorisation should be carried out for all groups of animals including reptiles and nocturnal animals in the study area. Their present status along with schedule of the species. • Information of (authenticated) on Avi-fauna and wild life in the study area. • Status of avifauna their resident/migratory/passage migrants etc. • Documentation of butterflies, if any, found in the project area. • Details of endemic species found in the project area. • RET species-voucher specimens should be collected along with GPS reading to facilitate rehabilitation. RET faunal species to be classified as per IUCN Red Data list and as per different schedule of Indian wildlife (protection) Act, 1972. • Existence of barriers and corridors, if any, for wild animals. • Compensatory afforestation to compensate the green belt area that will be removed, if any, as part of the proposed project development and lose of biodiversity. • For categorization of sub-catchment into various erosion classes and for the consequent CAT plan, the entire catchment (India portion) is to be considered and not only the directly the draining catchment.	The faunal study of the area including mammals, amphibians, reptiles, birds and butterflies are discussed section 3.16.10 in Chapter-3. As per the IUCN red list of threatened species 2016 most of the species were found are belongs to Least Concern (LC) categories and some are belongs to Near Threatened (NT) and Vulnerable (VU) categories. There is no wildlife corridor and migration of animals is not happening in the study area. Since no forest land is involved in this project, compensatory afforestation will not be required. However, canal bank plantation and colony plantation are proposed for this project.
D.	**Aquatic Ecology**	
	• Documentation of aquatic fauna like macro-invertebrates, zooplankton, phytoplankton, benthos etc. • Fish and fisheries, their migration and breeding grounds. • Fish diversity, composition and maximum length & weight of the measured populations to be studied for estimation of environmental flow. • Conservation status of aquatic fauna	Documentation of aquatic fauna like zooplankton, phytoplankton and fish is in table No. C3-33, C3-32 and Fig.No. C3.13 in Chapter-3.

E.	**Irrigation and cropping pattern**	
	• Cropping pattern and Horticultural practices in the study area. • Collection of primary data on agricultural activity, crop and their productivity and irrigation facilities component. • Component of pressurized/drip irrigation and micro irrigation. • Details of conjunctive use of water for irrigation	Cropping pattern and Horticultural practices in the study area is given in section 3.16.9 of Cahpter-3. The pre-irrigation Cropping pattern is given in Table No. C2-7 of Chapter-2.
F.	**Socio-Economic**	
i.	Collection of baseline data on human settlements, health status of the community and existing infrastructure facilities for social welfare including source of live hood, job opportunities and safety and security of workers and surrounding pollution	Data on human settlements, health status and existing infrastructure facilities are given in section 3.17 in Chapter-3.
ii.	Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project proponent.	The existing amenities such as educational facilities, health facilities, bank, post office etc. are described in Table No. C3-46, C3-47 and C3-48 in Chapter-3. However, the proposed welfare measures as demanded by public will be incorporated after public hearing.
iii.	Collection of information on sensitive habitat of historical, cultural and religious and ecological importance.	Historical place is given in Chapter-3, Table No. C3-6.
iv.	The socio-economic survey/profile within 10km of the study area for Demographic profile; Economic structure; Development profile; Agricultural practices; Infrastructure, education facilities; health and sanitation facilities; available communication network etc.	Socio-economic profile of the study area is given in Chapter-3, Page C3-66 to 84.
v.	Documentation of Demographic, Economic structure and development profile of the area.	Given in Socio-economic study in Chapter-3.
vi.	Information on Agricultural practices, Cultural and aesthetic sites, Infrastructure facilities etc.	Agricultural practices i.e. cropping patterns are given in Table No. C2-7 in Cahpter-2.
vii.	Information on the dependence of the local people on minor forest produce and their cattle grazing	Dependency of people on forest is very less due to lack of forest.

	rights in the forest land.	However, depends on common plant species like Am, Mohua, Amla, Jamun, Barhgad, Bel etc.
viii.	List of all the project Affected Families with their names, education, land holdings, other properties, occupation, source of income, land and other properties to be acquired, etc.	Land acquisition is in process.
ix.	In addition to Socio-economic aspects of the study area, a separate chapter on socio-cultural aspects based upon study on Ethnography of the area should be provided.	Nil
7.	**Impact predication and Mitigation Measures**	
	The adverse impact due to proposed project should be assessed and effective mitigation steps to abate these impacts should be described	
	Air Environment	
	• Changes in ambient and ground level concentrations due to total emissions from point, line and area sources. • Effect on soils, material, vegetation and human health. • Impact of emissions from DG sets used for power during the construction, if any, on air environment. • Pollution due to fuel combinations in equipments in equipments & vehicles. • Fugitive emissions from various sources. • Impact on micro climate	Air pollutions during construction phase are due to excavation, other construction activity, borrowing earth from borrow area and quarry operations, disposal of wastes, construction spoils & debris, vehicle moment, operation of heavy machinery, running of batching plant, mixing plant. These activities are expected to generate airborne fugitive dusts. Details are given in section 4.5.4 of Chapter-4 of EIA/EMP Report.
	Water Environment	
	• Changes in surface & ground water quality. • Steps to develop pisci-culture and recreational facilities. • Changes in hydraulic regime and down steam flow. • Water pollution due to disposal of sewage. • Water pollution from labour colony/camps and washing equipment	No permanent impact is anticipated on water quality due to the project. Construction activity may temporarily deteriorate surface water quality near the alignment and borrow areas through increase in turbidity as well as in oil and grease. Details are given in section 4.5.3 of Chapter-4, EIA/EMP Report,
	Land Environment	
	• Adverse impact on land stability, catchment	Impact on Land environment is

	of soil erosion, reservoir sedimentation and spring flow (if any) [a] due to considerable road construction/widening activity [b] interference reservoir with the following streams [c] blasting for excavation of canals and some other structures. • Changes in land use/land cover and drainage pattern. • Immigration of labour population. • Quarrying operation and mock disposal. • Changes in land quality including effects of waste disposal. • River bank and their stability. • Impact due to submergence	given in section 4.5.1 Chapter-4, of EIA/EMP Report. There is no blasting activity for this project. Due to immigration of labour population, disposal of kitchen and domestic waste in haphazard manner on land around the labour camp will not only hamper the asthetic look of the area but at the same time creates soil pollution. Excavation of borrow area can lead into disfiguration of topography of the area. This project is an extension of canal so there is no possibility of submergence.
	Biological Environment	
	• Impact on forests, flora fauna including wildlife, migratory avi-fauna, rare and endangered species, medicinal plants etc. • Pressure on existing natural resources. • Deforestation and disturbance to wildlife, habitat fragmentation and wild animal's migratory corridors. • Compensatory afforestation-Identification of suitable native tree species for compensatory afforestation & green belt. • Impact on fish migration and habitat degradation due to decreased flow of water. • Impact on breeding and nesting grounds of animals and fish.	Impact Biological Environment is given in section - 4.5.6 of Chapter-4, EIA/EMP Report. Since no forest land is involved in this project, compensatory afforestation will not be required.

	Socio-economic Aspects	
	• Impact on local community including demographic profile. • Impact on socio-economic status. • Impact on economic status. • Impact on human health due to water/vector borne disease. • Impact on increases traffic. • Impact on Holy places and Tourism. • Impact of blasting activity during project construction which generally destabilizes the land mass and lead to landslides, damage to properties and drying up of natural springs and cause noise pollution will be studied. Proper record shall be maintained of the base line information in the post project period. • Positive as well as negative impacts likely to be accrued due to the project are to be listed	Impact on local community, human health and due to increase in traffic in described in section - 4.5.12 in Chapter-4, EIA/EMP Report.
8.	**Environment Impact Analysis**	
i.	Environmental Impact Analysis due to the project on the above mentioned components should be carried out for construction and operation phase using qualitative or quantitative methods.	Matrix method is used to evaluate Impacts both beneficial and detrimental due to implementation of the project. Impact analysis and assessment is given in section - 4.3 & 4.4 in Chapter-4.
9.	**Environment Management plan(EMP)**	
	Environmental Management plan aimed at minimizing the negative impacts of the project should be given in detail. The mitigation measures are to be presented for all the likely adverse impacts on the environment. The flowing suggestive mitigating plans should be included	
1.	**Catchment Area Treatment (CAT) plan** should be prepared micro-watershed wise. Identification of area for treatment based upon Remote sensing & GIS methodology and silt yield index (SYI) method of SLUSOI coupled with ground survey. Areas/watersheds falling under 'very severe' erosion categories are required to be treated. Both biological and engineering measures should be proposed in consultation with state forest Department. Year-wise schedule of work and monetary allocation should be	This is an extension of canal project. The barrage for diversion of water to canal has been built since 1964. The storage and water stream remains unaltered. Catchment Area Treatment (CAT) plan is given in section - 4.9.1 in Chapter-4.

	provided. CAT plan is to be completed prior to reservoir impoundment. Mitigations measures to check shifting cultivation in the catchment area with provision for alternative and better agricultural practices should be included.	
2.	**Command Area Development (CAD) Plan** giving details of implementation schedule with a simple CAD plan.	Detailed description of Command Area Development (CAD) Plan is furnished in section - 4.9.5 in Chapter-4, of EIA/EMP Report.
3.	Compensatory afforestation in lieu of the forest land required for the project needs to be proposed. Choice of plants should be made in consultation with state Forest Department including native and RET species, if any.	Since no forest land is involved in this project, compensatory afforestation will not be required. However, canal bank plantation and colony plantation are proposed for this project.
4.	**Biodiversity and Wildlife Conservation & Management plan** for conservation and preservation of endemic, rare and endangered species of flora and fauna to be prepared in consultation with state Forest Department.	Management plan is given in section 4.9.2 in Chapter-4. The no RET species of flora and fauna are observed in the project area.
5.	**Resettlement and Rehabilitation (R&R) Plan** need to be prepared with due consultation with project Affected Families (PAFs). The provision of the R&R Plan should be according to the National Resettlement and Rehabilitation policy (NRRP-2007) as well as state Resettlement and Rehabilitation policy. Detailed budgetary estimates are to be provided. Resettlements sites should be identified.	Resettlement and Rehabilitation (R&R) Plan is not required as there will be no displacement of population.
6.	**Plan for Green Belt Development** along the periphery of reservoir, colonies, approach road, canals etc. to be prepared in consultation with the state Forest Department. Local plant species suitable for greenbelt development should be selected.	In this Project, plantation has been proposed alongside the approach roads, canal bank service road & around the staff colonies. Detailed Plan for Green Belt Development is given section - 4.9.20 in Chapter-4.
7.	**Reservoir Rim Treatment plan** for stabilization of land slide/land slip zones if any, around the reservoir periphery to be prepared. Suitable engineering and biological measures for treatment of the identified slip zones to be provided with physical and financial schedule.	Reservoir Rim Treatment plan is given in section - 4.9.1 in Chapter-4 which includes steps like necessary plantation to be taken up in the rim of reservoir.

8.	**Plan for Land Restoration and Landscaping** of project sites.	Land Restoration and Landscaping plan is Given in section 4.9.4 in Chapter-4.
9.	**Fisheries conservation & Management plan-** Fish fauna inhabiting the affected stretch of river, a specific fisheries management plan should be prepared for river and reservoir.	The affected people in the project area can be selected for pisciculture training with project assistance for enhancing fish production. Given in section 4.9.21 in Chapter-4.
10.	**Muck Disposal Plan-**suitable sites for dumping of excavated material should be identified in consultation with the state pollution control Board and Forest Department. All muck disposal sites should be minimum 30 m away from the HFL of river. Plan for rehabilitation of muck disposal sites should also be given. The L-section/cross section of muck disposal sites and approach roads to be given. Financial out lay for this may be given separately.	Muck disposal plan includes identification of dumping site, dumping and its management and biological, bioengineering and structural measures, which are described in section 4.9.9 in Chapter-4.
11.	**Plan for Restoration** of quarry sites and landscaping of colony areas, working areas, roads, etc	Restoration of quarry sites and restoration of working areas are given in section 4.9.10 and 4.6 in Chapter-4 respectively.
12.	**Study of Design Earthquake parameters:** A site specific study of earthquake parameters should be done. The results of the site specific earth quake design parameters should be approval by National Committee of seismic Design Parameters, Central Water Commission (NCSDP), New Delhi.	The canal will have medium type of structures which will not attract major disaster earthquake parameters.
13.	**Dam Break Analysis and Disaster Management plans:** The outputs of Dam Break Model should be illustrated with appropriate graphs and maps clearly bringing out the impact of Dam break scenario. Provision for early warning systems should be provided.	This project deals with medium type of structures and dam break analysis does not come under its purview. Disaster Management plan is given in section 7.1.5 of chapter-7.
14.	**Water and Air Quality & Noise Management plans** to be implemented during construction and post-construction periods.	Management plans during & post construction phase is given in section 4.9.12, 4.9.13 and 4.9.14 in Chapter-4.
15.	Mitigating measures for impacts due to blasting on the structures in the vicinity.	No blasting will be done for this project.

16.	Ground water Management plan	Groundwater management plan which needs for preventing water logging is discussed in section 4.9.6 in Chapter-4.
17.	**Public Health Delivery Plan** including the provisions for drinking water facility for the local community.	Given in section 4.5.12.2, in Chapter-4.
18.	**Labour Management Plan** for their Health and safety.	Details of Labour Management Plan is described in section 4.9.15 in Chapter-4
19.	**Sanitation and solid waste Management Plan** for domestic waste from colonies and labour camps etc.	Sanitation and solid waste Management Plan for domestic waste from colonies and labour camps etc is described in section 4.9.16 in Chapter-4.
20.	**Local Area Development Plan** to be formulated in consultation with Revenue Officials and Village panchayats. Local skill development schemes should be given. Details of various activities to be undertaken with financial out lay should be provided.	Local Area Development Plan is given in section 4.9.23 of Chapter-4 and section 7.2.2 in Chapter-7 which discusses the corporate social development plan.
21.	Environmental safeguards during construction activities including Road construction.	Given in section 4.9.24 of Chapter-7.
22.	Energy Conservation Measures	A hydro-power station will be built in RD 3.66 km. This is renewable energy project by utilising natural water resources
23.	**Environmental Monitoring Programme** with physical & financial details covering all the aspects of EMP. A summary of cost estimate for all the plans, cost for implementing all Environmental Management plans including the cost for implementing environmental monitoring programme should be given. Provision for an Environmental Management cell should be made.	Environmental Monitoring Programme and cost detail is given in section 6.3 and 6.9 in Chapter-6.
24.	In the EMP, also include a sample CAD Plan for a distributary outlet command. Such a plan is to show the alignment of irrigation and drainage channels. The components of the OFD works to be undertaken may be clearly mentioned along with a time schedule for their completion vis-à-vis the progress of irrigation.	CAD plan is given in section 4.9.5.2 in Chapter-4

25	All issues discussed in the Public hearing/Consultations should be addressed and incorporated in the EIA/EMP report.	Public hearing/consultation of respective four districts is discussed in 7.0, 7.0.1, 7.0.2, 7.0.3, 7.0.4. And Public Hearing proceeding and attendance sheet is attached as annexure-7, 8, 9 and 10.

CONTENTS

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ABBREVIATION

B.G.	: Broad Gauge
CAD	: Command Area Development
CADA	: Command Area Development Authority
CCA	: Cultural Command Area
CD	: Cross Drainage
CSR	: Corporate Social Responsibilities
Cumec	: Cubic meter per second
CWC	: Central Water Commission
DPR	: Detailed Project Report
D/S	: Downstream
EAC	: Expert Appraisal Committee
EC	: Electrical Conductivity
EHS	: Environmental Health and Safety
EIA	: Environmental Impact Assessment
EKMC	: Eastern Kosi Mechi Canal
EMP	: Environment Management Plan
FSD	: Full Supply Depth
FSL	: Full Supply Level
FYM	: Farm Yard Manure
GCA	: Gross Command Area
Ha	: Hectare
IMD	: Indian Meteorological Department
INM	: Integrated Nutrient Management
IPM	: Integrated Pest Management
IUCN	: International Union for Conservation of Nature
IVI	: Importance Value Index
Km	: Kilometer
LC	: Least Concern
M	: Meter
MCM	: Million Cubic Meter
M.G.	: Meter Gauge
MoEF&CC	: Ministry of Environment, Forest & Climate Change
MoWR	: Ministry of Water Resources
MW	: Mega Watt
NAAQS	: National Ambient Air Quality Standard
NABET	: National Accreditation Board for Education and Training

No.	: Numbers
NPK	: Nitrogen Phosphorous Potassium
NT	: Near Threatened
NWDA	: National Water Development Agency
PFA	: Prevention of Food Adulteration
PPC	: Plant Protection Chemicals
QCI	: Quality Council of India
R&R	: Resettlement & Rehabilitation
RET	: Rare, Endangered and Threatened
SEIAA	: State Environment Impact Assessment Authority
Sq km	: Square Kilometer
STDs	: Sexually Transmitted Diseases
ToR	: Terms of Reference
VU	: Vulnerable
WKMC	: Western Kosi Mechi Canal
WM	: Water Management
WRD	: Water Resources Department
WSSA	: Weed Science Society of America

CHAPTER – 1
INTRODUCTION

1.0 INTRODUCTION:

Ministry of Water Resources, Government of India in the year 2004 decided to undertake comprehensive assessment of feasibility of linking of the rivers of the country in a fully consultative manner and to explore the feasibility of intrastate river links of the country. In this context, the functions of NWDA were modified vide MoWR Resolution dated May 19, 2011 to undertake the work of preparation of Detailed Project Reports (DPRs) of intrastate links.

In the meantime, NWDA requested all the State Governments to identify the intrastate link proposals in their States and send details to NWDA for their prefeasibility / feasibility studies. Bihar responded to NWDA's request vide letter No. PMC-5(IS)-01/2006-427, Patna dated May 15, 2008 and submitted their proposals and accordingly requested NWDA to prepare the prefeasibility reports of six intrastate links out of which two were irrigation schemes. The Kosi-Mechi Link is one of them.

The present proposal is an extension of Eastern Kosi Mechi Canal (EKMC) system upto river Mechi, a tributary of river Mahananda. The Government of Bihar proposed to extend the existing EKMC beyond its tail end RD 41.30 km upto 117.50 km so that rivers Kosi and Mechi which flow through Bihar itself after crossing Indo-Nepal border, can be linked within Bihar State by taking off the link canal from existing Hanuman Nagar barrage (Birpur) and outfalling in river Mechi at suitable point while running the canal adjacent to Indo-Nepal border.

For the above scheme NWDA prepared the prefeasibility report in June, 2009.The Govt. of Bihar on 18th Jan, 2010 requested NWDA for preparation of Detailed Project Report (DPR). After the DPR was prepared, it was submitted in May, 2014 to Central Water Commission (CWC) for scrutiny & appraisal. The DPR was examined by the variousspecialised Directorate of CWC and the comments were duly considered in preparation of modified report.Subsequently Techno-Economic Clearance for Kosi-Mechi Intrastate Link Project has been accorded by the Advisory Committee for consideration of Techno-Economics of Major & Medium Irrigation, FloodControl and Multipurpose proposal of Ministry of Water Resources & G.R. on 04.08.2016.

As required under law for obtaining Environmental Clearance of the above project, the govt. of Bihar prepared the details under Form-1 of Appendix-1 along with the prefeasibility report as required under notification of MoEF&CC, 14th, September 2006.The above document was prepared by the QCI accredited Environment Consultant M/s Centre for Envotech& Management Consultancy Pvt. Ltd. (CEMC), Bhubaneswar.

1.1 PURPOSE OF THIS REPORT:

Environmental Clearance is the permission required from the Ministry of Environment, Forest and Climate Change, Govt. of India for execution of certain projects, which may impact environment considerably. Accordingly, any new projects or existing projects going for enhancement in capacity require environmental clearance from Ministry of Environment, Forest& Climate Change (MoEF&CC), Govt. of India, New Delhi for the matters falling under Category 'A' (as the schedule of notification number S.O. 1533 (E), date 14th September 2006) or at state level in the State Environment Impact Assessment Authority (SEIAA) for the matters falling under Category B.

As discussed above the project was submitted to MoEF&CC, Govt. of India for obtaining Environmental Clearance. The project was considered by the Expert Appraisal Committee (EAC) for River Valley & Hydro Electric Project in its 96th meeting held on 11-12th August, 2016 and the approved ToR along with other information was sent to Dept. of Water Resources, Govt. Of Bihar on 23rd Sept, 2016 for taking further action in seeking Environmental Clearance from MoEF&CC. Thus the preparation of EIA & EMP report as designed under the generic structure is a part of the conditionality of MoEF&CC.

The draft EIA report has been prepared by the QCI accredited Environment Consultant M/s Centre for Envotech & Management Consultancy Pvt. Ltd. (CEMC), Bhubaneswar according to the Environmental guidelines contained in MoEF notification 14th Sept 2006, and subsequent amendments for consideration for discussion in following regulatory authorities:

(i) **Holding public hearing/public consultation.**
At the 1st stage; this draft report along with its Executive summary will be submitted to the State Pollution Control Board, Bihar for holding public hearing/public consultation. The report will facilitate public hearing in four districts of Bihar i.e., Araria, Purnia, Katihar and Kishanganj which are likely to be benefitted by this project.

(ii) **Consideration of Environmental Clearance.**
Later, at the 2nd stage, the draft report will be finalized with inclusion of public hearing proceedings comments of the people and compliances by the project proponent. The final report will be submitted to the MoEF& CC, Govt. of India, New Delhifor consideration of Environmental Clearance.

The present report is an Environmental Impact Assessment report prepared as per latest stipulations of Ministry of Environment, Forests and Climate Change (MoEF&CC), Government of India. This report focuses on following aspects;

- Protect the surrounding environment during the implementation and operation period with appropriate environmental safeguards.
- Provide protection to the native floral and faunal diversity of the area.
- Provide protection and free movement of wild life population in the region.

- Protect both surface and groundwater qualities of the area from contamination.
- Adopt precautionary measures to prevent deterioration of air quality.
- Minimize risks related to public health and improve economic status.
- Ensure that ecological balance of the area is not adversely affected.
- Minimization of noise and vibration impacts on surroundings.
- Study the Socio-economic aspects of the new command area and ensure to have positive impact in this region.
- Implement safeguard measures to protect Soil quality of the ayacut area.

1.2 IDENTIFICATION OF PROJECT AND PROJECT PROPONENT

1.2.1 Identification of Project:

The proposed Irrigation Project of Kosi-Mechi Intrastate Link Project (CCA 214812 Ha) which according to the environmental notification 14th September, 2006 at project identification schedule read at 1(c) "River Valley Projects", comes under category 'A' projects.

The Kosi-Mechi Intrastate Link Project with its extended ayacut beyond 41.30 km originates from existing Hanuman Nagar Barrage (Birpur)located on Kosi river and proposed to be continued up to river Mechi, for providing irrigation to Araria, Purnia, Katihar and Kishanganj districts of Bihar more or less parallel Indo-Nepal border. In its extended portion the canal from 41.30 km to 117.50 km to the outfall point in river Mechi, a tributary of Mahananda basin between river Parman and Mechi lies within the state of Bihar.

1.2.2 Project Proponent:

The proposed project will be developed by Water Resource Department Government of Bihar and the project falls under Water Resources Department Government of Bihar.

The **registered address of the Project Proponen**t is given below.

Engineer-in-Chief (HQ),
Water Resources Department, Government of Bihar,
Sinchai Bhawan,
Patna, Bihar.
Pin-800015,
Phone No. 0612-2215345 (Office), Fax - 0612-2217649.

1.3 BRIEF DESCRIPTIPON OF NATURE, SIZE AND LOCATION OF THE PROJECT

1.3.1 Natureand Size of project:

The project is an irrigation project and not interlinked with any other Scheme.

The Kosi-Mechi Link canal Project envisages diversion of part of surplus water of Kosi river through existing Hanuman Nagar barrage (Birpur) to Mahananda basin.

Main components of the project involve remodeling of existing EKMC up to 41.30 km and construction of a new canal from RD 41.30 km to 117.50 km long. The FSL of link canal at head is 74.371 m and at tail end is 54.239 m respectively.

The water available at Hanuman Nagar barrage (Birpur) will be diverted through a 117.50 km long link canal to Mahananda basin and for enroute utilization for irrigation during monsoon. In this entire length of the canal 14 syphon aqueduct, 9 canal syphon, 10 cross regulator, 27 head regulator, 9 pipe culverts, 43 road bridges, 1 settling basin and 8 escapes are required to be constructed.

1.3.2 Purpose of the project:

The project is proposed to meet the irrigation water demands for Kharif season in four districts of Bihar i.e., Araria, Purnia, Katihar and Kisanganj. Since this region of Bihar lies in North East which is more fertile has considerable significance for irrigation. The Cultural Command Area (CCA) has been worked out using latest 5 years land use statistics for the period 2006-07 to 2009-10. The culturable area being highest in the year 2006-07, the Gross Command Area (GCA) under the new extended canal is worked out as 2,75,135 ha and CCA works out to 2,14,812 ha (2.15 lakh ha). The details of CCA in four districts are as below.

Sl. No.	Particulars	Districtwise area (in ha)				Total area in ha
		Araria	Purnia	Katihar	Kishanganj	
1.	Gross Command Area	88000	85750	49235	52150	2,75,135
2.	Culturable Command Area	69642	69970	35653	39548	2,14,812

(Source: DPR)

As this project is designed to supply Khariff water only, the drinking water facilities is not considered from this project at present.

1.3.3 Location of the project:

Table No. C1-1: Location of the project:

Sl. No.	Particulars	Description
1.	Head works	Existing Hanuman Nagar Barrage (Birpur)
2.	District	Supaul, Araria, Purnia, Kishanganj and Katihar (Ayacut)
3.	State	Bihar
4.	Latitude	26^0 31' 27.4" N
5.	Longitude	86^0 55'40.3" E
6.	Toposheet No.	72 J/14, 72 J/15, 72 N/2, 72 N/3, 72K/9, 72 K/10, 72 K/13, 72 K/14, 72 O/1, 72 O/2, 72 O/3, 72 O/5, 72 O/6,

		72 O/7, 72 O/9, 72 O/10, 72 O/11, 72 O/13 & 72 O/14
7.	Nearest Road	NH-106 :(Birpur-Madhepura-Bihpurroad) – 1.9 Km SH-91 : 3.1 Km
8.	Nearest Air Port	Bagdogra-200km
9.	Nearest rail head	Forbesganj
10.	Nearest Town, city, District Headquarters along with distance in km.	Nearest Town from the head works [Existing Hanuman Nagar Barrage (Birpur)] is Hanuman Nagar in Nepal and Birpur in India at a distance of approximately 8.5 km& 6.0 km respectively.
	Link Canal	
11.	Length	117.50 km
12.	Existing Eastern Kosi Main canal	41.30 km
13.	New canal beyond EKMC	76.20 km

1.3.4Importance to the Country:

The river Kosi is an international river originating from Tibet flowing through Tibet, Nepal in Himalayan Mountains and the lower portion through plains of North Bihar. To overcome the acute problem of shifting of course of Kosi river, heavy sediment load, flooding etc. and to alleviate the severe suffering of the people of Bihar, the then His Majesty's Government of Nepal and The Government of India signed an agreement on 25th April 1954 for implementation of Kosi project. The Kosi project includes a barrage namely Hanuman Nagar across river Kosi located near Hanuman Nagar town close to Indo-Nepal border, canal head works, Western Kosi Main Canal (WKMC) system in Nepal, Eastern Kosi Main Canal (EKMC) system in India. The present proposal is an extension of EKMC up to river Mechi, a tributary of river Mahananda.

The aim of extension of EKMC up to Mechi River is mainly to provide irrigation benefits to the water scarce Mahananda basin command in the districts of Araria, Purnia, Katihar and Kishanganj during kharif season only, depending upon the pondage available in Hanuman Nagar barrage (Birpur). Though this intrastate link canal will not have any back-up storage scheme presently, it can be later supported by and linked with proposed Kosi High Dam which is likely to take concrete shape after joint surveys and investigations by Government of Nepal and India.

Out of the total command area 4.40 lakh ha of Mahananda river basin, the proposed Kosi-Mechi link canal will irrigate 2.15 lakh ha areasin new unirrigated areas lying between rivers Parman and Mechi excluding CCA covered by other schemes falling

under this river basin. This intrastate link scheme will thus transfer part of surplus water of Kosi basin to Mahananda basin. In view of irrigation benefit from the link canal, the project is fully justified.

This link will have advantage of complete independent control of Bihar and enhance the economic activities in the command area.

1.4 DETAILS OF REGULATORY COMPLIANCE:

This project is considered to be of Category 'A' project since the Culturable Command Area is more than 10,000 ha and also Indo-Nepal international boundary (Nepal-India) lies within 5 km distance from the main canal.

The following agreements such as Indo-Nepal agreement, Indo-Bangladesh Agreement and Bihar-West Bengal agreement were signed during different times for management of Kosi river water need to be examined.

- **Indo-Nepal agreement:**To overcome the acute problem of shifting of course of Kosi river, heavy sediment load, flooding etc. and to alleviate the severe suffering of the people of Bihar, the then His Majesty's Government of Nepal and The Government of India signed an agreement on 25th April 1954 for implementation of Kosi project. The Kosi project includes a barrage namely Hanuman Nagar (Birpur) across river Kosi located near Hanuman Nagar town close to Indo-Nepal border, canal head works, Western Kosi Main Canal (WKMC) system in Nepal, Eastern Kosi Main Canal (EKMC) system in India. So Indo-Nepal treaty will not be affected.
- **Bilateral agreement between Bihar-West Bengal:** The Kosi-Mechi intrastate link envisages diversion of Kosi water for utilization between river Parman and Mechi in Bihar state and not utilizing any water from Mahananda Basin. Hence, the bilateral agreement signed between Govt. of West Bengal and Govt. of Bihar will not be affected.
- **Indo-Bangladesh Agreement on Ganga water:** The water diversion from Kosi barrage to Mechi river is proposed only in Khariff season, therefore, the Indo-Bangladesh treaty will not be affected.

1.4.1 Statutory clearances:

The following statutory clearances have been obtained or on the process of obtaining clearance as below.

1. **From MoWR Govt. of India:**
   The DPR of Kosi-Mechi link project was considered by the Advisory Committee of Irrigation, flood control and multipurpose project of MoWR in its meeting held on 8thJuly 2016 andthe project were approved subject to submission of all statutory clearances.
2. **From MoEF&CC, Govt. of India:**
   Environmental appraisal process for the proposed irrigation project has been already initiated and Terms of Reference (ToR) at the scoping stage has been approved by the Expert Appraisal Committee for River Valley and Hydroelectric Projects, MoEF&CC, New Delhi in the meeting held in the month

of August 2016 and approval communicated to the project proponent vide No.J-12011/22/2016-IA-I (R),Dated.23.09.2016 for preparation of the EIA Report and submission of the same for consideration of Environmental clearance. [Copy of the approved ToR furnished in **Annexure-1**].

3. **From Ministry of Tribal Affairs, Govt. of India:**
   Clearance from Ministry of Tribal Affairs is not applicable as because no tribal population is likely to be displaced by this project.

4. **Resettlement &Rehabilitation (R&R) clearance:**
   This project also does not require any R&R approvals as no R&R problem is anticipated due to Implementation of the project.

5. **Forest Clearance:**
   It also does not require any forest clearance from MOEF&CCas the project is so nicely planned; no forest land is involved in the link canal project.

However, the applicant is seeking prior environmental clearance from EAC of the MoEF&CC, New Delhi. The Form-I and PFR was already prepared by Centre for Envotech& Management Consultancy Pvt. Ltd. (NABET Accredited Consultant QCI No. 24 as in MoEF&CC web site on July 2017), Bhubaneswar, Odisha and submitted along with the Application form while applying for Environment Clearance.

This EIA report thus prepared was duly considered the Terms of Reference (ToR) communicated by MoEF&CC in their letter dated 23rd Sept. 2016 for preparation and submission of EIA report as per the generic structure recommended by MoEF&CC.

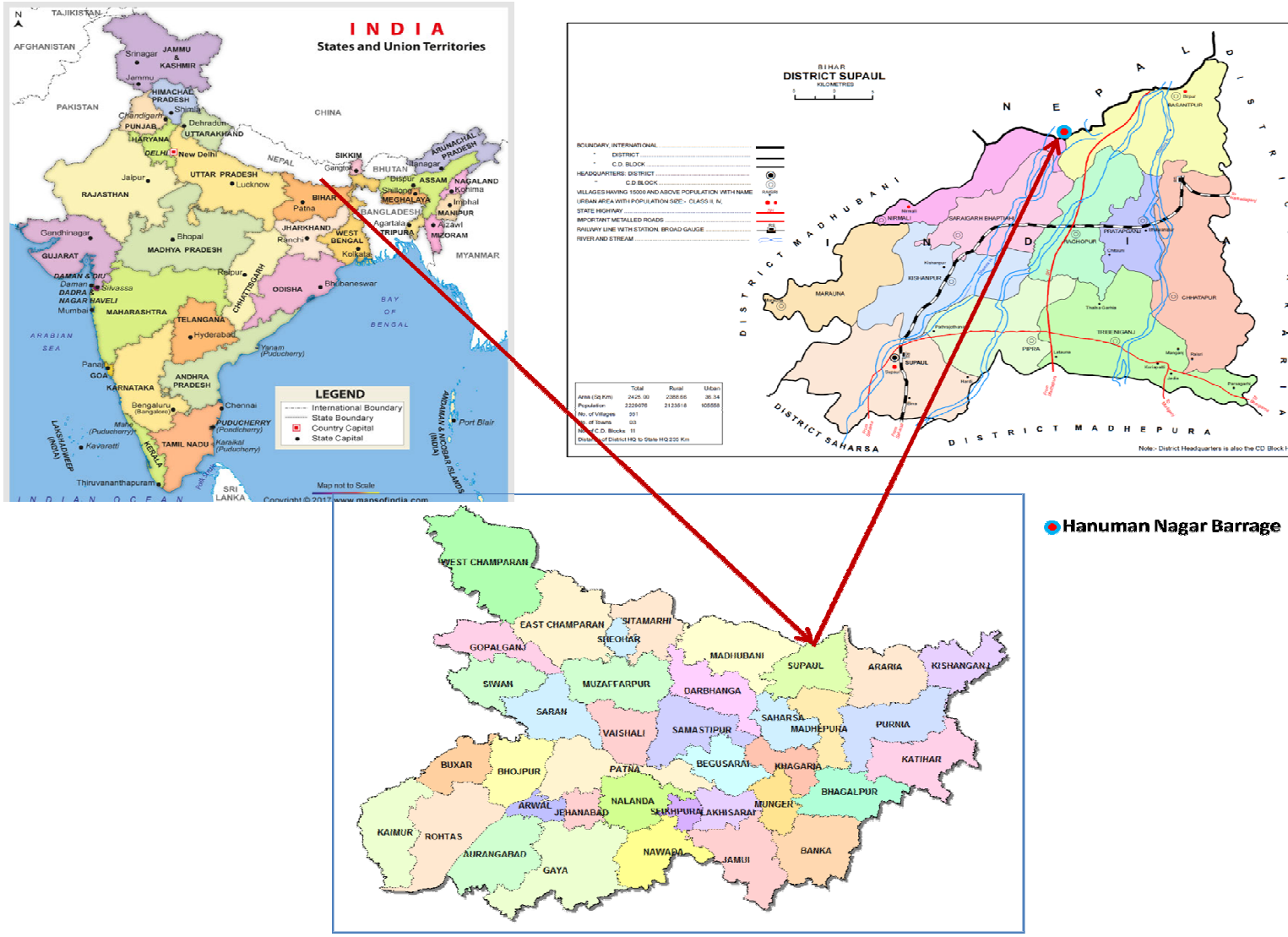


Fig. No. C1-1: Index Map of Hanuman Nagar Barrage (Birpur).

CHAPTER-2
PROJECT DESCRIPTION

2.0 PROJECT CONCEPT:

The proposed Kosi-Mechi Intrastate Link Project is an Irrigation Project meant for providing irrigation facilities in four districts (Araria, Purnia, Katihar and Kishanganj) of Bihar. The project has been proposed for irrigation facilities covering culturable command area of 214812 ha (CCA 2.15 Lakh ha) for irrigation in Kharif seasons. The project consist of Intake Structure, Canal syphon, Hume pipe culvert, Syphon aqueduct, Bridges, head regulator, Cross regulator etc.

The Kosi-Mechi Link Project envisages diversion of part of surplus water of Kosi river through existing Hanuman Nagar barrage (Birpur) to Mahananda basin. Main components of the project involve remodeling of existing EKMC upto 41.30 km and construction of a new canal from RD 41.30 km to 117.50 km. The FSL of link canal at head is 74.371 m and at tail end is 54.239 m.

The water available at Hanuman Nagar barrage (Birpur) will be diverted through a 117.50 km long link canal to Mahananda basin and for enroute utilization.

2.1 TYPE OF PROJECT:

The project is basically a river linking project, joining the rivers Kosi and Mechi situated in the state of Bihar with following purposes and that is why it is named as Kosi-Mechi intrastate link project.

1. Providing Irrigation facility in four districts of Bihar State.
2. Diversion of part of surplus water of Kosi River through existing Hanuman Nagar barrage (Birpur) to Mahananda basin.

2.2 NEED FOR THE PROJECT:

Bihar is India's most flood-prone state, with about 76% of the population in north Bihar living under the recurring threat of flood devastation. According to some historical data, 16.5% of the total flood affected area in India is located in Bihar while 22.1% of the flood affected population of India lives in Bihar.

The need for extension of EKMC upto Mechi river is mainly to provide irrigation benefits to the water scarce Mahananda basin lying between river Parman and Mechi command in the districts of Araria, Purnia, Katihar and Kishanganj during kharif season depending upon the pondage available in Hanuman Nagar barrage (Birpur). Though this intrastate link canal will not have any back-up storage scheme at present, later it can be supported by and linked with proposed Kosi High Dam which is likely to take concrete shape after joint surveys and investigation conducted by Government of Nepal and India. Out of the total command area 4.40 lakh ha of Mahananda river basin, the proposed Kosi-Mechi link canal will irrigate 2.15 lakh ha areas excluding CCA covered by other schemes falling under this river basin. This intrastate link scheme will thus transfer part of surplus water of Kosi basin to Mahananda basin. In view of irrigation benefit from the link canal, the project is fully justified.

2.3 PROJECT LOCATION:

The Kosi-Mechi Intrastate link project, an extension of EKMC is located in northern part of Bihar state and more or less parallel and close to Indo-Nepal international border. This canal runs through the Supaul, Arariaand Kisanganj Districts up to RD 117.50km.It originates from Kosi river in west and merge with Mechi river on east. The link canal forms the northern boundary of ayacut while river Parman and river Mahananda form the western and eastern boundaries. In south it is spread up to river Kosi on its enroute to join River Ganga.

Accessibility:

Nearest Town from the head works (Existing Hanuman Nagar Barrage) is Hanuman Nagar in Nepal and Birpur in India and distance is approximately 8.5 km& 6.0 km respectively. The major part of the project area is well connected by road networks and railways as detailed below:

Highways:

1. Birpur–Forbesganj road.
2. Purnia-Murliganj-Madhepura-Saharsa-Mahisi road.
3. Purnia-Dhamdaha-Rupauli-Bijayghat road.
4. Purnia-Korha-Kursella road.
5. Katihar–Korha–Farrakha road.
6. Pratapganj–Narpatganj–Forbesganj road (N.H.57).
7. Supaul–Pipara–Tribeniganj–Jadia road.
8. Jogbani–Forbesganj–Araria.
9. Kursela–Mirganj–Sarsi–Raniganj–Forbesganj road.

Railways (North Eastern Railway):

1. Purnia–Murliganj–Madhepura–Saharsa station (M.G.)
2. Supaul–Saharsa–Mansi section (B.G. AND M. G.)
3. Supaul–Narpatganj–Forbesganj section (M.G.)
4. Banmankhi–Bihariganj section (M.G.)
5. Katihar–Barauni section (B.G.)
6. Katihar–Purnia–Jogbani section (North East Frontier Railway)

The nearest railway stations from offtake point are Bathnaha and Forbesganj located at about 38 km and 42 km respectively from Hanuman Nagar Barrage (Birpur) site. Bagdogara is the nearest airport located about 200 km from Hanuman Nagar barrage (Birpur) and about 125 km from tail end point of canal.

The major component of the project i.e. the Barrage is located on Kosi River near Hanuman Nagar in Nepal.

Location of existing Hanuman Nagar Barrage (Birpur): Latitude – $26^0$31' 27.4" N
Longitude–86^0 55' 40.3"E.

The link canal traverses
From Latitude -26°30' 38.59" N & Longitude -$86^0$56' 42.54" E
to Latitude-26°14'24.36"N & Longitude-$87^0$57'31.43"E.

The location map is shown in **Fig. No. C2.1.**

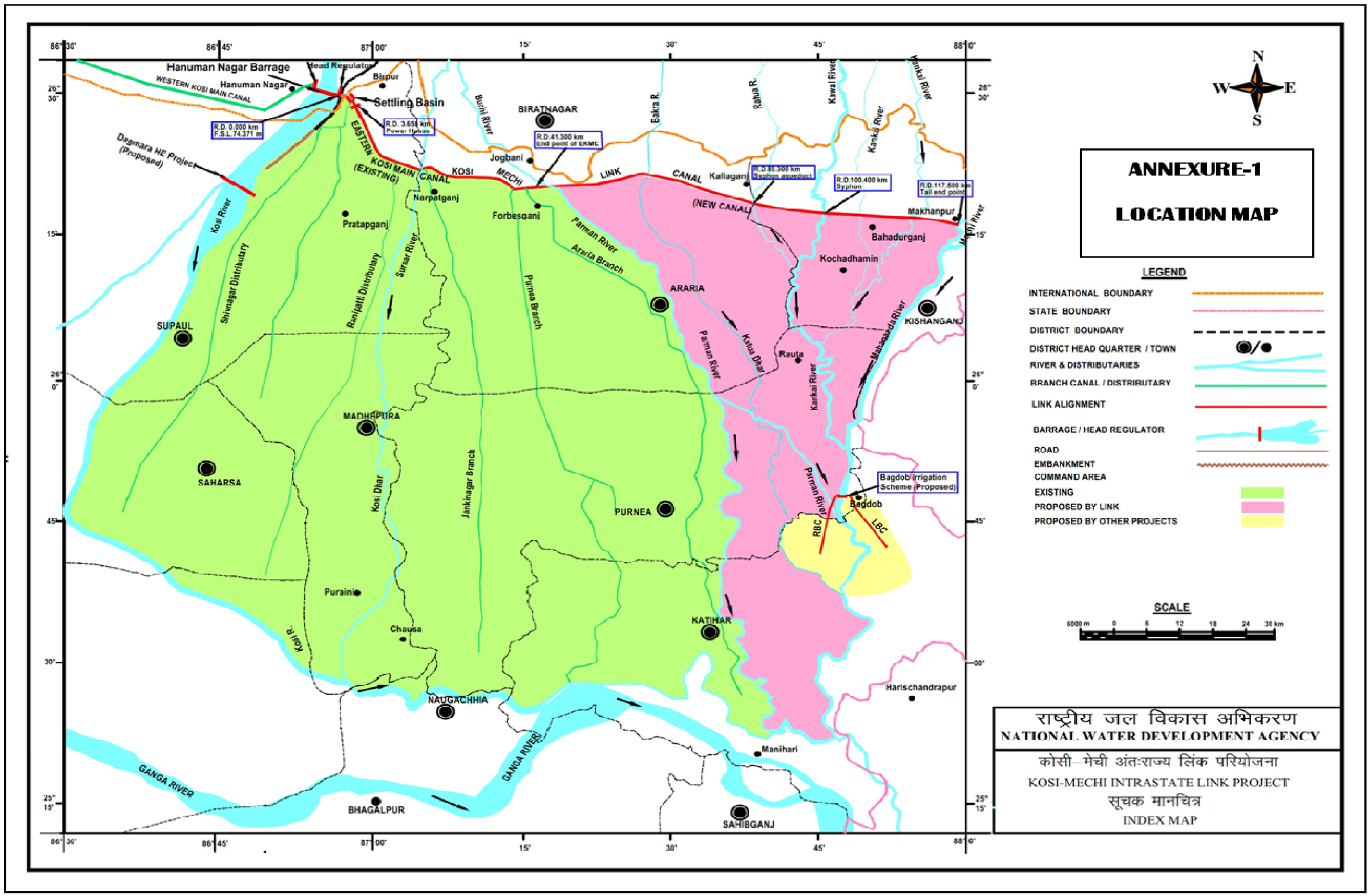


Fig.No.C2.1: Location Map of Kosi-Mechi Intrastate Link Project in Four Districts of Bihar

2.4 SIZE OF THE PROJECT:

The length of the project is 117.50km.
The length of the proposed canal from 41.3 km to 117.5 km is 76.2 km.

The proposed project has

- Gross Command Area (GCA) = 275135 ha. (2.75 Lakhs ha)
- Culturable Command Area (CCA) = 214812 ha (2.15 Lakhs ha)

2.5 COUNTRYWISE DISTRIBUTION OF CATCHMENT AREA:

Kosi river is an international river. The upper portion of river Kosi flows through Tibet and Nepal in Himalayan Mountains and the lower portion through plains of north Bihar. This river is 468 km long from its origin to outfall in Ganga and has a total catchment area of 93,355 sqkm. The countrywise breakup of the catchment area among Tibet, Nepal and India is as follows:

Sl. No.	Country	Catchment area (sqkm)
1	Tibet (China)	32671
2	Nepal	39678
3	India (Bihar state)	21006
	Total	**93355**

(*Source: History of Kosi Project, WRD, Govt. of Bihar*)

2.6 INTERNATIONAL AGREEMENT ON KOSI PROJECT:

Considering the needs of short term measures that were immediately required for the alleviation of the sufferings of the people of Kosi valley and for prevention of large scale devastation of crops during floods, the then His Majesty's Government of Nepal and the Government of India signed an agreement on 25th April 1954 for implementation of Kosi Project,

As per the agreement, the Govt. of India was authorized for the construction, operation and maintenance of the following:

i) Hanuman Nagar barrage (Birpur) across river Kosi,
ii) Canal head works at barrage
iii) Afflux bund embankment and canal system in the territory of His Majesty's Government of Nepal.
iv) Establishing hydropower generating stations at canal.

The above agreement was further revised in 1966.

2.7 PROPOSED SCHEDULE FOR APPROVAL AND IMPLEMENTATION:

Schedule of approval:

The draft EIA / EMP report of Kosi-Mechi Intrastate link Project will be submitted to SPCB Bihar for public hearing in four districts. The final EIA report will be prepared after incorporating the feedbacks of public obtained during the public hearing. The final EIA report will be submitted to MoEF&CC for obtaining environmental clearance.

Schedule of implementation:

It is planned to complete the project in 5 years. The construction schedule of Kosi-Mechi intrastate link project is given in **Annexure 2.**

2.8 PROJECT DESCRIPTION:

The extension of Kosi-Mechi Link Project envisages diversion of part of surplus water of Kosi River through existing Hanuman Nagar barrage (Birpur) to Mahananda basin and irrigates 2.15 lakh Ha area in four districts.

2.8.1 SALIENT FEATURES OF THE KOSI-MECHI INTRASTATE LINK PROJECT

1. Name of Project	: Kosi-Mechi Intrastate Link Project
2. Purpose	: Irrigation
3. River/ Basin	: Kosi\Ganga
4. Sub-Basin	: Kosi-Mechi
5. Project area reference to degree sheet	: 72J, 72N, 72O
6. Location	: Supaul, Araria, Purnia, Kishanganj and Katihar (Bihar)
7. Headworks Name	: Existing Hanuman Nagar Barrage
8. Latitude	: $26^0$31'27.4"N
9. Longitude	: $86^0$55'40.3"E
10. River	: Kosi
11. Nearest town	: Hanuman Nagar (Nepal) Birpur (India)
12. Catchment Area of Kosi basin upto existing Hanuman Nagar barrage (Birpur)	: 61792 Sq. km
13. Design flood of the existing barrage	: 26900 cumec
14. Annual yield at 75% dependability at Hanuman Nagar barrage (Birpur)	: 45374 MCM
15. Length of canal	: 117.50 km
a. Existing Eastern Kosi Main Canal (EKMC)	: 41.30 km
b. New canal beyond EKMC	: 76.20 km
c. Total (a+b)	: 117.50 km
16. Flow	: Gravity
17. Lining	: Concrete lining
18. Design discharge at head	: 573 cumec
19. Design discharge at tail	: 27 cumec
20. Full supply depth at head	: 3.50 m
21. Full supply depth at tail	: 2.00 m
22. Bed width at head	: 131.50 m
23. Bed width at tail	: 15.00 m

24. Sideslopes : 1: 1.5
25. Bed slope : 1 : 11,000 and 1:12,000
26. FSL of canal at head : 74.371 m
27. FSL of canal at tail end : 54.239 m
28. Number of structures : 113No.
    a. Road bridge : 43 No.
    b. Syphon aqueduct : 14 No.
    c. Canal siphon : 09 No.
    d. Cross regulator : 10No.
    e. Head regulator : 27No.
    f. Hume pipe culvert : 9No.
    g. Settling basin : 1 No.
    h. Canal escape : 8No.
29. Water needs of link canal
    I. Culturable command area (CCA)
    II. Existing CCA of EKMC : 4.40 lakh ha
    III. Proposed CCA : 2.15 lakh ha
    IV. Area under irrigation in new command
        a. Kharif : 2,10,516 ha
        b. Rabi : -
        Total : 2,10,516 ha
        c. Intensity of irrigation (proposed) : 98%
30. Water requirement
    A. Existing utilization of EKMC : 5740.37 MCM
    B. Enroute water requirement for new command
        a. Irrigation : 2050.15 MCM

2.8.2 Existing Hanuman Nagar Barrage (Birpur):

1. As per agreement signed between Govt. of India and the then H.M.G. of Nepal in 1954, Kosi barrage was constructed as a component of Kosi Project 1954. Accordingly, 1149 m long Hanuman Nagar barrage (Kosi barrage) was constructed near Bhimnagar village located at $26^0$31'27.4"Nand $86^0$55'40.3"E and 48 km below Chatra with pond level of 74.69 meters (245 Feet).It consist of 76 bays of 30 feet each with 7 feet piers and under sluices portion consist of 5 bays of 30 feet each. Provision of one fish ladder has also been made in the main spillway. The crest of under sluices is kept at R. L. 222 feet and is 3 feet lower than that of the weir. However the U/S apron and D/S stilling pool levels are same in both portions. The basic purpose of the barrage is:

(i) To raise the water level in the Barrage sufficiently to cause flattening the slope of the river during flood.

(ii) To create such a pond level as to enable flow irrigation water through the Eastern and Western Main canals off-taking from the head regulators situated at both ends of the barrage.

(iii) To generate hydro electric power (A hydro electric generation power plant was constructed at R.D. 3.66 km of Eastern Kosi Main canal having power generation capacity of 19.20 MW)

The construction of the barrage was started in 1959 and completed in March-1963.

The Kosi-Mechi intrastate link canal offtakes from Left Head Regulator of existing Hanuman Nagar barrage (Birpur). In its initial reach, the link canal will utilize entire length of existing Eastern Kosi Main Canal after its remodelling to provide adequate water supply to new command.

2.8.3 Canal alignment:

The Kosi-Mechi Intra-State link envisages to utilize the existing EKMC after its remodelling up to RD 41.30 km and new canal up to 117.50 km. for providing irrigation in new command lying between rivers Parman and Mechi by diverting balance surplus water into river Mechi. The total length of the link canal including the length of the existing EKMC was 117.50km.

The brief details of both the parts of the canal are as given below:

(i) Existing Eastern Kosi Main Canal after remodelling

The existing alignment of EKMC from RD 0.00 km to RD 41.30 km is proposed to be utilised unchanged with remodelling.

(ii) New canal from EKMC RD 41.30 km to outfall Point inMechi (RD 117.500 km)

Beyond the EKMC tail end RD 41.30 km, the link canal traverses towards south–east direction upto RD 53.156 km. near village Sunmani.

From RD 53.156 it turns towards north-east direction and traverse upto RD 62.160 km. near village Khesroil. In this reach it crosses some important rivers i.e. Tehri (Lat. 26^0 20' 47" and Long. 87^0 22' 00"), Lohandra and Bhalua.

From RD 62.160 km. canal again turns towards south-east direction and cross a major road (Araria to Kuari) at RD 63.110 km near Kursakata village (Lat. 26^0 21' 30" and Long. 87^0 26' 39").

From RD 63.729 km alignment follows the path in north-east direction upto RD 68.761 km.In this reach canal crosses a major river, Bakra at RD 65.925 km (Lat. 26^0 21' 32" and Long. 87^0 28' 18") and a small river Ghaghi at RD 68.630 km.

From RD 68.761 km to 82.843 km canal runs in south-east direction. In this reach alignment crosses Pahara and Nona river at RD 71.900 km and 77.850 km respectively and an important road (Jokihat to Tehragach) at RD 80.600 km (Lat. 26^0 18' 54" and Long. 87^0 36' 16") near village Charbana.

From RD 82.843 km to 91.200 km alignment traverses almost in east direction and crosses a major river Ratua/Gerua at RD 89.300 km. near village Suiha.

After RD 91.200 km it turns towards south east direction upto RD 98.400 km. In this reach it crosses the largest river of sub-basin i.e. Kankai/Kawal at RD 95.900 km near village Laucha (Lat. 26^0 16' 58" and Long. 87^0 44' 52"). The Kankai river originates from Nepal and carries a large quantum of silt.

The Kosi-Mechi link after RD 98.400 km to RD 112.250 km traverse towards east direction and crosses some important roads viz. Bahadurganj to Samesar road at RD 103.957 and Araria to Siliguri road (SH-63) at RD 104.905 km (Lat. 26^0 16' 29" and Long. 87^0 50' 15") it also cross old Kankai river at RD 103.050 km, Kankai/Sarrah river at RD 107.725 km (near village Bharadhar) and Kankai river at RD 111.735 km near village Dala.

In final reach from RD 112.250 km to RD 113.887 km it is aligned towards south-east direction and thereafter it turns towards east, it finally outfalls into Mechi river at RD 117.500 km near Makhanpur village (Lat. $26^0$14′ 27″ N and Long. 87^0 57′ 23″ E) about 1.50 km upstream of confluence of Mechi river with Mahananda river.

Thus the total length of link canal form its offtake (Kosi barrage) to outfall (Mechi river) is 117.500 km including 41.30 km of EKMC and 2.9 km escape channel. The alignment passes through Supaul, Araria and Kishanganj districts of Bihar state.

The EKMC and its extension beyond Parman river at RD 44.20 km and the new proposed canal upto RD 117.50 km are gravity canals throughout in its length. The proposed canal alignment passes through full cutting, partial cutting partial filling and in full filling. The canal crosses a number of rivers, roads, canals, distributaries, railway line etc. therefore, provisions of CD structures have been made at each crossing. 113 No. of structures at various reaches have been proposed. Eight No. of Escape channels have also been proposed along the link canal in various reaches wherever it is necessary for safety of canal. The details of structures provided for the project are given below.

1.	Canal syphon	-	09
2.	Syphon aqueduct	-	14
3.	Road bridge	-	43
4.	Cross regulator	-	10
5.	Head regulator	-	27
6.	Hume pipe culvert	-	09
7.	Settling basin	-	01
	Total	:	113 Nos.

The L-section showing structures from RD 41.30 km to 117.50 km are given in **Fig. No. C2.3.**

2.8.4 Project components:

As stated earlier, the Kosi-Mechi Intra State link will utilize existing Eastern Kosi Main canal after its remodelling to provide water to the new command for irrigation purpose. Keeping in view the economical and technical feasibility of project, studies have been carried out for firming up the utility of existing structures without remodelling where it is technically feasible.

Remodelling of Existing Eastern Kosi Main Canal

While firming up the design parameters of existing canal, the following ground positions were considered.

(i) The river Kosi is one of the largest silt carrying river of the world and silt control is a challenging task in irrigation structures. The Water Resources Department, Govt. of Bihar has constructed a settling tank at about 1.07 km RD.

(ii) There is an existing canal power house at RD 3.66 km utilizing a fall of 3.96 m and having an installed capacity of 19.2 MW. The maximum tail water level of this power house is 70.104 m.

(iii) The existing Eastern Kosi Main Canal is a contour canal providing irrigation south wards. Most of the distributary system of existing Eastern Kosi Main canal is on its right bank. Efforts have been made for the optimum utilization of these structures.

In view of the above, the following provisions have been made while carrying out the design of remodelled canal.

To protect canal power house at RD 3.66 km, the existing design parameters of EKMC such as FSL, FSD and bed slope have been maintained in remodelled section also upto RD 4.57 km.

The bed slope is proposed uniformly as 1 in 11000 upto entire length of existing canal i.e. upto RD 41.30 km and FSD is proposed little greater than existing full supply depth, varying from 4.25 m to 3.5 m. In rest of the link beyond Eastern Kosi Main Canal, the bed slope is proposed uniformly as 1 in 12000. By making such provisions, some of the structures upto RD 4.572 km can be utilized without remodelling. In addition, eight nos. of existing bridges constructed across the drainages and parallel to their canal syphons in existing canal portion can also be utilized without remodelling.

The 13 structures up to RD40.945 km will be utilized without remodelling. Remaining structures of existing Eastern Kosi Main Canal are proposed for reconstruction due to considerable variation in canal FSL and FSD. The canal sections for various reaches have been carried out keeping in view of the above ground positions. The link canal is a lined canal of trapezoidal shape.

The reachwise canal parameters are as given in **Table No. C2-1.**

Table No.C2-1: Reachwise canal parameters:

Sl. No.	Reach RD (km)			Bed slope			Discharge (cumec)	Depth (m)	Bed width (m)
1	0.00	-	4.57	1	:	11000	573	3.50	131.50
2	4.57	-	13.35	1	:	11000	489	4.25	79.50
3	13.35	-	23.90	1	:	11000	444	4.25	72.00
4	23.90	-	39.99	1	:	11000	331	4.00	59.00
5	39.99	-	41.30	1	:	11000	235	3.50	52.50
6	41.30	-	61.00	1	:	12000	191	3.50	43.50
7	61.00	-	80.60	1	:	12000	122	3.00	36.50
8	80.60	-	100.40	1	:	12000	50	2.30	23.00
9	100.40	-	117.50	1	:	12000	27	2.00	15.00

(Source: DPR)

2.8.5 Canal System:

The typical section of canal is shown in Fig.No.C2.2. Normally, canals have following three types of sections.

1. Full cutting
2. Full filling
3. Partial cutting and Partial filling

As discussed earlier, the extension of existing EKMC will extend beyond 41.30 km to 117.50 km with outfall point at river Mechi, a tributary of Mahananda. The extension of Kosi main canal will have 10No. of new Branch and Distributary canals in the above reach.

The details of Branch and Distributary canals system are as below.

Canal system from RD 41.30 km to 117.50 km.:

1. Distributary at RD 57.890 km
2. Branch canal at RD 61.00 km
3. Distributary at RD 66.515 km
4. Distributary at RD 70.940 km
5. Branch canal at RD 80.600 km
6. Distributary at RD 92.975 km
7. Branch canal at RD 100.400km
8. Distributary at RD 106.800 km
9. Branch canal at RD 111.000 km
10. Distributary at RD 112.600 km

The above will have 6No. of Distributaries and 4No. of Branch canal. The canal system will have Minors, Sub-minors and water course for each canal. The detail alignment of each Branch canal and Distributary will be furnished after the field survey is completed for each canal.

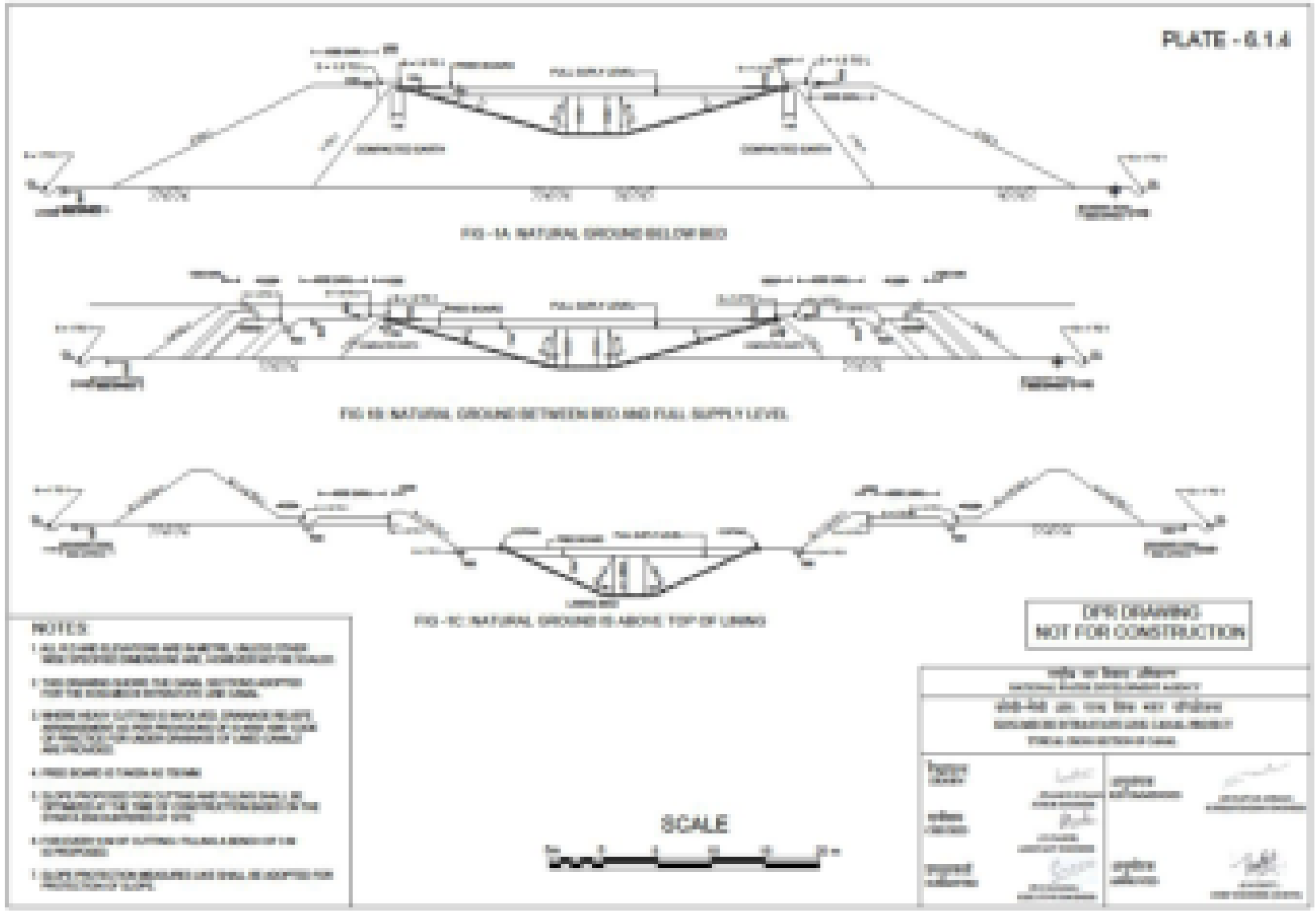


Fig. No. C2.2: Typical cross section of canal

2.8.6 River system enroute to link canal:

The link canal crosses a number of streams beyond river Parman. All these streams are the tributaries of river Mahananda. The new command area is well drained. All these rivers originate in Nepal. The Parman, Tehri, Lohandra, Bhalua, Bakra, Ghaghi, Pahara, Nona, Ratua, Kawal, and Kankai are the main rivers enroute the link canal. Most of the rivers have stable banks. However river Kankai and River Kawal carries a tremendous sediment load. The salient details of these rivers are given in **Table No.C2-2**.

Table No.C2-2: Salient Details of Enroute Rivers

Sl. No.	Name of river	Crossing of link canal at RD
1	Parman	44.20
2	Tehri	55.150
3	Lohandra	56.930
4	Bhalua	60.450
5	Bakra	65.925
6	Ghaghi	68.630
7	Pahara	71.900
8	Nona	77.850
9	Ratua/Gerua	89.300
10	Kawal	95.900
11	Kankai	103.05
12	Sarrah	107.725
13	Kankai river	111.735

(Source: DPR)

2.8.7 Land requirement for canal system:

Total land required for canal system 1396.81 ha &632.23 ha land has been acquired and additional land to be acquired is 764.58 ha. The requirements of land in canal system are given in **Table No. C2-3**.

Table No. C2-3: Land acquisition:

Sl. No.	Reach in km	Length of reach (m)	Permanent width of canal (m)	Total land required (ha)	Already acquired for EKMC (ha)	Additional land to be acquired (ha)
1	0.000-4.572	4572	220	100.58	100.58	0.00
2	4.572-13.350	8778	170	149.23	149.23	0.00
3	13.350-23.905	10555	160	168.88	168.88	0.00
4	23.905-39.990	16485	140	230.79	197.82	32.97
5	39.990-41.300	1310	130	17.03	15.72	1.31
6	41.300-61.000	19700	120	236.40	0.00	236.40
7	61.000-80.600	19600	100	196.00	0.00	196.00
8	80.600-100.400	19800	90	178.20	0.00	178.20
9	100.400-117.500	17100	70	119.70	0.00	119.70
			Total	**1396.81**	**632.23**	**764.58**

(Sources: DPR)

2.8.7.1 Land requirement for distribution system:

Besides the land requirement of main canal there will be 10No. Branch canal and Distributaries. Further, there will be minors and sub-minors for each distributary system. The land requirement for each system will be worked out after detail survey is conducted. However, 20% of canal system will be pressurised system for which some land requirement will be reduced.

2.9 HYDROLOGY OF PROJECT:

The Hydrology of a project is an important study prefixing its planning and design aspects. National Water Development Agency has conducted hydrological studies of Kosi basin at Hanuman Nagar barrage (Birpur). The objective of the studies is to estimate the water yield and conduct water balance studies at existing Hanuman Nagar barrage (Birpur).

The catchment area of Kosi river up to Hanuman Nagar barrage (Birpur) is 61792 km^2. The hydrological studies of river Kosi at Hanuman Nagar barrage (Birpur) have been carried out on the basis of observed discharge data of Birpur Gauge and Discharge(G & D) site located downstream of Hanuman Nagar barrage maintained by Water Resources Department, Government of Bihar for period 1965 to 2013.

2.9.1 Monsoon and lean season flow:

The monthly inflow data observed at Hanuman Nagar barrage (Birpur) for the period from 1965-66 to 2012-13 indicate that monthwise maximum flow of 9921.61 cumec occurs during August 1981 and minimum flow of 43.54 cumec during January, 1967. The monthwise maximum, minimum observed flow, 75% dependable monthly flow and year of occurrence are shown in **Table No.C2-4**.

Table No.C2-4: Monthly maximum, minimum and 75% dependable monthly flow (in cumec)

Sl. No.	Months	Maximum		Minimum		75% dependability flow during the month
		Year	Discharge	Year	Discharge	
1	June	1971	5296.0	1992	470.9	1485.77
2	July	1970	8042.07	2001	1871.26	3594.41
3	August	1981	9921.61	2006	2346.09	3973.17
4	September	1988	7092.01	1979	1547.11	2959.08
5	October	1968	6721.15	1966	675.51	1275.36
6	November	1971	1504.11	1967	275.93	652.41
7	December	1968	1043.4	1991	263.75	453.96
8	January	2002	902.03	1967	43.54	453.96
9	February	1976	443.09	1968	72.92	254.75
10	March	1973	501.89	1967	60.03	243.64
11	April	1975	839.51	2004	204.64	323.76
12	May	1975	1778.4	2004	284.75	558.45

(Source: DPR)

2.9.2 Assessment of yield:

In the present study, water availability at Hanuman Nagar barrage (Birpur) also called Kosi barrage, has been assessed by accounting the average monthly inflow data of Birpur discharge site at Hanuman Nagar barrage(Birpur) which is available for a period of 47 years, from 1965-2013. The discharge data for the year 2008-09 has been discarded due to its inconsistency. The gross annual yield at Hanuman Nagar barrage (Birpur) works out to 49,990 MCM and 45,374 MCM at 50% and 75% dependability respectively. This is shown in **Annexure-3.**

2.9.3 Environmental Flow:

20% of 4 lean months of 90% dependable year.
30% of monsoon months of 90% dependable year.
90% dependable year = year 1992-93
i.e. 43year of total 47 years flow series
Annual flow = 41903 MCM

Non Monsoon Flow:

4 lean season = Feb to May 4077.12 MCM
20% of above = 815.42 MCM
There are no drawal of water in East Kosi main canal during non-monsoon as such Environmental Flow is assured in dry season.

Monsoon Flow: Year 1992-93

Monsoon flow = 33281.27 MCM.
30% of flow = 9984.381 MCM.
Say = 9985 MCM.
Drawal for east Kosi main canal = 7791 MCM.
Drawal for west Kosi main canal = not Known.
However, Environmental Flow of 9984.381 MCM assured.
In view of the above, the guidelines of environmental flow are fully assured.

2.10 COMMAND AREA OF LINK CANAL:

The link canal will provide irrigation in new command areas lying in Araria, Purnia, Katiharand Kishanganj districts of Bihar. The district wise details of link command are given in **Table No. C2-5.**

Table No. C2-5: District wise break up of gross command area (Unit: ha)

Sl. No	Name of district	Area falling in the command	% of total command area	Area of the district	% of the district
1	Araria	88000	31.98	271712	32.38723
2	Purnia	65885	23.95	313883	20.99031
3	Katihar	69100	25.11	291349	23.71726
4	Kishanganj	52150	18.95	189080	27.58092
	Total	**275135**	**100.00**		

(Source: DPR)

2.11 LAND USE OF COMMAND AREA LYING UNDER THE LINK:

The CCA has been worked using latest 5 years land use statistics for the period 2006-07 to 2009-10. It was seen that culturable area is highest in the year 2006-07. Taking that land use data of 2006-07, the gross command area under the new canal is worked out as 2,75,135 ha and CCA works out to 2,14,812 ha (2.15 ha).

The classification of land use in the enroute command area is furnished in **Table No. C2-6** below.

Table No. C2-6: Abstract of land use of command area lying under thelink canal (in ha)

Sl. No.	Particulars	Area under link canal in the districts of				Total area
		Araria	Purnia	Katihar	Kishanganj	
1	Gross command area	88000	85750	49235	52150	275135
2	Forest	271	31	302	98	702
3	Barren & un-cultivable land	1646	3394	3764	3139	11943
4	Land put to non-agricultural use	16394	12235	9472	9301	47403
5	Cultivable waste land	183	317	133	341	974
6	Permanent pastures & grazing land	46	120	45	64	275
7	Land under Misc. tree, crop & groves	6127	2389	1856	1374	11746
8	Fallow land other than Current fallow	969	1306	1029	854	4159
9	Current fallow	3152	8907	4033	2335	18427
10	Net area shown	59211	57052	28601	34644	179507
11	Area shown more than once	30962	19995	15356	12396	78708
12	Total Culturable land (5+7+8+9+10)	69642	69970	35653	39548	214812

(Source: DPR)

2.12 CROPPING PATTERN:

2.12.1 Existing Cropping pattern:

The new command area lies between river Parman and river Mahananda and falls in Araria, Purnia, Katihar and Kishanganj districts of Bihar. As per the information collected from agriculture offices of concerned districts, the cropping pattern in all the districts is almost similar. However, there are some variations in cropped areas. The paddy is the main crop in the area. The district wise details of existing cropping pattern are given in **Table No. C2-7**.

Table No. C2-7: Existing cropping pattern in proposed command:

Sl. No	Season / crop	Percentage cropped area				
		Araria (69642 ha)	**Purnia**(69 970 ha)	**Kishanganj** (39548 ha)	**Katihar** (35652 ha)	**Wetted average intensity**
I.	**Summer**					
i)	Paddy	0	0	20.22	0	3.72
Sub-total-I		**0**	**0**	**20.22**	**0**	**3.72**
II.	**Kharif**					
i)	Paddy	48.60	41.8	59.98	40.70	47.17
ii)	Pulses	0.40	0.5	0.80	0.50	0.52
iii)	Maize	7.90	9.6	1.74	19.00	9.16
iv)	Jute	12.50	10.4	26.85	10.80	14.18
v)	Oilseeds	0.40	0.5	0.77	0.50	0.52
Sub-total-II		**69.80**	**62.8**	**90.14**	**71.50**	**71.55**
III.	**Rabi**					
i)	Wheat	21.20	23.0	16.04	14.00	19.64
ii)	Pulses	3.60	2.5	1.95	3.00	2.84
iii)	Oil seeds	2.20	2.0	2.79	2.10	2.23
iv)	Maize	1.80	5.7	5.86	6.40	4.58
v)	Pea/Potato	1.40	4.0		3.00	2.25
Sub-total-III		**30.20**	**37.2**	**26.64**	**28.50**	**31.54**
IV).	Perennial	0.00	0.00	2.79	0.00	0.51
Sub-total-IV		**0.00**	**0.00**	**2.79**	**0.00**	**0.51**
	Intensity	100	100.00	139.79	100.00	107.33

Source: District Agriculture Offices of Concerned districts of Bihar

A part of district Purnia located west of river Parman, is irrigated by existing EKMC. The farmers of this irrigated area are growing hybrid maize, peas, potato, green vegetables and other valued crops. The production of hybrid maize is reported to the tune of 72 to 78 quintals per ha.

2.12.2 Proposed cropping pattern:

The cropping pattern for the proposed command as suggested by the Agricultural Department Govt. of Bihar has been adopted in this study and furnished in **Table No. C2-8.**

Table No.C2-8: Suggested cropping pattern in the command of link:

Sl. No.	Name of crop	Total Cropped area (ha)	Percentage of CCA
A.	**Kharif**		
i)	Paddy	103110	48.00
ii)	Pulses	24703	11.50
iii)	Vegetables	17185	8.00
iv)	Maize	54777	25.50
v)	Fodder/jowar	8592	4.00
vi)	Oil seeds & others crops	2148	1.00
Sub-total		**210516**	**98**
B.	**Rabi**		
i)	Wheat	42192	19.64
ii)	Pulses	6097	2.84
iii)	Oilseeds	4784	2.23
iv)	Maize	9841	4.58
v)	Pea/potato	4843	2.25
Sub-total		**67760**	**31.54**

(Source: DPR)

Note: However, since the water is available for kharif only, cropping pattern for kharif is only considered. Rabi crop can be irrigated after construction of Sapt Kosi High Dam. In existing scenario, the link canal will provide irrigation in kharif season only at irrigation intensity of 98%.

2.13 Month wise Water Requirement for link canal:

The purpose of Kosi-Mechi intrastate link is to extend irrigation in new command areas of Mahananda basin lying between river Parman and river Mahananda. The link canal will utilize existing EKMC after its remodelling to provide irrigation to new command areas. Thus in its initial reach, the link canal will carry a combined flow of Existing EKMC and the water to be diverted to the new command. The month wise requirement of canal as worked out given in **Table No. C2-9.**

Table No. C2-9: Ten daily water needs of Kosi-Mechi Link (excluding EKMC)

Season	Month	Decadays	Irrigation needs (MCM)
Kharif	June	1-10	47.59
		11-20	97.23
		21-30	106.92
	July	1-10	119.34
		11-20	119.34
		21-31	131.28
	August	1-10	143.63
		11-20	152.72
		21-31	172.11
	September	1-10	157.28
		11-20	146.81
		21-30	143.60
	October	1-10	166.33
		11-20	166.33
		21-31	179.63
		Total Kharif	**2050.15**

(Source: DPR)

2.13.1 Existing Eastern Kosi Main Canal:

In its initial reach from RD 0.00 km to RD 41.30 km , the Kosi-Mechi link canal will follow the existing EKMC off taking from the left bank head regulator of Hanuman Nagar barrage (Birpur). The annual water requirement of existing EKMC is 5740 MCM. The command area of existing canal upto 41.30 km is as below:

i) CCA of EKMC 3.49 lakh ha
ii) CCA of Rajpur Canal System 0.91 lakh ha
Total 4.40 lakh ha

The present assured utilisation of EKMC inclusive of losses is 5740 MCM

2.13.2Irrigation requirement of new command:

The new command of Kosi-Mechi link is bounded by river Parman on the west and river Mahananda on the east. The entire command is located in the south of link alignment and lies in Araria, Purnia, Kishanganj and Katihar districts of Bihar.

The canal will run from June to October to provide irrigation in monsoon months only. Water to the tune of 2050.15 MCM will be utilized for enroute irrigation in new command.

2.13.3 Total Water Requirement:

The total water requirement of EKMC which will run from June to October is as below:

Existing requirement :5740.37 MCM
Requirement for Proposed 41.30to 117.50 km :2050.15 MCM
Total : 7790.52MCM

Pressurised Irrigation:

Command area survey work in 10% of CCA has been done and survey plan has also been enclosed in DPR of this project.

Further course of action be initiated at the time of implementation of the project.

Govt. of Bihar will take necessary steps to introduce pressurised irrigation as demonstrative steps so that pipelines can be laid underground.

2.14 ENVIRONMENTAL STUDY:

Environmental baseline study shall be conducted by the experts of the accredited consultant organisation according to the recommended methodology which broadly includes:

Primary data:

- The baseline data should be collected for one season only.
- Instruments used and methodology adopted for analysis of air, water, soil and noise is to be mentioned.
- Physico-chemical analysis of surface water and groundwater will be done for all items as indicated in ToR.
- Soil characteristic study will also be undertaken as recommended.
- Ambient air quality and noise level data will also be collected.
- Groundwater table data will be collected from field.
- Biodiversity data as per guideline in ToR.

Secondary data:

- Meteorology data i.e. temperature, relative humidity, wind speed/ direction are to be collected from nearest IMD station.
- Remote sensing imagery system will be used for developing thematic maps for landuse, land cover and drainage etc.
- Data on fauna species, migratory route of wild animals if any are to be collected from PCCF& wildlife warden of the state.
- Details of environmentally sensitive areas i.e., National Park, Wildlife sanctuary, Biosphere resource etc if any to be obtained from records of Forest department and locations to be shown on a map with respect to project area.
- Groundwater table data are to be obtained from CGWB report.
- Details of Socio-economic aspect.

2.15 PREDICTION OF IMPACTS:

Prediction of impact is essentially a process to forecast the future environmental conditions of the project area that may be expected to occur because of implementation of the project. Impact due to various project activities are normally predicted by using appropriate techniques like modeling, overlay/super-

impositions of activity or comparison of impacts observed in similar type of projects already executed in other areas of the state or in other parts of India.

Some of the impacts on environmental issues predicted during the EIA study are as below.

- General / socio-economic status
- Loss of land
- Change in land use pattern
- Impact on drainage system
- Impacts on water quality
- Impacts on air and noise quality
- Impact on Ecology & Biodiversity
- Impact on Health system.
- Impact due to waterlogging
- Impact during project construction phase
- Impact due to command area development.

2.16 IMPACT ASSESSMENT AND MANAGEMENT PLAN:

EIA Study:

EIA study will include:

I. Identification and prediction of impacts.

II. Evaluation of impact using standard matrix.

III. Suggesting mitigation measures for each of the negative/ adverse impacts.

IV. Suggesting environmental safeguard measures.

Environmental management plan:

I. Management strategy for land acquisition and land compensation payment.

II. Free flow of river system and its management in extended canal system.

III. Command area management plan

IV. Drainage and weed control management plan

V. Irrigation water logging and soil salinity management

VI. Health management in command area through infection in water channel and water bodies including water quality.

VII. Labour management during construction.

VIII. Communication management in canal road system and safeguards.

IX. Greenbelt development management

X. Construction planning and management

XI. Muck disposal plan

XII. Local area development plan

XIII. Fisheries conservation plan

XIV. Reservoir rim treatment plan

2.17 ENVIRONMENTAL MONITORING PROGRAMME:

I. Strategy for effective monitoring of environmental mitigation measures.

II. Monitoring of water quality against excessive use of fertiliser and pesticides.

III. Monitoring of ground water table and water logging of command area.

IV. Monitoring of weed infestation and effective functioning of canal system.

V. Monitoring of health parameters in command area likely to be affected by virus and other infections responsible to water bodies in canal system.

2.18 PUBLIC CONSULTATION:

This is an important event for the successful environmental appraisal as the entire benefit is likely to be transferred to the population of the four districts. Four separate public consultation meetings were carried out in each district of Araria, Purnia, Katihar and Kishanganj. The recommendations of public hearing of all four districts were incorporated in this final EIA document for submitting to EAC of MoEF&CC for final appraisal.

2.19 Validity of ToR and submission of EIA report to MoEF&CC:

The ToR is valid for 4 years from the date of issue i.e. from 23rd September 2016 vide letter no. J-12011/22/2016-IA-I (R) dated23rd September 2016 of MoEF&CC.

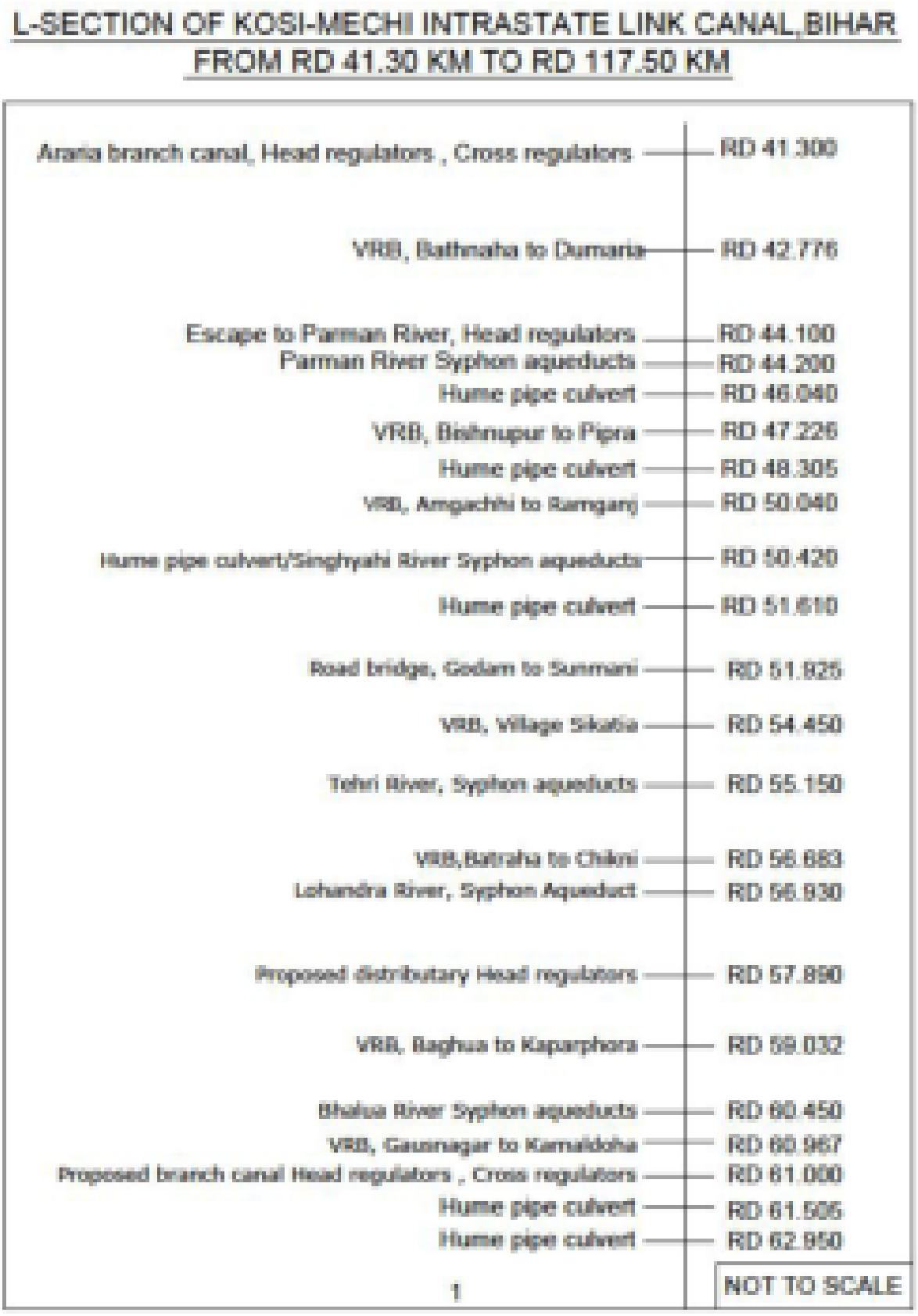


Fig.No.C2.3:L-SECTION showing structures from RD 41.30 km to 117.50 km

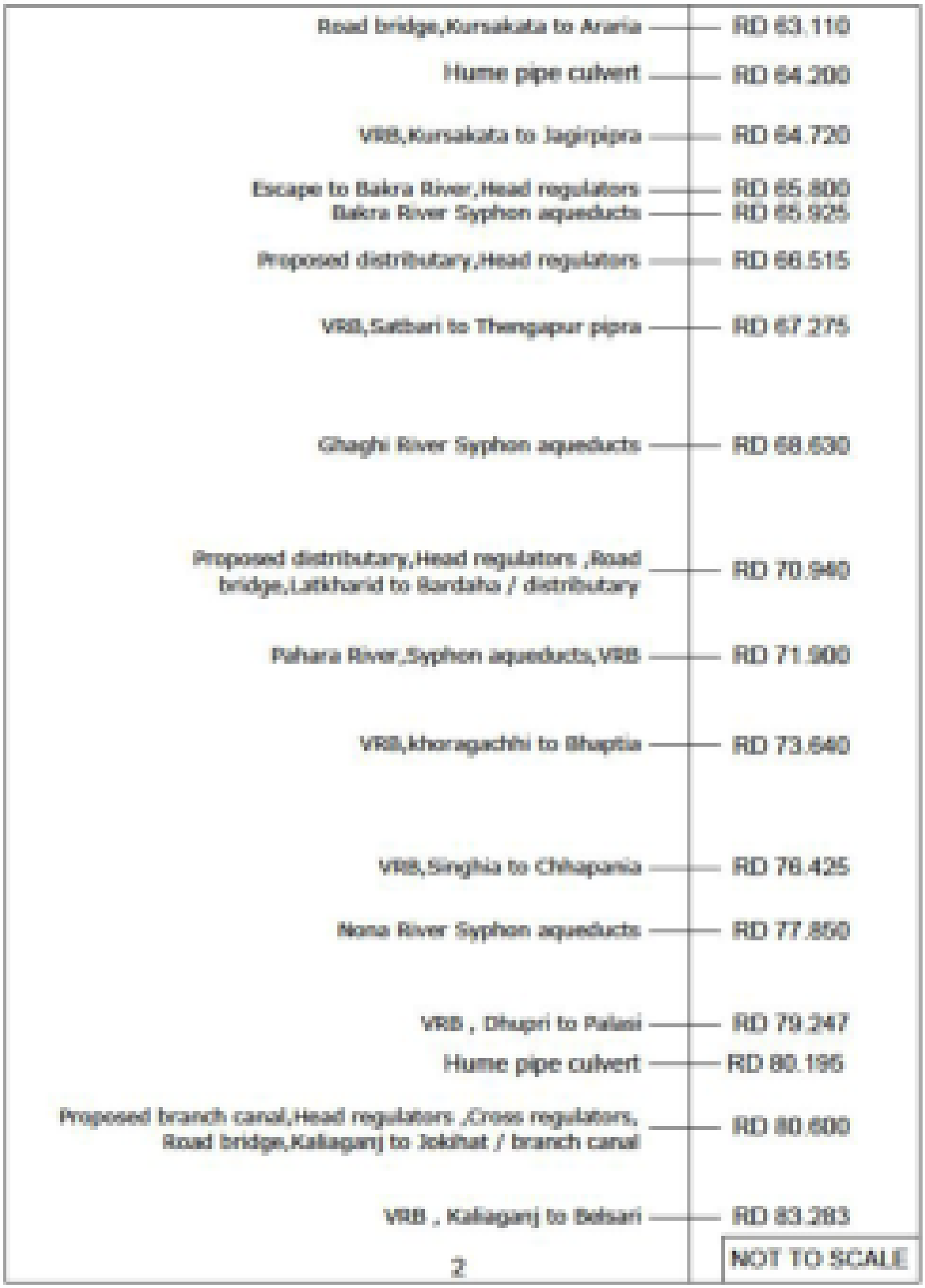
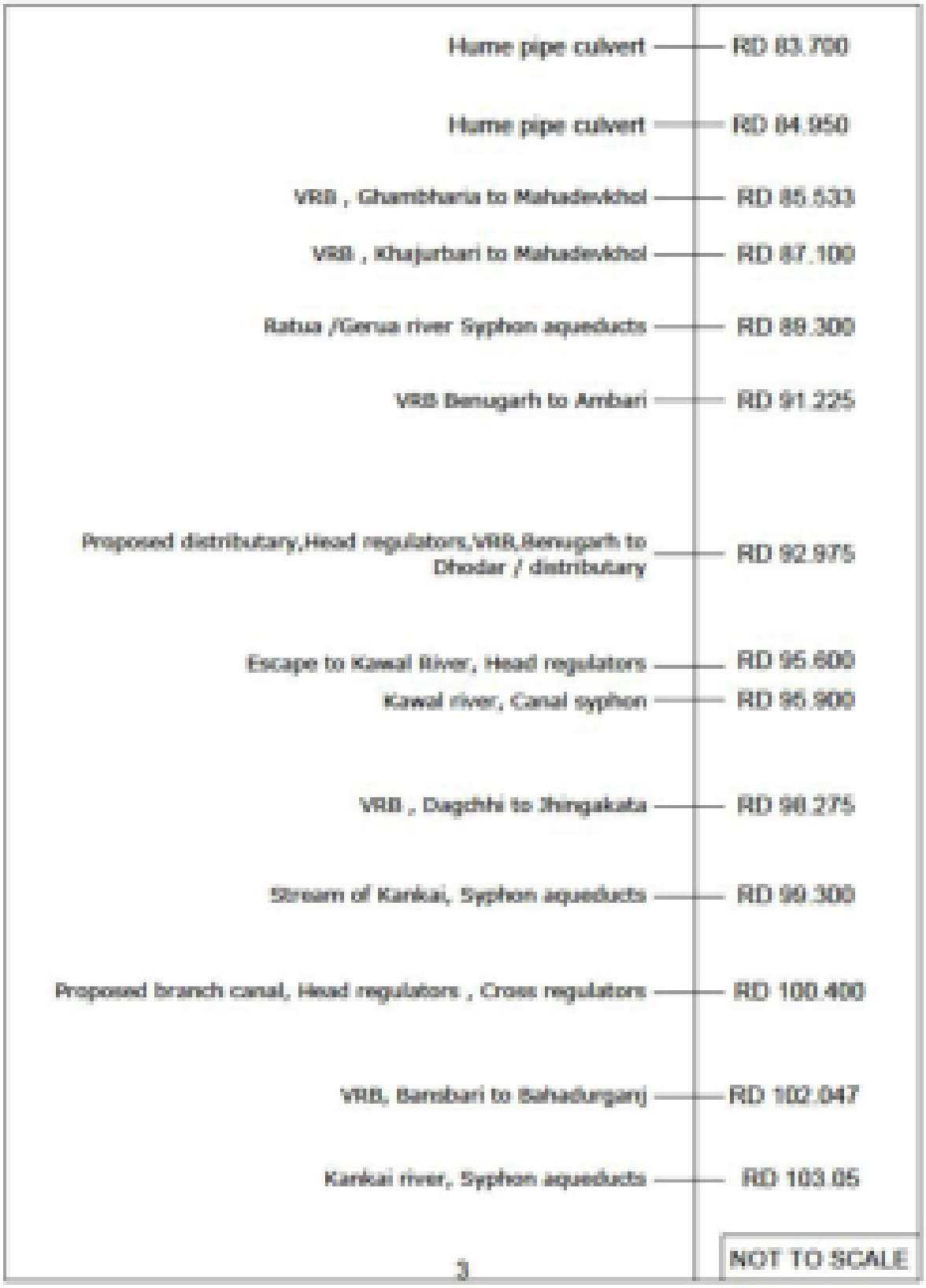


Fig.No.C2.3: L-SECTION showing structures from RD 41.30 km to 117.50 km



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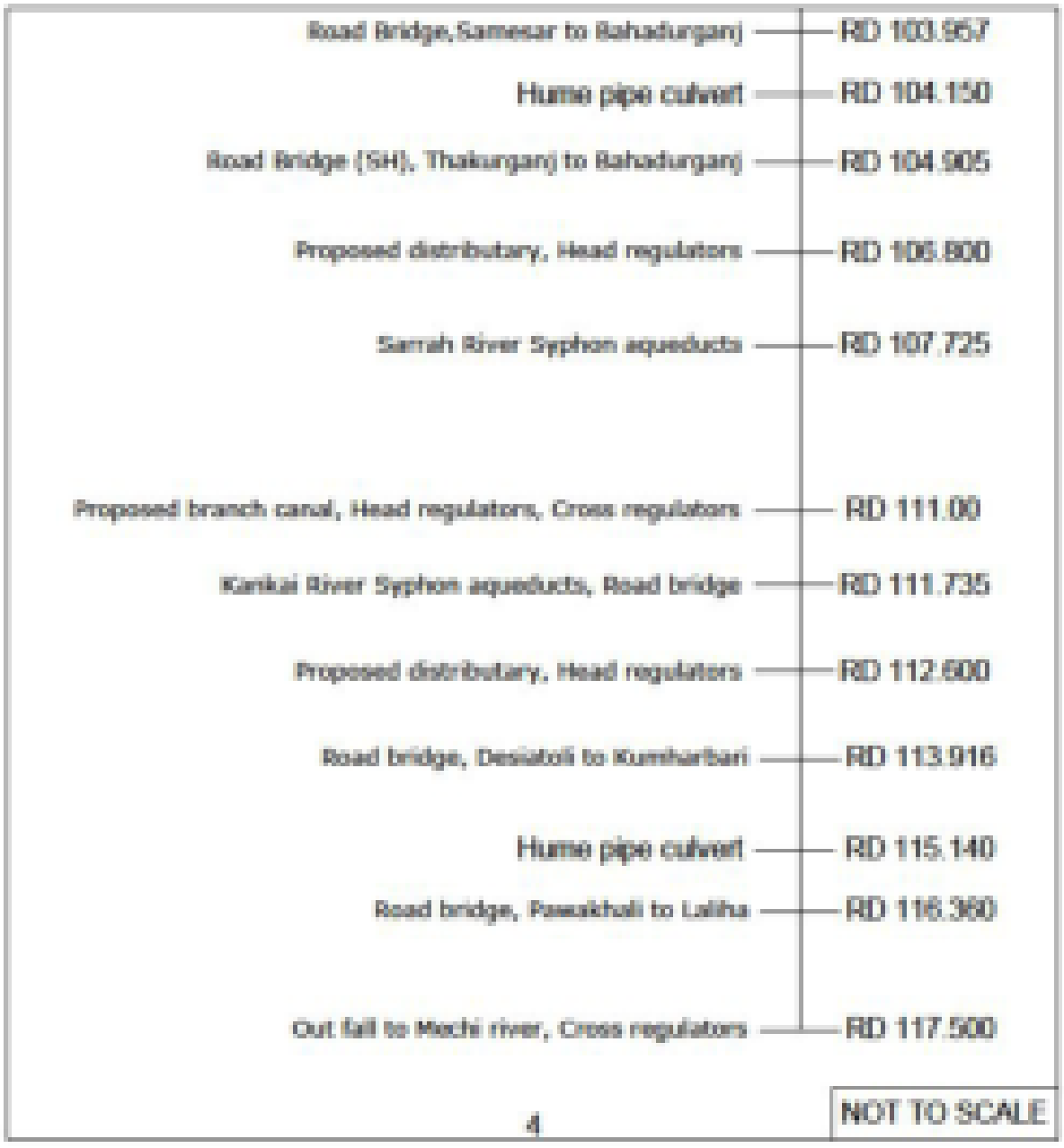


Fig.No.C2.3: L-SECTION showing structures from RD 41.30 km to 117.50 km

CHAPTER-3
PRESENT ENVIRONMENTAL SCENARIO

3.0 OBJECTIVE:

The objective of conducting baseline survey of the existing environmental settings and data collection is to provide a data base for predicting the likely changes that are expected in implementation of the project. Simultaneously, it provides a reliable platform for monitoring such changes in the operation phase. This chapter deals with the approach for data collection, Environmental scoping / identification of Environmental attributes and baselines survey details.

3.1 THE PROJECT PROPOSAL:

The Kosi-Mechi intrastate link project envisages diversion of 12,582 MCM of Kosi river water from existing Hanuman Nagar Barrage (Birpur) on Indo-Nepal border to Mechi river (a tributary of Mahananda) about 1.5 km upstream of its confluence with Mahananda river in Makhanpur village of Kishanganj district of Bihar state. The proposed link canal offtakes from the eastern side of the barrage near Hanuman Nagar at FSL 74.371 m and outfalls into Mechi river at FSL 54.239 m. The total length of the link canal is 117.50 km. This link canal will cross number of streams/rivers, road and railway lines for which 9 canal syphons, 14 syphon aqueducts, 43 road bridges and 9 hume pipe culverts have been proposed. 27 head regulators, 10 cross regulators, 1 settling basin and 8 escapes have also been provided for the link canal regulation.

The aim of proposed EKMC upto Mechi River is mainly to provide irrigation benefits to the command areas located in Araria, Kishanganj, Purnia & Katihar.

3.2 STUDY AREA:

Kosi-Mechi intrastate linked project is proposed for the irrigation purpose mainly by expanding the existing canal from Kosi River to the Mechi River in East direction. The proposed irrigation system is situated in Bihar state and it covers seven districts of the state such as Supaul, Araria, Kishanganj, Purnia, Katihar, Madhepura and Saharsa. But the main canal will pass through only three districts such as Supaul, Araria & Kishanganj. Hanuman Nagar Barrage(Birpur) is located at Latitude: $26^0$31′ 27.4″ N & Longitude:86^0 55′ 40.3″ E. As the proposed project is an expansion cum modification irrigation project so, the study was done for the total canal coverage area from the starting 0 km RD to 117.50 km RD from the existing Hanuman Nagar Barrage(Birpur). The total study area was covered, 10 km buffer zone from the Hanuman Nagar Barrage & 1km southward from the main canal. The study area of 10 km buffer zone is also stands on the international border of India-Nepal. Hence, about 55% of the study area falls on the Nepal Boundary. So, only buffer zone within India was taken for the study. The soil & ground water level study were conducted for the Ayacut area also to know the baseline.

The study area with the above features is described with River Kosi flowing N-SW-SE direction forming the southern boundary towards the River Ganges, while the river Mechi is flowing N–S direction and it falls on the Mahananda river and

the Mahananda river is flowing N-S direction towards the Ganges in the South. Both the Kosi & the Mahanda River forms the boundary the study area as showing in the location map furnished in **Fig.No. C3-1.**

3.2.1 Connectivity:

The project area is well connected with road and railway networks. Forbesganj is the nearest rail head, located at a distance of about 5 km from link alignment and 42 km from Hanuman Nagar barrage (Birpur). Bagdogra is the nearest airport located about 140 km from the Hanuman Nagar barrage (as air distance). NH-106 (Birpur-Madhepura-Bihpur road) is passing near to Hanuman Nagar Barrage about 1.9 km away & NH-57 (Forbesganj and Araria) is 40 km away. Also Bihar SH-91 is about 3.1 km far from the barrage.

3.3 APPROACH FOR DATA COLLECTION:

3.3.1 Study Period:

According to the Terms of Reference (ToR), collection of one season baseline data was verified for all the environmental parameters. For the study of present environmental parameters, three months of pre monsoon data, i.e. from 1st Mar to 31st May, 2017 was taken.

3.3.2 Approach:

The consultant's team of experts have adhered to a standard approach for collection of baseline data.

I. Environmental reconnaissance (ER) of the project area

Sl	Activities	Period
1.	Visual inspection	22th – 27th February, 2017
2.	Interaction with the local people	22th – 27th February, 2017
3.	Discussion with the project authority, collection of data from relevant project records performance overview of the completed phases	28th February, 2017

II. The studied environmental parameters include land, water, Air, Soil and ecology with meteorological data for the impact prediction & calculate the mitigating measures. With that also the pre-project Socio–economic status of the people of study area.

III. Sampling stations were strategically located. Soil & Water samples were collected as per recommended procedure. Suitable equipments are used to record Air quality and Noise level at site. Literature and authentic records were consulted to study the Environment & Socio–Economic status concerning the study areas.

IV. Field survey and sampling period:

Sl	Items	Season	Period
1.	Water quality (Surface & Ground)	Pre-Monsoon	22nd – 24thMarch, 2017
2.	Soil quality	Pre-Monsoon	22nd – 24thMarch, 2017
3.	Ambient Air Quality	Pre-Monsoon	1st March–31st May, 2017
4.	Noise level	Pre-Monsoon	4th – 6thApril, 2017
5.	Natural Environment (Flora & Fauna with specific attention to Elephant)	Pre-Monsoon	12th& 13st March and 22nd& 23rd April 2017

V. Methodology adopted for data collection is highlighted wherever necessary.

3.4 SCOPING MATRIX:

A scoping matrix along with frequency of monitoring proposed for key Environmental attributes are summarized in **Table No.C3-1.**

Table No. C3-1: Environmental Attributes.

Sl. No	Attributes	Parameters for study	Frequency / period	Methodology /source
A – Land Environment				
1	Soil	Soil Characteristics /type	Once / Pre monsoon season	• Field studies • Sampling for physical and chemical analysis according to standard laboratory test procedures. • Detailed project report (DPR) and literature view
2	Physiography	Land use – land cover pattern	Pre-project status (Data)	DPR & remote sensing interpretation
3	Geology	Geological status	Pre-project status (Data)	Literature review
4	Seismology	Seismic hazards	Pre-project status (Data)	Literature review
B – Meteorology				
1	Meteorology	Climate conditions precipitation, temperature cloud cover, relative humidity, wind speed, wind direction etc.	Pre-project status using survey data and secondary data	Literature review • IMD Data • Organisation data

C – WATER ENVIRONMENT				
1	Water quality (Surface & Ground Water)	Pollution parameters recommended by IS- 2296 & 10500 respectively.	Once pre Monsoon data	• Field studies sampling for physico – chemical &biological. Tests & Analysis with reference to IS- 2296 & 10500 respectively. • Literature review • Data interpretetion
2	Ground Water Level	Depth of Ground Water Table from the ground level	-	• Literature review • Data interpretetion
3	Drainage	Land Drainage pattern – impact on natural streams & drains	Pre-project status	• Literature review • Remote sensing interpretation
D – AIR, NOISE				
1	Ambient air Quality	$PM_{2.5}$, PM_{10}, SO_2, NO_x, CO, Ozone, Arsenic, Ammonia, Benzene, Nickel, Benzo pyrene, Lead etc.	Once /pre Monsoon	• Field studies sampling • Analysis • Literature
2	Noise levels	Noise levels assessment in dB (A)	Once /pre Monsoon	• Field studies • Monitoring
E – BIOLOGICAL ENVIRONMENT				
1	Biological study	Study of Flora - Fauna and Wild Animals (Conservation) Rare and Endangered Species	Once /pre Monsoon	• Field studies • Consultation with DFO for local information • Literature review (which covers all seasons)
F – SOCIO–ECONOMIC ASPECTS				
1	• Social status • Socio – economic background	Socio–economic status survey of PAPs and benefited community infrastructure	Once - Pre-project status	• Field studies - Consultation - census data - Project supplied data & literature review

3.5 LAND ENVIRONMENT:

Base line assessment included field survey, sampling, laboratory tests, consultations and literature review of significant Environmental issues which were identified during the process of environmental reconnaissance (ER) and review of earlier studies undertaken for similar activities.

- **Approach:**
  Baseline assessment of land Environment comprises of Physiography, Geology, Seismology and soil characteristics of the study area. The relevant information's and data mostly relates to literature review, thematic interpretation and consultation of statistical records. Field sampling and laboratory testing methods for soil quality parameters were adopted.

- **Study Area:**
  For the study of land environment 10 km radius buffer zone from the existing Hanuman Nagar Barrage (Birpur) and 1 km area towards south direction from the East Kosi-Mechi Canal (Main Canal) was considered. Hence, the topography study was done for the Ayacut area of the propject.

3.5.1 Landform:

The CCA has been worked using latest 5 years land use statistics for the period 2006-07 to 2009-10. It was seen that culturable area is highest in the year 2006-07. Taking that land use data of 2006-07, the gross command area under the new canal is worked out as 2,75,135 ha and CCA works out to 2,14,812 ha (2.15 ha). The Slope Map of Ayacut area is given in **Fig.No. C3-2**.

3.5.2 Land Use and Land Cover:

Landuse and Land cover of the Total Ayacut Area is given in table below and the map is given in **Fig. No. C3-3** and the distribution is given in **Table no. C3-2.**

Table No. C3-2: Landuse & Land Cover of Total Ayacut Area:

Landuse/ Landcover Category	Area Statistics in sq.km.	Percentage
Agriculture Land	10193.41	**81.39**
Settlement	1478.87	**11.81**
Scrub Land	204.76	**1.64**
Plantation	158.73	**1.27**
River/ Water Body	487.75	**3.89**
Total	**12523.52**	**100**

It is observed from the above distribution that land under agriculture comprises bulk of the distribution at around 81.39 percent. Total settlement is about 11.81 percent and about 3.89 percent of river/water body are seen in the total Ayacut area.

- **Land Use of Command Area:**

The classification of land use in the enroute command area is furnished in **Table No. C3-3** below.

Table No. C3-3: Abstract of Existing Land Use of Command Area lying under the link:

Sl. No.	Particulars	Name of districts				Total area
		Araria	Purnia	Katihar	Kishanganj	
1	Gross command area	88000	85750	49235	52150	275135
2	Forest	271	31	302	98	702
3	Barren & un-cultivable land	1646	3394	3764	3139	11943
4	Land put to non-agricultural use	16394	12235	9472	9301	47403
5	Cultivable waste land	183	317	133	341	974
6	Permanent pastures & grazing land	46	120	45	64	275
7	Land under Misc. tree, crop & groves	6127	2389	1856	1374	11746
8	Fallow land other than Current fallow	969	1306	1029	854	4159
9	Current fallow	3152	8907	4033	2335	18427
10	Net area shown	59211	57052	28601	34644	179507
11	Area shown more than once	30962	19995	15356	12396	78708
12	Total Culturable land (5+7+8+9+10)	69642	69970	35653	39548	**214812**

3.6 TOPOGRAPHY OF AYACUT AREA:

The topography of the Mechi basin (Mahananda river system) varies from rugged hills of Himalayas (in Nepal) to plains at its outfall into the Mahananda. The upper portion of the catchment extends to an altitude of about 200 m and lies mostly in Himalayas in Nepal (a small portion is also in West Bengal) while the portion in plains lies mostly in India. The northern part of the river system is hilly and the southern part has mostly plain lands traced by a number of channels falling into the main river, Mahananda. The reach from origin upto Siliguri is mountainous covered with thick forest upto Sonapurhat 37 km, below Siliguri, the river bed consists of boulder and sand brought by the river during the floods and the banks are remarkably stable. The Kosi sub-basin is bounded in the North by the Tsangpo (Brahmaputra) basin, on South by the Ganga basin, on East by the Mahananda basin and on West by the Gandak / Burhi Gandak basins. The two major tributaries of River Kosi are Kamla and Bagmati, which join it upstream of its confluence with Ganga (much below the Barahkshetra dam site and Hanuman nagar barrage) from right.

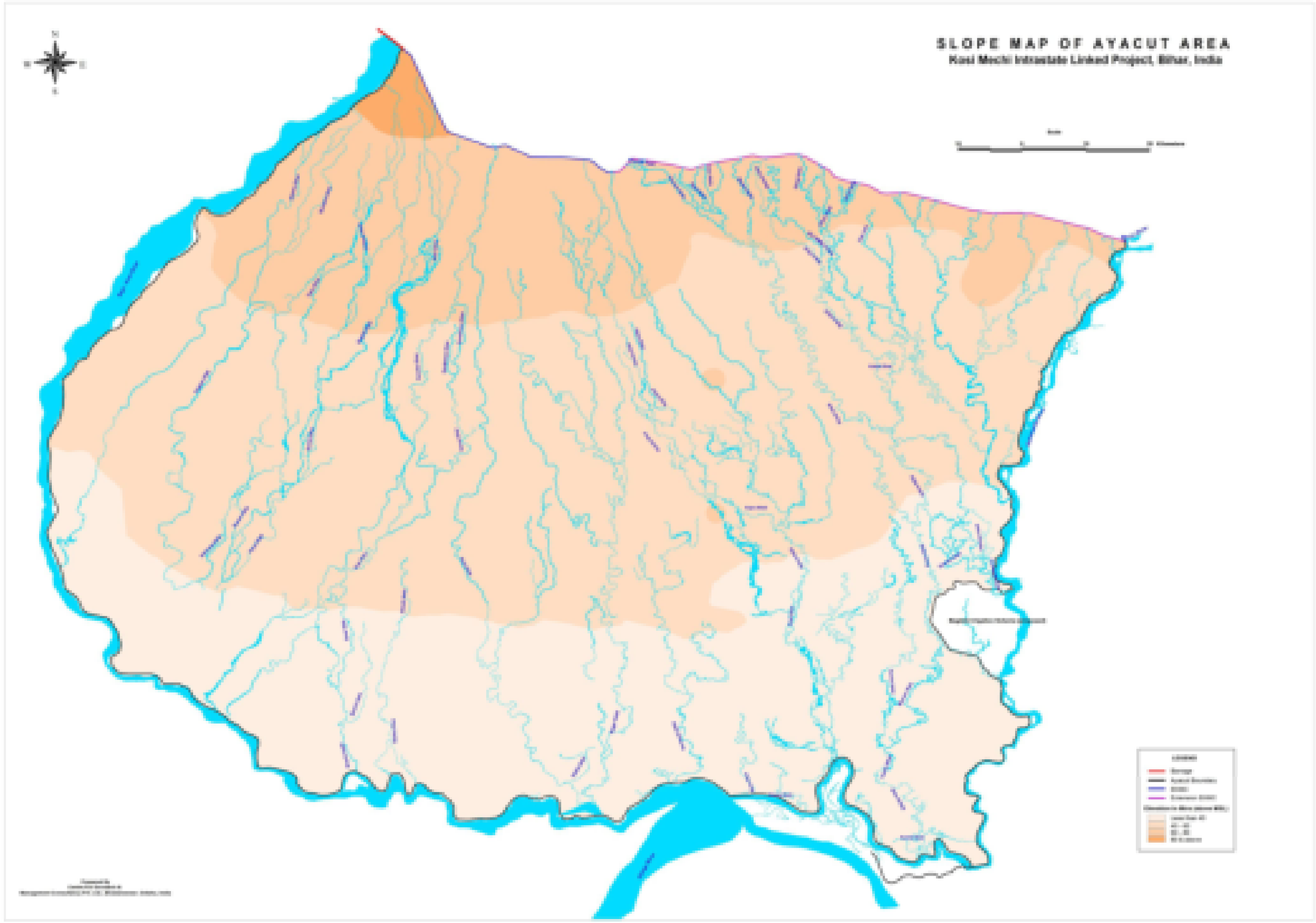


Fig. No. C3-2: Slope Map of Ayacut Area

The study area represents flat topography with regional slope towards South & East. The areas towards north are at higher elevation. It gradually reduces towards south. The regional slope takes a tilt from west to east. The MSL from Hanuman Nagar Barrage (Birpur) towards the last point of proposed canal at Mechi is varies from 85m to 53 m.

The ayacut area covers the Toposheet of Survey of India bearing no.**72J/14, 72J/15, 72N/2, 72N/3, 72N/4, 72N/7, 72N/8, 72N/11, 72N/12, 72N/15, 72N/16, 72K/9, 72K/10,72K/13, 72K/14, 72O/1, 72O/3,72O/5, 72O/6, 72O/7, 72O/9, 72O/10, 72O/11, 72O/13** &**72O/14**.

3.7 GEOLOGY OF AYACUT AREA:

The geological formations of Mahananda river system in the northen area consist of unaltered sedimentary rocks confined to the hills on the north consisting of different grades of metsmorphic rocks over the rest of the area. The outcrops of the various rocks from a series of bonds more or less to the general line of the Himalayas, dipping one below the other into the hills. The characteristics feature of the southern area is that the older formations rest on the younger formations, showing complete reversal of the original order of superposition.

The Geological Survey of India, Kolkata was entrusted the work of geological mapping along link canal alignment, beyond RD 41.30 km upto the tail end links into Mechi river, for various Cross Drainage (CD/CM) structures.

The Kosi-Mechi river system, which forms the part of Ganga basin varies in its geological settings. Since the proposed canal is fully lined, the ground water hydrology is not supposed to differ much and shall not have any negative effect on the drainage or ground water hydrology.

The study area is mainly alluvial with good ground water potentialities having considerablegranulose zone with effective porosity.Recharge of aquifer is very quick due to pervious nature of soil.

System	Series	Formation	Lithology
Quaternary	Upper Holocene	Diara formation	Alteration of fine grey silt and Clay.
	Unclassified Holocene	Kosi formation	Grey silt and clay alteration with fine to medium sand
		Purnia Formation	Pale yellow and grey silt and Silty clay, fine sand, grey Medium to coarse sand with thin partings of sand and fine silt

The ayacut area comprises of varied lithology ranging from Archaean to recent age. The area is underlained by Archaean crystallines mainly of granites and granite gneisses. The occurrence of alluvium and laterites are of recent to sub-recent period.

3.8 SEISMICITY:

Bihar is located in the high seismic one that falls on the boundary of the tectonic plate joining the Himalayan tectonic plate near the Bihar-Nepal Border and has six sub-surface fault lines meaning towards the Gangetic planes in fault lines moving towards the Gangetic planes in four directions. Of the 38 district of Bihar, 8 districts fell in **Seismic Zone V** of which Supaul fall entirely whereas maximum part of Araria & Madhepura fall in **Seismic Zone V**. Again Kishanganj, Saharsa & Purnia also partially fall in the zone. The state has in the past experienced major earthquake; the worst was the 1934 earthquake in which more than 10,000 people lost their lives followed by 1988 earthquake and recent earthquake was the Sikkim earthquake in September 2011.

The project site *and* the study areas are situated on both the Seismic Zone-V & Seismic Zone-IV.

The Seismic Zone-V covers the area with the highest risks zone that suffers earthquakes of intensity MSK IX or greater. This IS code assigns zone factor of 0.36 for Zone-V. Structural designers use this factor for earthquake resistant design of structures in zone-V. This zone factor of 0.36 in indicative (zero period) level earthquake in this zone. It referes to the Very High Damage Risk Zone. Generally, the areas having trap rock or basaltic rock are prone to earthquake.

This zone is called the High Damage Risk Zone and covers areas liable to MSK VIII. The IS code assigns zone factor of 0.24 for Zone-IV. In Bihar the northern part of the state like- Raksaul, Near the border of India and Nepal, is in zone no-IV.

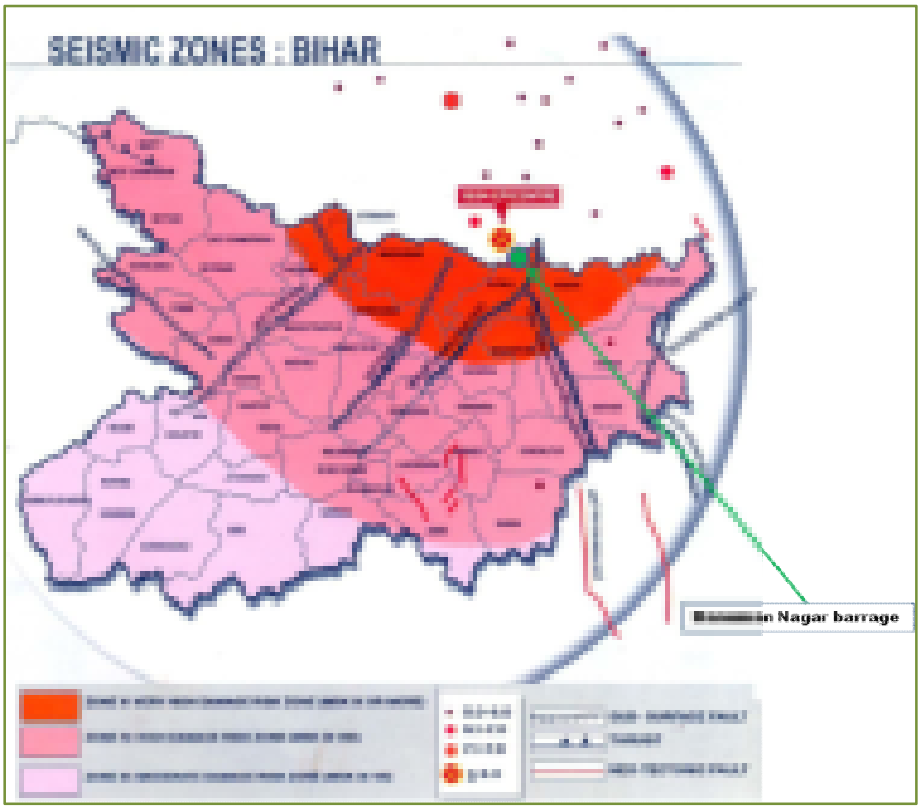


Fig.No. C3-4: Showing the earthquake zone of the study area:

3.9 SOIL:

Soil in the present context, is the most important medium for supporting agricultural development in the command area. Its properties influence fertility, water retention capacity, gas exchange ability and physical support capacity of plant roots, determination of various other chemical constituent parameters in command area. It is thus a vital necessity to study the nutrient status of soil regime for designing the cropping pattern. The following activities will have to be undertaken for assessment of soil quality / soil properties. Three types of texture have seen in the Ayacut area such as Coarse texture, fine texture, medium texture. Medium black Soil is seen at the Ayacut area of propiosed Kosi-Mechi Linked Irrigation Project. The soil map showing the various types is given in **Fig. no. C3-5.**

3.9.1 Methodology:

For studying the soil profile of the region nine soil sampling stations were selected to assess the existing soil conditions in and around the project area. Soil samples were collected 22nd - 24th March, 2017 and its physical and chemical properties were analyzed.

This will establish the baseline characteristics and will facilitate in the identification of the incremental concentrations from the proposed activities at a later stage. The baseline characteristics which are analyzed now takes into consideration theeffect on soil due to the existing agricultural activities and other anthropogenic activities in the study area.

Thus the sampling locations are decided based on one or more criteria listed below:

- To determine the existing soil characteristics of the study area.
- To determine the impact on soil characteristics due to the various activities in the study area.
- To determine the impact on agricultural productivity of soil.

3.9.2 Soil Sampling Locations:

For studying the existing soil quality status of the study area eleven soil sampling locations were selected in and around the project area. A detail of the soil sampling locations is presented in **Table No. C3-4 & Fig.No**. **C3-6.** Soil samples were collected from each of the sampling locations to analyse the physico-chemical properties. This will establish the baseline characteristics and will facilitate in the identification of the incremental concentrations from the proposed activities at a later stage. The baseline characteristics which are analyzed now include the impact on soil due to the existing agricultural activities and other anthropogenic activities in the study area.

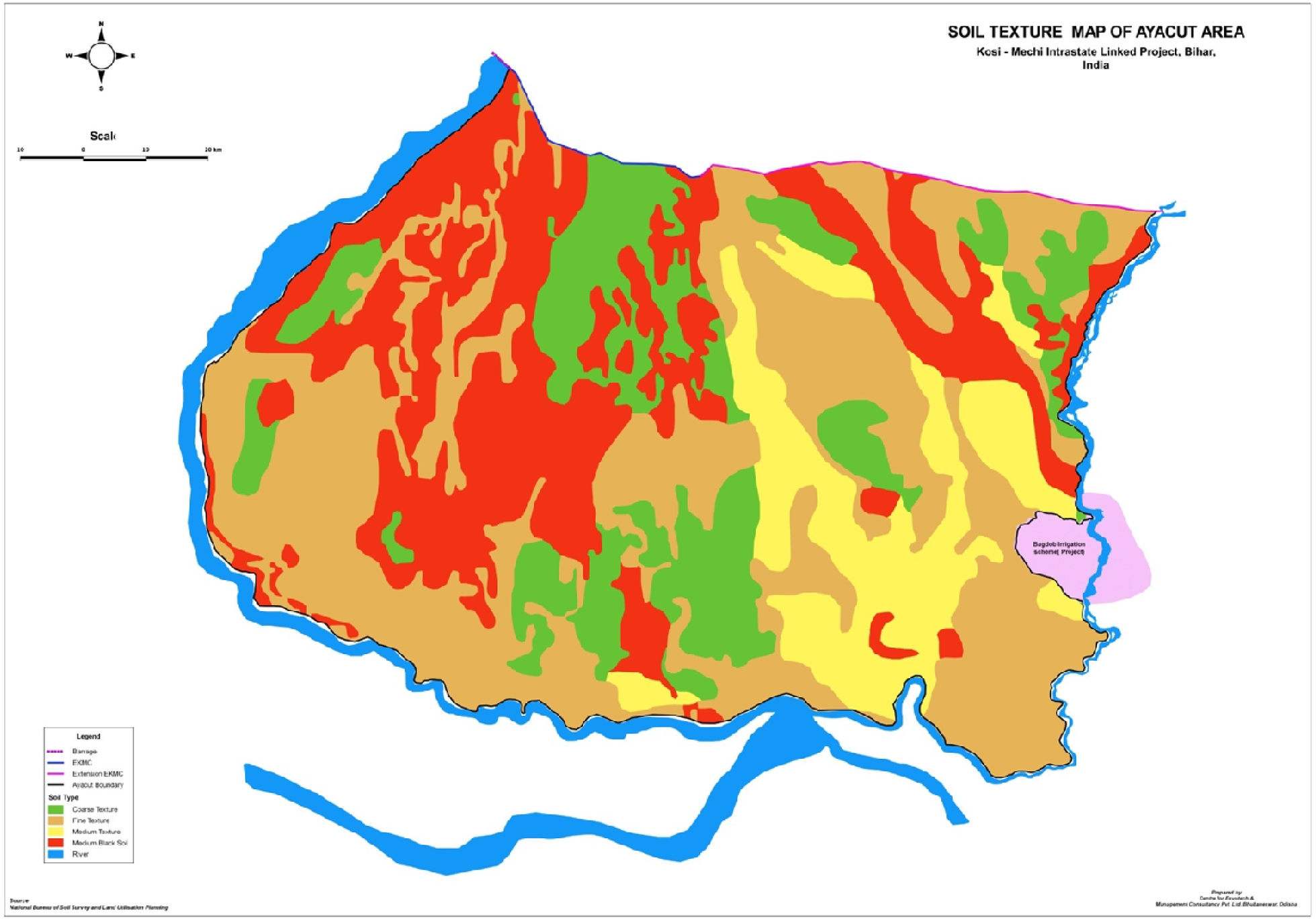


Fig. No. C3-5: Map Showing the Soil Texture of the Ayacut Area of the Proposed Project:

Table No. C3-4: Details of Soil Sample Monitoring Locations:

10 km radius from Hanuman Nagar Barage(Birpur)						
Sl. No	**Station Code**	**Location**	**Latitude & Longitude**	**Distance (km)**	**Direction**	**Type of Area**
				with respect to Hanuman Nagar barrage(Birpur)		
1	S1	Bhimnagar	26^0 29' 44.45" N, 86^0 57' 0.58" E	3.22 km	E	Settlement
2	S2	Near Kataia	26^0 27' 0.25" N, 86^0 57' 27.07" E	8.00 km	SE	Settlement
1 km from Main Canal						
				with respect to main canal (existing & proposed)		
3	S3	Near Dahrahra Village	26^0 21' 38.56" N, 87^0 4' 55.42" E	0.50 km	SW	Settlements & Near village road
4	S4	Kauakhoh Village	26^0 20' 31.92" N, 87^0 27' 4.61" E	0.40 km	S	Settlements & Near Araria-Kursakanta-Sikti
5	S5	Charbana Village	26^0 18' 16.24" N, 87^0 35' 40.42" E	0.80 km	S	Settlements
6	S6	Near Bahadurganj	26^0 15' 16.38" N, 87^0 48' 15.01" E	0.70 km	SW	Near Konkai River
7	S7	Rangamani	26^0 12' 32.04" N, 87^0 55' 45.19" E	0.71 km	SW	Near Mechi River
8	S8	Harda, Purnia	25^0 51' 43" N, 86^0 22' 39" E	68 km	S	Near NH-31,
9	S9	Majua, Purnia	25^0 42' 58.54" N 87^0 21' 52.67" E	67 km	S	Near a distributary canal, baren land
10	S10	Kharahia Basti, Araria	$26^0$9' 2.84" N $87^0$27' 14.29" E	22 km	S	Near NH-57, Purnia-Araria-Forbejganj road.
11	S11	Nageswarnath Mandir, Saharsa	$25^0$52' 11.60" N 86^0 34' 11.53" E	72 km	SW	Near the roadside, barren land.

Fig.No. C3-6: Soil Sampling Location Map for the Study Area

3.9.3 Soil Sampling:

Soil samples were taken in the dry season during the 2017 irrigation season from both the core and buffer areas of the Koshi Michi Intrastate Linked project in order to obtain detailed information. Two soil samples were randomly collected from each selected site of the study area. Soil samples were taken at 0 to 30 cm depth from each sampling spot, making a total of 22 samples. These were taken to the laboratory, air dried, and ground using a stainless steel mill and sieved through 2 mm sieve mesh. The samples were stored in sealed containers at 4°C before analysis following Fang (2007). The stored soil samples were subjected to physical and chemical analyses. The soils should be analysed for determining the nutrient content present in it for plant growth.

3.9.4 Soil Characteristics:

Various physico-chemical parameters of soil samples collected from different locations of the study area were analyzed to determine the soil nutrient status. pH was measured with a pH meter. Electrical conductivity (EC) (µmho/cm) at 25^{o}C was determined in soil extract by using EC- meter (Hesse, 1972). Organic matter and total nitrogen were estimated using Walkely and Black and Micro-kjeldahl methods, respectively as mentioned in Rowell (1996). Estimation of available phosphorus was done according to Bray's no. 1 method (Bray and Kurtz, 1945), CEC by ammonium saturation method (Black, 1965) and exchangeable bases from CEC determination extract. Potassium and sodium were determined by flame photometry and Ca and Mg by EDTA titration method. The moisture content of soil was determined on dry weight basis as per Hoque et al. (2008) and bulk density of soil samples was determined as per Misra (1968).

Table No. C3-5: Soil Analysis Results of the study area:

Sl. No.	Test Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
01	pH value (1:10) at 25ºC	7.15	7.21	6.55	7.06	7.02	6.89	6.99	6.43	6.27	7.05	7.2
02	Electro Conductivity at 25 ºC (µmho/cm)	139	187	233	97	156	241	126	123.1	94.5	169.1	179.6
03	Moisture content in %	10.2	5.1	7.4	9.1	8.6	12.3	7.6	13.6	8.7	13.2	12.3
04	Sodium (as Na) in mg/Kg	51.75	44.2	55.65	28.95	35.69	48.25	52.98	29.7	28.1	38.3	39.2
05	Bulk Density in g/cc	1.09	1.15	1.06	1.11	1.02	1.1	1.05	1.05	1.12	1.03	1.1
06	Sand in %(W/W)	80.63	80.14	38.42	81.81	74.65	29.23	74.5	50.1	55.4	43.2	39.6
07	Silt in % (W/W)	12.48	16.32	51.23	10.56	15.36	79.19	18.33	40.3	37.7	48.4	51.6
08	Clay in %(W/W)	6.89	3.54	10.35	7.63	9.99	8.42	7.17	9.6	6.9	8.4	8.8
09	Texture in %(W/W)	Loamy sand	Loamy sand	Loam	Loamy sand	Loamy sand	Silt loam	Loamy sand	Loam	Sandy Loam	Loam	Loam
10	Nitrogen as N in %	0.09	0.07	0.07	0.02	0.06	0.03	0.05	0.055	0.039	0.045	0.051
11	Phosphorus as P in mg/Kg	20.1	16.9	17.24	15.5	18.6	15.9	15.2	18.9	16.2	17.2	19.7
12	Potassium as K in mg/Kg	232.58	199.32	206.3	156.18	178.31	178.95	136.91	115.2	110.2	137.1	141.4
13	Sodium absorption ratio (SAR)	1.79	1.71	2.34	1.58	1.69	1.75	1.88	1.78	1.64	1.83	1.57
14	Cation Exchange Capacity (meq/100g)	5.3	4.1	9.6	6.5	9.4	7.1	6.3	9.1	5.5	6.9	7.8
15	Organic Matter in %	0.053	0.04	0.21	0.06	0.18	0.11	0.19	0.16	0.06	0.13	0.14

3.9.5 Results &Discussion:

From the above analysis report it was found 15 parameters were analysed.

a. Texture:

Soil texture is an indicator parameter, through which other soil properties can be studied, but if used alone, it has limited predictive value; viz., ability of a soil to adsorb cations from solution depends on the mineralogy of the clay fraction as well as on the percentage of clay. It also depends on the amount and nature of organic matter, the soil holds. It indicates the ease with which the application of the soil can be recommended. Higher content of clay in soils are described, as 'heavy' and sandy soils are known as 'light'. Clay soils retain more water against gravity and warm up more slowly in comparison to other soil textural forms. Soil texture of the project area was experienced a great variation i.e. loamy sand, silty loam, sandy loam and loam. Soil texture experienced by most of the selected study sites of the project area is favorable for agricultural practices (Delgado and Gomez, 2016).

b. pH:

The result of the chemical properties of the soils at different selected sites of the project area (Koshi Michi Irrigation Project) at 0-30 cm soil depth is shown in **Table No. C3-5.** The soil pH values of the study area was slightly acidic to alkaline and ranged between 6.27 to 7.21 with a maximum of 7.21 at site-2 and minimum at site-9. Soil pH of most of the sites experienced neutral to basic conditions. This may be primarily due to the presence of base forming citations associated with carbonates and bicarbonates found naturally in soils and irrigation waters. Due to relatively low precipitation amounts, there is little leaching of base forming citations resulting in pH values 7 or more than 7 in more or less half of the sites. The range of soil pH of the study area indicates a good sign for agricultural production. Further, pH values of the study area were similar as reported by Ibrahim and Dikko (1998), Graham and Singh (1997). The optimum pH for best performance of most tropical crops was reported to be 6 - 7 when most essential nutrients are available at adequate amounts (Brady and Weil, 1999; Olaitan and Lombin, 1984).

c. Electro Conductivity:

Electro conductivity, as the measure of current carrying capacity, gives a clear picture of the amount of soluble salts present in the soil. It plays a major role in the salinity of soils. There is a relation between electrical conductivity and salinity, i.e. lesser the EC value low will be the salinity value of soil and vice-versa. Soil conductivity of the study area showed site wise variation but compared to pH there was a big difference between the lowest and highest conductivity recorded at the four selected sampling locations of the project area. The soil conductivity of the project area ranged from 94.5 to 241 µmho/cm. Electro conductivity values within 800 µs/cm are considered as normal nature of soil and thus almost all the selected sites of the study area are found to be suitable for agriculture.

d. Total Nitrogen:

Nitrogen is having a major role in maintaining the fertility status of the soil. Nitrogen content in almost all the soils is observed to be very low. Plants are more dependent upon nitrate nitrogen, during the aerobic conditions and ammonical nitrogen during anaerobic conditions. In the study area most of the soil samples are deficient in nitrogen and ranged from 0.02 to 0.09 %. Lower value of total nitrogen content of the project area may be due to lack of return of crop residues common with the farmers practice in the selected study areas. From another point of view decrease in N in the study area could be linked to continuous cultivation of the soils for many years without proper soil management by local farmers with little or no assistance from extension workers gradually continuous with time (Olaitan and Lombin, 1984). Nitrogen is also easily loss from 0-30 cm depth through various processes such as leaching, crop removal, denitrification and volatilization, especially at high temperatures as obtained in the study area. The results obtained in the present study agree with reports of Agboola (1990) that tropical soils are intrinsically low in N.

e. Phosphorus:

Phosphorus is the second most important macronutrient available in the soil of the biological systems. It is a major component of nucleic acids, phospholipids and many phosphorylated compounds. Similarly, it is also a second most limiting factor often affecting plant growth. Chemically, phosphorus exists in the soil in the form of both organic and inorganic forms. Generally plants are dependent on inorganic phosphorus especially in the form of phosphate ions, whereas organic phosphates are also important sources of phosphorus in almost all types of soils. Comparatively the phosphorus is, required in small quantities; but it may be the most likely limiting element in productivity of the plant. Therefore ecologically it is very much significant. In the project area level of phosphorus in the soil as determined by Bray's No. 1 method were intermediate (medium) ranging from 15.2 to 20.1 mg/kg with a maximum at site-1 and minimum at site-7. All the selected sites of the project area experienced soil available phosphorus values more than 15 mg/kg is generally considered as the critical level below which phosphorus deficiency symptoms are likely to occur in many crops. Thus the soil of the project area is suitable for crop production.

f. Organic Matter:

Soil resource is a major anchor to living organisms, such as plants, animals and microorganisms in various stages of decomposition process, which gives the end products in the form of organic matter. The organic substances are a major determinant of soil structure, moisture content, pH and the soil nutrient status of the topsoil. The importance of organic matter in the soil improved soil structure and fertility status of the soil. This differentiates among the fertile and non-fertile soils. Organic matter levels were generally low throughout the project area, ranging from 0.04 to 0.21 % with a maximum at site-3 and minimum at site-2. The low levels of organic matter are not surprising because of the continuous intensive cropping without much additions of organic matter

in form of manure and crop residues. Organic matter content of soil samples collected from different locations (sites) of the project area observed was very low i.e. below the threshold level (less than 3) of agricultulal land (Rangasamy and Olson, 1991; Naidu and Rangasamy, 1993).

g. Potassium:

This element is important in grain formation, and is absolutely necessary for tuber development. All crops generally respond to application of potassium. As with phosphorus, it may be present in large quantities in the soil and yet exert no harmful effect on the crop. Potassium increases crop resistance to certain diseases. It helps to prevent the undesirable growth of plants that is sometimes caused by excessive nitrogen. Potassium delays maturity, thereby working against undue ripening of fruits and seeds. In general way, potassium exerts a balancing effect on the effects of both nitrogen and phosphorous; consequently it is especially important as a multi-nutrient fertilizer. From the analytical results of potassium content of the soil samples collected from different locations of the project area, it was found that **110.2** to **232.58** mg/kg. Except site-1, 2 and 3 all other sites of the project area experienced low potassium content in the soil. The normal range of potassium content of soil for various agricultural crops is 195.5 to 312.8 mg/kg.

h. Sodium adsorption ratio (SAR):

The sodium adsorption ratio is a measure of the amount of sodium (an undesirable element) relative to calcium and magnesium (desirable elements) in soil. Soils with high SAR values tend to have poor structure, and low water infiltration and percolation rates. Soils with a high SAR usually have a high pH and EC_e. If pH and EC_e are within acceptable ranges, SAR should also be acceptable. In the present study the range of SAR across the sites varied from 1.57 to 2.34 is well within the permissible limit of agricultural practices.

3.9.6 Conclusion:

From the analytical results of soil samples collected from different locations of the project area indicates the following characteristic features.

- **Permeability:**

Sandy soils are highly permeable and excessively well-drained with low water retentive capacity and thus need more frequent irrigation for successful crop growth than fine textured soils. The clayey soils can hold more moisture, but they have high wilting point. Due to poor infiltration rate these soils are subject to water-logging, resulting in poor aeration and workability. The moderately fine-textured soils e.g. loams, clay loams or silt loams are by far the best group of soils for crop growth, since they have the advantages of balanced proportion of both sands and clays. Soil analytical results of the study with respect to soil texture indicated that all study sites except S-1, 2, 4, 5, 7and 9 having loamy and silty loam type of soil and experienced balanced proportion of both sands and clays. Such condition may be better suited for crop growth.

- **Leachability:**

Status of leachability and nutrient retention capacity of soil is predicted indirectly from the soil analytical characters like CEC and organic matter. In the present study the range of CEC (4.1-10.4 meq/100g) and organic matter (0.04 - 0.21%) of soil was low with a maximum at site-3 and minimum at S-2. The observed CEC values of soil in all study sites indicated low nutrient retention capacity. The variation of organic matter (OM) in the soil indicates a relationship with CEC values whereby low OM corresponds with low CEC values explaining the contribution of OM to the CEC of soil. The low CEC levels observed in the studied soil could also be attributed to strong leaching of the bases down the soil as well as to the low clay content in the soil. The observed low CEC values imply that all fertilizers except P have to be applied in split applications so as to reduce nutrient losses through leaching.

- **Soil Productivity:**

Although organic matter is a small part of mineral soil, it plays a vital role in the productivity and conditioning of soils. Organic matter act as a source of food for soil bacteria and fungi, which are responsible for converting complex organic materials into simpler substances, which are easily available to the plants. The presence of organic matter also helps to improve the physical conditions of the soil in terms of its working quality. Presence of organic matter and clay in right proportion may form a good soil physical condition for better crop performance. Organic matter can also be used as mulch and can prevent the soil from losing moisture by evaporation. Results of the soil organic matter content of the study sites ranged from 0.04 to 0.21% which is very low for crop development. This may arise due to continuous development of high yielding variety of rice, maize and other agricultural crops. These HYVs often produce more grain and less straw, compared with locally developed varieties leads to reduced amounts of crop residues remain after harvest for soil cover and organic matter to act as manure. Furthermore repetitive tillage or burning of vegetation may results in low amount of organic matter in the soil. To supplement the organic matter animal manures, compost, mulch, etc. may be added.

- **Soil fertility:**

It is an important factor determines the growth of plant. It depends on the concentration of N, P, K organic and inorganic materials, micronutrients and water. In general soil chemical fertility and in particular lack of nutrient inputs is a major factor in soil degradation. Analytical results of the soil samples collected from different locations of the project area envisaged that soil of the study area was low in fertility with respect to N, K and OM. The low inherent fertility status of soil in the study site may be the result of intensive land use and high application of chemical fertilizer. This problem of the project site may be supplemented by balanced nutrient application, supplement mineral fertilizers with organic manures, soil- restorative farming systems and nutrient recycling.

- **Soil Moisture Status:**

Moisture is a most important physical property of soil. The absorption of nutrients is depends on the moisture of the soil. The water content of soil is also much related to its texture and structure. The soil moisture commonly depends on void ratio, particle size, clay minerals, organic matter and ground water condition. Wetness depends largely on the porosity of a soil, and for that reason clayey soil, which have a high porosity generally have larger water content than do sandy soils. Good water holding capacity shows the good physical condition of soil. Knowledge of the soil water holding capacity is essential to the evaluation of regional soil water balance. Thakare et al. (2006) reported maximum water holding capacity of red and black soils. The sandy soil can quickly be recharged with soil moisture but it enable to hold as much water as the soils with heavier textures. Decomposition of organic matter is mainly depending on the soil moisture. If water becomes too low, a plant becomes stressed. Water is present in more in soil; it is not available to plants due to high degree of salinity. As per Tale and Ingole (2015) the average range of moisture content for better growth of agriculturable crop is 7.9 to 26.67%. In the present study the soil moisture ranged from 5.1 to 13.6 % with a maximum at Site-8 and minimum at Site-2. Low moisture content of soil at S-2 needs to increase in soil organic matter content for retention of soil moisture.

3.10 EXISTENCE OF ARCHAEOLOGICAL SITES AND HISTORICAL MONUMENTS:

An attempt has been taken to identify locations of some of those tourist spots having religious and archaeological significance in the benefited districts.

Table No. C3-6: Religious, Historical & Cultural places in three districts

Districts	Name of some important locations with significance	Distance from the Head Quarter
Supaul	1. Durga Sthan :Historical and religious place	10 km
	2. Rajdevi Temple: famous 8th century historical Temple	10 km
	3. Cninnmasta shakti Peeth: Religious Place at Kunauli Border	10km
Araria	1. Kali Mandir: Six-story Kali Mandir	00 km
	2. Thakurbari: Old Shiva Temple in Thakurbari	00 km
	3. Shiva Mandir : Araria-Madanpur Road Temple	00 km
	4. Gidwas: Maata aasawar mandir	5 km
	5. Replica Stoop: Araria	26 km
	6. Sultan phokher:Important place for Hindu & Muslim religious people	00 km

[Sources: District Official Website]

3.11 METEOROLOGY:

Meteorology of the study area plays an important role in air pollution studies. The prevailing meteorological conditions at the Project site will regulate the dispersion and the dilution of air pollutants in the atmosphere. The predominant wind speed at theproject site will decide the direction and the distance of the most affected area from the proposed activity.

The critical weather elements that influence air pollution are wind speed, wind direction, temperature, which together determines atmosphere stability.

To study the meteorological parameters of the study area data obtained from the nearest IMD stations located at Purnia.

Purnia is known for its favourable climate; it has earned the name "Mini Darjeeling" for this reason. Purnia has a largely humid climate, with the highest level of rainfall in Bihar state and humidity rising to above 70%. The cold season or winter is from November to February and followed by a hot season, Summer from March to June. The monsoon season begins in early June and lasts until September; 82% of its total annual rainfall falls during the monsoon season because the depressions originating in the Bay of Bengal and causing heavy rain & strong wind.

The parameters observed from these IMD stations are Temperature, Relative Humidity, Rainfall, Wind Speed and Wind Direction of Nearest IMD station & site specific which are reflected in **Table No.C3-7&Table No. C3-9.**

As per the data obtained from the nearest IMD station Purnia (1960-1990), average rain fall in this area is 1283.5 mm. the maximum temperature has been recorded as 39.9^{0}C and minimum temperature is 9.2^{0}C, in rainy season maximum and minimum temperature recorded as 35.4^{0}C &21.5^{0}C respectively. and in winter season maximum and minimum temperature has been recorded as 31.0^{0}C &4.3^{0}C respectively. *[Source: Climatological Normal (1961-1990)].*

Table No. C3-7: Meteorological dataof IMD station Purnia (1960-1990):

PURNIA (Climatological Normals, 1961-1990)									
Month	**Temperature (^{0}C)**		**Relative Humidity (%)**		**Wind Speed**	**Predominant Wind Direction (Wind from)**	**Rainfall**	**Station Level Pressure (hPa)**	
	Max	**Min**	**Max**	**Min**	**Avg.**		**mm**	**Max**	**Min**
JAN	24.0	7.8	80	64	2.4	W	6.1	1013.1	1009.3
FEB	26.7	10.0	70	51	3.6	W	8.8	1010.5	1006.6
MAR	32.0	14.5	58	39	4.7	W	14.8	1007.5	1003.0
APR	35.4	19.7	62	43	6.1	E	38.5	1003.9	999.1
MAY	34.7	22.4	73	59	6.6	E	125.8	1000.9	996.4
JUN	33.7	24.4	82	73	5.7	E	250.3	996.5	993.0
JUL	32.0	24.8	88	82	4.8	E	405.4	996.4	993.5
AUG	32.2	24.9	86	81	4.7	E	287.0	998.0	994.6
SEP	32.1	24.1	86	82	3.9	E	250.5	1001.9	998.4
OCT	31.4	20.6	80	76	2.4	E	100.6	1007.2	1003.6
NOV	29.1	14.1	76	72	1.6	E	9.8	1011.4	1007.6
DEC	25.4	9.0	79	70	1.8	W	5.2	1013.6	1009.6

[Source: Climatological Normal (1961-1990)]

During study period the site specific meteorological data shows that the maximum & minimum temperaturewere recorded as 14^0 C & 39^0 C respectively.The pressure & relative humidity were recorded as 991-1015 hPa and 38-100% respectively. During study period the predominant wind direction is NE followed by E and the wind aped varied from 0.1 to 19.4 m/sec. Detailed wind rose diagram is given in **Fig.No. C3-7(A) to C3-7(D)** and the windrose has been done as per the data given in **Table No. C3-9.**

Monthly rainfall data for seven districts of total Ayacut area for last 5 years period i.e. from 2012-2016 have obtained from Hydro-met Division, IMD and furnished in **Table No.C3-8** presented below**.**

Table No. C3-8: Comparison of monthly Rainfall of All Districts for the period 2012 to 2016.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Supaul													
2012	5.8	0.0	5.5	41.4	45.4	160.7	306.4	159.0	131.0	33.0	0.0	0.0	888.2
2013	11.8	9.4	3.8	17.0	65.1	335.6	308.4	177.9	191.1	171.5	0.0	0.0	1291.6
2014	2.0	13.2	3.1	0.5	123.9	205.8	223.5	453.3	175.5	45.2	0.0	0.0	1246
2015	13.1	4.8	56.5	65.6	75.9	101.8	192.6	235.2	194.5	13.2	0.0	0.0	953.2
2016	18.1	0.0	0.0	28.1	189.2	311.8	300.2	139.3	448.3	120.9	0.0	0.0	1555.9
Monthly Average	10.16	5.48	13.78	30.52	99.9	223.14	223.14	266.22	232.94	228.08	0.0	0	1186.98
Araria													
2012	9.8	1.0	8.5	42.6	41.2	121.0	464.0	147.9	267.6	34.8	0.0	0.0	1138.4
2013	25.5	24.4	5.8	42.3	163.0	391.6	623.2	347.2	136.5	233.3	0.0	0.0	1992.8
2014	5.1	25.2	1.0	10.3	142.4	223.8	237.7	389.1	215.8	30.6	0.0	0.5	1281.5
2015	13.0	8.2	43.9	75.5	165.9	137.5	192.0	301.6	174.2	2.0	1.5	0.0	1115.3
2016	27.8	0.0	29.6	1.0	193.4	276.4	690.4	149.8	564.6	124.9	0.0	0.0	2057.9
Monthly Average	16.2	11.76	17.76	34.34	141.18	230.06	441.46	267.12	271.74	85.12	0.3	0.1	1517.18
Kishanganj													
2012	0.0	0.0	2.6	75.4	155.6	539.7	526.1	208.8	417.7	113.6		0.0	2039.5
2013		0.0	0.0	23.4	166.0	503.0	1026.5	472.0	324.6	121.4	0.0	0.0	2636.9
2014	3.0	23.0	0.5	7.4	190.6	449.0	317.4	520.1	345.8	13.1	0.0	0.0	1869.9
2015	10.6	1.3	53.5	105.5	259.4	229.5	346.6	604.3	211.6	0.2	0.0	0.0	1822.5

2016	0.0	0.3	4.6	0.0	236.7	425.0	827.7	174.8	676.0	141.1	0.0	0.0	2486.2
Monthly Average	3.4	4.92	12.24	42.34	201.66	429.24	608.86	396	395.14	77.88	0	0	2171

Katihar													
2012	11.7	0.0	5.3	46.4	16.9	48.1	242.7	148.0	244.6	120.5	0.0	0.0	884.2
2013	0.0	13.4	0.1	37.7	97.9	279.1	157.4	282.3	148.1	326.8	1.2	0.0	1344
2014	5.8	28.5	4.5	0.0	249.1	164.5	215.4	276.7	114.3	30.4	0.0	0.0	1083.4
2015	44.0	11.1	17.7	48.9	111.4	196.9	281.8	252.3	122.3	13.3	0.0	0.0	1099.7
2016	0.0	0.0	0.0	13.6	91.2	67.3	363.7	97.5	329.2	62.7	0.0	0.0	1025.2
Monthly Average	12.3	10.6	5.52	29.32	113.3	151.18	252.2	211.36	191.7	110.74	0.24	0	1087.3
Purnia													
2012	6.1	3.6	7.9	118.4	22.1	91.1	296.8	89.2	164.2	47.0	0.2	0.0	846.6
2013	1.2	12.5	1.6	81.4	101.5	372.5	237.1	217.0	190.1	226.7	0.0	0.0	1441.6
2014	6.8	26.0	9.7	5.6	275.2	114.2	229.7	190.1	234.0	21.8	0.0	0.0	113.1
2015	9.2	3.9	32.0	29.5	81.0	131.7	140.7	193.7	99.6	24.4	0.0	0.0	745.7
2016	6.0	1.2	24.3	22.0	280.3	217.6	396.8	113.6	333.2	21.5	0.0	0.0	1466.5
Monthly Average	5.86	9.44	15.1	51.38	152.02	185.42	260.22	160.72	204.22	78.28	0.04	0	1122.7
Madhepura													
2012	11.6	0.0	5.9	23.4	56.5	200.2	206.0	210.1	132.8	35.5	0.0	0.0	882
2013	3.7	7.0	0.3	17.6	93.6	374.4	199.9	197.3	224.9	302.0	6.0	0.0	1426.7
2014	7.9	24.0	2.7	0.0	202.7	155.7	285.6	190.8	106.1	17.4	0.0	0.0	992.9
2015	14.2	6.7	19.0	34.6	70.0	110.0	173.3	163.1	165.3	1.3	0.0	0.0	757.5
2016	1.2	0.0	0.0	16.0	133.8	176.6	359.8	120.2	440.6	73.2	0.0	0.0	1321.4
Monthly Average	7.72	7.54	5.58	18.32	11.32	203.38	244.92	176.3	213.94	85.88	1.2	0	976.1

Saharsa													
2012	8.4		6.0	52.4			152.8	219.6	168.9	47.8		0.0	81.9875
2013	0.0	10.6	3.2	132.4	22.4	191.6	225.5	173.0	285.8	144.6	0.0	0.0	1189.1
2014	0.0	7.4	0.0	0.0	80.4	24.8	175.4	182.5	42.5	6.0	0.0	0.0	519
2015	6.0	0.0	13.0	28.0	36.0	119.7	176.6	243.7	162.8	0.0	0.0	0.0	785.8
2016	0.0	0.0	0.0	0.0	106.2	87.4	298.7	70.7	444.1	60.9	0.0	0.0	1068
Monthly Average	2.88	4.5	4.44	42.56	61.25	105.875	205.8	177.9	220.82	51.86	0	0	877.885

[Source: Customised Rainfall Information System (CRIS), Hydromet Division, IMD, Ministry of Earth Science.]

Table No.C3-9: Site Specific Meteorological data 2017

Sl. No.	**Parameters**		**Purnia**		
			Mar.	**Apr.**	**May**
1	Temperature (^{0}C)	Maximum	37.6	36.9	39.0
		Minimum	13.9	20.1	22.5
		Average	21	28	31.0
2	Relative Humidity	Maximum	81	100	98
		Minimum	78	46	38
3	Wind speed(m/s)	Maximum	10.4	16.1	19.4
		Minimum	0.2	0.1	0.1
4	Predominant Wind Direction Followed by		NE	NE	NE
			E	E	SE
5	Rainfall(mm)	Monthly Total in mm	252.7	202.1	112.4

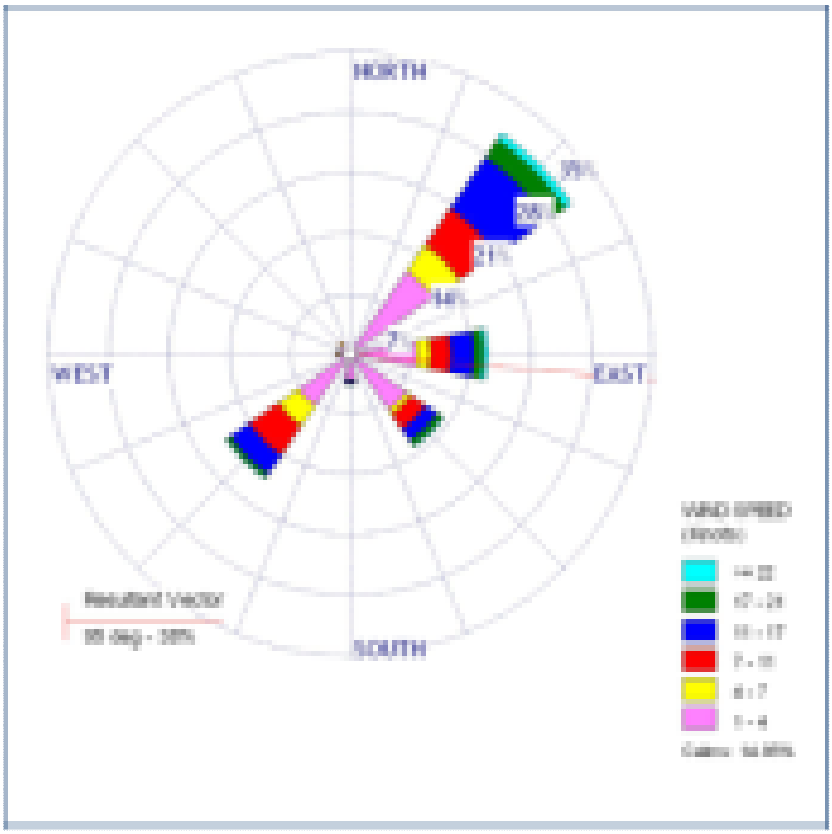


Fig.No.C3-7(A): Wind Rose Diagram March 2017

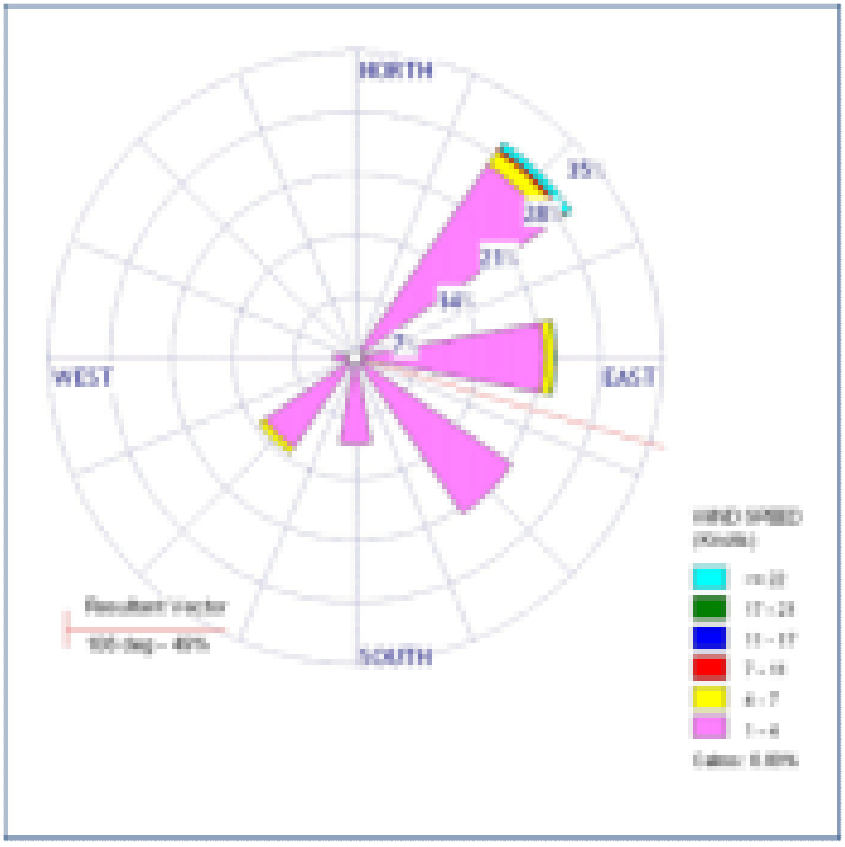


Fig.No.C3-7(B): Wind Rose Diagram April 2017

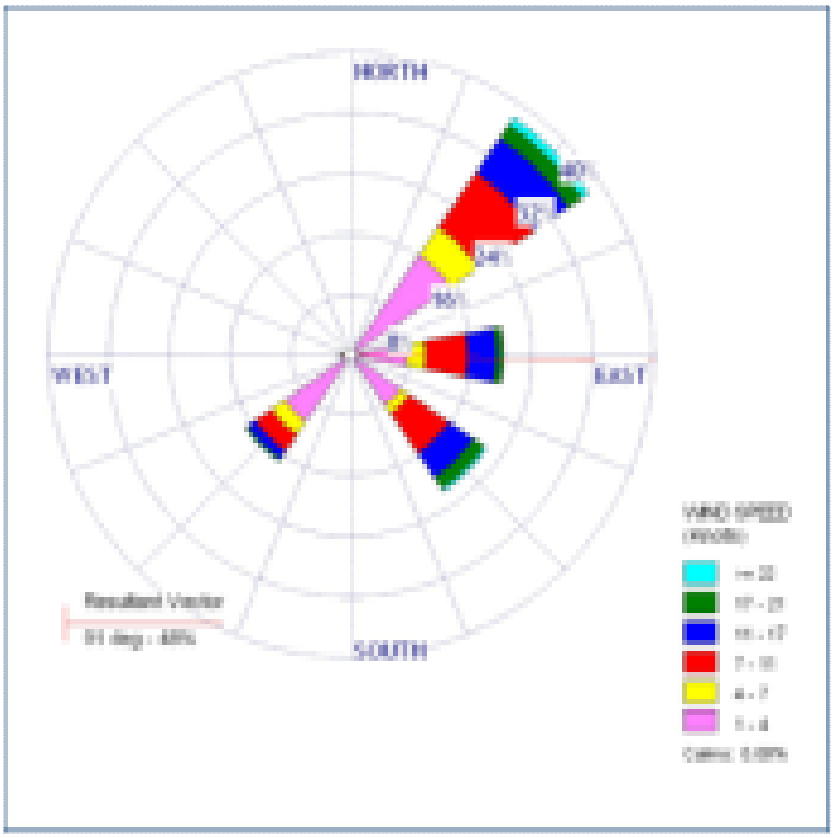


Fig.No.C3-7(C): Wind Rose Diagram May 2017

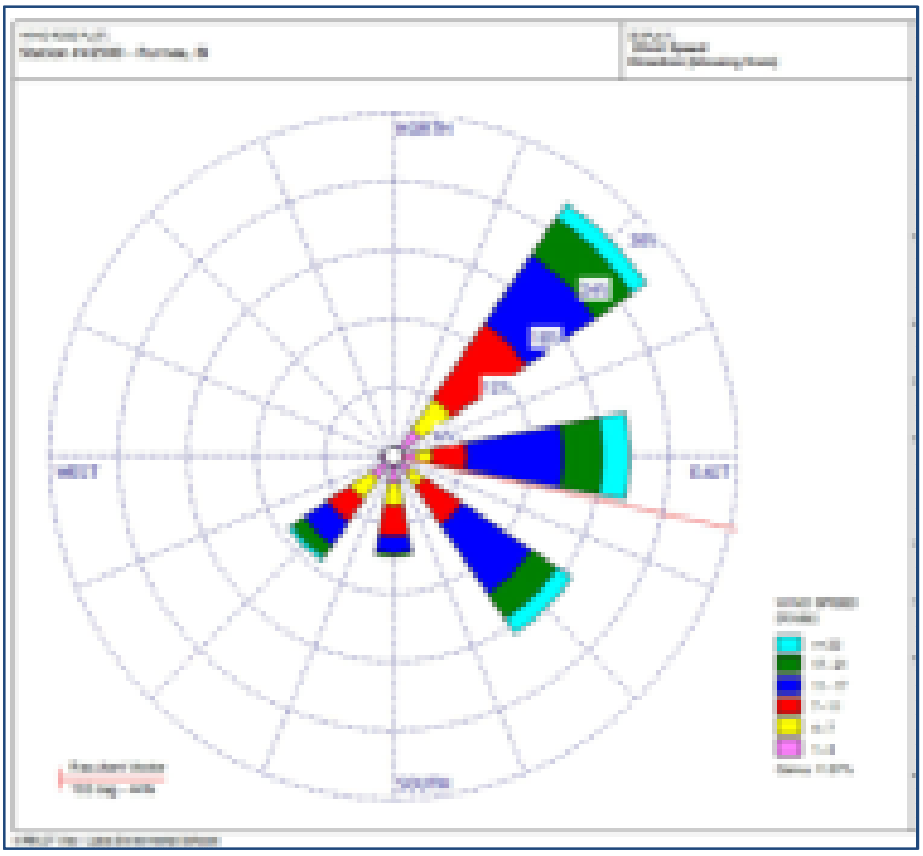


Fig.No.C3-7(D): Overall Wind Rose Diagram (MAR-MAY, 2017)

3.12 AIR QUALITY:

The objective of the study is to analyze the existing ambient air quality within the study area and compare it with the NAAQ standards specified by CPCB/SPCB to know about the pollution status of air in and around the irrigated area. To quantify the impact of the construction activities on the ambient air quality at the ayacut and its surrounding area, it is necessary to evaluate the existing ambient air quality in those areas. The existing ambient air quality of the ayacut & its surrounding area was measured from March to May, 2017 and analysed, in terms of Particulate Matter (PM_{10}), Particulate Matter ($PM_{2.5}$), Sulphur-dioxide (SO_2), Oxides of Nitrogen (NOx) and Carbon Monoxide (CO) with other parameters specified in NAAQS. The causes of air pollution in the area will be due to construction activities i.e. excavation, construction and allied work, vehicular movement, dust arising from unpaved village roads and domestic fuel burning. The critical weather elements that influence air pollution are wind speed, wind direction, temperature, which together determines atmospheric stability.

Table No. C3-10:National Ambient Air Quality Standard(as per MoEF Notification of 16 Nov., 2009)

Sl. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, residential, Rural and Other Area	Ecologically Sensitive Area	Methods of Measurement
1	Sulphur Dioxide (SO_2), µg/m^3	Annual * 24 hours **	50 80	20 80	- Improved West and Gaeke - Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), µg/m^3	Annual * 24 hours **	40 80	30 80	- Modified Jacob & Hochheiser (Na-Arsenite) - Chemiluminescence
3	Particulate Matter (size < 10µm or PM_{10}) µg/m^3	Annual * 24 hours **	60 100	60 100	- Gravimetric - TOEM - Beta attenuation
4	Particulate Matter (size < 2.5µm) or $PM_{2.5}$ µg/m^3	Annual * 24 hours **	40 60	40 60	- Gravimetric - TOEM - Beta attenuation
5	Ozone (O_3) µg/m^3	8 hours ** 1 hour **	100 180	100 180	- UV photometric - Chemilminescence - Chemical Method
6	Lead (Pb) µg/m^3	Annual * 24 hours **	0.50 1.0	0.50 1.0	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
7	Carbon monoxide (CO), mg/m^3	8 hours ** 1 hour **	02 04	02 04	- Non dispersive Infra Red (NDIR) spectroscopy
8	Ammonia (NH_3) µg/m^3	Annual * 24 hours **	100 400	100 400	- Chemiluminescence - Indophenol blue method
9	Benzene (C_6H_6) µg/m^3	Annual *	05	05	- Gas chromatography based continuous analyzer - Adsorption followed by GC analysis
10	Benzo(a) Pyrene (BaP)–particulate phase only, ng/m^3	Annual *	01	01	- Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m^3	Annual *	06	06	- AAS/ ICP method after sampling on EMP 2000 or equivalent filter paper
12	Nickel (Ni), ng/m^3	Annual *	20	20	- AAS/ ICP method after sampling on EMP 2000 or equivalent filter paper

* Site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly or 01 hourly mentioned values, as applicable, shall be complied with 98% of the time in a year, 2% of the time; they may exceed the limits but not on two consecutive days of monitoring.

3.12.1 Method of Sampling and Analysis:

Respirable Dust Samplers have been used for monitoring PM_{10} (<10 microns) and for gaseous pollutants like SO_2 and NOx whereas Fine Particulate Air Sampler is used to measure $PM_{2.5}$ (<2.5 microns).

Table No. C3-11: Methodology of Sampling & Analysis and Equipment Used:

Sl. No.	Parameters	Instrument / Apparatus used	Method followed
1	Fine Particulate matter: $PM_{2.5}$ (size <2.5 micrometer), $\mu g/m^3$	Fine Particulate Air Sampler (FPAS), Teflon membrane Filter Paper, Balance	Gravimetric
2	Particulate matter PM_{10} (size <10 micrometer), $\mu g/m^3$	Respirable Dust Sampler (RDS), Filter Paper Whattman Glass Fiber GF/A, Balance	Gravimetric
3	Nitrogen Oxides (NOx), $\mu g/m^3$	RDS with Impinger tubes, Spectrophotometer	Jacobs & Hochheiser modified (Na-Arsenite) methods
4	Sulphur dioxide (SO_2), $\mu g/m^3$	RDS with Impinger tubes, Spectrophotometer	Improved west & Gaecke method
5	Carbon Monoxide (CO), mg/m^3	CO Analyser, Non dispersive infrared spectroscopy	----
6	Ozone (O_3) $\mu g/m^3$	Atomic Adsorption Spectrophotometer	- Chemilminescence
7	Lead (Pb) $\mu g/m^3$	Atomic Adsorption Spectrophotometer	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
8	Ammonia (NH_3) $\mu g/m^3$	Atomic Adsorption Spectrophotometer	Indophenol blue method
9	Benzene (C_6H_6) $\mu g/m^3$	Atomic Adsorption Spectrophotometer	Gas Chromatography followed by solvent extraction
10	Benzo(a) Pyrene (BaP)–particulate phase only, ng/m^3	Atomic Adsorption Spectrophotometer	Gas Chromatography followed by solvent extraction
11	Arsenic (As), ng/m^3	Atomic Adsorption Spectrophotometer	AAS/ ICP method after sampling on EMP 2000 or equivalent filter paper
12	Nickel (Ni), ng/m^3	Atomic Adsorption Spectrophotometer	AAS/ ICP method after sampling on EMP 2000 or equivalent filter paper

3.12.2 Location of Monitoring Stations:

The baseline status of the ambient air quality has been established through a scientifically designed ambient air quality monitoring network and was based on following considerations:

- Meteorological condition on synoptic scale.
- Topography of the study area.
- Representatives of regional background air quality for obtaining baseline status.
- Location of residential areas representing different activities.

Sampling was done in all the sampling locations at a height of 3 meter above the ground on a platform. The station represents approximately the highest ground level of the area and practically having no obstruction. 10 (Ten) monitoring stations were set up. 3 stations within 10 km radius considering Hanuman nagar

Fig. No. C3-8: Showing the Ambient Air Monitoring Location of Study Area

Barrage as point and 7 locations along the canal allignment in the study area and their details of locations are presented in **Table No. C3-12**. The summerized report are given in **Table No. C3-13.** The stations are shown in **Fig. No. C3-8**. During the monitoring, 24 hour average samples were collected continuously.

Table No.C3-12: Ambient Air Quality (AAQ) Monitoring Stations within the Study Area

10 km radius from Hanuman Nagar Barage(Birpur)						
Sl. No	**Station Code**	**Location**	**Latitude & Longitude**	**Distance (km)**	**Direction**	**Type of Area**
				with respect to Hanuman Nagar Barage		
1	A1	Near Bhim Nagar	26^0 29' 56.72" N, 86^0 56' 30.88" E	2.69 km	SE	Settlements
2	A2	Near Saheban	26° 27' 39.17" N, 86° 56' 6.43" E	6.06 km	S	Settlements, Near NH-106
3	A3	Bhawanipur	26° 27' 32.83" N, 87° 0' 17.17" E	9.13 km	SE	Settlements
1 km from Main Canal						
				with respect to main canal (existing & proposed)		
4	A4	Near Hanuman Nagar Barrage	26° 30' 9.22" N, 86° 54' 13.72" E	–	–	Settlements
5	A5	Bhadreswar Village	26° 19' 39.40" N, 87° 15' 11.66" E	0.38 km	S	Settlements & Near NH-57A, Bihar SH-60
6	A6	Kauakhoh Village	26° 20' 37.46" N, 87° 27' 28.98" E	0.42 km	S	Settlements & Near Araria-Kursakanta-Sikti road
7	A7	Phulsara Village	26° 17' 6.11" N, 87° 38' 48.23" E	0.95 km	S	Settlements
8	A8	Dadar Village	26° 16' 45.12" N, 87° 43' 37.34" E	0.22 km	S	Settlements & Near Bahadurganj-Terhagachh road
9	A9	SH-99, Near Bahadurganj	26° 15' 17.03" N, 87° 49' 3.76" E	0.80 km	S	Near Bahadurganj Settlement & Bihar SH-99.
10	A10	Rangamani Village	26° 13' 20.06" N, 87° 55' 42.52" E	0.09 km	SW	Settlements

3.12.3 Data Analysis of AAQ Levels:

The ambient air quality of buffer zone of 10 km radius from Existing Hanuman Nagar Barrage (Birpur) & 1km southward from the main canal of the study area was monitored during 1st Mar 2017 to 31st May 2017 continuously for 24 hours at each location twice a week. The existing concentrations of the critical pollutants in the study area are presented in the following tables. The project is an expansion cum modification Irrigation Project and the areais scattered agricultural and barren land & many rivers. There are no such industries around but not within the close proximity.

However, as presented in the table below the background concentrations of the critical pollutants is very much within the limit of NAAQS. The range of maximum and minimum concentrations reflect that the pollution levels are varying depending on the prevailing activity i.e. either industrial, or domestic fuel burning or vehicular traffic etc.

TableNo.C3-13: Summarized Ambient Air Quality Monitoring Results:

Location	PM_{10}(µg/m^3)			$PM_{2.5}$ (µg/m^3)			SO_2 (µg/m^3)			NO_X (µg/m^3)			CO (mg/m^3)		
	Max.	**Min.**	**Avg**	**Max.**	**Min.**	**Avg**	**Max.**	**Min.**	**Avg**	**Max.**	**Min.**	**Avg**	**Max.**	**Min.**	**Avg**
Locations within 10 km radius from Hanuman Nagar Barage(Birpur)															
Near Bhim Nagar (A1)	59.1	53.4	56.25	33.6	28.4	31.0	5.8	4.0	4.9	17.9	13.2	15.55	0.19	0.12	0.16
Near Saheban Village (A2)	54.1	**42.5**	48.3	29.7	**22.9**	26.3	6.1	**<4**	5.0	16.0	**11.9**	13.95	0.20	**0.09**	0.15
Bhawanipur (A3)	60.4	51.2	55.8	34.0	25.8	29.9	6.8	4.3	5.55	15.8	12.9	14.35	0.21	0.10	0.16
Locations within 1 km from the Main Canal															
Near the Hanuman Nagar Barrage (A4)	**79.6**	70.8	75.2	**40.1**	35.2	37.65	7.1	4.2	5.65	16.7	13.5	15.1	**0.24**	0.14	0.19
Near Bhadreswar (A5)	76.1	66.9	71.5	39.4	32.9	36.15	7.4	4.6	6.0	16.7	**11.9**	14.3	0.21	0.12	0.17
Kursakatta Village (A6)	65.3	59.9	62.6	33.6	28.9	31.25	6.7	4.5	5.1	17.1	12.6	14.85	**0.24**	0.13	0.19
Phulsara Village (A7)	58.6	45.2	51.9	34.1	29.6	31.85	**8.4**	5.2	6.75	18.2	14.2	16.2	0.20	0.12	0.16
Dak Pokhar Village (A8)	71.2	67.8	69.5	34.1	27.6	30.85	6.1	4.2	5.15	19.0	13.9	16.45	0.21	0.14	0.18
Near Bahadurganj (A9)	76.0	68.9	72.45	38.1	32.6	35.35	5.9	4.6	5.25	20.1	15.5	17.8	0.23	0.16	0.20
Rangamani Village (A10)	72.5	66.6	69.55	39.5	33.9	36.7	7.3	4.3	5.8	**21.0**	16.1	18.55	0.21	0.14	0.18
Range Value	**42.5- 79.6**			**22.9- 40.1**			**<4- 8.4**			**11.9- 21.0**			**0.09- 0.24**		
NAAQ STANDARD	**100**			**60**			**80**			**80**			**< 4.0**		

Note: Other parameters such as O_3, NH_3, Pb, As, Ni, C_6H_6& BaP, are analyzed whose results are found within the NAAQS limit.

3.12.4 Observations:

Particulate Matter (PM_{10}):

Maximum concentration of PM_{10} of i.e. **79.6** $\mu g/m^3$ was recorded at A4 (Near Hanuman nagar barrage) location and this is due to NH-106 is passing nearby the location. And the minimum concentration of **42.5** $\mu g/m^3$ was recorded at A2 sampling station. The average values of PM_{10} at all the locations are quite below the NAAQS values for rural, residential and other areas.

Particulate Matter ($PM_{2.5}$):

The maximum concentration of $PM_{2.5}$ of **40.1** $\mu g/m^3$ was recorded at monitoring station A4 and the minimum concentration of **22.9** $\mu g/m^3$ was recorded at A2. The mean values at all the locations are below the NAAQS norms for rural, residential and other areas.

Sulphur Dioxide (SO_2):

The SO_2 analysis data shows, that SO_2 concentration of AAQ ranged from **<4** to **8.4**$\mu g/m^3$.Maximum SO_2 concentrations was exhibited at Phulsara village and minimum at Saheban village. In general the range of SO_2 concentration in the AAQ of the study area is within the specified norms of NAAQS.

Nitrogen Oxides (NO_x):

The concentration of NO_X ranged between **11.9** to **21.0** $\mu g/m^3$. In all the sampling location the value of NO_X is within the permissible standard of NAAQS.

Carbon Monoxide (CO):

The concentration of carbon monoxide ranged between **0.09** to **0.24** mg/m^3.

Other parameters were also found within the NAAQS limit.

3.13 WATER ENVIRONMENT:

The study of water Environment basically consists of water resources and its quality which are most desirable for this irrigation project, at its various stages of development. The baseline study dovetailed assessment of sufficiency of water source as per the project designed demand and determination of quality parameters to ascertain best use against water pollution.

3.13.1 Water Resources:

The project envisages supply of water from Hanuman Nagar barrage (Birpur) on the Kosi river through well designed canal network for the basic purpose of irrigation and agriculture development.

The pond thus created by the Barrage structure maintains a maximum pond level, which is intended for supply of irrigation water through its two major canal systems namely the WKMC & EKMC located at either flanks of the Barrage structure.

3.13.2 Study of Drainage Pattern:

The project site lies in Gangetic plane region. The Ayacut area lies on the Kosi Basin, Mahananda Basin & Mechi Sub-basin. Basically two types of drainage patterns are seen in the Ayacut area such as Parallel Drainage Pattern & Dendritic Drainage Patterns. The Kosi River and the Mahananda River are the Primary Drainage pattern in the area. Hence, these rivers have many tributaries like the Mechi River.

The Kosi River is flowing from north to south direction and then towards east direction & falls in the Ganga river. The Mahananda River is also flowing towards south to the Ganga. The Mechi River is a tributary of Mahananda river. The proposed canal is linking two rivers for the irrigation of the basins. Besides the rivers there are also many rivers and streams (Dhars) are flowing in the plain.There are also few surface water bodies in the form of water tanks & reservoirs and streams & canals from main surface water resources are also present for domestic and other purpose.

3.13.3 Principal Drainage in Work Area:

The Ayacut is primarily bounded by the EKMC in the north Parman in the west and Mechi & Mahananda in the east. The drainage pattern of ayacut primarily flows from north east to south west. Three prescribed river system i.e. Parman, Kosi on flows east wards to join river Mahananda. There are few local drains & sub-drain flowing in the ayacut to meet the prescribed drains. The drainage pattern of ayacut is shown in **Fig.No.C3-9** due to absolute flat terrain of land with very mild slope, the flow pattern remains sluggish besides large amount sediments as well shifting of drains due to inadequate flushing velocity the entire area is prone water logging. The major concern to improve the ayacut is to review the drains by de-silty removal of vegetation as well as to excavate the drains to bring of back to its original section with proper slope to ensure functioning of drains in perfect condition.

The name of existing prescribed secondary and tertiary drains are below.

- **Some Significant Streams/ Riversin the Ayacut Area:**

The rivers which flowing in the study area and the Ayacut zone are Tilabeh, Chilauni, Sursar, Burhi, Jura, Kamla, Garh phuphri, Parman, Bhalua, Bakra, Ghaghi, Jogian, Pahara, Surkia, Gerua, Kawal/Kankoi, Kankoi, etc. The rivers are tributaries of the large rivers.

The streams which are primary water distributors to the rivers namely: Sanjay Dhar, Dighi Dhar, Haiya Dhar, Kosi (Purani) Dhar, Berdaha Dhar, Lohangra Dhar, Bochaha Dhar, Genra dhar, Kharra Dhar, Burkesh Dhar, Kajra Dhar, Dadra Dhar, Tengra Dhar, Dhamna Dhar, Sita Dhar, Soti Dhar, Changmari Dham etc. Map showing natural dreaige is given in **Fig.No. C3-9.**

3.13.4 Ground Water Hydrology:

The occurrence and behaviour of the ground water depends upon the climatology, geology structure and hydrogeological factors. The Kosi-Mechi river system, which forms the part of Ganga basin varies in its geological settings. Since the proposed canal is fully lined, the ground water hydrology is not supposed to differ much and shall not have any negative effect on the drainage or ground water hydrology.

The study area is mainly alluvial with good ground water potentialities having considerable granulose zone with effective porosity. Recharge of aquifer is very quick due to pervious nature of soil.

3.13.5 Hydrogeology of Ayacut Area:

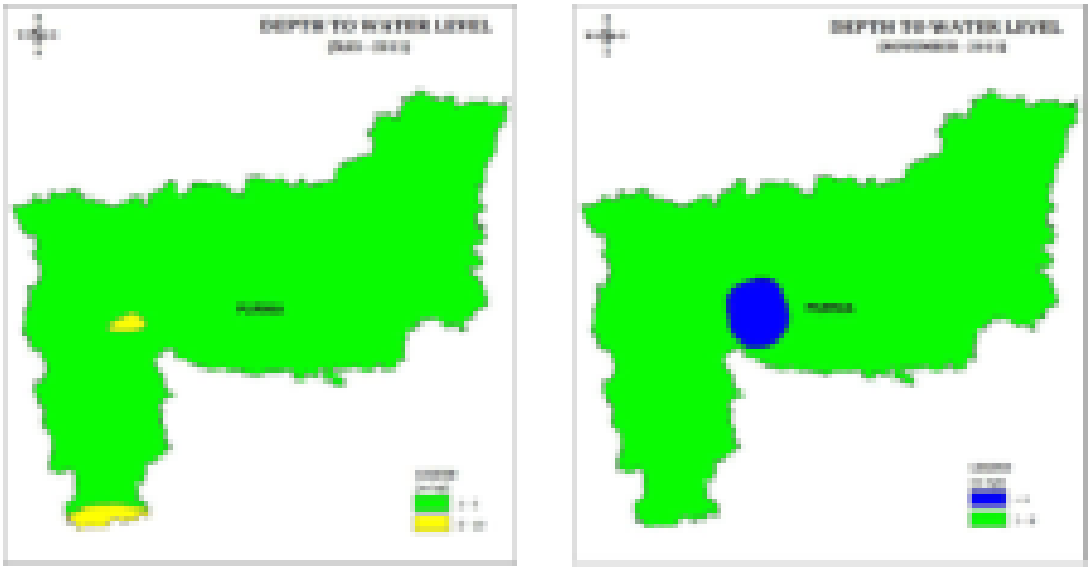
Purnia district lies in the Gangatic alluvial plain. The older alluvium is found in thenorth of Purnia consisting of coarse gravel and surface kankar and the newer alluviumcomposed of silts, clays occurring south of Purnia. The entire district is occupied by thickquaternary alluvial deposits. These alluvial deposits are carried by the river system originatingfrom the Himalayas. The alluvial deposit ranges from clay, silt to sand of various sizes, gravelpebble and boulders. These alluvial deposits contain one of the most prolific aquifer systems inthe Gangatic alluvium of North Bihar plain.

- **Mode of Occurrence of Ground Water:**

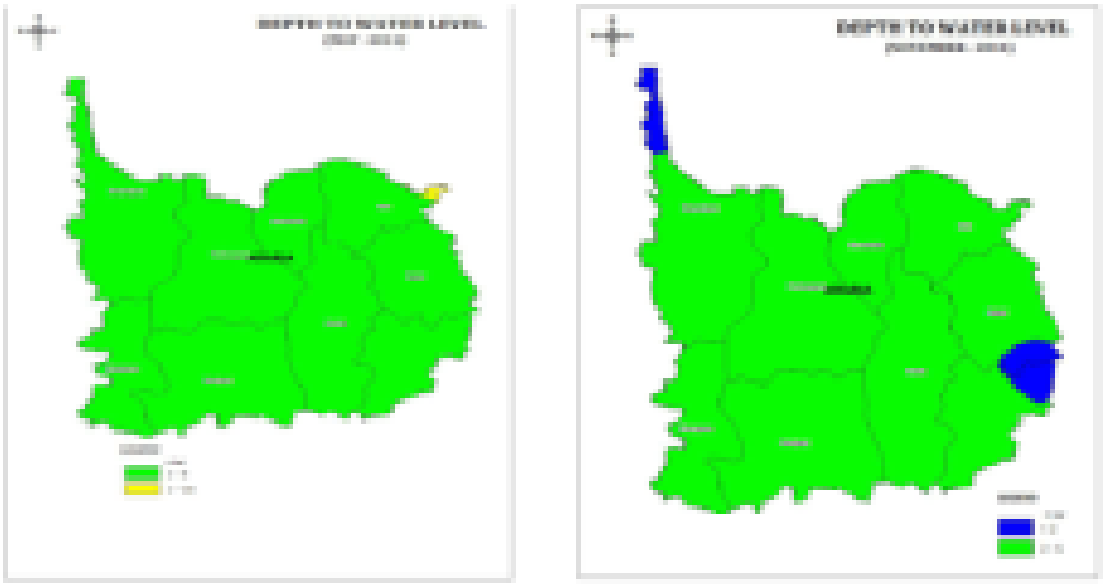
The district contains of one of the most excellent aquifer system in the Gangaticalluvium of North Bihar plain. Quaternary sediments in the area comprise sand, gravel and pebble constitute the potential aquifer. The nature of the granular material may change within short distance. However due to dominance of granular material over fine clastics in alluvial sediments, the aquifer are continuous and regionally extensive. It is found to occur continuously down to the depth of exploration of 80- 90 meter, at places capped by thin clay capping. Though lateral facies changes have been observed, the 10 aquifer system behaves as single continuous one. The aquifers are highly potential and yield 200 m^3/hr for nominal draw down of 2 m. The ground water occurs under water table condition in the district.

- **Water Level Fluctuation:**

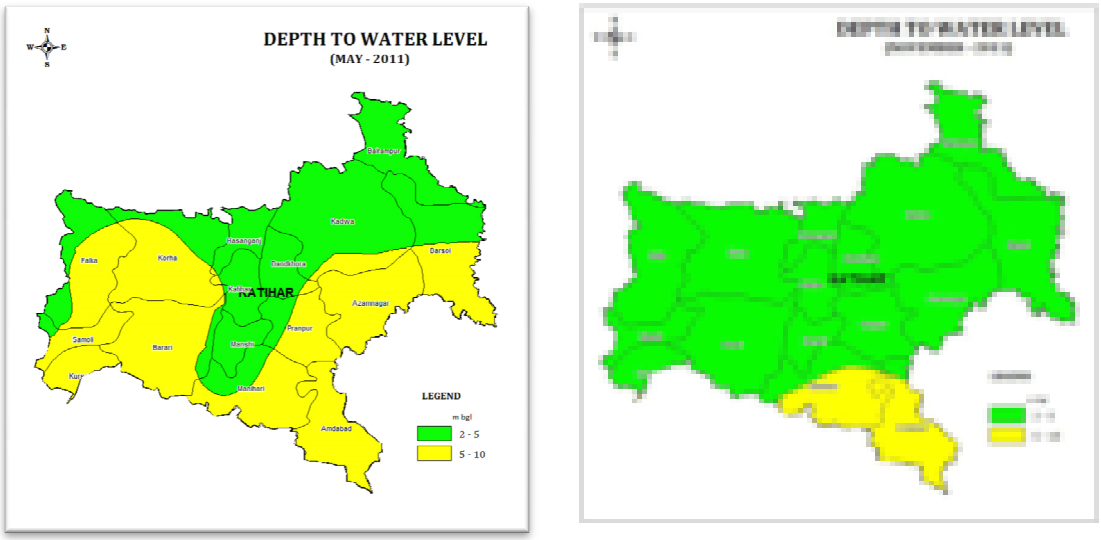
Water level map of Purnia district



Water level map of Araria district



Water level map of Katihar district



[Source: CGWB report]

Fig.No. C3.10: Ground Water Level Fluctuation Map:

- **Water Level Fluctuation**

  The water levels data of CGWB were taken into consideration to observe the likely water logged areas of the project area. The pre-monsoon water level measurements were done during May where as those of post monsoon were done during November. It is revealed from the above maps that in most parts of the Purnia district the depth to water level remains within 2-5 m bgl during pre & post monsoon. The water level lies between 5-10m bgl during pre-monsoon period in SW corner and south central portion. During post-monsoon period the depth to water level rises upto less than 2m bgl in south-central part.

Similarly, in most prts of Araria district, the depth to water level remains between 2-5 m bgl during pre and post monsoon period. However, in north east portion the depth to water level goes beyond 5m bgl in pre-monsoon. During post-monsoon the depth to water level rises up i.e. less than 2m bgl in eastern part and NW corner.

In Katihar district the situation is slightly different. The depth to water level lies beyond 5m bgl during pre-monsoon in east, west and in southern, where as occurs at a depth between 2-5 m bgl in rest parts of the district. During post-monsoon the depth to water level occurs between 2-5m bgl throughout the district except southern portion where it occurs at adepth more than 5 m bgl.

It is inferred from the above fact that through out the whole ayacut the depth to water level varies between 2-5 m bgl in general.

3.13.6 Depth to Water Level:

Baseline survey was conducted in 5 nos. of sample wells at various locations to assess the present Ground water status in the command area.

The Depth to Water Level observations during the pre-monsoon period have been formatted and furnished in **Table No.C3-14.**

Table No.C3-14: Details of locations of monitoring wells and water levels (Observation period – Pre Monsoon)

Well No.	Location of wells	Co-ordinates	Water level in m from MP	MP in m from ground level	Diameter of well	Water level mbgl
W1	Bhokria,Purnia	25°49'47" N 87°23'0" E	4.1m	0.75m	1.55m	**3.35 m**
W2	Thakurbari, Raniganj, Araria	26°3'57" N 87°14'44" E	3.15m	0.6m	1.5m	**2.55 m**
W3	Durgapur, Saharsa	25°57'89" N 87°33'11" E	3.2m	0.5m	1.4m	**2.7 m**
W4	Nageshwar nath mandir, Saharsa	25°46'30" N 87°28'25" E	3.8m	0.75m	0.95m	**3.05 m**
W5	Raua Dusahi, Saharsa	25°46'30" N 87°28'25" E	3.0m	0.8m	1.80m	**2.2 m**

Conclusion: From the above table, ground water level analysis at all the study areas show very good quantity. At Bhokria, Purnia the ground water exhibits at 3.35 m below ground water level and Raua Dusahi, Saharsa the water table is at 2.2mbgl.

3.14 WATER QUALITY:

In the base line study for the project, some Physical-chemical and biological parameters have been determined to ascertain the baseline status of the existing surface & ground water.

3.14.1 Surface- Water Quality Monitoring:

The quality of surface water was assessed by taking samples from different locations based on the following objectives:

- For rational planning of pollution control strategies and their prioritization

- To assess the nature and extent of pollution control needed in different water bodies or their part
- To evaluate the effectiveness of pollution control measures already in existence
- To assess the assimilative capacity of a water body thereby reducing costs on pollution control
- To understand the environmental fate of different pollutants
- To assess the fitness of water for different uses

3.14.2 Methodology for Water Quality:

- **For Surface Water:** Reconnaissance survey was undertaken and monitoring locations for surface water were selected based on:
  - Location of the major water bodies
  - Location of industries, their water intake and effluent disposal locations
  - Critical pockets of pollution occurrence
  - Likely areas that can represent baseline conditions

  The water samples were collected as grab samples and were analyzed for physical, chemical and biological characteristics as per CPCB guidelines.

- **For Ground Water:** Reconnaissance survey was undertaken and monitoring locations for ground water were finalized based on;
  - Location of Residential areas representing different activities / likely impact areas;
  - Likely areas, which can represent baseline conditions.

  The physico-chemical quality of water samples were analyzed by adopting the methods prescribed under IS: 10500. The ground water samples are compared with the standards for drinking water as per IS: 10500:2012.

3.14.3 Sampling Locations (Surface & Ground Water):

Four sampling locations within 1km from the proposed main canal, one from the point at which Kosi river falls in the Ganga River and two sampling points are selected from the 10km radius buffer zone considering the Hanuman Nagar barrage (Birpur) for the surface water sampling.

Samples from ground water sources were collected by adopting grab sampling. Each sample was filled into a sampling bottle. For the study of ground water parameters we choose 5 locations for this proposed project, including the project site.

Samples for both surface & ground water were collected during 22nd -24th March, 2017. All the sample points of the study area of proposed project from which surface & ground water samples were collected are marked in **Fig.No. C3-11** and presented in **Table No.C3-15** below.

TableNo.C3-15: Surface & Ground Water Quality Monitoring Locations of the Study Area (Pre Monsoon)

10 km radius from Hanuman Nagar Barage(Birpur)						
Sl. No	**Station Code**	**Location**	**Latitude & Longitude**	**Distance (km)**	**Direction**	**Type of Area**
				with respect to Hanuman Nagar Barage(Birpur)		
1	SW1	Pond water from Fatehpur	26° 30' 56.09" N, 86° 59' 58.42" E	6.79 km	E	Settlements
2	SW2	Pond water from Kataia	26° 27' 52.78" N, 86° 57' 40.93" E	6.9 km	SE	Settlements
3	GW1	Bhimnagar	26° 30' 9.14" N, 86° 56' 59.68" E	2.91 km	SE	Settlement
4	GW2	Saheban	26° 28' 8.18" N, 86° 56' 5.24" E	6.02 km	S	Settlement, Near NH-106
1 km from Main Canal						
				with respect to main canal (existing & proposed)		
1	SW3	River water from Kosi	26° 30' 12.49" N, 86° 56' 27.38" E	–	–	Near Hanuman Nagar Barrage
2	SW4	River water from Ganga	25^0 25' 1.96" N, 87^0 15' 14.43" E	101.4 km	S	South of ayakut area
3	SW5	Pond water from Bhadreswar Village	26° 20' 0.71" N, 87° 14' 57.12" E	0.50 km	SE	Settlements
4	SW6	Pond water from Charbana Village	26° 18' 38.38" N, 87° 35' 48.80" E	0.25 km	S	Settlements
5	SW7	River water from Kawal River	26° 16' 25.07" N, 87° 45' 8.75" E	0.90 km	S	Settlements & Near Charakpara-Lauchha road
6	GW3	Near the Matiari Village	26° 22' 42.74" N, 86° 0' 43.2" E	0.89 km	SW	Settlements
7	GW4	Bhadreswar Village	26° 20' 5.14" N, 87° 14' 48.16" E	0.34 km	SE	Settlements & Near NH-57A, Bihar SH-60
8	GW5	Kauakhoh Village	26° 21' 19.12" N, 87° 26' 28.68" E	0.43 km	S	Settlements & Near Araria-Kursakanta-Sikti road
9	GW6	Phulsara Village	26° 17' 43.40" N, 87° 38' 12.95" E	0.45 km	S	Settlements
10	GW7	Dadar Village	26° 17' 2.62" N, 87° 43' 30.18" E	0.19 km	S	Settlements & Near Bahadurganj-Terhagachh road
11	GW8	Near Bahadurganj	26° 15' 58.79" N, 87° 49' 28.67" E	0.09 km	S	Near Bahadurganj Settlement & Bihar SH-99.

Fig.No. C3-11: Map Showing Surface & Ground Water Sampling Locations of Study Area

The analysis results for surface water & ground water are given in **Table No.C3-16 & C3-17**respectively.

Table No.C3-16: Analysis results of Surface Water Quality of the study area:

Sl. No.	Test Parameters	Unit	Standard as per IS 2296	SW1	SW2	SW3	SW4	SW5	SW6	SW7
1	Colour, Max.	Hazen	300	15	32	15	45	23	28	26
2	pH value @ 25ºC	--	6.5 - 8.5	7.52	7.14	7.36	7.84	7.72	7.56	7.16
3	Iron as Fe, Max.	mg/l	50	0.42	0.21	0.36	0.42	0.25	0.33	0.26
4	Chloride as Cl, Max.	mg/l	600	32	29	12	26	42	28	22
5	Dissolved Solids, Max.	mg/l	1500	125.8	133.9	68.6	94.8	104.6	123.1	162.3
6	Dissolved Oxygen, Min.	mg/l	4	6.8	6.3	6.5	6.6	6.7	6.7	6.5
7	BOD: 3 days at 27^0C, Max.	mg/l	3	2.0	2.1	2.0	2.2	2.3	2.1	2.6
8	Oil & Grease, Max.	mg/l	0.1	ND	ND	ND	ND	ND	ND	ND
9	Copper as Cu, Max.	mg/l	1.5	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
10	Sulphate as SO_4, Max.	mg/l	400	2.8	4.1	2.8	4.6	5.1	4.5	3.6
11	Nitrate as NO_3, Max.	mg/l	50	1.3	0.9	0.56	1.2	1.4	2.3	0.26
12	Fluoride as F, Max.	mg/l	1.5	0.08	0.05	<0.05	0.06	0.06	0.1	0.05
13	Anionic detergent	mg/l	1	ND	ND	ND	ND	ND	ND	ND
14	Cadmium as Cd, Max.	mg/l	0.01	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
15	Selenium as Se, Max.	mg/l	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
16	Arsenic as As, Max.	mg/l	0.2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
17	Cyanide as CN, Max.	mg/l	0.05	ND	ND	ND	ND	ND	ND	ND
18	Phenolic compound as C_6H_5OH, Max.	mg/l	0.005	ND	ND	ND	ND	ND	ND	ND
19	Lead as Pb, Max.	mg/l	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
20	Zinc as Zn, Max.	mg/l	15	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
21	Sodium as Na	mg/l	--	28.4	24.9	21.9	26.5	36.7	41.1	32.5
22	Total Hardness as	mg/l	--	68	74	48	62	76	98	86

Sl. No.	Test Parameters	Unit	Standard as per IS 2296	SW1	SW2	SW3	SW4	SW5	SW6	SW7
	$CaCO_3$									
23	Calcium as Ca	mg/l	--	13.63	14.83	9.62	12.42	15.23	19.64	17.23
24	Magnesium as Mg	mg/l	--	8.26	8.99	5.83	7.53	9.23	11.91	10.49
25	SAR	--	--	3.14	2.6	2.80	3.05	3.82	3.79	3.17
26	Hexavalent Chromium as Cr^{+6}, Max.	mg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
27	Total Coliform, Max.	MPN/l00ml	5000	280	310	240	160	140	240	260
28	Faecal Coliform	MPN/l00ml	--	ND	ND	ND	ND	ND	ND	ND
29	Pesticide	mg/l	--	0.001	0.002	<0.001	0.001	0.003	0.002	0.002
30	Temperature	°C	--	32	33	31	32	34	32	32
31	Electrical Conductivity	µS/cm	--	228.72	243.45	172.36	124.72	190.18	223.81	295.09
32	Total Suspended Solid	mg/l	--	25.8	36.1	28.4	25.6	15.3	51.6	42.9
33	COD	mg/l	--	30	20	40	60	50	50	30
34	Phosphate as PO4	mg/l	--	0.15	0.19	0.22	0.1	0.29	0.42	0.11
35	Potassium as K	mg/l	--	12.5	10.2	11.5	10.2	11.9	13.5	10.4
36	Silica as SiO_2	mg/l	--	0.1	0.14	0.11	0.09	0.15	0.27	0.11
37	Residual Sodium Carbonate	meq/l	--	0.85	0.53	0.69	0.55	0.48	0.69	0.78
38	Total Chromium as Cr	mg/l	--	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
39	Mercury as Hg	mg/l	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

* *ND- Not Detectable*

3.14.4 Description Surface Water Analysis Report:

Physico-chemical characteristics:

The physico-chemical characteristics of surface water are summarized in the **Table No.C3-16**. In Kosi river water, 2 sampling points are selected at upstream & downstream & the downstream sample was collected from the point where the Kosi river falls in the Ganga. Another two river samples were collected from Kawal river & Mechi river. From the river sampl, the pH are varies from 7.16 – 7.84, the dissolved solids are 68.6-162.3 mg/l, chlorides are 12-26 mg/l, fluorides are <0.05-0.06 mg/l, Sulphate 2.8 -4.6 mg/l respectively.

In the pond water samples the pH varies from 7.14-7.72, dissolved solids are 104.6-133.9 mg/l, chloride are 28-42 mg/l, fluoride are 0.05-0.1 mg/l, sulphate are 2.8-5.1 mg/l.

Nutrient value in the form of nitrite-nitrogen and total phosphate indicate the values for demand parameters BOD were given in above table.

Bacteriological Characteristics:

The coliform group of bacteria are significant as a principal indicator of degree of pollution of water and thus of sanitary quality. The coliform density is now a criterion to assess the suitability of water for domestic and recreational uses. The standard test for the coliform group was carried out by the Multiple Tabe Fermentation (MTF). The MTF technique involves direct plating for detection and estimation of total coliform densities.

The total coliform density in river water ranges from 160-260 MPN/100 ml, whereas in the pond water, it was found from 140-310 MPN/100 ml, which are within the limit as per IS-2296.

Table No. C3-17: Ground water Analysis Results:

Sl. No	Parameter	Unit of measurement	Standard as per IS: 10500, 2012		GW1	GW2	GW3	GW4
			Acceptable Limit	Permissible Limit				
1	Colour	Hazen	5	15	<5	<5	<5	<5
2	Odour	--	AL	AL	AL	AL	AL	AL
3	Taste	--	AL	AL	AL	AL	AL	AL
4	Turbidity	NTU	1	5	<1	<1	<1	<1
5	pH Value @ 25ºC	--	6.5-8.5	No Relaxation	7.1	6.8	6.9	7.1
6	Total Hardness (as $CaCO_3$)	mg/l	200	600	96	108	126	104
7	Iron (as Fe)	mg/l	0.3	No Relaxation	0.11	0.09	0.15	0.12
8	Chloride (as Cl)	mg/l	250	1000	46	58	28	42
9	Residual, free Chlorine	mg/l	0.2	1.0	ND	ND	ND	ND
10	Total Dissolved Solids	mg/l	500	2000	152.2	177.9	196	175
11	Calcium (as Ca)	mg/l	75	200	11.66	21.64	25.25	20.84
12	Magnesium (as Mg)	mg/l	30	100	20.9	13.12	15.31	12.64
13	Copper (as Cu)	mg/l	0.05	1.5	<0.03	<0.03	<0.03	<0.03
14	Manganese (as Mn)	mg/l	0.1	0.3	<0.05	<0.05	<0.05	<0.05
15	Sulphate (as SO_4)	mg/l	200	400	9.3	7.8	10.3	6.9
16	Nitrate (as NO_3)	mg/l	45	No Relaxation	0.63	0.84	0.56	0.39
17	Fluoride (as F)	mg/l	1.0	1.5	0.03	0.08	0.09	0.02
18	Phenolic Compounds (as C_6H_5OH)	mg/l	0.001	0.002	<0.001	<0.001	<0.001	<0.001
19	Mercury (as Hg)	mg/l	0.001	No Relaxation	<0.001	<0.001	<0.001	<0.001
20	Cadmium (as Cd)	mg/l	0.003	No Relaxation	<0.003	<0.003	<0.003	<0.003
21	Selenium (as Se)	mg/l	0.01	No Relaxation	<0.001	<0.001	<0.001	<0.001

22	Arsenic (as As)	mg/l	0.01	0.05	<0.001	<0.001	<0.001	<0.001
23	Cyanide (as CN)	mg/l	0.05	No Relaxation	ND	ND	ND	ND
24	Lead (as Pb)	mg/l	0.05	No Relaxation	<0.05	<0.05	<0.05	<0.05
25	Zinc (as Zn)	mg/l	5	15	0.15	0.09	0.15	0.14
26	Chromium (as Cr^{+6})	mg/l	0.05	No Relaxation	<0.05	<0.05	<0.05	<0.05
27	Mineral Oil	mg/l	0.5	No Relaxation	<0.05	<0.05	<0.05	<0.05
28	Total Alkalinity (as $CaCO_3$)	mg/l	200	600	48	64	40	48
29	Aluminium (as Al)	mg/l	0.03	0.2	<0.01	<0.01	<0.01	<0.01
30	Boron (as B)	mg/l	0.5	1.0	<0.2	<0.2	<0.2	<0.2
31	Temperature	°C	--	--	29	29	28	31
32	Electrical Conductivity	µS/cm	--	--	276.72	323.45	356.36	318.18
33	Total Suspended Solid	mg/l	--	--	<5	<5	<5	<5
34	COD	mg/l	--	--	<10	<10	<10	<10
35	Phosphate as PO_4	mg/l	--	--	<0.05	<0.05	<0.05	<0.05
36	Sodium as Na	mg/l	--	--	18.6	21.4	20.3	22.5
37	Potassium as K	mg/l	--	--	<10	<10	<10	11.2
38	Silica as SiO_2	mg/l	--	--	<0.05	0.06	<0.05	0.06
39	Residual Sodium Carbonate	meq/l	--	--	0.89	0.42	0.88	0.74

* AL- Agreeable, ND-Not Detected

Sl. No.	**Parameter**	**Unit of measurement**	**Standard as per IS: 10500, 2012**		**GW5**	**GW6**	**GW7**	**GW8**
			Acceptable Limit	**Permissible Limit**				
1	Colour	Hazen	5	15	<5	<5	<5	<5
2	Odour	--	AL	AL	AL	AL	AL	AL
3	Taste	--	AL	AL	AL	AL	AL	AL
4	Turbidity	NTU	1	5	<1	<1	<1	<1
5	pH Value @ 25ºC	--	6.5-8.5	No Relaxation	6.8	6.8	6.9	6.9
6	Total Hardness (as $CaCO_3$)	mg/l	200	600	104	132	92	84
7	Iron (as Fe)	mg/l	0.3	No Relaxation	0.09	0.19	0.2	0.14
8	Chloride (as Cl)	mg/l	250	1000	32	58	34	28
9	Residual, free Chlorine	mg/l	0.2	1.0	ND	ND	ND	ND
10	Total Dissolved Solids	mg/l	500	2000	156	182	137.9	162.3
11	Calcium (as Ca)	mg/l	75	200	20.84	26.45	18.44	16.83
12	Magnesium (as Mg)	mg/l	30	100	12.64	16.04	11.18	10.21
13	Copper (as Cu)	mg/l	0.05	1.5	<0.03	<0.03	<0.03	<0.03
14	Manganese (as Mn)	mg/l	0.1	0.3	<0.05	<0.05	<0.05	<0.05
15	Sulphate (as SO_4)	mg/l	200	400	5.6	8.5	7.3	6.2

16	Nitrate (as NO_3)	mg/l	45	No Relaxation	0.32	0.42	0.26	0.27
17	Fluoride (as F)	mg/l	1.0	1.5	0.06	0.08	0.09	0.1
18	Phenolic Compounds (as C_6H_5OH)	mg/l	0.001	0.002	<0.001	<0.001	<0.001	<0.001
19	Mercury (as Hg)	mg/l	0.001	No Relaxation	<0.001	<0.001	<0.001	<0.001
20	Cadmium (as Cd)	mg/l	0.003	No Relaxation	<0.003	<0.003	<0.003	<0.003
21	Selenium (as Se)	mg/l	0.01	No Relaxation	<0.001	<0.001	<0.001	<0.001
22	Arsenic (as As)	mg/l	0.01	0.05	<0.001	<0.001	<0.001	<0.001
23	Cyanide (as CN)	mg/l	0.05	No Relaxation	ND	ND	ND	ND
24	Lead (as Pb)	mg/l	0.05	No Relaxation	<0.05	<0.05	<0.05	<0.05
25	Zinc (as Zn)	mg/l	5	15	0.09	0.09	0.1	0.13
26	Chromium (as Cr^{+6})	mg/l	0.05	No Relaxation	<0.05	<0.05	<0.05	<0.05
27	Mineral Oil	mg/l	0.5	No Relaxation	<0.05	<0.05	<0.05	<0.05
28	Total Alkalinity (as $CaCO_3$)	mg/l	200	600	28	32	34	20
29	Aluminium (as Al)	mg/l	0.03	0.2	<0.01	<0.01	<0.01	<0.01
30	Boron (as B)	mg/l	0.5	1.0	<0.2	<0.2	<0.2	<0.2
31	Temperature	°C	--	29	29	29	28	30
32	Electrical Conductivity	µS/cm	--	--	330.91	283.63	250.72	295.09
33	Total Suspended Solid	mg/l	--	--	<5	<5	<5	<5
34	COD	mg/l	--	--	<10	<10	<10	<10
35	Phosphate as PO_4	mg/l	--	--	<0.05	<0.05	<0.05	<0.05
36	Sodium as Na	mg/l	--	--	24.1	21.6	20.4	19.9
37	Potassium as K	mg/l	--	--	<10	11.9	<10	<10
38	Silica as SiO_2	mg/l	--	--	0.06	<0.05	<0.05	<0.05
39	Residual Sodium Carbonate	meq/l	--	--	0.96	0.59	0.68	0.74

* AL- Agreeable, ND-Not Detected

3.14.5 Description of Ground Water Analysis Report:

The physico-chemical characteristics of ground water samples are presented in **Table No. C3-17**. The drinking water quality standard "ISO 10500: 2012" is mentioned alongside the ground water analysis results for comparison.

The levels of total dissolved solids varied from 137.9-196 mg/l, total hardness from 84-132 mg/l, chloride from 28-58 mg/l, Sulphate from 5.6-10.3 mg/l. Total Alkalinity ranged from 20-64 mg/l.

The analysis results of groundwater samples showed that all parametersat every sampling locations are within the prescribed limits as per IS: 10500 standards for drinking water. So, proper treatment should be carried out to reduce the exceed limit within the specification for drinking purpose.

3.15 NOISE ENVIRONMENT:

The physical description of sound concerns its loudness as a function of frequency. Noise in general is an unwanted sound, which is composed of many frequency components of various types of loudness level distributed over the audible frequency range. Noise Levels (NL's) are measured in decibels on the A-weighted scale, dB (A), where the A-weighting scheme accounts for the sensitivities of the human ear over the audio spectrum.

3.15.1 Noise Levels in the Study Area:

Baseline noise levels have been monitored at different points during4th to 6th April, 2017 within the study area using a noise level meter. Within 1 km southward from the Main Canal, seven noise monitoring stations were identified. And for the 10km radius buffer from the Hanuman Nagar barrage (Birpur) three locations were selected. The locations were identified for the assessment of the existing noise levels keeping in view the nature of the monitoring location i.e. residential areas in villages, schools etc. The noise monitoring locations with reference to the Project is given in the **Table No.C3-18**.

Table No.C3-18: Details of Noise Level Monitoring Locations:

1 km from Main Canal						
Sl. No	**Station Code**	**Location**	**Latitude & Longitude**	**Distance (km)**	**Direction**	**Type of Area**
				with respect to Hanuman Nagar Barage(Birpur)		
1	N1	Near Bhim Nagar	26° 29' 49.78" N, 86° 56' 31.48" E	2.69 km	SE	Settlements
2	N2	Near Saheban	26° 27' 38.59" N, 86° 56' 9.09" E	6.08 km	S	Settlements
3	N3	Bhawanipur	26° 27' 38.59" N, 86° 56' 9.09" E	9.13 km	SE	Settlements
10 km radius from Hanuman Nagar Barage(Birpur)						
				with respect to main canal (existing & proposed)		
4	N4	Near the Hanuman Nagar Barrage	26° 30' 3.92" N, 86° 54' 10.37" E	–	–	Settlements
5	N5	Bhadreswar Village	26° 19' 34.53" N, 87° 15' 13.17" E	0.36 km	S	Settlements & Near NH-57A, Bihar SH-60
6	N6	Kauakhoh Village	26° 20' 28.82" N, 87° 27' 19.83" E	0.42 km	S	Settlements & Near Araria-Kursakanta-Sikti road
7	N7	Phulsara Village	26° 17' 3.12" N, 87° 38' 38.26" E	0.95 km	S	Settlements
8	N8	Dak Pokhar Village	26° 16' 21.58" N, 87° 43' 32.52" E	0.22 km	S	Settlements & Near Bahadurganj-Terhagachh road
9	N9	SH-99, Near Bahadurganj	26° 15' 4.0" N, 87° 49' 23.23" E	0.80 km	S	Near Bahadurganj Settlement & Bihar SH-99.
10	N10	Rangamani Village	26° 13' 35.58" N, 87° 56' 23.53" E	0.09 km	SW	Settlements

Noise Level monitoring was carried out to measure the sound pressure level in the surrounding villages of the study area on hourly basisto study the impact of the noise on the local environment. The day levels have been monitored between 6.00 A.M and 10.00 P.M and the night levels have been monitored between 10.00 P.M and 6.00 A.M. The monitoringresults are presented below in **Table No.C3-19**and locations are shown in **Fig.No.C3-12.**

Table No.C3-19: Noise Level in the Study Area:

Code	Location	Area Category	L_{eq}[dB(A)]	
			Day	Night
N1	Near Bhim Nagar	Residential	48.3	43.8
N2	Near Saheban	Residential	52.9	41.1
N3	Bhawanipur	Residential	50.2	42.9
N4	Near the Hanuman Nagar Barrage	Residential	69.2	65.8
N5	Bhadreswar Village	Residential	50.3	41.9
N6	Kursakatta Village	Residential	52.8	43.5
N7	Phulsara Village	Residential	50.6	42.3
N8	Dak Pokhar Village	Residential	52.1	42.6
N9	SH-99, Near Bahadurganj	Residential	49.9	40.2
N10	Rangamani Village	Residential	51.2	42.5

Table No. C3-20: Ambient noise quality standards:

Area Category	Limits in dB(A)L_{eq}	
	Day Time (6.00 AM to 10.00 P.M)	Night Time (10.00PM to 6.00 AM)
Industrial	75	70
Commercial	65	55
Residential	**55**	**45**
Silence Zone	50	40

3.15.2 Observations:

The analysis result of noise at different locations shows that noise levels are within the ambient noise quality standards mentioned in **Table No.C3-19**.However, during the construction period the noise level at the limited areas of construction may be slightly higher for a very temporary period. But this will remain within the permissible limits by proper management of machinery and equipment operations.

Fig. No. C3-12: Noise Monitoring Location Map

3.16 ECOLOGY & BIODIVERSITY:

Ecology study has been carried out to know the forest types, flora and faunal composition of the study area, both qualitatively and quantitatively, which were computed & compared with the information from other sources like BSI, ZSI, Forest & Wildlife Department and local NGO's. It provided important information about the overall health and sensitivity of the ecosystem, endangered /rare plant and animal species found in the area and thus helped in formulating a conservation plan.

3.16.1 Scope of the Work:

i. Documentation of the list of plant species available in the project area.
ii. Phyto-sociological features of the plant community.
iii. Enumeration of the faunal composition of the area.

3.16.2 Study Area:

Kosi-Mechi intrastate link project is located at Latitude **26^0 31' 27.4"N** and Longitude **86^0 55' 40.3"E** (Hanuman Nagar Barrage) and the main canal covering parts of the Supaul. Araria & Kishanganj districts of Bihar. The altitude of the existing & proposed canal area ranges between 55-81m above mean sea level. The region receives an average rainfall of 1350-1450 mm annually and average temperature varies between 14°C and 39°C during study period. The boundaries considered in this project were the influence zone and the aycut area. The area which covers the irrigation facilities from the proposed link canal site in the downstream is considered as the aycut area. The study was conducted in the project area between March to May 2017.

The forest type in the region is mostly tropical dry deciduous type with low density of tree. Area of thick forest is very less; Sal is the most dominant species in these forests. However some tropical moist deciduous forest is observed mostly towards north of the project; near Hanuman Nagar barrage (Birpur). The area is flood prone and no strong climax vegetation isfound. Some of them are planted in small patches on the road side/bund. However, their numbers are few. Most of the species are utilized bythe villagers for fodder and fuel.

3.16.3 Vegetation Survey:

In order to collect quantitative data on plant species and vegetation patterns, a community structure analysis was carried out in aycut areas, 1km along the canal and 10km around the Hanuman Nagar Barrage (Birpur). The technique used for data collection was a proportionate stratified random sampling method involving the use of various size of quadrants for various growth forms and life forms of plants (Roy *et al*., 1999). In this method, a number of sampling points were determined for each area according to the relative proportion of the forest area. These pre-identified random sampling locations were then visited for the primary data collection. The precise sampling locations were verified using a hand-held GPS. The size of the quadrates used in the field surveys were 20 m × 20 m plot for trees (of ≥ 30 cm circumference at breast height (cbh). The plant specimens collected during the field work were brought to the laboratory and were taxonomically identified referring to Flora of Bihar & Orissa by Hanes.

3.16.4 Methodology:

The floral diversity and vegetation analysis falling into the aycut area and along the canal is involved. The sampling was undertaken at each location during the period March to May, 2017. Quadrate-wise data were used for the computation of analytical features such as species richness, density, frequency, abundance, basal cover and Importance Value Index (IVI), following standard phyto-sociological methods (Misra, 1968). Circumference at breast height (cbh) at 1.37 m from the ground of all the trees with ≥30 cm in each quadrate was measured and recorded for each species. The IVI for the tree species was determined as the sum of the relative density, relative frequency and relative dominance (Curtis, 1959).

As the impacts due to the construction of proposed canal were likely to be confined mainly around 10km radius of the Hanuman Nagar Barrage (India side only), along the canal (1km on both sides) and aycut areas of the project, sampling plots (quadrates) were laid down only in these respective areas to collect the floral diversity and vegetation data.

Frequency: Frequency is the number of sampling units (as %) in which the particular species occur. This is equal to the total number of sample plots (quadrate) examined in which species occurs divided by total number of quadrate studied. It is expressed in percentage of the total number of samples.

Density: Density represents the numerical strength of the community. It is the number of individuals of the species in a unit area. This is equal to the total number of individuals of a species in all the sample plots, divided by the total number of sample plots (quadrate) studied.

Cover & Basal Area: Cover implies the area covered or occupied by the leaves, stems & flowers, as viewed from the top. Canopy cover is usually defined as the area occupied by the aerial parts of a species in perpendicular projection and is expressed as percentage of total cover. The coverage is studied at the canopy level and at the basal region.Basal area refers to the ground actually penetrated by the stems and is readily seen when the leaves and stem re clipped at the ground surface. It is one of the main characters to determine dominance.

Important Value Index (IVI): Important Value Index (IVI) of a species in a community gives an idea of the relative importance. It is obtained by adding the value of Relative Density (RD), Relative Dominance (RDo) and Relative Frequency (RF).

Table No. C3-21: Composition of tree, shrub, herb and climber species in three different zones (Aycut, 1km along the proposed canal & 10km around the barrage) of the proposed project area

Local Name	Name of the Species	Family	Aycut	1km along canal	10km around Barrage (India side)
Tree					
Babool	*Acacia nilotica*	Mimosaceae	√	√	
Bel	*Aegle marmelos*	Rutaceae	√		√
Siris	*Albizzia lebbek*	Mimosaceae	√		√
Saripha	*Anona squamosa*	Annonaceae	√	√	
Kathahal	*Artocarpus heterophyllus*	Moraceae	√	√	
Neem	*Azadirachta indica*	Meliaceae	√	√	√
Simal	*Bombax ceiba*	Bombacaceae	√	√	√
Amaltas	*Cassia fistula*	Fabaceae	√		√
Sisam	*Dalbergia sisso*	Fabaceae	√		√
Pangar	*Erythrina variegeta*	Fabaceae	√	√	
Barhgad	*Ficus bengalensis*	Moraceae	√	√	√
Peepal	*Ficus religiosa*	Fabaceae	√		√
Gamhaar	*Gmelenia arborea*	Verbenaceae	√		√
Dhamani	*Grewia tiliaefolia*	Tiliaceae	√		√
Mahua	*Madhuca indica*	Sapotaceae	√		√
Am	*Mangifera indica*	Anacardiaceae	√	√	√
Amla	*Phyllanthus emblica*	Euphorbiaceae	√	√	√
Jungle Jalebi	*Pithecellobium dulce*	Mimosaceae	√	√	
Karanj	*Pongamia pinnata*	Fabaceae	√		√
Sal	*Shorea robusta*	Dipterocarpaceae	√		√
Jamun	*Syzygium cumini*	Myrtaceae	√	√	√
Imli	*Tamarindus indica*	Fabaceae	√		
Arjun	*Terminalia arjuna*	Combretaceae	√		√
Ber	*Ziziphus mauritiana*	Rhamnaceae	√		
Shrub					
Arusha	*Adhatoda zeylanica*	Acantaceae	√		
Arka	*Calotropis gigantea*	Asclepiadaceae	√	√	√
Behaya	*Ipomoea carnea*	Convolvulaceae			√
Jamal Gota	*Jatropha curcas*	Euphorbiaceae	√		√
Putus	*Lantana camara*	Verbenaceae	√	√	
Nirgundi	*Vitex negundo*	Verbenaceae	√	√	√
Banber	*Ziziphus oenoplia*	Rhamnaceae	√	√	
Herb					
Chirchita	*Achyranthus aspera*	Amaranthaceae	√	√	√
Jangji pudina	*Ageratum coenozoides*	Asteraceae	√		√
Satyanasi	*Argemone mexicana*	Papaveraceae	√		
Punarnava	*Boerhavia diffusa*	Nyctaginaceae	√	√	√
Charota	*Cassia tora*	Fabaceae	√		√
Kala bhangra	*Croton bonplandianus*	Euphorbiaceae	√	√	

Dub	*Cynodon dactylon*	Poaceae	√	√	√
Bans	*Bambusa bambos*	Poaceae	√	√	√
Motha	*Cyperus rotundus*	Cyperaceae	√		√
Dudhi	*Euphorbia hirta*	Euphorbiaceae	√	√	√
Visnukrantha	*Evolvulus alsnoides*	Convolvulaceae	√		√
Anantamul	*Hemidesmus indicus*	Periplocaceae		√	√
Uloo	*Imperate cylindrica*	Poaceae	√	√	
Lajwanti	*Mimosa pudica*	Mimosaceae	√	√	√
Amrul	*Oxalis corniculata*	Oxalidaceae	√		
Khal-muriya	*Tridax procumbens*	Asteraceae	√	√	

3.16.5 Results:

Floral Diversity

Based on the rapid floral survey conducted in and around 10km of the Hanuman Nagar Barrage (Birpur) of the project, a total of 33 plant species (18 trees, 4 shrubs and 11 herbs and grasses) belonging to 22 families were reported **(Table No. C3-24).** Similarly on the basis of floristic analysis in the zone of 1km to the north & south side along the canal, a total of 24 plant species (10 trees, 4 shrubs, and 10 herbs and grasses) belonging to 17 families were present **(Table No. C3-23)**. In the aycut area, a total of 45 species (24 trees, 6 shrubs and 15 herbs and grasses) belonging to 24 families were recorded **(Table No. C3-22).** The floral diversity in the zone is fairly good, amounting to 54% (61 species out of the total of 113 species) of the total species of the area.

Table No. C3-22: Ecological Enumeration (Density, Frequency, Basal Area& Importance Value Index (IVI)) of tree species in the Aycut area:

Local Name	Name of the Species	N	No. of quadrates in which the sp. occurs	D	F	TBA	RD	RF	RDo	IVI
Babool	*Acacia nilotica*	12	9	0.23	17.31	1915.81	6.49	6.38	4.68	17.55
Bel	*Aegle marmelos*	8	7	0.15	13.46	1674.71	4.32	4.96	4.09	13.38
Siris	*Albizzia lebbek*	4	3	0.08	5.77	1230.99	2.16	2.13	3.01	7.30
Saripha	*Anona squamosa*	13	8	0.25	15.38	1408.03	7.03	5.67	3.44	16.14
Kathahal	*Artocarpus heterophyllus*	4	4	0.08	7.69	1445.42	2.16	2.84	3.53	8.53
Neem	*Azadirachta indica*	15	11	0.29	21.15	3544.05	8.11	7.80	8.65	24.56
Simal	*Bombax ceiba*	5	4	0.10	7.69	1618.93	2.70	2.84	3.95	9.49
Amaltas	*Cassia fistula*	10	7	0.19	13.46	1247.40	5.41	4.96	3.05	13.42
Sisam	*Dalbergia sisso*	3	3	0.06	5.77	861.96	1.62	2.13	2.10	5.85
Pangar	*Erythrina variegeta*	5	4	0.10	7.69	691.60	2.70	2.84	1.69	7.23
Barhgad	*Ficus bengalensis*	4	4	0.08	7.69	1386.00	2.16	2.84	3.38	8.38
Peepal	*Ficus religiosa*	2	2	0.04	3.85	561.33	1.08	1.42	1.37	3.87
Gamhaar	*Gmelenia arborea*	4	3	0.08	5.77	1004.96	2.16	2.13	2.45	6.74
Dhamani	*Grewia tiliaefolia*	3	3	0.06	5.77	896.72	1.62	2.13	2.19	5.94
Mahua	*Madhuca indica*	5	4	0.10	7.69	1375.12	2.70	2.84	3.36	8.90
Am	*Mangifera indica*	19	13	0.37	25.00	6209.91	10.27	9.22	15.16	34.65
Amla	*Phyllanthus emblica*	9	6	0.17	11.54	2056.78	4.86	4.26	5.02	14.14
Jungle Jalebi	*Pithecellobium dulce*	13	8	0.25	15.38	2178.63	7.03	5.67	5.32	18.02
Karanj	*Pongamia pinnata*	7	5	0.13	9.62	1293.62	3.78	3.55	3.16	10.49

Sal	*Shorea robusta*	10	8	0.19	15.38	2209.21	5.41	5.67	5.39	16.47
Jamun	*Syzygium cumini*	8	6	0.15	11.54	2031.43	4.32	4.26	4.96	13.54
Imli	*Tamarindus indica*	4	4	0.08	7.69	1336.06	2.16	2.84	3.26	8.26
Arjun	*Terminalia arjuna*	6	5	0.12	9.62	1391.73	3.24	3.55	3.40	10.19
Ber	*Ziziphus mauritiana*	12	10	0.23	19.23	1385.63	6.49	7.09	3.38	16.96
		185	141			40956.02				

Table No. C3-23: Ecological Enumeration (Density, Frequency, basal area and Importance Value Index (IVI)) of tree species in 1km on both side of the canal:

Local Name	Name of the Species	N	No. of quadrates in which the sp. occurs	D	F	TBA	RD	RF	RDo	IVI
Babool	*Acacia nilotica*	8	6	0.17	13.04	1085.44	12.90	12.00	8.34	33.24
Saripha	*Anona squamosa*	7	4	0.15	8.70	795.60	11.29	8.00	6.11	25.40
Kathahal	*Artocarpus heterophyllus*	2	2	0.04	4.35	613.52	3.23	4.00	4.71	11.94
Neem	*Azadirachta indica*	11	9	0.24	19.57	2832.91	17.74	18.00	21.76	57.50
Simal	*Bombax ceiba*	3	3	0.07	6.52	876.36	4.84	6.00	6.73	17.57
Pangar	*Erythrina variegeta*	5	4	0.11	8.70	715.02	8.06	8.00	5.49	21.56
Barhgad	*Ficus bengalensis*	1	1	0.02	2.17	322.77	1.61	2.00	2.48	6.09
Am	*Mangifera indica*	10	9	0.22	19.57	2959.89	16.13	18.00	22.74	56.87
Amla	*Phyllanthus emblica*	6	5	0.13	10.87	1183.66	9.68	10.00	9.09	28.77
Jungle Jalebi	*Pithecellobium dulce*	7	5	0.15	10.87	1087.82	11.29	10.00	8.36	29.65
Jamun	*Syzygium cumini*	2	2	0.04	4.35	544.45	3.23	4.00	4.18	11.41
		62	50			13017.43				

Table No. C3-24: Ecological Enumeration (Density, Frequency, Basal area and Importance Value Index (IVI)) of tree species in the 10km radius of the Barrage (India Side):

Local Name	Name of the Species	N	No. of quadrates in which the sp. occurs	D	F	TBA	RD	RF	RDo	IVI
Bel	*Aegle marmelos*	7	4	0.15	8.70	1315.18	6.25	4.60	4.77	15.61
Siris	*Albizzia lebbek*	3	2	0.07	4.35	950.16	2.68	2.30	3.44	8.42
Neem	*Azadirachta indica*	16	12	0.35	26.09	3906.20	14.29	13.79	14.16	42.23
Simal	*Bombax ceiba*	3	3	0.07	6.52	983.57	2.68	3.45	3.56	9.69
Amaltas	*Cassia fistula*	7	5	0.15	10.87	774.70	6.25	5.75	2.81	14.80
Sisam	*Dalbergia sisso*	2	2	0.04	4.35	531.50	1.79	2.30	1.93	6.01
Barhgad	*Ficus bengalensis*	3	3	0.07	6.52	1087.29	2.68	3.45	3.94	10.07
Peepal	*Ficus religiosa*	2	2	0.04	4.35	591.98	1.79	2.30	2.15	6.23
Gamhaar	*Gmelenia arborea*	3	2	0.07	4.35	808.32	2.68	2.30	2.93	7.91
Dhamani	*Grewia tiliaefolia*	3	3	0.07	6.52	879.25	2.68	3.45	3.19	9.31
Mahua	*Madhuca indica*	4	3	0.09	6.52	1037.40	3.57	3.45	3.76	10.78
Am	*Mangifera indica*	20	16	0.43	34.78	6274.29	17.86	18.39	22.74	58.98
Amla	*Phyllanthus emblica*	12	9	0.26	19.57	2492.52	10.71	10.34	9.03	30.09
Karanj	*Pongamia pinnata*	9	6	0.20	13.04	1554.64	8.04	6.90	5.63	20.57

Sal	*Shorea robusta*	8	7	0.17	15.22	1918.01	7.14	8.05	6.95	22.14
Jamun	*Syzygium cumini*	6	5	0.13	10.87	1572.50	5.36	5.75	5.70	16.80
Arjun	*Terminalia arjuna*	4	3	0.09	6.52	917.54	3.57	3.45	3.33	10.34
		112	**87**			**27595.04**				

N-No. of individuals; **D-** Density (Stems/ha); **F**- Feequency (%); **TBA**- Total Basal Area (cm^2); **RD**- Relative Density; **RF**- Relative Frequency; **RDo**- Relave Dominance; **IVI**-Importance Value Index.

3.16.6 Phyto-sociological characteristics:

The phyto-sociological data of important tree species found in different zones of the project area are presented in **Table No. C3-22, Table No. C3-23 and Table No. C3-24**. Phyto-sociological data showed that in the Aycut area, Am *(Mangifera indica)* is the dominant species (IVI =34.65). Neem (*Azadirachta indica*), Saripha (*Anona squamosa*), Sal (*Shorea robusta*), Ber (*Ziziphus mauritiana*) and Karanj (*Pongamia pinnata)* are the co-dominant species of the aycut area. Similarly in the 1km zone of both sides of the proposed canal is dominated by Neem (*Azadirachta indica*) (IVI=57.5). As per the IVI value Am (*Mangifera indica*), Babool (*Acacia nilotica*) and Jungle jalebi (*Pithecellobium dulce*) are the co-dominant species in this zone.

The floral pattern in the study area has been studied in detail. During the survey, no endemic plant species were observed from study area. As such from floristic stand point, the study area cannot be considered as unique site. As per the IUCN red list of threatened species 2016, no species were found to be listed as R.E.T (Rare, Endangered & Threaten) category. Local people depend on the plant species for their food, fodder, medicines & use products as a source of earning.

3.16.7 Non- Flowering Plant Species:

The non-flowering group of plants mainly consist of Bryophytes & Pteridophytes, apart from Algae, Fungi, etc. Bryophytes play an important role in nutrient cycling, soil formation, providing microhabitat for other plants and animals, promote seed germination and fill gaps in the habitat. In the recent years bryophytes have been widely used for pollution monitoring and bioremediation as well as in the molecular biology studies. During the course of study we have encountered the following mosses varieties;

Sl. No.	**Scientific Name**	**Classification**
1.	*Physcomitrium cyathicarpum*	Family– Funariaceae, Order- Funariales
2.	*Fissidens diversifolius*	Family-Fissidentaceae, Order- Dicranales
3.	*Fissidens subpalmatus*	Family-Fissidentaceae, Order- Dicranales
4.	*Fissidens sylvatus*	Family-Fissidentaceae, Order- Dicranales
5.	*Hyophila involuta*	Family- Pottiaceae, Order- Pottiales
6.	*Barbula indica*	Family- Pottiaceae, Order- Pottiales
7.	*Meteoriopsis reclinata*	Family- Meteoriaceae, Order - Hypnales

Pteridophytes group have a long connection on our planet and were known as far back as 380 million years ago. Their position known as intermediate between the

lower plants and higher plants has made the whole group interesting for research & study.

Sl. No.	Scientific Name	Classification
1.	*Azolla pinnata*	Family - Azollaceae
2.	*Marsilea minuta*	Family - Marsileaceae
3.	*Pteris vittata*	Family - Pteridaceae
4.	*Dryopteris cochleata*	Family - Aspidiaceae
5.	*Adiantum caudatum*	Family - Adiantaceae
6.	*Ophioglossum vulgatum*	Family - ophioglossaceae

3.16.8 Aquatic Plants:

An aquatic ecosystem is characterized by presence of water. It plays vital role in the cycling of chemical substances and influence the growth & activities in the terrestrial ecosystem. The aquatic plants can be rooted or floating or submerged type. In the zone of aycut following aquatic plants are observed in the ponds & ditches.

Table No. C3-25: List of Aquatic Plants:

Local Name	Name of the Species	Family
Rooted Plants		
Guroo	*Alternanthera sessilis*	Amaranthaceae
Kalmi sag	*Ipomoea aquatica*	Convulvulaceae
Machechi	*Polygonum plebeium*	Polygonaceae
Kumudini	*Nymphoides indica*	Gentianaceae
Chaupatira	*Marsilea minuta*	Marsileaceae
--	*Ludwigia adscendens*	Onagraceae
Patera	*Typha angustata*	Typhaceae
Floating Plants		
--	*Pistia stratiotes*	Araceae
--	*Ceratophyllum demersum*	*Ceratophylaceae*
--	*Lemna minor*	Araceae
--	*Wolfia globosa*	Araceae
--	*Azolla pinnata*	Azollaceae
Jal kumbhi	*Eichhornia crassipes*	Pontederiaceae
--	*Salvinia cucullata*	Salviniaceae
Submerged Plants		
Jhangi	*Hydrilla verticillata*	Hydrocharitaceae
--	*Vallisneria spiralis*	Hydrocharitaceae

Table No. C3-26: List of Phytoplankton found from Kosi River:

Sl. No.	Name of Phytoplankton
1	*Anabaena sp.*
2	*Aphanizomenon sp.*
3	*Asterionella sp.*
4	*Chlorococcus sp.*
5	*Closterium monoliferum*
6	*Cosmarium sp.*
7	*Cymbrlla cymbiformis*
8	*Diatomella sp.*
9	*Eudorina sp.*
10	*Fragilaria sp.*
11	*Gomphonema sp.*
12	*Hydrodictyon sp.*
13	*Melosira ambiguans*
14	*Microcystis aeroginosa*
15	*Mougeotia sp.*
16	*Nitzschia sp*
17	*Nostoc sp.*
18	*Oedogonium sp.*
19	*Oscillatoria sp.*
20	*P anorina sp.*
21	*Phormidium sp.*
22	*Pinnularia sp.*
23	*Scenedesmus quadricula*
24	*Spirogyra sp.*
25	*Spirulina sp.*
26	*Synedrasp.*
27	*Volvox sp.*
28	*Zygnemasp.*

3.16.9 Cropping Pattern:

The dept. of Agriculture, Govt. of Bihar has been given the details of existing cropping pattern in the 4 districts in Araria, Purnia, Kishanganj and Katihar. The major crops grown in the districts during Kharip vary from 72-90 % of cultivated areas. This has been given in Chapter-2, Table No. C2-7 in page C2-16. The Govt. of Bihar is now proposing a cropping Pattern for these districts, total 98% of agricultural products in Kharif. This is predominant in Peddy & Maize with some areas covering Pulses & vegetables.

However, it is seen that presently the farmers are also done the agriculture for some horticultural activities. Horticulture is growing popularity owing to the high value of horticulture produces than agriculture crops. However, there needs to be a grater impetus in boosting the irrigation resources of the state and in promoting horticulture in intensive mode in the state. Mango, Pineapple & Lychee are the major horticultural products of the area. Makhana, a pioneer fruit of Bihar is also grown intensively in the districts of Katihar, Araria and Purnia. Now-a-days Tea Plantation is growing in Kisanganj district as major cash crop. Apart from it, Jute is also cultivated during the Kharif seasons in the study area. North eastern parts of the study area have some areas under the potato crop but their productivity levels are low. In some flood prone areas, sweet potato, Colocasia are raised after the recession of flood. As a Rabi crops the farmers are also produces pulses.

3.16.10 Study of Fauna:

The objective to prepare a detailed report on the status of faunal diversity in in aycut areas, 1km along the canal and 10km around the Hanuman Nagar Barrage (Birpur) to identify the existing fauna species, assess the impacts due to various activities and evolve suitable mitigation measures & conservation plan to protect and conserve faunal diversity. Following components were studied in the course of survey:

a) Faunal survey (diversity)
b) Habitat study (feeding, breeding, roosting areas) Migratory paths of major wildlife species
c) Food & feeding habits of faunal species in last few years
d) Birds & Fish survey (diversity)
e) Rare & Endangered species of fauna
f) Specific local characteristics of biodiversity in study area

3.16.11 Methodology:

Since it is a long process to observe the floristic composition in the field, a preliminary survey was limited to field visits and direct and indirect sightings of animals. A total of three months (March to May 2017) regular survey was carried out by our survey team by staying inside the nearest village to the project area. The presence of wildlife was also confirmed from the local inhabitants and the forest staffs depending on the animal sightings and the frequency of their visits to the study area. In addition, data from secondary sources mainly published literatures and Submitted EIA reports were referred for preparing checklists and other analysis in the study of wildlife of the study area.

- **Mammals**

For mammalian survey direct sighting and indirect evidences of mammals were recorded along the survey routes. Our survey team visited the area repeatedly for collection of such sample and also made consult to the local villagers by showing the photographs of animals to document the mammalian species available in the study area.

- **Amphibians & Reptiles**

Similarly the amphibian species samplings were conducted along the river banks, canals and 4–5 m away from the river banks. Microhabitats such as bushes, ditches, swampy areas, temporary puddles, tree buttress, tree holes, leaf litter, rotten logs, rocks, tree branches and trunks around the areas were examined. Night survey were also conducted (20:00 to 23:00 h) in field consisting of three to four persons by active searching or chance encounters using bare hands and fish nets.

Survey of reptiles were carried out in all available microhabitats mainly in leaf litter, under rocks, fallen and decaying logs, tree bark, grass clumps, on shrubs (plants > 1 m and < 7 m in height), on herbs (plants < 1 m in height), in tree holes and alongside the river and canal utilizing the visual encounter methodology. Identification was made followed by the book of Indian reptiles and amphibians.

- **Birds**

  For birds survey, point counts and line-transect methods were adopted. The transects were visited by foot and when possible by vehicle in morning and evening time during the study period. In some area where lying of transect was not possible point count method was adopted for the survey. During survey birds were observed using 7 X 50 and 7 X 42 binoculars for identification. Identification and checklist were made on reference of Grimmett et al. (2009).

- **Butterfly**

  To prepare the checklist of butterfly for the study area random survey was carried out from March to May 2017. Butterflies were primarily identified directly in the field by direct sighting. In critical conditions, specimens were captured only with hand held aerial sweep nets for further identification and released into their habitat without harming them. All scientific names follow Varshney (1983), Kunte (2000) and common English names are after Wynter-Blyth 1957)

- **Fish and Fisheries**

  The information on the diversity of fish in the survey area was collected in consultation with the local fisherman followed by the literature (Shah 2016 and Jha 2009). The primary data on fish were also compiled on the basis of detailed surveys conducted in the Kosi River and its tributaries with the help of local fishermen. In order to strengthen the data fishermen were interviewed on the fish composition and fisheries.

- **Phytoplankton & Zooplankton**

  For phytoplankton study the sample water was passed through a tow phytoplankton net and the residual phytoplankton biomasses in the collecting chamber of the phytoplankton net were pooled together to obtain the phytoplankton sample for study. Then the sample were preserved in Lugol's solution and brought in to the laboratory for identification. In the laboratory the samples were identified as per (Adhikari, 2000) and (Adhikari & Sahoo 1992).

  Similarly the zooplankton samples from the study area were collected by using a zooplankton net and preserved in 4% formalin. Then the samples were brought in to the laboratory and observed under the microscope for identification.

3.16.12 Results:

On following the above methodology the study was carried out for a period of three months and as a result a total 8 species of mammals, 8 species of reptiles 6 species of amphibians, 43 species of birds and 44 species of butterflies were recorded. As per the IUCN red list of threatened species 2016 most of the species were found are belongs to Least Concern (LC) categories and some are belongs to Near Threatened (NT) and Vulnerable (VU) categories where as in case of Rare Endangered and Threatened species according to the literature available (Sinha & Sharma 2003 : Choudhary et al., 2012 and Behera et al., 2013) the The Ganges river dolphin (Platanista gangetica) which belongs to Schedule I and declared as endangered species by IUCN and is also declared as National aquatic animal by Indian Govt. is found in the Kosi river near the barrage during the Monsoon season. But during our field survey no such species were found in the study area. Similarly in case of schedule species no such other schedule 1 species were

recorded during the study period and no secondary records were also available for them for the concern area. Besides, there are 12 species of Schedule II, 01species of Schedule III, 49 species of Schedule IV and 3 species of Schedule V were recorded which also indicates that no such rare endangered species were present in the study area. The list provided below.

Table No. C3-27: List of Mammals observed in the study area:

Sl. No.	Name of the species	Scientific name	Schedule	IUCN Status
1	Jackal	*Canis aureus*	II	LC
2	Squirrel	*Funambulus pennanti*	IV	LC
3	Mongoose	*Herpestes edwardsi*	II	LC
4	Mouse	*Rattus rattus*	V	LC
5	Indian hare	*Lepus nigricollis*	IV	LC
6	Common langur	*Semnopithecus entellus*	II	LC
7	Jungle cat	*Felis chaus*	II	LC
8	Indian Fox	*Vulpes bengalensis*	II	LC

[N.B. LC – Least Concern/ Lower Risk– This taxon has not yet been assessed for the IUCN Red List (IUCN Red List of Threatened Species, 2016)]

Table No. C3-28: List of Reptiles found in the study area:

Sl. No.	Name of the species	Scientific name	Schedule	IUCN Status
1	Indian Chameleon	*Chamaeleo zeylanicus*	II	LC
2	Common garden lizard	*Calotes versicolor*	IV	LC
3	Russell's Viper	*Daboia russelii*	II	LC
4	Indian Rat snake	*Ptyas mucosus*	II	LC
5	Binocellata Cobra	*Naja naja*	II	LC
6	Banded Krait	*Bungarus fasciatus*	II	LC
7	Monitor lizard	*Varanus bengalensis*	II	LC
8	Common boa	*Boa constrricta*	II	LC

[N.B. LC – Least Concern/ Lower Risk (IUCN Red List of Threatened Species, 2016)]

Table No. C3-29: List of Amphibians found in the study area:

Sl. No.	Name of the species	Scientific name	Schedule	IUCN Status
1	Indian toad	*Bufo melanostictus*	IV	LC
2	Indian Bullfrog	*Rana tigrina*	IV	LC
3	Paddy field Frog	*Rana limnocharis*	IV	LC
4	Tree frog	*Racophorus lencamystale*	IV	LC
5	Skipping frog	*Rana cyanophyclics*	IV	LC
6	Hyla	*Hyla hyla*	IV	LC

[N.B. LC – Least Concern/ Lower Risk (IUCN Red List of Threatened Species, 2016)]

Table No. C3-30: List of Birds observed in the study area:

Sl.No.	Name of the species	Scientific name	Schedule	IUCN Status
1	Indian Myna	*Acridotheres tristis*	IV	LC
2	Common Kite	*Milvus migrans*	IV	LC
3	Jungle crow	*Corvus macrorhynchos*	V	LC
4	Black headed Oriole	*Orialux xanthornus*	IV	LC
5	Black Drongo	*Dierurus macrocercus*	IV	LC
6	House crow	*Corvus splendens*	V	LC
7	Asian Koel	*Eudynamys scolopacea*	IV	LC
8	Spotted Owlet	*Athene brama*	IV	LC
9	Common Iora	*Aegithina tiphia*	IV	LC
10	Common Crow	*Corvus splendens*	V	LC
11	House Sparrow	*Passer domesticus*	IV	LC
12	Cattle Egret	*Bubulcus ibis*	IV	LC
13	Pond Heron	*Ardeola grayii*	IV	LC
14	Little Egret	*Egretta garzetta*	IV	LC
15	Cow Pheasant	*Centropus sinensis*	IV	LC
16	Doves	*Streptopelia spp.*	IV	LC
17	Red Vented Bulbul	*Pycnonotus cafer*	IV	LC
18	Tailor Bird	*Orthotomus sutorius*	IV	LC
19	Tree Pie	*Dendrocitta vagabunda*	IV	LC
20	White breasted kingfisher	*Halcyon smyrnensis*	IV	LC
21	Barbet	*Psilopogon zeylanicus*	IV	LC
22	Beater	*Merops orientalis*	IV	LC
23	Blue Rock Pegion	*Columba livia*	III	LC
24	Jungle Babbler	*Turdoides striatus*	IV	LC
25	Ruddy Shelduck	*Tadorna ferruginea*	IV	LC
26	Common Shelduck	*Tadorna tadorna*	IV	LC
27	Indian Spot-billed Duck	*Anas poecilorhyncha*	IV	LC
28	Tufted Duck	*Aythya fuligula*	IV	LC
29	Common Quail	*Coturnix coturnix*	IV	LC

30	Lesser Whistling-Duck	*Dendrocygna javanica*	IV	LC
31	Red-crested Pochard	*Netta rufina*	IV	LC
32	Common Pochard	*Aythya ferina*	IV	LC
33	Eurasian Wigeon	*Anas penelope*	IV	LC
34	Mallard	*Anas platyrhynchos*	IV	LC
35	Red Junglefowl	*Gallus gallus*	IV	LC
36	Little Grebe	*Tachybaptus ruficollis*	IV	LC
37	Asian Openbill	*Anastomus oscitans*	IV	LC
38	Black Stork	*Ciconia nigra*	IV	LC
39	Woolly-necked Stork	*Ciconia episcopus*	IV	VU
40	Painted Stork	*Mycteria leucocephala*	IV	NT
41	Little Cormorant	*Microcarbo niger*	IV	LC
42	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	IV	LC
43	Bronze-winged Jacana	*Metopidius indicus*	IV	LC

[N.B. LC – Least Concern/ Lower Risk, VU- Vulnereble, NT- Near Threatened, (IUCN Red List of Threatened Species, 2016)]

Table No. C3-31: List of butterfly observed in the study area:

Sl. No.	Common name	Scientific name	IUCN Status
1	Common Snow Flat	*Tagiades japetus*	-
2	Chestnut Bob	*Iambrix salsala*	-
3	Common Redeye	*Matapa aria*	-
4	Small Branded Swift	*Pelopidas mathias*	-
5	Common Jay	*Graphium doson*	VU
6	Tailed Jay	*Graphium agamemnon*	VU
7	Common Banded Peacock	*Papilio crino*	-
8	Common Mormon	*Papilio polytes*	VU
9	Spot Swordtail	*Graphium nomius*	-
10	Lime Butterfly	*Papilio demoleus*	-
11	Common Mime	*Papilio clytia*	LC
12	Striped Albatross	*Appias libythea*	-
13	Psyche	*Leptosia nina*	-
14	Common Jezebel	*Delias eucharis*	VU
15	Common Wanderer	*Pareronia hippia*	VU
16	Common Emigrant	*Catopsilia pomona*	VU
17	Mottled Emigrant	*Catopsilia pyranthe*	-
18	Common Grass Yellow	*Eurema hecabe*	VU
19	Common Lineblue	*Prosotas nora*	-
20	Common Cerulean	*Jamides celeno*	-
21	Pea Blue	*Lampides boeticus*	-
22	Common Pierrot	*Castalius rosimon*	-
23	Pale Grass Blue	*Zizeeria maha*	-

24	Common Silverline	*Spindasis vulcanus*	VU
25	Common Guava Blue	*Virachola isocrates*	VU
26	Indian Red Flash	*Rapala iarbus*	-
27	Blue Tiger	*Tirumala limniace*	LC
28	Common Indian Crow	*Euploea core*	VU
29	King Crow	*Euploea klugii*	VU
30	Plain Tiger	*Danaus chrysippus*	VU
31	Common Evening Brown	*Melanitis leda*	-
32	Fourring	*Ypthima huebneri*	-
33	Angled Castor	*Ariadne ariadne*	-
34	Common Leopard	*Phalanta phalantha*	-
35	Lemon Pansy	*Junonia lemonias*	VU
36	Peacock Pansy	*Junonia almana*	-
37	Grey Pansy	*Junonia atlites*	-
38	Chocolate Pansy	*Junonia iphita*	-
39	Great Eggfly	*Hypolimnas bolina*	-
40	Common Sailer	*Neptis hylas*	-
41	Commander	*Moduza procris*	-
42	Baron	*Euthalia aconthea*	-
43	Baronet	*Euthalia nais*	-
44	Tawny Coster	*Acraea violae*	-

[N.B. LC – Least Concern/ Lower Risk, VU- Vulnereble (-) – This taxon has not yet been assessed for the IUCN Red List (IUCN Red List of Threatened Species, 2016)]

- **Ichthyo Fauna**

In the present study a total 59 species of fish were recorded in which most were belongs to Least Concern (LC) category and only 4 specie i.e. Parambassis ranga, Wallago attu, Ompok bimaculatus, Parambassis lala were belongs to Near Threatened (NT) category which indicates no RET species of Icthyofauna is present in the study area.

Table No. C3-32: List of Fish found in the Kosi River:

Sl.No.	Name of fish	IUCN STATUS
1.	*Anabus testudinous*	Data deficient
2.	*Anabus cobojious*	Data deficient
3.	*Badis badis*	LC
4.	*Barbonymous gonionotus*	LC
5.	*Barilius barna*	LC
6.	*Botia lohachata*	-
7.	*Botia dario*	LC
8.	*Cabdio maror*	LC
9.	*Canthophrys gongota*	LC
10.	*Catla catla*	LC
11.	*Chaca chaca*	LC

Sl.No.	Name of fish	IUCN STATUS
12.	*Chagunius chagunio*	LC
13.	*Chanda nama*	LC
14.	*Channa gachuwa*	LC
15.	*Channa orientalis*	-
16.	*Channa punctatus*	LC
17.	*Channa striatus*	LC
18.	*Chela cachieus*	LC
19.	*Cirrhinus mrigala*	LC
20.	*Cirrhinus reba*	LC
21.	*Clarias batrachus*	LC
22.	*Clupisoma garuwa*	LC
23.	*Clupisoma montana*	LC
24.	*Ctenopharyngodon idella*	-
25.	*Crossocheilus latius*	LC
26.	*Danio rerio*	LC
27.	*Eutropichthys vacha*	LC
28.	*Gagata cenia*	LC
29.	*Glossogobius giuris*	LC
30.	*Glyptothorax telchitta*	LC
31.	*Glyptothorax boitus*	LC
32.	*Heteropneustes fossilis*	LC
33.	*Hypothalmichthys nobilis*	Data deficient
34.	*Hara hara*	LC
35.	*Labeo bata*	LC
36.	*Labeo calbasu*	LC
37.	*Labeo fimbriatus*	LC
38.	*Labeo rohita*	LC
39.	*Labeo gonius*	LC
40.	*Leiodon cutcutia*	-
41.	*Lepidocephalichthys guntea*	LC
42.	*Lepidocephalichthys menoni*	Data Deficient
43.	*Macrognathus aral*	LC
44.	*Macrognathus pancalus*	LC
45.	*Mastacembelus armatus*	LC
46.	*Monopterus cuchia*	LC
47.	*Mystus cavasious*	LC
48.	*Mystus tengara*	LC
49.	*Mystus vittatus*	LC
50.	*Nandus meni*	-
51.	*Nandus nandus*	LC
52.	*Nangra assamensis*	LC
53.	*Notopterus notopterus*	LC
54.	*Nemacheilus beavani*	LC
55.	*Nemacheilus corica*	LC
56.	*Nangra nangra*	LC
57.	*Puntius conchonius*	LC
58.	*Puntius sophore*	LC
59.	*Puntius terio*	LC
60.	*Puntius sarana*	-

Sl.No.	Name of fish	IUCN STATUS
61.	*Psillorbyncbus sucatio*	-
62.	*Raiamas guttatus*	LC
63.	*Salmophasia bacaila*	LC
64.	*Sperata aor*	LC
65.	*Sisor rheophilus*	Data Deficient
66.	*Sisor rhabdophorus*	LC
67.	*Trichogaster fasciata*	LC
68.	*Xenentodon cancilla*	LC

[N.B. DD - Data Deficient, LC – Least Concern/ Lower Risk, VU- Vulnereble, NT- Near Threatened, (-) – This taxon has not yet been assessed for the IUCN Red List (IUCN Red List of Threatened Species, 2016)]

Nearly Threatened Species as per IUCN

S.No.	Name of Fish	Status
1.	*Hypothalmichthys molitrix*	NT
2.	*Ompok bimaculatus*	NT
3.	*Parambassis lala*	NT
4.	*Parambassis ranga*	NT
5.	*Tor tor*	NT
6.	*Wallago attu*	NT

Endangered Species as per NBFGR

S.No.	Name of Fish	Status
1.	*Chaca chaca*	EN
2.	*Chagunius chagunio*	EN
3.	*Devario acuticephala*	EN
4.	*Hemibagrus menoda*	EN
5.	*Sisor rhabdophorus*	EN

Vulnerable Species as per NBFGR

S.No.	Name of Fish	Status
1.	*Ctenops nobilis*	VN
2.	*Danio dangila*	VN
3.	*Glypthothorax telchitta*	VN
4.	*Rhinomugil corsula*	VN
5.	*Silonia silondia*	VN

***Tor tor* (Mahsheer)**

It grows better in rivers with a rocky bottom. It breeds during August-September and continues up to December. After spawning, downstream migration occurs in large shoals. It's a benthopelagic and potamodromous species found in depth range of 3-4 metres. The species travel toward headwaters at the start of the rainy season and downstream at the end of the rainy season. It's an omnivorous fish, which feeds on filamentous algae, chironomid larvae, water beetles and crustaceans. It spawns from March to September, over stones and gravel. It is reported to reach 150 cm TL and gain a maximum weight of 68 kg and is considered a long- living species.

Spawning habitat is increased when the stream flow is high enough to cover suitable gravels but is decreased when velocity becomes too high for successful spawning activities. Adequate water depth and flow will be maintained for the survival of migratory fish species *Tor tor*.

Apart from fish species found during primary survey and site visit, it was observed that fresh water prawns also forms major catch in the upstream of the canal.

Fig. No. C3.13: Some of Fish Species of Kosi River

Table No. C3-33: List of Zooplankton found from Kosi River:

Sl. No.	Name of Zooplankton
1	*Alona sp.*
2	*Arcella discoides*
3	*Arcella megaston1a*
4	*Brachionus caudatus*
5	*Brachionusforjlcula*
6	*Centropyxis arcelloides*
7	*Centropyxix ecornis*
8	*Chydorus sphaericus*
9	*Cyclops sp.*
10	*Diaphanosoma sp.*
11	*DifJlugia lebes*
12	*DifJlugia lobostoma*
13	*Hexarthra sp.*
14	*Keratella cochlearis*
15	*Keratella quadrata*
16	*Mesocyclops edex*
17	*Polyarthra sp.*

3.16.13 Migration of Animal & Wildlife Corrider:

There are no wildlife corrider and migration of animals is not happening in the study area.

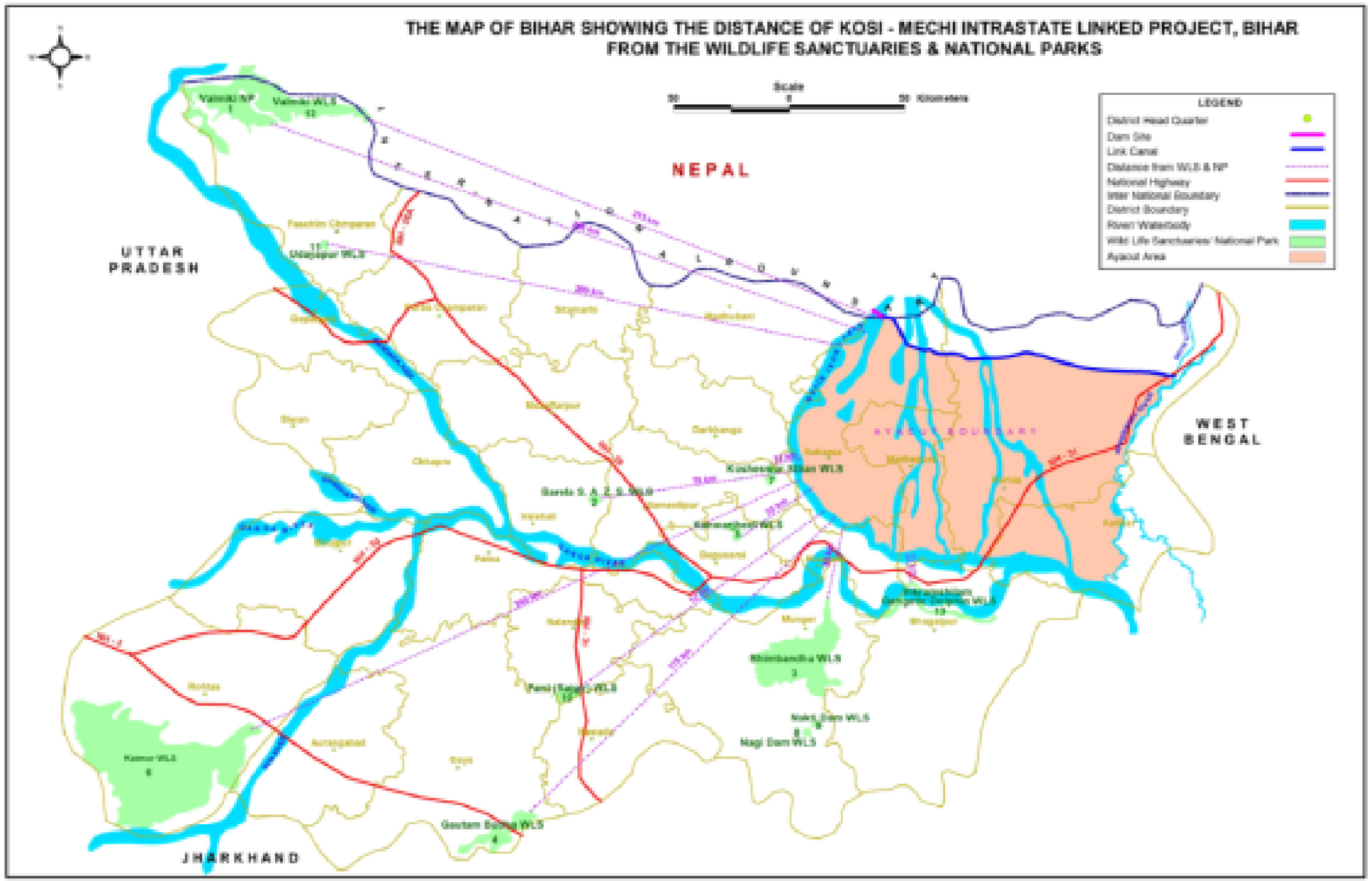


Fig.No.C3-14: Eco-sensitive Map of Bihar:

3.17 SOCIO-ECONOMIC STUDY:

The socio-economic development is a value-added concept and there should not be a consensus as to its meaning and should have the option of application and its implementation in multiple way to achieve the ultimate goal.

Socio-economic study of a particular study area indicates the levels of socio-economic status that already exists and what could be the possible achievements during subsequent years after implementation of the project.

The socio-economic development has multiple dimensions such as economic status, social placement, availability and utilization of basic amenities, working pattern and work category etc and the development could be conceptualized as a set or vector of desirable social objectives or a development index. Socio-economic survey of the study area was carried out to assess the status of existing demographic pattern, Literacy profile, Economic Profile of that area & Occupational Pattern among the people and general amenities based on the secondary information available with different Government agencies.

The socio-economic study wasmade around ayacut of main canal system of East Kosi-Mechi inter-link project. The study area combined to 1km south from the main canal & 10 km radius from the Hanuman Nagar Barrage (Birpur). Again the study also taken for seven number of districts such as Supaul, Araria, Kishanganj, Saharsa, Katihar, Madhepura & Purnia which are situated in the ayacut area. The Irrigation Project broadly comprises the study of economic condition and social structure of the main study area covering three districts namely Supaul, Araria & Kishanganj of Bihar.

The socio-economic profile of the study area is prepared based on site visits, discussions with the villagers and the secondary data available from various agencies, District Statistical Hand Books and Census 2011.

3.17.1 Demography of Study Area:

Population Statistics of Study Area of 1 km southward from the existing & proposed Main Canal (As Per Census Data 2011)

Total number of villages & towns	53
Number of Households	27,167
Total Population	1,33,972
Total number of Males	68,913
Total number of Females	65,059
Male/ Female (Sex) ratio	1000:944
Percentage of S.C population	12.85%
Percentage of S.T Population	0.97%
Percentage of Literates	44.39%

Total demographic pattern of the study area has been given in **Table No.C3-34.**

Population Statistics of Study Area of 10km radius from Hanuman Nagar Barrage (As Per Census Data 2011)

Total number of villages & towns	25
Number of Households	9,672
Total Population	48,662
Total number of Males	25,381
Total number of Females	23,281
Male/ Female (Sex) ratio	1000:917
Percentage of S.C population	21.072%
Percentage of S.T Population	0.24%
Percentage of Literates	46.36%

Total demographic pattern of the study area has been given in **Table No.C3-35.**

It is observed from the **Table No.C3-34** that 3 districts are present within the study area of 1 km southward from canal alignment and from the **Table No. C3-35**, only one district present in the study area for 10 km radius from the barrage.

Table No. C3-34: Village Wise Demographic Pattern of the Study Area of 1km southward from the Existing & Proposed Main Canal:

Sl. No.	Village Name	No.of Household	Total Population	Total Male	Total Female	SEX Ratio	Population of 0-6 yrs			SC Population			ST Population			Percentage of SC to Total Population	Percentage of ST to Total Population
							Total	Male	Female	Total	Male	Female	Total	Male	Female		
Supaul District																	
1	Bhawanipur Tharha	208	901	456	445	976	160	80	80	106	53	53	0	0	0	11.76	Nil
2	Chapain	815	4104	2108	1996	947	1011	540	471	950	496	454	0	0	0	23.15	Nil
3	Dumaria	200	1065	542	523	965	167	85	82	230	123	107	0	0	0	21.60	Nil
4	Gareria Chakla	97	379	207	172	831	78	50	28	210	111	99	0	0	0	55.41	Nil
5	Kataia	591	2840	1482	1358	916	604	301	303	174	91	83	0	0	0	6.13	Nil
6	Matiari	752	3305	1725	1580	916	618	312	306	1341	706	635	0	0	0	40.57	Nil
7	Parwaha	430	2268	1161	1107	953	479	237	242	765	404	361	1	1	0	33.73	0.04
8	Surea urf Siripur	173	845	425	420	988	171	84	87	0	0	0	0	0	0	Nil	Nil
Araria District																	
9	Asuri	239	1171	586	585	998	273	128	145	51	30	21	0	0	0	4.36	Nil
10	Baghua	226	1079	578	501	867	195	106	89	658	338	320	3	1	2	60.98	0.28
11	Barantpur	328	1640	860	780	907	300	159	141	117	55	62	0	0	0	7.13	Nil
12	Bhadesar	1230	5677	3059	2618	856	980	511	469	452	226	226	31	28	3	7.96	0.55
13	Bhag Parasi	168	795	400	395	988	174	79	95	136	71	65	0	0	0	17.11	Nil
14	Bhaptia	373	2021	1072	949	885	394	219	175	780	403	377	1	1	0	38.59	0.05
15	Bishunpur	293	1264	669	595	889	231	119	112	67	33	34	0	0	0	5.30	Nil
16	Chhapania	543	3503	1797	1706	949	815	396	419	1006	505	501	2	1	1	28.72	0.06

17	Chainpur	790	4119	2134	1985	930	907	477	430	525	278	247	1	1	0	12.75	0.02
18	Charbana	285	1309	659	650	986	285	134	151	0	0	0	0	0	0	0.00	Nil
19	Chhaparia	69	319	170	149	876	71	36	35	89	44	45	5	1	4	27.90	1.57
20	Chikni	1970	9986	5107	4879	955	2166	1090	1076	998	530	468	13	7	6	9.99	0.13
21	Dahrahra	438	2124	1122	1002	893	423	221	202	95	46	49	0	0	0	4.47	Nil
22	Deghli	920	4624	2394	2230	931	1055	524	531	0	0	0	0	0	0	0.00	Nil
23	Dipaul	282	1424	756	668	884	275	141	134	81	45	36	0	0	0	5.69	Nil
24	Gausnagar	418	2040	1069	971	908	383	189	194	84	42	42	0	0	0	4.12	Nil
25	Khajurbari	452	2401	1249	1152	922	476	243	233	851	438	413	1	0	1	35.44	0.04
26	Kursakatta	964	5195	2722	2473	909	966	489	477	621	325	296	48	25	23	11.95	0.92
27	Mohiuddinpur	419	1930	1020	910	892	370	184	186	468	257	211	1	0	1	24.25	0.05
28	Musanda	824	4228	2202	2026	920	748	383	365	943	510	433	2	2	0	22.30	0.05
29	Parasi	567	2899	1530	1369	895	515	299	216	476	230	246	85	45	40	16.42	2.93
30	Pararia Ranikatta	418	1963	1023	940	919	422	214	208	369	195	174	1	1	0	18.80	0.05
31	Parwaha	1458	7234	3740	3494	934	1542	778	764	269	143	126	2	2	0	3.72	0.03
32	Phulsara	588	2936	1525	1411	925	610	332	278	62	32	30	0	0	0	2.11	Nil
33	Pipra	245	1266	636	630	991	291	140	151	565	273	292	1	1	0	44.63	0.08
34	Pipra	123	719	373	346	928	109	50	59	0	0	0	22	11	11	0.00	3.06
35	Pipra Bijwara	1349	6900	3587	3313	924	1345	703	642	442	218	224	0	0	0	6.41	Nil
36	Ramganj	367	1696	883	813	921	322	163	159	144	80	64	1	0	1	8.49	0.06
37	Thengapur Pipra Milik Arazi	70	390	198	192	970	81	36	45	0	0	0	0	0	0	Nil	Nil
Kishanganj District																	
38	Babhantola	338	1721	899	822	914	331	172	159	55	30	25	1	1	0	3.20	0.06
39	Betbari	541	2536	1190	1346	1131	541	271	270	57	27	30	35	18	17	2.25	1.38
40	Bhaurdah	2073	10122	5184	4938	953	2167	1096	1071	662	354	308	643	335	308	6.54	6.35
41	Chanaur	957	4555	2106	2449	1163	1004	515	489	331	159	172	17	6	11	7.27	0.37
42	Chanaur Milik	79	381	176	205	1165	95	50	45	0	0	0	58	25	33	0.00	15.22

43	Charakpara Laucha	78	382	198	184	929	66	33	33	9	3	6	41	21	20	2.36	10.73
44	Chhota Laucha	142	661	332	329	991	136	66	70	197	99	98	194	99	95	29.80	29.35
45	Chilhania	454	1990	1030	960	932	387	196	191	342	181	161	7	3	4	17.19	0.35
46	Dahgaon	387	1797	835	962	1152	410	207	203	103	55	48	0	0	0	5.73	Nil
47	Dak Pokhar	634	2743	1418	1325	934	469	238	231	182	85	97	29	12	17	6.64	1.06
48	Dala	76	429	226	203	898	83	46	37	0	0	0	0	0	0	0.00	Nil
49	Dala Mohiuddinpur	273	1339	638	701	1099	259	118	141	25	17	8	13	6	7	1.87	0.97
50	Ghani Phulsara	319	1477	776	701	903	320	177	143	628	327	301	13	9	4	42.52	0.88
51	Koimari	855	3988	1999	1989	995	944	471	473	364	185	179	1	0	1	9.13	0.03
52	Rangamani	110	567	302	265	877	120	69	51	0	0	0	0	0	0	0.00	Nil
53	Suhia Gopalnagar	169	725	378	347	918	83	39	44	131	68	63	33	14	19	18.07	4.55
Total		**27167**	**133972**	**68913**	**65059**	**944**	**27427**			**17211**			**1306**			**12.85**	**0.97**

The status of demographic profile in the study area has been reflected of Census 2011. The study area has 53 villages and Towns with 27,167 number of households. The demographic profile study of a particular area gives a picture to visualize the status of population i.e. male population, female population, no. of households and their occupation. The sex ratio of male and female are also the part of the study which represents a futuristic assessment for balancing the ratio for a biological sustainability.The work force particularly in rural areas is sometimes categorized based on their occupation and some are also identified on the basis of their caste.

The socio-economic profile of the study area is presented based on site visits, discussions with the villagers and the secondary data available from various agencies and District Census Hand Books, 2011.

The total population of the study area is 1,33,972. Out of which 17,211 (12.85%) population belongs to Scheduled Castes and 1,306 (0.97%) belongs to Scheduled Tribes. In the study area, there are 1000 male for every 944 female. Children constitute about 20.47% of the total population.

Table No. C3-35: Village Wise Demographic Pattern of the Study Area of 10 km radius from Hanuman Nagar Barrage(Birpur):

Sl. No.	Village Name	No.of Household	Total Population	Total Male	Total Female	SEX Ratio	Population of 0-6 yrs			SC Population			ST Population			Percentage of SC to Total Population	Percentage of ST to Total Population
							Total	Male	Female	Total	Male	Female	Total	Male	Female		
	Supaul District																
1	Bahadurganj	0	0	0	0	Nil	0	0	0	0	0	0	0	0	0	Nil	Nil
2	Bahorwa	519	2232	1174	1058	901	420	223	197	564	280	284	9	4	5	25.27	0.40
3	Baijnathpur	271	1371	699	672	961	324	169	155	466	239	227	11	8	3	33.99	0.80
4	Barantpur	364	1751	921	830	901	352	185	167	254	134	120	0	0	0	14.51	Nil
5	Bhagwanpur	510	2695	1378	1317	956	552	249	303	746	396	350	0	0	0	27.68	Nil
6	Bhawanipur	589	2643	1391	1252	900	499	257	242	140	68	72	0	0	0	5.30	Nil
7	Bhimnagar	1610	7688	4051	3637	898	1410	716	694	1272	660	612	3	2	1	16.55	0.04
8	Dubiahi	15	80	42	38	905	16	3	13	0	0	0	0	0	0	0	Nil
9	Dumri Milik	41	218	113	105	929	42	21	21	19	9	10	0	0	0	8.72	Nil
10	Fatehpur	341	1649	865	784	906	329	164	165	235	131	104	0	0	0	14.25	Nil
11	Hanuman Nagar	205	918	488	430	881	175	94	81	205	104	101	0	0	0	22.33	Nil
12	Hirde Nagar	1121	5118	2671	2447	916	915	455	460	1024	540	484	0	0	0	20.01	Nil
13	Kapurah	4	20	9	11	1222	4	2	2	0	0	0	0	0	0	0	Nil
14	Kataia	1246	6971	3622	3349	925	1706	888	818	1521	783	738	83	47	36	0	1
15	Khantaha	102	481	255	226	886	85	39	46	2	1	1	0	0	0	0.42	Nil
16	Lalpur	759	3878	2018	1860	922	800	438	362	1036	547	489	0	0	0	26.71	Nil
17	Madhora	71	374	188	186	989	75	35	40	0	0	0	0	0	0	0	Nil
18	Munshi piprahi	114	601	297	304	1024	107	46	61	0	0	0	0	0	0	0	Nil
19	Panchpanduria	106	697	372	325	874	119	55	64	145	84	61	0	0	0	20.80	Nil
20	Piprahipatti	478	2545	1326	1219	919	479	230	249	961	496	465	0	0	0	37.76	Nil

	Golari																
21	Raghunathpur	132	632	342	290	848	101	56	45	142	74	68	0	0	0	22.47	Nil
22	Raniganj	195	1196	614	582	948	231	112	119	171	93	78	0	0	0	14.30	Nil
23	Saheban	510	2805	1428	1377	964	563	277	286	896	451	445	11	8	3	31.94	0.39
24	Saranpur	0	0	0	0	Nil	0	0	0	0	0	0	0	0	0	Nil	Nil
25	Shibnagar	369	2099	1117	982	879	411	212	199	455	245	210	0	0	0	21.68	Nil
Total		**9672**	**48662**	**25381**	**23281**	**917.3**	**9715**			**10254**			**117**			**21.0719**	**0.24**

The study area has 25 villages and Towns with 9,672 numbers of households. The demographic profile study of a particular area gives a picture to visualize the status of population i.e. male population, female population, no. of households and their occupation.

The total population of the study area is 48,662. Out of which 10,254 (21.07%) population belongs to Scheduled Castes and 117 (0.24%) belongs to Scheduled Tribes. In the study area, there are 1000 male for every 917 female. Children constitute about 20% of the total population.

3.17.2 Economic Profile of the Study Area:

The economic profile deals with the economic aspects of the study area which include agriculture, industry and occupational structure of the inhabitants as per the 2011 census.

Economic Profile of the study area are given in **Table No. C3-36** & **Table No. C3-37**.

Table No. C3-36: Village Wise Employment Potential of the Study Area of 1km southward from the Existing & Proposed Main Canal:

Sl. No.	Village Name	Total Population	Total Working Population	Total Main Working Population	Total Marginal Working Population	Total Nonworking Population	Percentage of Working Population to Total Population	Percentage of Main worker to Working Population	Percentage of Marginal worker to working Population
Supaul District									
1	Bhawanipur Tharha	901	173	98	75	728	19.20	56.65	43.35
2	Chapain	4104	1532	267	1265	2572	37.33	17.43	82.57
3	Dumaria	1065	516	165	351	549	48.45	31.98	68.02
4	Gareria Chakla	379	194	1	193	185	51.19	0.52	99.48
5	Kataia	2840	1358	678	680	1482	47.82	49.93	50.07
6	Matiari	3305	1367	640	727	1938	41.36	46.82	53.18
7	Parwaha	2268	633	410	223	1635	27.91	64.77	35.23
8	Surea urf Siripur	845	216	213	3	629	25.56	98.61	1.39
Araria District									
9	Asuri	1171	496	254	242	675	42.36	51.21	48.79
10	Baghua	1079	615	117	498	464	57.00	19.02	80.98
11	Barantpur	1640	734	610	124	906	44.76	83.11	16.89
12	Bhadesar	5677	1975	1202	773	3702	34.79	60.86	39.14
13	Bhag Parasi	795	203	198	5	592	25.53	97.54	2.46
14	Bhaptia	2021	873	717	156	1148	43.20	82.13	17.87
15	Bishunpur	1264	475	412	63	789	37.58	86.74	13.26
16	Chhapania	3503	1468	1301	167	2035	41.91	88.62	11.38
17	Chainpur	4119	1357	617	740	2762	32.94	45.47	54.53
18	Charbana	1309	510	282	228	799	38.96	55.29	44.71
19	Chhaparia	319	150	115	35	169	47.02	76.67	23.33
20	Chikni	9986	3812	1891	1921	6174	38.17	49.61	50.39
21	Dahrahra	2124	755	221	534	1369	35.55	29.27	70.73
22	Deghli	4624	1828	822	1006	2796	39.53	44.97	55.03
23	Dipaul	1424	448	445	3	976	31.46	99.33	0.67
24	Gausnagar	2040	1051	162	889	989	51.52	15.41	84.59
25	Khajurbari	2401	1227	359	868	1174	51.10	29.26	70.74
26	Kursakatta	5195	1486	962	524	3709	28.60	64.74	35.26

27	Mohiuddinpur	1930	834	406	428	1096	43.21	48.68	51.32
28	Musanda	4228	1863	1039	824	2365	44.06	55.77	44.23
29	Parasi	2899	1203	1106	97	1696	41.50	91.94	8.06
30	Pararia Ranikatta	1963	639	597	42	1324	32.55	93.43	6.57
31	Parwaha	7234	2183	1492	691	5051	30.18	68.35	31.65
32	Phulsara	2936	964	506	458	1972	32.83	52.49	47.51
33	Pipra	1266	456	355	101	810	36.02	77.85	22.15
34	Pipra	719	206	201	5	513	28.65	97.57	2.43
35	Pipra Bijwara	6900	2560	1783	777	4340	37.10	69.65	30.35
36	Ramganj	1696	611	325	286	1085	36.03	53.19	46.81
37	Thengapur Pipra Milik Arazi	390	196	191	5	194	50.26	97.45	2.55
Kishanganj District									
38	Babhantola	1721	479	365	114	1242	27.83	76.20	23.80
39	Betbari	2536	807	566	241	1729	31.82	70.14	29.86
40	Bhaurdah	10122	3239	2042	1197	6883	32.00	63.04	36.96
41	Chanaur	4555	1193	887	306	3362	26.19	74.35	25.65
42	Chanaur Milik	381	133	102	31	248	34.91	76.69	23.31
43	Charakpara Laucha	382	299	155	144	83	78.27	51.84	48.16
44	Chhota Laucha	661	259	15	244	402	39.18	5.79	94.21
45	Chilhania	1990	764	371	393	1226	38.39	48.56	51.44
46	Dahgaon	1797	417	199	218	1380	23.21	47.72	52.28
47	Dak Pokhar	2743	811	619	192	1932	29.57	76.33	23.67
48	Dala	429	148	5	143	281	34.50	3.38	96.62
49	Dala Mohiuddinpur	1339	309	113	196	1030	23.08	36.57	63.43
50	Ghani Phulsara	1477	552	303	249	925	37.37	54.89	45.11
51	Koimari	3988	1118	710	408	2870	28.03	63.51	36.49
52	Rangamani	567	148	63	85	419	26.10	42.57	57.43
53	Suhia Gopalnagar	725	199	191	8	526	27.45	95.98	4.02
Total		**133972**	**48042**	**27866**	**20176**	**85930**	**35.86**	**58.00**	**42.00**

Only 35.86% of total population are working population in the study area of 1km southward from the main canal. From total working population 58.00 % are main workers means fulltime working population & 42.00% are marginal workers. And total 64.14 % are non-working population, which include children, school & college groups, women and aged & sick.

Table No. C3-37: Village Wise Employment Potential of the Study Area of 10 km radius from Hanuman Nagar Barrage(Birpur):

Sl. No.	Village Name	Total Population	Total Working Population	Total Mainworking Population	Total Marginalworking Population	Total Nonworking Population	Percentage of Working Population to Total Population	Percentage of Main worker to Working Population	Percentage of Marginal worker to working Population
Supaul District									
1	Bahadurganj	0	0	0	0	0	Nil	Nil	Nil
2	Bahorwa	2232	608	145	463	1624	27.24	23.85	76.15
3	Baijnathpur	1371	522	262	260	849	38.07	50.19	49.81
4	Barantpur	1751	615	419	196	1136	35.12	68.13	31.87
5	Bhagwanpur	2695	899	892	7	1796	33.36	99.22	0.78
6	Bhawanipur	2643	698	616	82	1945	26.41	88.25	11.75
7	Bhimnagar	7688	2381	1479	902	5307	30.97	62.12	37.88
8	Dubiahi	80	51	51	0	29	63.75	100	0
9	Dumri Milik	218	55	55	0	163	25.23	100	0
10	Fatehpur	1649	524	364	160	1125	31.78	69.47	30.53
11	Hanuman Nagar	918	250	198	52	668	27.23	79.2	20.80
12	Hirde Nagar	5118	1853	1332	521	3265	36.21	71.88	28.12
13	Kapurah	20	4	4	0	16	20.00	100.00	0.00
14	Kataia	6971	2371	1371	1000	4600	34.01	57.82	42.18
15	Khantaha	481	214	99	115	267	44.49	46.26	53.74
16	Lalpur	3878	1141	542	599	2737	29.42	47.50	52.50
17	Madhora	374	184	183	1	190	49.20	99.46	0.54
18	Munshi piprahi	601	228	179	49	373	37.94	78.51	21.49
19	Panchpanduria	697	208	206	2	489	29.84	99.04	0.96
20	Piprahipatti Golari	2545	913	200	713	1632	35.87	21.91	78.09
21	Raghunathpur	632	178	175	3	454	28.16	98.31	1.69
22	Raniganj	1196	336	306	30	860	28.09	91.07	8.93
23	Saheban	2805	903	860	43	1902	32.19	95.24	4.76
24	Saranpur	0	0	0	0	0	Nil	Nil	Nil
25	Shibnagar	2099	688	521	167	1411	32.78	75.73	24.27
Total		**48662**	**15824**	**10459**	**5365**	**32838**	**32.52**	**66.10**	**33.90**

From the above table of 10 km radius from Hanuman Nagar barrage (Birpur), only 32.59% of total population are working population. From total working population 66.10 % are main workers means fulltime working population & 33.90% are marginal workers. And total 67.48 % are non-working population, which include children, school & college groups, women and aged & sick.

3.17.3 Occupational Pattern of the Study Area:

Income and expenditure are two important indicators which determine to a large extent the economic standards of the households. In a subsistence economy, consumption pattern mainly revolves around food items. Due to industrialization & various income generating activities the socio-economic condition of the people has been improved in last few years.

The economy is majorly Agrarian. Supaul region is rich with fertile land, due to the silt of Koshi river repleting the land with useful minerals quite often. Some of the major agricultural produce in Supaul constitutes - paddy, wheat, pulses (moong, arhar, kurthi, khesari etc.), bamboos and mangoes. Animal husbandry is also quite popular with major focus on milch animals such as - buffaloes, cows, goats and pigs. Rearing fishes is also a major source of income for people, owing to the vast number of water bodies in the region.

Apart from agriculture a vast majority of people earn their living by providing government or private services in big cities in other states. Manufacturing is quite limited with a few examples of plywood and wood pulp industry.

The employment potential and the occupational pattern are given below in **Table No. C3-38 and Table No. C3-39.**

Table No. C3-38: Village Wise Occupational Pattern of the Study Area of 1km southward from the Existing & Proposed Main Canal:

Sl. No.	Village Name	Total Population	Total working Population	MAIN LABOURS				MARGINAL LABOURS				TOTAL OF MAIN AND MARGINAL LABOURS				PERCENTAGE TO TOTAL WORKERS			
				Cultivators	Agricultural Labours	Household Labours	Others	Cultivators	Agricultural Labours	Household Labours	Others	Cultivators	Agricultural Labours	Household Labours	Others	Cultivators	Agricultural Labours	Household Labours	Others
Supaul District																			
1	Bhawanipur Tharha	901	173	75	10	0	13	2	71	0	2	77	81	0	15	44.51	46.82	0.00	8.67
2	Chapain	4104	1532	28	195	3	41	290	951	8	16	318	1146	11	57	20.76	74.80	0.72	3.72
3	Dumaria	1065	516	96	63	0	6	0	281	17	53	96	344	17	59	18.60	66.67	3.29	11.43
4	Gareria Chakla	379	194	0	0	0	1	0	193	0	0	0	193	0	1	0.00	99.48	0.00	0.52
5	Kataia	2840	1358	296	360	7	15	148	522	6	4	444	882	13	19	32.70	64.95	0.96	1.40
6	Matiari	3305	1367	128	457	0	55	44	661	2	20	172	1118	2	75	12.58	81.78	0.15	5.49
7	Parwaha	2268	633	100	278	8	24	4	208	3	8	104	486	11	32	16.43	76.78	1.74	5.06
8	Surea urf Siripur	845	216	63	149	0	1	0	3	0	0	63	152	0	1	29.17	70.37	0.00	0.46
Araria District																			
9	Asuri	1171	496	44	111	0	99	24	166	2	50	68	277	2	149	13.71	55.85	0.40	30.04
10	Baghua	1079	615	59	26	0	32	104	390	1	3	163	416	1	35	26.50	67.64	0.16	5.69
11	Barantpur	1640	734	79	510	2	19	12	110	0	2	91	620	2	21	12.40	84.47	0.27	2.86
12	Bhadesar	5677	1975	334	340	6	522	16	509	8	240	350	849	14	762	17.72	42.99	0.71	38.58
13	Bhag Parasi	795	203	33	161	1	3	0	5	0	0	33	166	1	3	16.26	81.77	0.49	1.48
14	Bhaptia	2021	873	155	523	7	32	8	84	3	61	163	607	10	93	18.67	69.53	1.15	10.65

15	Bishunpur	1264	475	77	320	0	15	2	57	0	4	79	377	0	19	16.63	79.37	0.00	4.00
16	Chhapania	3503	1468	255	623	200	223	16	135	13	3	271	758	213	226	18.46	51.63	14.51	15.40
17	Chainpur	4119	1357	221	319	6	71	138	578	3	21	359	897	9	92	26.46	66.10	0.66	6.78
18	Charbana	1309	510	82	180	0	20	18	194	5	11	100	374	5	31	19.61	73.33	0.98	6.08
19	Chhaparia	319	150	8	107	0	0	2	33	0	0	10	140	0	0	6.67	93.33	0.00	0.00
20	Chikni	9986	3812	455	1283	26	127	271	1435	114	101	726	2718	140	228	19.05	71.30	3.67	5.98
21	Dahrahra	2124	755	72	128	4	17	57	467	0	10	129	595	4	27	17.09	78.81	0.53	3.58
22	Deghli	4624	1828	220	462	13	127	257	603	63	83	477	1065	76	210	26.09	58.26	4.16	11.49
23	Dipaul	1424	448	166	137	29	113	2	0	0	1	168	137	29	114	37.50	30.58	6.47	25.45
24	Gausnagar	2040	1051	115	6	0	41	298	429	14	148	413	435	14	189	39.30	41.39	1.33	17.98
25	Khajurbari	2401	1227	228	107	4	20	214	584	4	66	442	691	8	86	36.02	56.32	0.65	7.01
26	Kursakatta	5195	1486	161	425	1	375	10	395	7	112	171	820	8	487	11.51	55.18	0.54	32.77
27	Mohiuddinpur	1930	834	44	337	13	12	5	382	29	12	49	719	42	24	5.88	86.21	5.04	2.88
28	Musanda	4228	1863	104	815	63	57	16	727	48	33	120	1542	111	90	6.44	82.77	5.96	4.83
29	Parasi	2899	1203	118	920	17	51	12	59	0	26	130	979	17	77	10.81	81.38	1.41	6.40
30	Pararia Ranikatta	1963	639	259	329	0	9	3	27	0	12	262	356	0	21	41.00	55.71	0.00	3.29
31	Parwaha	7234	2183	210	573	3	706	4	591	3	93	214	1164	6	799	9.80	53.32	0.27	36.60
32	Phulsara	2936	964	269	204	6	27	64	371	17	6	333	575	23	33	34.54	59.65	2.39	3.42
33	Pipra	1266	456	69	280	0	6	10	89	1	1	79	369	1	7	17.32	80.92	0.22	1.54
34	Pipra	719	206	133	66	1	1	1	1	3	0	134	67	4	1	65.05	32.52	1.94	0.49
35	Pipra Bijwara	6900	2560	424	1282	13	64	57	663	8	49	481	1945	21	113	18.79	75.98	0.82	4.41
36	Ramganj	1696	611	77	152	8	88	13	240	1	32	90	392	9	120	14.73	64.16	1.47	19.64
37	Thengapur Pipra Milik Arazi	390	196	5	185	0	1	0	3	0	2	5	188	0	3	2.55	95.92	0.00	1.53
Kishanganj District																			
38	Babhantola	1721	479	77	265	10	13	15	82	7	10	92	347	17	23	19.21	72.44	3.55	4.80
39	Betbari	2536	807	306	227	2	31	42	196	1	2	348	423	3	33	43.12	52.42	0.37	4.09

40	Bhaurdah	10122	3239	599	1258	31	154	96	730	165	206	695	1988	196	360	21.46	61.38	6.05	11.11
41	Chanaur	4555	1193	340	418	17	112	9	136	22	139	349	554	39	251	29.25	46.44	3.27	21.04
42	Chanaur Milik	381	133	37	50	0	15	0	17	0	14	37	67	0	29	27.82	50.38	0.00	21.80
43	Charakpara Laucha	382	299	0	54	68	33	0	67	49	28	0	121	117	61	0.00	40.47	39.13	20.40
44	Chhota Laucha	661	259	8	3	0	4	15	227	1	1	23	230	1	5	8.88	88.80	0.39	1.93
45	Chilhania	1990	764	220	121	2	28	164	142	82	5	384	263	84	33	50.26	34.42	10.99	4.32
46	Dahgaon	1797	417	67	87	3	42	10	188	5	15	77	275	8	57	18.47	65.95	1.92	13.67
47	Dak Pokhar	2743	811	181	330	5	103	24	133	10	25	205	463	15	128	25.28	57.09	1.85	15.78
48	Dala	429	148	1	2	0	2	61	81	0	1	62	83	0	3	41.89	56.08	0.00	2.03
49	Dala Mohiuddinpur	1339	309	65	38	0	10	5	188	0	3	70	226	0	13	22.65	73.14	0.00	4.21
50	Ghani Phulsara	1477	552	4	252	37	10	3	236	9	1	7	488	46	11	1.27	88.41	8.33	1.99
51	Koimari	3988	1118	186	488	8	28	61	253	48	46	247	741	56	74	22.09	66.28	5.01	6.62
52	Rangamani	567	148	9	31	0	23	17	54	0	14	26	85	0	37	17.57	57.43	0.00	25.00
53	Suhia Gopalnagar	725	199	43	127	0	21	0	5	0	3	43	132	0	24	21.61	66.33	0.00	12.06
Total												10049	31126	1406	5461				

As per the study and from the census data of 2011, from total working population 10049 are cultivators, 31126 are agricultural labours, 1406 are household labours and 5461 are other workers. As the climate of the study area is suitable for the agricultural purpose, maximum people are doing the agriculture and cultivation. Some people are doing the crafts of their traditional craftworks.

Table No. C3-39: Village Wise Occupational Pattern of the Study Area of 10 km radius from Hanuman Nagar Barrage(Birpur):

Sl. No.	Village Name	Total Population	Total Working Population	MAIN LABOURS				MARGINAL LABOURS				TOTAL OF MAIN AND MARGINAL LABOURS				PERCENTAGE TO TOTAL WORKERS			
				Cultivators	Agricultural Labours	Household Labours	Others	Cultivators	Agricultural Labours	Household Labours	Others	Cultivators	Agricultural Labours	Household Labours	Others	Cultivators	Agricultural Labours	Household Labours	Others
Supaul District																			
1	Bahadurganj	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Nil	Nil	Nil	Nil
2	Bahorwa	2232	608	90	18	6	31	32	393	4	34	122	411	10	65	20.07	67.60	1.64	10.69
3	Baijnathpur	1371	522	77	136	12	37	20	206	6	28	97	342	18	65	18.58	65.52	3.45	12.45
4	Barantpur	1751	615	95	287	0	37	6	183	0	7	101	470	0	44	16.42	76.42	0	7.15
5	Bhagwanpur	2695	899	258	602	0	32	2	5	0	0	260	607	0	32	28.92	67.52	0	3.56
6	Bhawanipur	2643	698	270	259	0	87	3	73	0	6	273	332	0	93	39.11	47.56	0	13.32
7	Bhimnagar	7688	2381	133	662	5	679	17	719	20	146	150	1381	25	825	6.30	58.00	1.05	34.65
8	Dubiahi	80	51	16	34	0	1	0	0	0	0	16	34	0	1	31.37	66.67	0	1.96
9	Dumri Milik	218	55	41	10	3	1	0	0	0	0	41	10	3	1	74.55	18.18	5.45	1.82
10	Fatehpur	1649	524	71	153	18	122	3	72	5	80	74	225	23	202	14.12	42.94	4.39	38.55
11	Hanuman Nagar	918	250	22	106	2	68	1	44	0	7	23	150	2	75	9.20	60	0.8	30
12	Hirde Nagar	5118	1853	425	710	32	165	150	340	8	23	575	1050	40	188	31.03	56.66	2.16	10.15
13	Kapurah	20	4	4	0	0	0	0	0	0	0	4	0	0	0	100	0	0	0
14	Kataia	6971	2371	337	848	13	173	139	796	21	44	476	1644	34	217	20.08	69.34	1.43	9.15
15	Khantaha	481	214	77	13	0	9	2	113	0	0	79	126	0	9	36.92	58.88	0.00	4.21
16	Lalpur	3878	1141	252	189	8	93	36	516	2	45	288	705	10	138	25.24	61.79	0.88	12.09
17	Madhora	374	184	112	70	0	1	0	1	0	0	112	71	0	1	60.87	38.59	0.00	0.54
18	Munshi piprahi	601	228	30	127	0	22	15	31	0	3	45	158	0	25	19.74	69.30	0.00	10.96
19	Panchpanduria	697	208	98	105	0	3	0	1	0	1	98	106	0	4	47.12	50.96	0.00	1.92

20	Piprahipatti Golari	2545	913	130	18	3	49	216	471	2	24	346	489	5	73	37.90	53.56	0.55	8.00
21	Raghunathpur	632	178	47	106	2	20	0	3	0	0	47	109	2	20	26.40	61.24	1.12	11.24
22	Raniganj	1196	336	123	168	2	13	27	3	0	0	150	171	2	13	44.64	50.89	0.60	3.87
23	Saheban	2805	903	141	667	4	48	20	15	0	8	161	682	4	56	17.83	75.53	0.44	6.20
24	Saranpur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Nil	Nil	Nil	Nil
25	Shibnagar	2099	688	208	269	3	41	39	109	0	19	247	378	3	60	35.90	54.94	0.44	8.72
Total												**3785**	**9651**	**181**	**2207**				

As per the study and from the census data of 2011, from total working population 3785 are cultivators, 9651 are agricultural labours, 181 are household labours and 2207 are other workers. As the climate of the study area is suitable for the agricultural purpose, maximum people are doing the agriculture and cultivation. Some people are doing the crafts of their traditional craftworks.

3.17.4 Literacy Profile of Study Area:

Literacy is an important indicator for understanding the socio-economic development of any area.

The overall study indicates that the literacy rate in female population is alarmingly low which can be attributed to the male dominated social structure prevailing in the villages. The educational facilities in the district will good as the district is in developing stage. The literacy status of the study area is given below in **Table no-C3-40 & C3-41.**

Table No. C3-40: Village Wise Literacy Profile of the Study Area of 1km southward from the Existing & Proposed Main Canal

Sl. No.	Village Name	No. of Household	Total Population	Total Literates	Male literates	Female literates	Total Illiterates	Male Illiterates	Female Illiterates	Percentage of Literates to Total Population
Supaul District										
1	Bhawanipur Tharha	208	901	386	233	153	515	223	292	42.84
2	Chapain	815	4104	1737	1079	658	2367	1029	1338	42.32
3	Dumaria	200	1065	662	395	267	403	147	256	62.16
4	Gareria Chakla	97	379	168	115	53	211	92	119	44.33
5	Kataia	591	2840	1012	737	275	1828	745	1083	35.63
6	Matiari	752	3305	1436	935	501	1869	790	1079	43.45
7	Parwaha	430	2268	1117	670	447	1151	491	660	49.25
8	Surea urf Siripur	173	845	154	104	50	691	321	370	18.22
Araria District										
9	Asuri	239	1171	496	297	199	675	289	386	42.36
10	Baghua	226	1079	351	230	121	728	348	380	32.53
11	Barantpur	328	1640	868	521	347	772	339	433	52.93
12	Bhadesar	1230	5677	3068	1916	1152	2609	1143	1466	54.04
13	Bhag Parasi	168	795	415	261	154	380	139	241	52.20
14	Bhaptia	373	2021	933	577	356	1088	495	593	46.17
15	Bishunpur	293	1264	359	230	129	905	439	466	28.40
16	Chhapania	543	3503	1526	974	552	1977	823	1154	43.56
17	Chainpur	790	4119	1946	1092	854	2173	1042	1131	47.24
18	Charbana	285	1309	318	190	128	991	469	522	24.29
19	Chhaparia	69	319	111	74	37	208	96	112	34.80
20	Chikni	1970	9986	3667	2137	1530	6319	2970	3349	36.72
21	Dahrahra	438	2124	972	636	336	1152	486	666	45.76
22	Deghli	920	4624	1354	954	400	3270	1440	1830	29.28
23	Dipaul	282	1424	681	403	278	743	353	390	47.82
24	Gausnagar	418	2040	1076	695	381	964	374	590	52.75

25	Khajurbari	452	2401	1060	678	382	1341	571	770	44.15
26	Kursakatta	964	5195	2777	1665	1112	2418	1057	1361	53.46
27	Mohiuddinpur	419	1930	974	597	377	956	423	533	50.47
28	Musanda	824	4228	2085	1255	830	2143	947	1196	49.31
29	Parasi	567	2899	1044	682	362	1855	848	1007	36.01
30	Pararia Ranikatta	418	1963	734	460	274	1229	563	666	37.39
31	Parwaha	1458	7234	3311	2024	1287	3923	1716	2207	45.77
32	Phulsara	588	2936	1067	706	361	1869	819	1050	36.34
33	Pipra	245	1266	566	356	210	700	280	420	44.71
34	Pipra	123	719	443	289	154	276	84	192	61.61
35	Pipra Bijwara	1349	6900	2931	1853	1078	3969	1734	2235	42.48
36	Ramganj	367	1696	744	468	276	952	415	537	43.87
37	Thengapur Pipra Milik Arazi	70	390	164	94	70	226	104	122	42.05
Kishanganj District										
38	Babhantola	338	1721	850	516	334	871	383	488	49.39
39	Betbari	541	2536	1239	659	580	1297	531	766	48.86
40	Bhaurdah	2073	10122	4980	2981	1999	5142	2203	2939	49.20
41	Chanaur	957	4555	1926	1031	895	2629	1075	1554	42.28
42	Chanaur Milik	79	381	89	48	41	292	128	164	23.36
43	Charakpara Laucha	78	382	159	104	55	223	94	129	41.62
44	Chhota Laucha	142	661	234	138	96	427	194	233	35.40
45	Chilhania	454	1990	925	585	340	1065	445	620	46.48
46	Dahgaon	387	1797	786	425	361	1011	410	601	43.74
47	Dak Pokhar	634	2743	1489	906	583	1254	512	742	54.28
48	Dala	76	429	156	104	52	273	122	151	36.36
49	Dala Mohiuddinpur	273	1339	855	444	411	484	194	290	63.85
50	Ghani Phulsara	319	1477	493	277	216	984	499	485	33.38
51	Koimari	855	3988	1811	1046	765	2177	953	1224	45.41
52	Rangamani	110	567	306	176	130	261	126	135	53.97
53	Suhia Gopalnagar	169	725	464	292	172	261	86	175	64.00
Total			**133972**	**59475**	**36314**	**23161**	**74497**			

The total literacy of the study area is 44.39 %. From the total literate, male literacy in the study area was found to be 61.06% and the female literacy in the study area was found to be 38.94%.

Table No. C3-41: Village Wise Literacy Profile of the Study Area of 10 km radius from Hanuman Nagar Barrage(Birpur)

Sl. No.	Village Name	No. of Household	Total Population	Total Literates	Male literates	Female literates	Total Illiterates	Male Illiterates	Female Iliterates	Percentage of Literates to Total Population
	Supaul District									
1	Bahadurganj	0	0	0	0	0	0	0	0	Nil
2	Bahorwa	519	2232	917	601	316	1315	573	742	41.08
3	Baijnathpur	271	1371	701	395	306	670	304	366	51.13
4	Barantpur	364	1751	726	461	265	1025	460	565	41.46
5	Bhagwanpur	510	2695	1180	749	431	1515	629	886	43.78
6	Bhawanipur	589	2643	1298	793	505	1345	598	747	49.11
7	Bhimnagar	1610	7688	4599	2682	1917	3089	1369	1720	59.82
8	Dubiahi	15	80	27	21	6	53	21	32	33.75
9	Dumri Milik	41	218	103	69	34	115	44	71	47.25
10	Fatehpur	341	1649	803	497	306	846	368	478	48.70
11	Hanuman Nagar	205	918	445	282	163	473	206	267	48.47
12	Hirde Nagar	1121	5118	2629	1606	1023	2489	1065	1424	51.37
13	Kapurah	4	20	8	2	6	12	7	5	40.00
14	Kataia	1246	6971	2252	1376	876	4719	2246	2473	32.31
15	Khantaha	102	481	229	145	84	252	110	142	47.61
16	Lalpur	759	3878	1973	1200	773	1905	818	1087	50.88
17	Madhora	71	374	185	108	77	189	80	109	49.47
18	Munshi piprahi	114	601	223	136	87	378	161	217	37.10
19	Panchpanduria	106	697	193	115	78	504	257	247	27.69
20	Piprahipatti Golari	478	2545	942	641	301	1603	685	918	37.01
21	Raghunathpur	132	632	415	261	154	217	81	136	65.66
22	Raniganj	195	1196	523	345	178	673	269	404	43.73
23	Saheban	510	2805	1117	708	409	1688	720	968	39.82
24	Saranpur	0	0	0	0	0	0	0	0	Nil
25	Shibnagar	369	2099	1070	697	373	1029	420	609	50.98
Total			48662	22558	13890	8668	26104			

The total literacy of the study area is 46.36 %. From the total literate, male literacy in the study area was found to be 61.57% and the female literacy in the study area was found to be 38.43%.

3.17.5 Socio-Economic Study within Ayacut Area:

The ayacut of total Existing & Proposed Irrigation project is covered 7 districts of Bihar state.

The Supaul District is lying in the study area of both 1km southward & 10 km radius of the barrage. The entire district lies north of the Ganges and is comprised of planes. The eastern portion of the district is more fertile and more densely populated. The deposits left by the turbulent Kosi have affected the fertility of the soil but progressive implementation of the Kosi project has turned the district into veritable granary. Supaul has four sub-divisions such as Supaul, Birpur, Triveniganj, Nirmali.

Araria is the one of the thirty eight district of Bihar state. It is located in between the Supaul & Kishanganj district. Kishanganj is lies in east, Supaul in west and Purnia in south direction and Nepal lies in north direction. Parmal is a major river of the district along with the Kosi, Suwara, Kali, Parmar and Koli. Main agricultural productions of this district are paddy, maize & jute. Araria, Hatgaon, Ramnagar are the major towns of the district.

Kishanganj is a Beautiful, Clean and Evergreen town and district of Bihar, India. It is also known as the 'CHERAPUNJI OF BIHAR' due to the heavy Rainfall that takes place here every year to more than any town or city in Bihar. It is surrounded by Araria in west, Purnia in southwest, Uttar Dinajpur district of West Bengal in the east and Darjeeling district and Nepal on the north direction. It covered the areas, west of Mahananda River. Kishanganj is only sub-division of the district and also the Disrict Headquarter.

The Purnia District is famous for its uniquely designed Ramakrishna Mission where Durga Puja in the month of April is celebrated. The district extends northwards from the Ganges. Purnia name stands for complete Jungle & is derived from the name of famous Goddess Puarn Devi. This is a level, depressed tract of country, consisting for the most part of a rich, loamy soil of alluvial formation. Several rivers are flowing from the Himalayas, which afford great advantages of irrigation and water-carriage. Major rivers are the Kosi, the Mahananda, the Suwara Kali and the Koli. In the west the soil is thickly covered with sand deposited by changes in the course of the Kosi. Its major agricultural products are jute, otr and banana. Purnia has seen three districts partitioned off from its territory: Katihar in 1976, and Araria and Kishanganj in 1990. Purnia city is the main city and headquater of the distict.

Katihar district is culturally a part of Bengal, although it is a disctrict of Bihar. It is surrounded by Purnia district in north & west, Bhagalpur & Sahebganj districts are in south and Malda & Uttar Dinajpur district of West Bengal in the east direction. It is situated on the Bank of Ganges. Manihari Ghat is linked with Sahebganj district (Jharkhand) through water way steamer & boat services. Katihar, Barsoi & Manihari are the subdivisions of the district.

Saharsa is the district headquater of saharsa districts and is located in the Mithila Region, one of the earliest centres of brahmanical civilisation in India. Saharsa

district is surrounded on the west by the river Kosi, which boasts an abundance of fish and makhana. Saharsa is famous for its varieties of mangoes and litchis. Saharsa district comprises the following Sub-Divisions: Saharasa Sadar and Simri Bakhtiyarpur.

Madhepura is the administrative headquater of Madhepura district. Madhepura is part of the Mithila region and the people here speak the Maithili language. Facing the onslaughts of the Kosi river, the history of Madhepura is replet with tales of owes, sorrow and sufferings. Since time immemorial, it has seen several ups and downs perpetuated by Kosi in the form of flood, famine and drought. Flood and drought have remained the regular feature of the area so much so that the then Government had to shift the Court & the Sub-divisional headquarters from Madhepura to Supaul from 1935 to 1938. The place has remained the meditation ground of Lord Shiva and other Gods. Madhepura district is surrounded by Araria and Supaul district in the north, Khagaria and Bhagalpur district in the south, Purnia district in the east and Saharsa district in the West. It is situated in the Plains of River Koshi and located in the North eastern part of Bihar. Madhepura & Uda Kishanganj are the subdivisions of the district.

Table No. C3-42: Administrative and Legislative Setup of the Ayacut area

Sl. No.	Districts Name	Total Land Occupation in km^2	Administrative Units			
			No. of subdivisions	No. of C.D Blocks	No. of GPs	No. of Villages
1	Supaul	2410	4	11	181	551
2	Araria	2830	2	9	318	742
3	Kishanganj	1884	2	7	126	771
4	Purnia	3229	4	14	246	1273
5	Katihar	3056	3	16	238	1540
6	Madhepura	1787	2	13	170	439
7	Saharsa	1702	2	10	153	468

[Source- District Census Handbooks]

3.17.6 Demographic Profile & LiteracyProfile within Total Command Area:

Table No. C3-43: Demographic Profile of the Ayacut area:

District	Total Population	Male	Female	Rural	Urban
Supaul	22,29,076	11,55,283	10,73,793	21,23,518	1,05,558
Araria	28,11,569	14,63,333	13,48,236	26,42,792	1,68,777
Kisanganj	16,90,400	8,66,970	8,23,430	15,29,277	1,61,123
Purnia	32,64,619	16,99,370	15,65,249	29,21,614	3,43,005
Katihar	30,71,029	16,00,430	14,70,599	27,97,207	2,73,822
Madhepura	20,01,762	10,47,559	9,54,203	19,13,301	88,461
Saharsa	19,00,661	9,97,174	9,03,487	17,44,121	1,56,540

Table No. C3-44: Literacy Profile of the Ayacut area:

Districts	Total Literate	Total Illiterate	Literacy Rate
Supaul	10,33,283	11,95,793	46.36
Araria	11,95,768	16,15,801	42.53
Kisanganj	7,45,056	9,45,344	44.08
Purnia	13,32,326	19,32,293	40.81
Katihar	12,80,190	17,90,839	41.69
Madhepura	8,34,577	11,67,185	41.69
Saharsa	8,04,996	10,95,665	42.35

Table No. C3-45: Districtwise Occupational Pattern:

Name of Districts	Total population	Total workers (main + marginal workers)	Cultivators		Agricultural labourers		Industry workers		Other workers	
			Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Araria	2811569	1069893	222913	20.84	691947	64.67	24367	2.28	130666	12.21
Purnia	3264619	1143318	197424	17.27	745015	65.16	28840	2.52	172039	15.05
Katihar	3071029	1013566	168857	16.66	672291	66.33	20577	2.03	151841	14.98
kishanganj	1690400	529064	107862	20.39	321867	60.84	11633	2.2	87702	16.58
Total	**10837617**	**3755841**	**697056**	**18.56**	**2431120**	**64.73**	**85417**	**2.27**	**542248**	**14.43**

From the above table, it is inferred that the agricultural labours are more than the other working populations, which is 64.73%, and 18.56% population are cultivators. This emphasises that agriculture is the main occupation of people of these districts. So, the agricultural labours and the cultivators will get benefit due to this irrigation project.

Table No. C3-46: Total Number of Villages Having Educational Facilities within District:

Districts	Pre-primary School	Primary School	Middle School	Secondary School	Senior Secondary School	Degree College	Other Institutes
Supaul	488	1183	392	83	21	17	33
Araria	188	1255	495	58	19	9	96
Kisanganj	190	864	289	35	10	7	183
Purnia	90	1455	686	69	27	22	69
Katihar	317	1475	555	95	27	16	231
Madhepura	136	988	525	66	24	15	10
Saharsa	67	932	494	66	30	1	5

[N.B.: Other Institutions-Engineering Colleges, Medical College, Management Institute, Polytechnic, Vocational Training School/ ITI, Non-formal Training Centre, Special School for Disabled & Others]

Table No. C3-47: Total Number of Villages having Health facilities within Districts:

Districts	Community Health Centre	Primary Health Centre	Primary Health Sub-centre	Dispensary	Veterinary Hospitals	Other Health Cares
Supaul	526	502	147	23	12	235
Araria	716	687	135	33	17	314
Kisanganj	732	723	95	8	15	248
Purnia	1113	1095	218	6	18	58
Katihar	1306	1283	234	34	14	129
Madhepura	380	350	144	10	17	234
Saharsa	445	435	138	5	14	54

[N.B.: Other Health cares -T.B. Clinic, Hospital-allopathic (HA), Hospital-alternative medicine, Mobile Health Clinic (MHC), Family Welfare Centre, Maternity & Child Welfare Centre (MCW) and Charitable non Govt. Hospital/Nursing home]

Table No. C3-48: Other Amenities of Total Command Area:

Districts	Post Office	Telephone	Bus Service	Commercial Bank	Coperative Bank	Agricultural Credit Societies
Supaul	261	142	167	69	100	261
Araria	270	125	226	92	229	270
Kisanganj	116	232	134	77	154	116
Purnia	245	201	249	101	277	245
Katihar	194	229	168	130	246	194
Madhepura	228	155	151	55	125	228
Saharsa	187	209	156	51	123	187

Fig. No. C3-15: Some of Photographs of Project Area:

CHAPTER-4
ANTICIPATED ENVIRONMENTAL IMPACT & MITIGATION MEASURES

4.0 INTRODUCTION:

Environmental Impact Assessment [EIA] study is a process to forecast the future environmental and social conditions of the project area that might be expected to bring a change in quality of life because of implementation of the project.

Environmental issues of Irrigation projects need to be thoroughly studied, evaluated and understood properly so that, after implementation of the project, the environmental degradation can be effectively minimized and project benefits optimized. With the above in perspective, a systematic and scientific impact assessment study of all project related activities have been undertaken.

In the present context, the EIA tool has been structured to meet the mandatory requirement as described in the Terms of Reference [ToR].

4.1 APPROACH AND METHODOLOGY:

The basic approach is adopted for conducting the environmental impact study for the proposed project to assess the existing environmental scenario in and around the project area, components and activities of the project having potential environmental impacts, analyse the project proposals with respect to prevailing institutional and legislative setup of the Government of Bihar as well as of Union government.

The main approach for the study are:

- Identification, appraisal and division between positive and negative impacts, direct and indirect impacts, and instant and long-term impacts likely to result from identification of unavoidable or irreversible impacts;
- Identification of feasible and cost effective mitigation measures to minimize negative impacts and enhance positive impacts by incorporating in the preliminary engineering design.
- Exploration towards the opportunities for environmental enhancement;
- Preparation of Environmental Management Plan for effective implementation of environmental mitigation measures at different stages of the project.

4.2 CRITERIA FOR DETERMINING DEGREE OF IMPORTANCE OF IMPACTS:

As because many social and environment components cannot be reliably quantified due to inherent association of complex inter-relationships, most impacts have been predicated qualitatively. Significance of impacts regulated by the degree of importance of impacts covering the areas is (i) Area of Impact, (ii) Duration, (iii) Intensity and (iv) Reversibility factors.

Table No.C4-1: Categorization Criteria:

Category A	Components which have major Social & Environmental Impacts require specific management plan and close monitoring of mitigation measures.
Category B	Components which have moderate social and environmental impacts, which can be mitigated with certain precautionary measures.
Category C	Components which have 'Negligible' or 'Nil' social &environmental impacts and does not require any mitigation measures.

4.2.1 Categorization of Components:

Categorization of components is necessary to assist determining the environmental and Social Consequences in regards of their severity, significance and duration. It ultimately entails convenient approach for deciding appropriate mitigation measures or a long term management intervention.

The identified components in **Table No.C4-2** are rationally categorised as below.

Table No.C4-2: Categorization of Components:

Sl. No.	**COMPONENTS**		
	CATEGORY A	**CATEGORY B**	**CATEGORY C**
1.	Construction of all Structures in canal alignment	Operation of Heavy machinery	Safeguard measures at work sites
2.	Borrowing of earth, change of landscape and muck disposal etc.	Running of Batching plant	Small Tools & Plants & Safe up-keeping
3.	Land acquisition and its impact on local population.	Running of Concrete Mixer & Heavy pumps	
4.	Drainage and river flow in canal alignment as well as water logging in canal alignment.	Material Handling & Storage	
5.	Water quality and health system	Transport of materials &machinery	
6.	Construction of labour camp, sanitation and health hazards.	Decommissioning- Tree felling and disposal	
7.	Dislocation of existing communication network in construction of new canal		

4.3 ANALYSIS OF ENVIRONMENTAL IMPACT WITH ENVIRONMENTAL MATRIX:

Matrix method is used to evaluate Impacts both beneficial and detrimental due to implementation of the project. The International commission have designed matrix for various activities that may cause impact both positive and negative. This was also incorporated by the Food and Agriculture Organization of United Nations which is a simplistic tool for broad evaluation of Impact.

Table No.C4-3: Environmental Matrix

Sl. No.		**Features likely to be affected (Env. Parameter)**						
		Roads & communication	**Colony construction**	**Borrowing of materials**	**Importing of labour**	**Canal construction**	**Soil conservation & landscaping**	**Irrigation**
A.	**Forestry & vegetation**	-1P	+2P		-1T	-1P	+3P	+3P
B.	**Sedimentation & erosion**	-1T	-1T	-2T		+2P	+3P	-1P
C.	**Communication**	+3P	+2P			+2P		
D.	**Land Area Development.**	-2P	+2P			+2P	+2P	+3P
E.	**Agriculture**	+2P	+1P			-1P	+2P	+4P
F.	**Food Production**	+2P	+1P			-1P		+4P
G.	**Public Revenue & Income**	+2P	+2P			+2T	+2P	+4P
H.	**Water quality**			-1T	-2T			+1P
I.	**Air quality**	-1T		-1T			+1P	+1P
J.	**Climate**						+1P	+1P
K.	**Ground water table**							+2P
L.	**Employment**	+1T	+1T			+1T		+2P
M.	**Health and Safety**			-1T	-2T	-1T	+2P	+2P

Notes – Likely effect is symbolized as follows Notation used: P=Permanent T=Temporary

	Mild	Considerable	High	Very high
Beneficial	+1	+2	+3	+4
Detrimental	-1	-2	-3	- 4

Ref: - A guide to environmental Impact Assessment of Irrigation & Drainage projects in developing countries.

FAO and agriculture organization of the United Nation – O.D.A. U.K

4.4 ASSESSMENTOF ENVIRONMENTAL IMPACTS:

An essential step in Environmental Impact Assessment (EIA) is to identify all potential environmental impacts and then examine critically to find out the major impacts both beneficial and adverse. Based on description of present environmental settings of the project area as described in Chapter-3 and the proposed project components and activities described in this chapter, a scientific evaluation on various impacts that are likely to influence the environment is furnished in this chapter. Possible mitigation measures have been suggested to overcome the various environmental problems.

In the present study, likely impact and its extent on various environmental parameters viz. topography and drainage, land, water, noise, air, ecological and socio-economic conditions were studied by assessing the baseline environmental status of the area and estimations were made as how this will change with commencement of project activity. The mitigation measures have been worked out with a view to bring down the levels of impacts within limits. In each of the areas of impact, measures have to be taken to mitigate adverse impacts and where these are beneficial in nature such impacts are to be enhanced. The potential environmental impacts due to the project have been studied for different stages of the project.

4.5 GENERAL IMPACT ON THE PROJECT AREA:

The project envisages construction of extended ayacut beyond 41.30 km originates from existing Hanuman Nagar Barrage(Birpur) located on Kosi river and continued up to river Mechi, more or less parallel to Indo-Nepal border, for provision of irrigation in Araria, Purnia, Katihar and Kishanganj districts of Bihar. The project on completion will provide irrigation to an area of 2.15 lakh ha in Khariff in all the four districts. General impacts due to project activities are briefly discussed below.

4.5.1 Impact on Land environment:

There is change in topography of the project area because of construction of a long canal i.e. from 41.30 km to 117.50 km. This canal will separate the single land mass of into two parts having the canal in between. There will be a positive impact on landuse pattern in project area because the un-irrigated land will be converted to irrigated land and will be utilised for crop production.

Unlike industries, this irrigation project does not involve any toxic disposals on land which may affect the existing soil quality inter-alia land degradation.

The result of soil quality tests conducted in the command area is conducive to irrigated agriculture. However, the nutrient levels will be upgraded and soil fertility ensured through application of Bio-fertilizers and adhering to a command area management plan to be prescribed by agricultural experts.

Earth required for canal construction is usually collected either from alongside the canal or identified borrow areas by excavating pits. Excavation of borrow area can lead into disfiguration of topography of the area. Water stagnation in the

borrow pit provides ideal breeding sites for mosquitoes and thereby can spread malaria and dengue if borrow pit is not properly managed. Pits near settlements can pose health risk.

The site clearance process includes excavation and vegetation clearance which ultimately induces vegetation loss as well as loss of top soil. The activities associated with the site preparation and excavation plus movement of vehicles and equipments can disturb the surrounding lands. At the borrow area, temporary camp site or stockyards, workshops and other ancillary sites there is chance of loss to soil fertility due to various activities.

Disposal of solid waste in haphazard manner on land around the project are will not only hamper the asthetic look of the area but at the same time creates soil pollution and creates water logged areas if deposited against flowing water body. Unwarranted disposal of construction spoil and debris will add to soil contamination.

4.5.2 Impact on Drainage:

The Kosi-Mechi intrastate link canal is proposed to offtake from left Head Regular of Hanuman Nagar Barrage (Birpur) located at Indo-Nepal boarder near Hanuman Nagar town in Nepal. The total length of link canal is 117.50 km. Out of this 41.30 km is existing EKMC and balance 76.20 km is proposed as new canal. This canal will cross a number of natural streams, nallahs along its alignment. If impact on natural drainage due to canal alignment is not considered and necessary provisions for management not made, then the whole area will be flooded with water and will create serious waterlogging situation.

As discussed in chapter-2 the following main rivers and nallahs listed in the table below are crossing the proposed canal from 41.30 km to 117.50 km.

Sl. No.	Name of river	Crossing of link canal at RD (km)
1	Parman	44.20
2	Singhyahi	50.420
3	Tehri	55.150
4	Lohandra	56.930
5	Bhalua	60.450
6	Bakra	65.925
7	Ghaghi	68.630
8	Pahara	71.900
9	Nona	77.850
10	Ratua/Gerua	89.300
11	Kawal	95.900
12	Kankai	103.05
13	Sarrah	107.725
14	Kankai river	111.735

[Source- DPR]

Besides, above 14 no. of major streams, there may be few minor streams which require some field detailing by which certain interlinking with major stream will be useful. The above aspect i.e. crossing of streams is one of the major impact in a canal system which calls for a detailed study and management action plan.

4.5.3 Impact on water quality:

The water quality management study on any development project is one of the most desirable objectives according to the norms of prevention and control of pollution Act, 1974. It entails maintaining a desirable level of the environmental quality of water within the project area.

Implementation of a new project often casts considerable impact on the natural water quality of existing water bodies in the region. But, as because the present scheme is an irrigation project, there are no industrial effluents or toxic releases to the river as often found in the case of industries which may cause severe problem to human population and other living organisms, no permanent impact is anticipated on water quality due to the project. However, water pollution may be caused due to following activities.

- Construction activity may temporarily deteriorate surface water quality near the alignment and borrow areas through increase in turbidity.
- Waste water from the construction area charged with cement slurry, Grease and oils etc are likely to flow to the nearest water body causing contamination of water.
- The water contamination may also be caused due to waste discharge from construction camps and labour camps.
- After introduction of irrigated agriculture, there is likelihood that farmers will be inclined to use extra dose of fertilizers and pesticides in the farm land. This may result in wastage of extra fertilizers and pesticides which may flow along the land drainage to natural stream and consequently pollute the water quality.

As discussed in chapter-3, seven no. of water samples from surface water sources and eight no. of samples from groundwater sources have been collected to ascertain the water quality of the project area. These samples thus collected have been tested in the accredited laboratory. Broadly all the tests conducted show that water quality is within the permissible limit. The test result of qualifying parameters confirm to class 'C' category of 'use-based inland surface water quality standard' of CPCB classification. It suggests best use of drinking water source with conventional treatment and disinfection. Simultaneously, other parameters when compared with the prescribed standards confirm to use based classification category 'E' i.e. suitable for irrigation use.

4.5.4 Impact on Ambient Air Quality:

Unlike Industries, this irrigation project will not emit any smoke or release any industrial or toxic fumes to atmosphere. Ambient air qualities were measured in ten no. of locations. The ambient air quality results at various locations indicate that all parameters are well within the tolerable limits.

However, there may have some impact on ambient air quality due to

- Excavation and other construction activity,
- Borrowing earth from borrow area and quarry operations,
- Disposal of wastes and construction spoils & debris,
- Vehicle moment, operation of heavy machinery,
- Running of batching plant.

These activities are expected to generate airborne fugitive dusts. It is observed during air quality monitoring that, the dust generations are short term and settle quickly within close ranges. There is very less scope of spreading of dust particles to the nearby residential areas. It is found that, the effect is localized and is mostly due to fugitive emission of dust particles. The construction activities may result into temporary deterioration of air quality in the habitation areas near the proposed canal and will have impact on human health. It requires special attention to curb dust in those stretches.

4.5.5 Impact on Noise Level:

Operation of heavy machineries; movement of heavy vehicles, aggregate mixing activities and operation of DG Set generates high noise and thereby increasing the ambient noise level in the surrounding. However, most of the construction activities will be confined to the canal alignment away from habitation area. The likely impact on noise pollution in the surrounding area will not be significant. However, workers working near the noise generating equipments and plants are likely to be exposed to high noise level. The acceptable limits (for 8 hour duration) of the equivalent noise level exposure during one shift is 90 dB(A). Hence, noise generated due to various activities in the construction camps may affect health of the workers if they are continuously exposed to high noise level.

For reasons of occupational safety, exposure to impulses or impact noise should not exceed 140 dB(A) (peak acoustic pressure). The noise likely to be generated during excavation, loading and transportation of material will be in the range of 90 to 105 dB (A) and this will occur only when all the equipment operate together and simultaneously. This is however, is a remote possibility. The workers in general are likely to be exposed to an equivalent noise level of 80 to 90 dB (A) in an 8-hour shift, for which all statutory precautions should be taken into consideration. However, careful planning of machinery selection, operations and scheduling of operations can reduce these levels.

The noise pollution generated due to different construction activities is a temporary affair. Each type of activity can generate different levels of noise that continue for a short period during the operations of those activities. Noise levels are measured in ten sites and the results are found to be within the standard.

4.5.6 Impact on Ecology and Bio-diversity:

The baseline study within the project area did not show any Schedule-I species or endangered or threatened species flora or fauna within the core zone. There is no natural habitat of any wild animals located in the project area. Also, there is no migratory route situated in and around the project area. So no impact on population of wild animals is anticipated due to the project. The detail study on flora, fauna and wildlife has been furnished in chapter-3.

Therefore, any potential direct impact on biological environmental characteristics such as loss of rare or endangered species, habitat fragmentation and wild life migrations is not envisaged. There may be some loss of vegetation due to felling of trees. The temporary impact may be in the visual appearance of the trees and shrubs as construction activity may lead to deposition of dust cover over the leaves and foliage.

4.5.7 Impact Due to Siltation:

The erosion effect on soil of the catchment, may lead to excess sediment flow into the storage pond of the barrage during the monsoon. The silt deposit in excess of the designed quantity will encroach upon the storage pond and thus would reduce the life of this irrigation project considerably. Therefore, it is essential to identify severely erodible areas in the catchment and restore the vegetative cover as well as implement proper treatment measures against soil erosion and supplement artificial regeneration to provide green clothing to the catchment. Further to these Biological measures; some engineering methods to reduce soil erosion from the catchment may be adopted comprising of many reel and gullies etc. However, this project being exclusively meant for extending a canal system no funding is available for catchment treatment.

As discussed in chapter 2, river Kosi carries huge amount of silt in its course. The necessary engineering methods for trapping sediment have been designed at RD 1.07 km. This project is an extension of EKMC from RD 41.30 km to 117.50 km. This project will not be able to undertake preventions of sediment flow due to fund and management constraint. However, some vegetation will be taken up in the rim of reservoir.

4.5.8 Impact on Health System:

There is a close relationship between water and public health. The commissioning of water resources project can have both beneficial and negative impact on health of the people around the project area.

Health and safety are of major concern during the construction phase. The impact on health and safety can be envisaged for workers working in different work sites.

Emission of gaseous pollutants and dusts are major result of various processes like material treatment, operation of batching plant, DG sets etc. This emission effect is only for short term and localized during active construction work but the effect may have some moderate effect in the area where workers are directly exposed to these emissions.

The dust and gaseous pollutant generation during the construction works near

habitation area will have moderate effect on the health of people residing in the close proximity. Post construction project may lead to some contamination of water due to excess trace of fertilizer and pesticides on water body.

4.5.9 Impact Due to Water-Logging:

Water logging occurs due to steady rise of ground water table after introduction of irrigated agriculture without adequate drainage. As land begins to get water logged, crop yields get reduced gradually. Farming becomes difficult and uneconomical in partially water logged areas.

Table No.C4-4: Classification of the water-logging conditions

0-2 m bgl	Severe water logging situation
2 – 4 m bgl	Prone for water logging

It is revealed from the water table fluctuation map of CGWB (furnished in chapter 3) that the depth to water level in a few villages of district Araria and Purnia is found to be within the depth of less than 2m bgl, during post-monsoon season. These locations are considered to be prone to water logging.

Water logging and salinity have adverse social and economical effects on rural communities causing poorer living standards and health problems in humans and animals. Loss of agricultural production and limited farm income generation activities have forced the local population to migrate to nearby cities to earn their living.

4.5.10 Impact Due to Construction Activities:

The impacts due to construction activities are not permanent feature of the project. The major construction related activities takes place in early phase of the project for a short period. After the construction of the project is over, the major construction related impacts will be over.

(i) **Construction:** Construction of canals will have certain impacts on the locality. Such impacts may be attributed to activities like:

- Noise level disturbances due to deployment of machineries and equipments.
- Solid waste generation.
- Dust generation due to various activities.

(ii) **Engagement of Labour and Labour camps:** The construction of this project will involve recruitment of skilled and un-skilled labour.

In view of the above, necessary labour camps will be set up for some highly skilled and skilled workers in different locations. These labour camps will have some impact on human health such as transmission of disease carried with imported labourers, conflicting with neighbouring community and sewage disposal system.

4.5.11 Impact due to increased Agricultural productions:

Thus after construction of Kosi-Mechi intra-state Irrigation Project, it is proposed that an area of 2.15 lakh ha. will be irrigated for sowing of different crops in the said ayacut during Khariff.

As against the farm produce availed by the cultivators prior to irrigation, the post-irrigation farm produce will be much on the higher side with very high income due to various crop cultivation. Obviously, there is an increase in economic status of local people. The increase in crop production will rise from 230194.4 MT to 1969778.0 MT after completion of project.

Nearby towns in command area will increase marketing activities, trading facilities and also business and trading activities will be increased considerably.

4.5.12 Impact on social environment:

4.5.12.1 Impairment of access to the properties:

During construction of road, closure of water channel and blockage of side drain, temporarily blockage of access road or interference with the access to the properties located along the proposed construction area, causing inconvenience to the users and enhances the accident risk if not managed properly.

4.5.12.2 Public health and safety:

Health and safety of local public residing in the project vicinity are of major concern during the construction as well as operational phases. Emission of gaseous pollutants and dusts are major result of various processes like material treatment, operation of batching plant, DG sets etc.. The dust and gaseous pollutant generation during the construction works near habitation area will adversely affect the health of people residing in the close proximity. The vehicles and equipment operation increase the chances of collision with local vehicles, pedestrians and livestock. The poor sanitation and poorly managing disposal of the waste may cause increase in communicable diseases. Public safety is also an issue associated with construction activities. Excavation of canal and operations of heavy equipments and machineries near to the habitation area and roads create potential risk for public accident.

4.5.12.3 Diversion of traffic:

Short term impacts associated with the project will be traffic diversion and management during construction phase. Construction activities will cause hindrance to the existing traffic flow. There is possibility of accident hazards during construction phase. There will be requirement for diversion of existing traffic at various construction sites during construction phase. It needs to be mentioned that though there are no direct impacts on the natural environment due to disruption/diversion of such services, but diversion can also lead to adverse impacts if not planned properly. Rapid restoration of diverted services can help in minimizing the severity of impacts arising out due to diversions of existing services.

4.6 GENERAL APPROACH TO MINIMIZE ADVERSE IMPACTS DURING CONSTRUCTION ACTIVITIES:

Some of the impacts induced by this project are,

- Leveling of construction areas and borrow areas
- Solid waste disposals
- Proper upkeep of labour camps to prevent damage to the eco-system and environment due to sewage etc.
- Felling of trees – Removal of green cover

During the baseline assessment various project components and their impact on the environment have been studied while activities with adverse impact are segregated through analytical approach.

However, mitigation measures mostly include preventive activities & corrective measures which are undertaken simultaneously with the project activities. Some activities and respective mitigation measures are mentioned below:

Sl. No.	Events	Activities	Environmental Management Plan	Remarks
1.	Leveling of burrow pits and excavated trenches	For canal construction in banking requirement, a lot of earthwork is taken up by burrowing earth from burrow pits and other selected locations.	Proper monitoring and management strategies to be developed to level up all the burrow pits and excavated pits, so that there will not be any stagnation of water.	Project incharge
2.	Development of green belt along the canal alignment to compensate felling of trees and loss of green cover.	A green belt will be developed by taking up of plantation along the road side. This plantation programme will be helpful in creating a green coverage for the area.	The necessary plantation practices will be taken up as per the present practice alongside the road and around the colony. This will compensate loss of green cover that might have taken place earlier.	-do-
3.	Disposal of solid wastes and Restoration of construction areas	Besides canal work, in other major C.D structures, colonies, a lot of construction activities will be taken up. For above construction a lot of excavation and burrowing of earth will take places. These areas create problems due to dug out pits remain	A meticulous guideline is to be evolved with contracting agencies that the solid wastes will be disposed at the pre-designated location leveling up of all dug out pit near construction site.	-do-

		without being leveled.		
4.	Supply of free fuel to construction labourers by opening up fuel depot.	There will be some outside labourers recruited for the work. These labourers maybe dissuaded for felling of trees for fuel purpose.	The management will provide free fuel by opening fuel depot and supply fuel to labourers so that unscrupulous felling of trees will be prevented.	-do-
5.	Unsanitary and unhygienic conditions in labour camp	Setting up of labour camps without sanitary measures like toilet and sewage disposal system.	Provision of toilets should be kept for each camp. Regular monitoring of camps is to be done.	-do-

4.7 MITIGATION MEASURES:

Commencement of development projects in any region of the state are grossly associated with disturbance of the eco system in the adjoining areas. It is desirable that both of them i.e. development and environment should adhere to priority consideration for most detrimental effects. Irrigation projects by and large do not involve serious environmental impacts compared to industries & chemical plants. Most of the impacts range from moderate to minor category which can be addressed through mitigation measures and management interventions.

4.8 ENVIRONMENTAL MANAGEMENT PLAN:

One of the most pervasive and complex challenges faced by the society today is how to provide better living standards consistent with maintenance of good environmental quality. Sustainable development considers an equitable balance between higher economic development and environmental quality.

It is with this objective that proper management plans are necessary for ensuring sustainable development and minimize stress on the system within its carrying capacity.

Based on the impact assessment study for various project activities, the environmental management plan (EMP) is prepared to suggest appropriate measures to minimize the negative impacts and maximise the positive impacts within the framework of legal and administrative policies of the state. It needs to ensure that there are adequate funds/resources available in the project cost for supervision and implementation of the management plans.

4.9 MITIGATION MEASURES THROUGH MANAGEMENT INTERVENTION:

Major environmental impacts which have detrimental outcome for sensitive areas and moderate impacts on human society are addressed through management interventions. Some other negative impacts as assessed in the analysis of activities through environmental matrix are:

- Catchment area treatment & reservoir rim treatment plan
- Biodiversity and wildlife conservation and management plan
- Land acquisition vis-a-vis resettlement and rehabilitation plan

- Land restoration and landscaping plan
- Command area management
- Water-logging and soil salinity management
- Nutrient management
- Fertilizer and pesticide management
- Muck disposal plan
- Quarry area management plan
- Borrow areas management plan
- Air quality management plans
- Water quality management plans
- Noise management plans
- Construction and labour camps management
- Sanitation and solid waste management plan
- Local area development plan
- Siltation management
- Weed infestation management
- Communication management
- Health delivery system management
- Green belt development and Plantation management
- Fisheries conservation and management plan
- Risks of canal failure and breaching of section of canal and prevention.

The management plan for the above mentioned impacts are discussed below in the following paragraphs.

4.9.1 Catchment Area Treatment & Reservoir Rim Treatment Plan:

This project is only an extension of East Kosi Main Canal from RD 41.30 km to RD 117.50 km. As such the scope is limited to canal work only. The funding support is also limited. As such this project cannot undertake any major activities of catchment treatment. As per minimum support for above activity i.e. to reduce the sediments inflow to Hanuman Nagar Barrage(Birpur) thereby to East Kosi Main Canal necessary plantation to be taken up in the rim of reservoir which can be supported by this project. Accordingly the species for plantation can be decided with the consultation of Forest Department. In view of above, certain funding arrangement can be made under M-Plantation funding arrangement of East Kosi Mechi link canal project.

4.9.2 Biodiversity and Wildlife Conservation and Management Plan:

Flora: Based on the detailed study made on the flora and fauna of the existing area it seems no endangered and threatened species exist. A small no. of trees will only be felled due to canal construction and some other construction activities in the vicinity. So no Rare, Endangered and Threatened (RET) species of flora are being affected due to this project.

Fauna: It is observed from baseline information that no schedule I species and no migratory path are found in this area i.e. along the canal alignment. So wildlife management plan is not required for this project.

4.9.3 Land Acquisition Vis-A-Vis Resettlement and Rehabilitation Plan:

According to the survey conducted by Water Resources Department of Government of Bihar, there is no population displacement for construction of Kosi-Mechi intrastate link canal, which is one of the most advantages point for this project. However, land acquisition will be done as per requirement for construction of main canal, branch canal, distributaries, minors and sub-minors etc. Hence, there is no need of preparation of such Resettlement and Rehabilitation plan for this intrastate link project.

Land acquisition is an important activity for which necessary action plan is required to be prepared as per land acquisition act of government of Bihar.

Land requirement:

For main canal:	Already acquired	: 632.23
	Balance to be acquired	: 764.58

For Branch canals/ Distributaries, Minors/sub-minors: The details are required to be prepared by the Water Resources Department, Government of Bihar.

However, entitlement against loss of property will be decided by the district level compensation advisory committee as per LARR Act 2013, Bihar R&R Policy and other statutory policies of Bihar.

The following activities are to be carried out to compensate the Losses.

- Carryout R&R survey and identify the affected persons for compensation and made advance planning to compensate the Losses.
- Payment to each affected person will be made by the Collector of the district through his designated officers.

4.9.4 Land Restoration and Landscaping Plan:

- Care should be taken to restore the vegetative cover in and around the construction site. Ensure that no trees are cut or disturbed outside the identified area.
- Beautification of the canal stretch with Plantation of Flowering species.
- Borrow area to be levelled properly after canal work and plantation to be taken up for green cover.
- Muck disposal area to be managed properly with plantation.

4.9.5 Command Area Management Plan:

4.9.5.1 Drainage Management Plan in the Command Area:

a. Management plan against crossing of natural streams:

Drainage management plan is one of the most important features in most irrigation projects. Construction of canals and its distribution net work on land will act as an artificial barrier to the natural rivers, streams, and nallahs which were free flowing prior to the construction. The study of topography of the region and its natural drainage system is a prima facie study to be carried out before the canal planning is made. The link canal is aligned from west to east which intercepts a large numbers of rivers flowing from north to

south. Besides there will be large number of small and medium nallas which will encounter the canal in its alignment. As discussed in 4.5.2, 14 no. Major streams are crossing the canal alignment.

Detailed study has been made to identify major streams and rivers which will cross the alignment of canal at respect RD. further, the structures i.e. mainly siphon aqueducts have been designed so that the rivers and streams will flow uninterruptedly and will not create any stagnations of water flow. This is one of the major environmental studies undertaken to prevent any flooding of river. However, during execution the canal alignment may come across some small streams which can be managed either by diverting flow to nearby streams or by providing small cross drainage structures.

For these rivers or nalla crossings about 113 numbers of cross drainage (CD) structures enroute of the link canal have been proposed to negotiate these crossing. These include 9 canal syphons, 14 syphon aqueducts, 42 road bridges, 9 Hume pipe culverts, 27 Head regulators and 10Cross regulators.

Due to provision of such structures, rivers, streams and nallas will not be obstructed and flows downstream as before the construction of canal.

Drainage in the command area:

After a detailed topographical study the following major drains have been identified which are draining the localized area to nearby streams in the command area.

1	Parman
2	Tehri
3	Lohandra
4	Bhalua
5	Bakra
6	Ghaghi
7	Pahara
8	Nona
9	Ratua/Gerua
10	Kawal
11	Kankai
12	Sarrah

After physical examination the following action will be taken to bring back drains to proper functioning.

- Deepening of existing drains by desilting and improving the carrying capacity.
- Leading the existing drains to nearby streams so as to drain the local area effectively.
- Removal of obstruction, weed growth and vegetation so as to make the drains fully functional.

All these activities will ensure the command area free from water logging situations and help in improved crop production.

b. Management plan against likely poor drainage inside the command area:

The ayacut is covered with a number of nallas, streams and drains which are serving as natural drainage for the entire ayacut. After canal irrigation is introduced these natural drains are to be properly maintained with the help of engineering method as because a lot of surface water from the canal system or from its escapes as well as tail of the minor will enter the drains. In addition to these, some field drains will be devised to remove excess water from the cultivated lands.

As improper draining in the command area is likely to reduce crop productivity, it is desirable to plan the internal drainage inside the ayacut so that likely drainage congestion will be avoided. This aspect will be examined in detail by Command Area Development Authorities (CADA).

Natural streams or nallahs which are filled up with silt are to be identified inside the ayacut. These streams or nallahs are required to be desilted and bring it to its original shape so that drainage system will be improved. The excess water can flow through them to downstream and eradicate flooded situation in the ayacut area.

4.9.5.2Command Area Development Plan:

There is an established fact that districts already having irrigated agriculture exhibits high crop yield rate compared to district which is partly rainfed.

With the above fact in view, the project authorities propose to adhere to a scientific and systematic approach for command area development through the CADA organization. The command area development plan (CAD plan) will be entrusted to the command area development authority (CADA). It aims at bridging the gap between the irrigation potential created and utilized and ensure optimum use of land and water.

Command Area Development & Water Management plan (CAD & WM) has prepared for this Link irrigation project. The following activities pertaining to the CAD & WM will be undertaken.

Command area will be properly managed by providing irrigation through branch canals, distributaries, minors and sub-minors. Each designated area will be directly irrigated by making a block of 2-5 ha for which water will be supplied either from minors or sub-minors.

Activities under CAD & WM:

- **Topographical survey:** Topographical survey will be taken up in the Gross command area at closer contour intervals. Alignment will be given on the contour map for the construction of field channels and field drains.
- **Construction of Minor, Sub-minors and field channels:** In this Link irrigation project, irrigation water will be delivered to the field. Thereafter, field channels will be constructed in carrying out water from the outlets up to the tail end of the fields at very short time. These will prevent loss of water

due to seepage inside the agricultural land and help equitable water distribution/judicious supply to each field. Construction of field channels will be taken up in the command area.

- **Construction of field drains:** Field drains will be constructed to help draining out surplus water from the agricultural land to the main drains through a network of Link drains and then to the Trunk drain. Required hydraulic structures such as Guard-walls, Road crossings and Falls etc will be provided; wherever necessary. In this Link Canal Project field drain system may be required to prevent water logging and enhance crop productivity.
- **Reclamation of water logged areas**: In this irrigation project, Ground water Table appears to be moderately high. Water logging and salinity problems are likely to appear in this area after receiving continuous irrigation. In order to reclaim the area and to bring the land under agriculture, surface drainage as well as sub-surface drainage system need to be implemented under the proposed CAD plan.
- **Multiple Crop demonstration & Adaptive Trial Programme:** The conventional agriculture practices with unscrupulous use of chemical fertilizers and pesticides for availing higher crop produce etc often lead to pollution of inland water bodies, causing side-effects on environment and human health. Such activities need to be curbed through dissemination of proper techniques by on-field demonstrations.

  In the CAD plan, crop demonstration programmes are proposed to be carried out on the farmer's field to show them practically how to adopt suitable cropping pattern and use of balanced doses of fertilizer & pesticides with proper management of available water in the command. It also entails active participation of farmers to ensure higher crop produce and environmental sustainability.
- **Farmer's training:** It is considered imperative to educate the farmers about the modern technologies on effective water management input management and crop management etc. for maximizing crop production with minimum pollution effect.

In the CAD plan, it is to be programmed to conduct about 20 farmers' training camps at strategic locations covering the entire command area during the project implementation period. Each camp will entertain at least 50 farmers as trainees. There is a provision of Rs.2 Lakhs for training programme.

4.9.6 Management Plan against Water-Logging and Soil Salinity:

(A) Water Logging:

When ground water level increases up to 0-2mts., severe to moderate water logging may occur causing soil salinity & crop loss. Various remedial measures may be adapted to reduce water logging and soil salinity problems such as:

(i) Adequate field drains in the water logged command area need to be provided so that drainage becomes effective and there will be less possibility of seepage of water into soil.

(ii) Vertical drainage by initiating a large scale public tube well programme.

(iii) Periodic observation on Groundwater level in the proposed command area.

(iv) Introduce Farmer's Training programme activities following waterlogging condition.

(v) Conjunctive use of Ground water may be made.

The locations which are prone to water logging needs good drainage and drawl of ground water by installations of borewell pumps as well as limiting of surface irrigation plan from canals in the area.

(B) Soil salinity:

Water logging induces soil salinity which is injurious to crop sustenance. The S.A.R value of irrigation water is low, so the probability of absorbing sodium and magnesium salt also becomes less. Soil salinity criteria will be curbed by preventing water logging. Selective crop may be raised in such areas whose water demand is high.

4.9.7 Nutrient Management:

a. Integrated Nutrient Management:

Integrated use of all the sources of plant nutrients is needed to check the nutrient depletion along with conservation of soil health and its environment.

Besides the chemical fertilizers the other components of integrated nutrient supply include, organic manures, green manuring and bio-fertilizers. For sustainable agriculture, the integrated nutrient management (INM) is proposed.

b. Organic Manure: Use of organics (FYM – Farm yard manure) is the oldest and most widely accepted practice of nutrient replenishment. The organic manure available in the village are inefficient and of poor quality. The quality can be improved through scientific process of composting.

c. Green Manuring: Green manuring is an effective process of nutrient recycling. Sesbania aculeate (Dhanicha) and sun hemp are the principal green manure crops. The former is suitable for low and medium lands and the latter greens in uplands. Besides green manures looping of trees and shrubs may be adopted for supplementation of nitrogen.

d. Bio Fertilizers: Bio fertilizers are represented by bacteria, algae and fungi. The bacteria may be symbiotic (Rhizobium) or non-symbiotic. They fix

atmospheric nitrogen. Blue green algae can add 20 – 30 kg N/ha to the wetland rice.

Some research in the field of nutrition management has recorded that application of FYM at 5t/ha along with recommended dose of NPK fertilizer to irrigated rice cultivation system helped to maintain soil health and increased the yield by 12 to 15% over NPK application liming the acid soils along with application of recommended NPK dose increased the crop yields by 20 to 50 percent higher than NPK only. Similarly Dhanichas along with NPK increases the yield considerably.

4.9.8 Fertilizer and Pest Management:

a. Impact of Pesticides: The major interest of this project is to ensure extra coverage of irrigation area. In the process farmers intending to boost up the crop production and to prevent pest attack may go for unscrupulous use of pesticides and insecticides which results in un-desirable effect on crop health as well as human health.

b. Integrated Pest Management Plan: Integrated pest management (IPM) is a collection of techniques to control agricultural pest including the use of pesticides when appropriate. IPM replaces use of some pesticides by bio-control agents and physical intervention so as to reduce the non-point source of water bodies by pesticides. IPM is knowledge intensive and requires extensive interaction amongst farmers within a region as well as in collaboration with govt. entities.

The services of the Line Departments such as Agriculture and Horticulture Departments would be used for promotion of IPM.

c. Promotion of IPM in Agriculture Command:

- Dissemination of knowledge to farming community emphasizing the advantages of IPM.
- Improving farmer's awareness about the health hazards due to misuse and mishandling of Plant Protection Chemicals (**PPC**)
- Improving awareness through training for proper handling, usage, storage and proper disposal of containers of PPC.
- Increasing awareness about efficacy and advantages of eco-friendly alternatives of chemical pesticides.
- Promoting use of bio-pesticides (Neem based products).
- Training and demonstration programs related to the use of IPM techniques and practices.
- Improving the information and knowledge on pests control methods.

d. Organic Farming & Bio-pesticide Use:

Wide propagation of organic farming includes

- Experience based sharing workshops with successful organic farming demonstration

- Linkage with organizations working for promotion of organic farming
- Building market linkages for organically produced fruits, vegetables and food grains. This needs to be addressed as part of implementation strategy in a comprehensive manner.

e. Policy, Regulatory Framework and Institutional Capacity:

- The Government of India as well as the State Government is striving hard to discourage the use of hazardous PPC and to promote the use of environmental friendly techniques dovetailed with IPM as well as to encourage the use of botanicals, pheromones, bio-control agents and microbial pesticides.
- The Prevention of Food Adulteration (PFA) Act is the policy tool which regulates the quality of food products manufactured, sold and consumed in India. Under this act, pesticides are noted contaminants and are defined as harmful to human health.

f. Institutional Support and Capacity Building: There are many institutes that are involved with teaching, research and extension aspects of IPM program. The National Centre for Integrated Pest Management has a mandate to develop and promote IPM techniques for major crops to sustain higher crop yields with minimum adverse ecological implications. Besides, the state government provides expertise through well trained professionals under the Department of Agriculture and Horticulture who can also impart the training on IPM techniques.

g. Promotional Activities / Program Components:

1. Create awareness about the negative impacts connected to over use of chemical fertilizers.
2. Create awareness regarding the importance of soil testing and optimizing the fertilizer dosing. It is to be decided on the basis of agro-climatic zones, crops cultivated as well as seasonal influence.
3. Train the farmers on the method, dose and time of application of fertilizers.
4. Train the farmers on ratio of fertilizers to be used for a particular type of crop and also the time of its application.
5. Promote use of bio-fertilizers to avoid negative impacts caused due to excess use of chemical fertilizers.
6. Train the farmers about proper way of preparing Farm Yard Manure (FYM).

h. Action Plan:

- Test the soil samples in nearest laboratory, motivate the group of farmers for soil testing by providing support for collection, transportation and testing at subsidized rate. This will help in selection of proper fertilizer with proper dosing.
- Obtain necessary expert advice for selection of fertilizer dose and application schedule through Agriculture Extension Officer.

- Extend necessary support for procurement of fertilizer at subsidized rate from Government programme.
- The ratio of chemical fertilizer and bio-fertilizer to be maintained.

4.9.9Muck Disposal Plan:

Muck will be generated from the digging of canal. Deposition of these mucks can cause serious adverse environmental impacts. The scope of this guideline includes measures that are required during project planning and design stage, preconstruction, construction stage and post construction stage.

Identification of the dumping areas:

Specific locations of muck dumping areas will be identified by contractor/Engineer-in Charge. The selection and recommendations of dumping area will be based on environmental as well as engineering& social considerations. The dumping shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the engineer that there is no suitable uncultivable land in the vicinity for dumping and private landowners are willing to allow dumping on their fields.

Dumping of Mucks and Its Management

The type of material to be generated due to excavation and cutting will be mainly soil and rocks. A part of the total quantity of excavated materials including all kind of soil and rocks will be utilized for construction and allied activities and a part of the excavated materials will be utilised for landscaping and the balance unutilised quantity will be required to dump at suitable dumping area.

So the Muck generated from the digging of canal will be dumped in the ear marked dumping area. Following steps will be practiced while dumping mucks and maintaining it;

- Precautionary measures such as the covering of vehicles will be taken to avoid spillage & dust generation during transport of mucks.
- Retaining wall of 1m height & 0.5m width followed by garland drain of 1m width and 0.5m depth will be provided around the proposed dumps.
- At least 2 no. of settling tanks will be constructed in suitable locations and also connected with the garland drain to arrest the soil that comes during rains despite the above measures.
- The settled water should be used in construction activity and plantation.
- It will be ensured that the carrying of muck will be done during day time only.
- Workers / labourers shall be provided with PPE. The use of PPE at all time during works will be ensured.
- The ultimate dump slope to be maintained around 28^0.

Dumping area should be rehabilitated immediately after completion of dumping of materials to the satisfactions of the Engineer.

The methods to be adopted for stabilization of dumps are as follows:

Vegetative /Biological Measures

Taking into consideration the site specific soil condition, indigenous species growing naturally are proposed to be planted. The topsoil will be spread over the muck dump areas and prior to that broadcast grass seeds on the slope of terrace. It is also proposed to plant hardy species such as Agave, Pongamia, Neem as they can survive in degraded and poor soils along the slope & toe of dump and prove to be most useful for controlling soil erosion.

Bio-Engineering Measures

Bio-engineering approach is proposed to be adopted with a view to retain loose spoils/ fines being transported from various waste /fines to the water course. Muck spoils are typically devoid of organic matter and the micro-flora count is not very conducive for plant. So in spite of plantation, survival and growth is observed to be very less. To combat this problem, actions are needed to supplement the organic carbon need and at the same time develop a micro eco-system with organisms tolerant to harsh environment. These requirements can be fulfilled by coir matting followed by grass/herbs plantation.

Structural Measures

Wash offs and rolling down of excavated materials from the dump slopes give way to slope failures and the dumps become unstable. Hence structural measures like construction of Catch drain, Garland drain, Check dam, Settling tank, Loose boulder structure etc. should be adopted for prevention of wash offs and to arrest excavated material from dump.

4.9.10 Quarry Area Management Plan:

Quarries generally required to provide material for concrete works and road construction sites, can have significant adverse environmental effects, especially on ecologically sensitive areas. Quarries can become environmental hotspots and can significantly affect the visual appearance of an area. Special mitigation and management measures are often required to avoid or minimise the environmental and impacts of due to quarry operations.

The construction materials i.e. the coarse aggregates are not available in and around the project site. The Water Resources Department of Bihar have decided to import the total quantity of aggregates and construction materials from its existing quarry developed at the Burhi Gandak project site. Necessary planning be made in advance so that quarries along with crusher be made operational so as to supply the total aggregate from Burhi gandak site.

Restoration of quarry area:

All the quarries should be rehabilitated as per approved rehabilitation plan immediately after completion of quarry material extraction.

Following rehabilitation works may be taken up.

Option A: **Revegetating the quarry to merge with surrounding landscape**. This is done by conserving and reapplying the topsoil for the vegetative growth.

Option B: **Development exhausted quarries as water bodies:** The pit shall be reshaped and developed into pond, for harvesting rainwater. This option shall

only be considered where the location of quarry is at the lowest point, i.e. surrounding area/natural drainage slopes towards it.

4.9.11 Borrow Areas Management Plan:

The East Kosi-Mechi link canal will have both cutting and filling sections as per map shown in Fig.No. C2.2. As per ideal planning of canal work attempts are always made to balance the cutting and filling section quantity. However, it is not possible ideally to calculate the quantity. In such cases earths are borrowed for filling sections. The identifications of borrow area and its suitability for use should have the following parameters.

Borrow Area Identification:

- Identify areas having present land use as barren land, riverside land;
- Prefer areas of highland with respect to surroundings;
- Avoid locating borrow area close to any road (maintain at least 30m distance from Rights Of Way (ROW) and 10 m from toe of embankment, whichever is higher);
- Should be at least 1.0 km away from inhabited areas;
- Minimum distance of about 1.0 km from ecologically sensitive area i.e. Reserve Forest, Protected Forest, Sanctuary, wetland etc.;
- Minimum distance of about 1.0 km from school, hospital and any archaeological sites;
- Having adequate approach road with minimum length of earthen road;
- Ensure that unsuitable soft rock is not prominent within the proposed depth of excavation which will render rehabilitation difficult.

Post construction stage:

Reclamation shall begin within one month of abandonment of borrow area, in accordance with the redevelopment plan. The site shall be inspected by the Engineer in charge after implementation of the reclamation plan.

Operation:

The Contractor will preferably use borrow area from already identified site by the Project Authority. Extract earth from identified borrow area (to be pegged) after getting permission from project authority.

To avoid any embankment slippage, the borrow areas will not be dug continuously, and the size and shape of borrow pits will be decided by the engineer. The contractor shall evolve site-specific redevelopment plans for each borrows area location, which shall be implemented after the approval of the Supervision /Independent Consultant.

Precautionary measures as the covering of vehicles will be taken to avoid spillage during transport of borrow materials. To ensure that the spills, which might result from the transport of borrow materials do not impact the settlements. It will be ensured that the excavation and carrying of earth will be done during day time only. The unpaved surfaces used for the haulage of borrow materials will be

maintained properly. A general guideline will be followed in the line of MoEF&CC conditions as follows:

- The borrowing/excavation activity shall be restricted to a maximum depth of 2 m below general ground level at the site.
- The borrowing/excavation activity shall be restricted to 2m above the ground water table at the site.
- The borrowing/excavation activity shall not alter the natural drainage pattern of the area.
- Appropriate fencing will be provided all around the borrowed/excavated pit made to prevent any mishap.
- Measures shall be taken to prevent dust emission by covering of borrowed/excavated earth during transportation.
- Safeguards shall be adopted against health risks on account of breeding of vectors in the water bodies created due to borrowing/excavation of earth.
- Workers / labourers shall be provided with PPE. The use of PPE at all time during works will be ensured.
- A minimum distance of 15 m from any civil structure shall be kept from the periphery of any excavation area.

Borrow area redevelopment:

Each borrow area should be rehabilitated immediately after completion of extraction of materials to the satisfactions of the Engineer. The borrow area shall be redeveloped appropriately as per approved plan. The borrow pits may be developed into pond after leveling the bottom and slope maintenance. The borrow pits may be refilled with earth materials covered with fertile to soil. The upland used as borrow area shall be leveled matching with the level of surrounding area. No scare created due to borrowing of earth should be left unattended.

4.9.12Air Quality Pollution Control Management Plans:

- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that pollution emission levels comply to the relevant requirements of SPCB norms.
- PUC certificates will be mandatory for all vehicles/ equipment/machinery used for the project.
- Transportation of loose earth, sand will be done in covered vehicles.
- Take every precaution to control dust nuisance at all the construction zones and allied sites where works are under progress.
- The crushers and the batching plants will be sited at least 1km in the downwind direction from the nearest human settlement (Boundary of town/village).
- Every equipments and machinery will be fitted with dust suppression devices such as water sprinklers, dust bags, cyclone etc. as appropriate.
- At all the construction zones and unpaved lead roads, earthen temporary diversions and plant premises periodical water sprinkling will be carried out to suppress dust.

- Workers at mixing sites will be provided with good quality personal protective equipments (PPE) reduce the chances of ill effect of emission.

4.9.13 Water Quality Pollution Control:

During Construction Phase

- Take all precautionary measures to prevent the wastewater generated during construction works from entering into water bodies during monsoon.
- All water and liquid wastes arising from construction activities will be properly disposed off and will not be discharged into water body or pond around project area without adequate treatment.
- All work site washouts be collected in a sedimentation pond where treatment may be imparted before releasing flow to the main drain.
- No construction materials/ spoils will be stored along the water bodies and adequate provision will be made for preventing spillage of materials into these water bodies.
- Ensure that all construction vehicle parking location, fuels/lubricants storage sites, vehicles, machinery and equipment maintenance sites are located at least 100m away from any water body. And also ensure that spillage of fuels and lubricants do not contaminate the ground.
- Water quality to be monitored periodically as per Environmental Monitoring Plan.

During operation period:

- Dissemination of knowledge to farming community emphasizing advantages of Integrated Pest Management (IPM).
- Improving farmer's awareness about the health hazards misuse and mishandling of Plant Protection Chemicals (PPC)
- Improving awareness through training for proper handling, usage, storage and proper disposal of containers of PPC.
- Increasing awareness about efficacy and advantages of eco-friendly alternatives of chemical pesticides.

4.9.14 Noise Pollution Control:

- All plants and equipments used in construction shall strictly conform to the MoEF/CPCB noise standards.
- All vehicles and equipment used in construction will be fitted with exhaust silencers.
- Servicing of all construction vehicles and machinery will be done for exhaust silencers and will be checked and if found defective will be replaced.
- All the construction sites within 150m of the nearest habitation, noisy construction work such as crushing, concrete mixing will be stopped during the night time between 10.00 pm to 6.00 am.
- No noisy construction activities will be permitted around educational institutions/health centers (silence zones) up to a distance of 100 m from the sensitive receptors.

- Monitoring shall be carried out at the construction sites as per the monitoring schedule and results will be submitted to PMC.

4.9.15 Construction and Labour Camps Management:

The scope of labour camps management pertains to the sitting, development, management and restoration of construction and labourers camps to avoid or mitigate impacts on the environment. The area requirement for the construction camp shall depend upon the number of labourers employed and the extent of machinery deployed. The following sections describe the siting, construction, maintenance, provision of facilities in the camps and finally rehabilitation of the construction and labourers camps.

It has been estimated that total labour strength will be around 1000 No. during peak construction activities. The unskilled and semi-skilled labourers shall be locally available. Highly skilled labourers will be imported. However, for smooth management of work the local labourers of required number are to be managed in the labour camp for smooth execution of work. The local labourers will adjust to the environment and minimum preliminary arrangement has to be made in camp so that the basic amenities are available.

PRE-CONSTRUCTION STAGE:

The suitable sites shall be selected and finalized in consultation with the Engineer in charge. Table below gives the type of lands that could be avoided for construction camps and conversely those that could be preferred.

Table No.C4-5: Selection Criteria for Camp site:

Avoid the following	Prefer the following
• Lands close to habitations • Irrigated agricultural lands. • Lands belonging to small farmers. • Lands under village forests. Lands within 100m of community water bodies and water sources as rivers. • Low lying lands. • Lands supporting dense vegetation. • Grazing lands and lands with tenure rights. • Lands where there is no willingness of the landowner to permit its use.	• Waste lands. • Waste Lands belonging to owners who look upon the temporary use as a source of income. • Community lands or government land not used for beneficial purposes. • Private non-irrigated lands where the owner is willing. • Lands with an existing access road.

SETTING UP OF LABOUR CAMP:

The contractor shall provide free of cost in the camp site, temporary living accommodation to all the migrant workers employed by him till completion of construction/maintenance work is in progress.

- The Contractor agency will setup their camping locations at different places as would be identified.

- These camps should be located away from the existing village or semi urban households to prevent likely social conflicts.
- Necessary permissions may be obtained from the respective revenue/municipal authorities.
- Temporary house structures should be provided by the contractor agencies to accommodate the labourers and their families, with provision of minimum infrastructure facilities, like water supply, sanitation and electricity etc.

PROVISION OF FACILITIES:

- The contractor shall provide for a continuous and sufficient supply of potable water in the camps.
- If required, a new well can be constructed and a pump will be fitted to the well for drinking water purpose of the labourers at the camp.
- In every site, adequate and suitable facilities for washing clothes and utensils shall be provided and maintained for the use of contract labour employed therein.
- Each labour camp should be provided with community toilets with septic tank and soak pit arrangement. Sanitary arrangements, latrines and urinals shall be provided in every work place separately for male and female workers.
- The project authorities would ensure supply of free fuel to these labourers through the contract agencies so as to prevent unscrupulous cutting of trees and bushes for meeting their fuel wood requirement.
- Disposal of sanitary wastes and excreta shall be into septic tanks.
- Kitchen waste water shall be disposed into soak pits/kitchen sump located preferably at least 15 meters from any water body.
- Provide segregated garbage bins in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner.
- The camping area should be periodically sprayed with Bleaching powder and other disinfectants.
- Medical facilities shall be provided to the labourers at the construction camp. Visits of doctor shall be arranged twice a month wherein routine checkups would be conducted for women and children.
- First Aid Box will be provided at every construction camp site.
- Formal arrangement shall be prescribed to carry injured person or person suddenly taken ill to the nearest hospital.
- Lighting arrangements should be made in all houses and camps.

4.9.16 Sanitation and Solid Waste Management Plan

- The sewage system for the camp will be designed, built and operated in such a fashion that it should not pollute the ground water or nearby surface water.
- Separate toilets/bathrooms, will be arranged for men and women.

- Adequate water supply is to be provided in all toilets and urinals.
- Garbage tanks, Bio toilets and other sanitation facilities will be provided at camps & construction site to avoid epidemics.
- The workplace will have proper medical approval by local medical, health or municipal authorities.
- Provide segregated garbage bins in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Environmental Expert of PMU.

4.9.17 Management Plan against possible weed infestation:

Weeds are the 'plants' growing in places where they are not desired. According to Weed Science Society of America (WSSA), the weeds are plants that are objectionable or interfere with activities and welfare of human society.

The efficiency of drainage system is reduced due to the growth of aquatic plants and ipomoea in water bodies. It is therefore necessary to develop a suitable strategy to control the development of weeds and ensure that its regeneration is checked considerably.

The following mitigating measures can be taken up for effective management.

a. **Manual Control**: In this method, labourers are deployed to cut the weeds by manual method using simple tools along the adjacent banks of the canal.

b. **Chemical Method:** This method is more effective than manual control. Herbicides are used in this method and considered as powerful tools in aquatic plant management. Herbicides are potentially more thorough and sometimes long lasting. This method can be applied effectively and safely with a solid understanding of the chemistry and biology of the ecosystem.

c. **Mechanical Control:** This indicates that the weed can be controlled be mechanical means i.e. by using machineries. In such method the equipment is usually mounted on a boat or on a tractor that operates from the bank or from the shore. One of the mechanical methods is Dredging that not only harvests the plant material but also removes the underground material of rooted plants and seeds. This provides an important advantages over other mechanical methods, because removal of roots, rhizomes, and other plant propagates causes a delay in regeneration of the weed. Unfortunately, even dredging can leave enough plant propagates behind for subsequent quick growth.

d. **Biological control:** Biological control methods potentially provide better long-term success than mechanical or chemical methods. For aquatic weeds, biological methods are based on the introduction of an herbivorous organism, fungus or virus into the affected ecosystem.

e. **Integrated control:** Integrated control refers to the application of combined physical, chemical, biological and environmental control methods when single methods are unlikely to succeed or when longer-lasting control of weeds or algae is required at reduced costs and with fewer undesired side effects.

The project will ensure the importance of involving stakeholders while implementing this method where in a long term monitoring will be required. Integrated approaches should also consider the timing of the control action in relation to the life cycle stages of aquatic plants.

Aquatic weed control program should preferably be executed as part of an integrated water management program.

In general, the aquatic weed and water hyacinth creates problem in tanks and canals. This can be handled by manual control, chemical control and biological control.

f. **Use of aquatic weeds (soil amendment):** Aquatic plant material can be used for preparation of compost. These may be used to increase the organic and nutrient content, the microbial activity and the texture of soils. After composting, this can be directly spread on the surface or mulched into the top layer of the soil. Mulching results in reduced evaporation, weed suppression, increased soil moisture and organic content and reduced erosion. Procurement of chemical fertilizers will be limited to some extent by poor section of the people as the compost is used in the field. However, the required parameter of the soil is to be supplemented by the advice of Agro Experts after conducting the soil test. Otherwise, the aquatic weed removed from different locations shall be dumped in a pit. After decomposition of the bio-mass, these can be used as land up-gradation agent prior to land preparation and cultivation.

4.9.18 Communication Management:

Establishing improved communication network in the project area is another Key objective contemplated for Kosi-Mechi Intra-state Project. It is comprised of modernizing the existing access routes, providing new roads for better workability, approach roads to villages and colonies, roads to quarry and construction sites etc. As such, development of road communication will not only establish better connectivity between villages and work environment but also turn out to be an indicator of socio economic development of the area.

Some important development activities proposed in construction/ modernization of the road system for the project are given below.

Construction of approach road to Staff Colony:

The staff colony is proposed to be established in the Government land located along the canal. The staff colony will be connected to the permanent approach road through a pucca road.

Construction of Canal Bank Road:

The extension of EKMC will be constructed for a total length of 76.20 km. The project authorities will convert one side of the canal bank to pucca road standard so as to facilitate all weather inspection of the canal as well as establishing communication link with the command area. The right side road will meant for service or maintenance of canal and also will be used by public. This road will connect to existing roads and village roads. It is proposed to make the top of the canal bank as eight meter so as to serve as canal bank road.

The canal in its traverse will touch many villages in the command area which are spaced apart from each other. The details are shown in L-Section in Chapter 2. After implementation of the project, shortest access to all these villages will be established through the canal bank road.

The Canal bank road will benefit the locality in the following way:

- The project authorities will re-establish communication through construction of 43 no. of Village Road Bridges.
- The farming community will be benefited with better communication Linkage to the nearest townships and would avail facilities to use rice mills, trade centers and storage Godowns.
- Improved Communication network will be utilized by the farmers for carrying grains, manure, fodders etc. from their field to village residential homes.

4.9.19 Management for health delivery system:

The increase in water fringe area provides suitable habitats for the growth of vectors of various diseases, which is likely to increase the incidence of water borne diseases.

A water resources project consists of various components and each requires a set of specific management measures.

a. Operation and maintenance

- Water management practices inherent in optimal agricultural practices should be introduced;
- Canals should be periodically cleared of weeds;
- Fish species consuming the mosquito larvae, i.e. Gambusia affinis and Bermuda are proposed to be introduced in the canals and stagnant water bodies in the command area.

b. Camping sites for workers

- The site selected for habitation of workers shall not be in the path of natural drainage. The labour camps shall be at least 2 to 3 km away from a main water body.
- Adequate drainage system to dispose storm water from the labour colonies shall be provided.

- Adequate vaccination and immunization facilities shall be provided for workers at the construction site.

c. Water borne diseases

Various measures recommended for control of water borne diseases are given below.

- It is recommended that details of incidence of various water borne diseases in the command area blocks be collected and detect existence of any particular trend.
- In areas showing incidence of water-borne diseases, intensive water quality monitoring need to be done.
- Development of sanitation facilities in the project area
- Disposal of solid waste and sewage from various sources at appropriate sites located at suitable distance from drinking water sources. The sites can be selected in consultation with the local administration
- Regular monitoring and surveillance of drinking water.

d. Public Awareness Programme

It is proposed that a detailed health awareness programme be implemented in the project area and its surrounding areas. The objectives of the programme are to:

- Enhance knowledge, awareness about various diseases, signs and symptoms of the disease and actions to be taken in case of an epidemic.
- Develop community education messages to provide the community with information about how to prevent transmission and when to seek treatment.
- Initiate proper communication with the community as soon as epidemic or public health problem is identified.
- Enhance knowledge When to come to the health facility for consultation and treatment
- Know Feasible and cost-effective preventive measures, Immunization recommendations, if any.

Health Extension Activities

The health extension activities will have to be carried out in the villages situated within the ayacut area. It is important to inculcate hygienic habits of environmental sanitation especially with respect to water pollution by domestic wastes. There would be possibility of the transmission of communicable diseases due to migration of labour population from other areas at the construction site. It is proposed to strengthen the health institutions like community centers and primary health centers already available in these blocks. The project authorities can take the initiative and release certain funds at least for first five years to streamline the medical assistance for malaria and gastro enteritis disorders. Following medical facilities are available in the districts.

Table No.C4-6: Medical facilities available in the Districts

Districts	Community Health Centre	Primary Health Centre	Primary Health Sub-centre	Dispensary	Veterinary Hospitals	Other Health Cares
Supaul	526	502	147	23	12	235
Araria	716	687	135	33	17	314
Kisanganj	732	723	95	8	15	248
Purnia	1113	1095	218	6	18	58
Katihar	1306	1283	234	34	14	129
Madhepura	380	350	144	10	17	234
Saharsa	445	435	138	5	14	54

[Source- District Census Handbooks]

The doctors from the Hospitals and Health Centers may be organized to work as a part of the command area health system and the dispensaries in various command area will make regular visits to the villages and organize health promotional activities with the active participation of the local village leaders, NGOs and available local health functionaries. The health functionaries would maintain close surveillance on incidence of communicable diseases in these villages.

However, the Directorate of Health Services under Health Department is to be consulted for suggesting a conducive Health Management Plan with physical and financial propositions for implementation. The project authorities would provide funds as a part of Corporate Social Responsibilities (CSR) program.

4.9.20 Green Belt Development Plan:

Plantation development on both sides of the canal will improve the climatological conditions and bio-aesthetics of the area. Amongst several methods prescribed to improve the environmental health standard in a Development project; extensive plantation programme has always proved to be very effective. In Kosi-Mechi Intrastate Link Project, plantation has been proposed alongside the approach roads, canal bank service road & around the staff colonies.

The proposed plantation scheme includes the following areas.

1. **Canal bank plantation:**
   - Plantation is proposed all along the canal alignment i.e. on the both sides of the main canal and branch canal or distributary.
   - **Plantation Area:**

Length of the Link Canal (41.30 to 117.50 km)	76.20 Km
Less Lengths occupied by Canal Structures, CD works & Bridges etc (-15%)	(-) 11.43 Km
Total Length available for plantation	64.77 Km say 65 km.
Plantation on both sides of Branch canal/distributaries	227 km

- **Plantation technique**
  - Plantation will be taken up at both sides of the canal bank.
  - Adequate number of seedlings will be raised in the Central Nursery. Only those fully grown seedling will be picked up for plantation.
  - Seedlings are proposed to be planted at an interval of 3.0 m at both sides of main canal in two rows on each side except for the reach where the canal structure exists and one row on each side of Branch canal/distributary. The plantation details are shown in Fig. No. C4.1.
  - Plant species having aesthetic and soil binding nature shall be preferred which shall be decided by the District Horticulture expert. It is proposed to include 50% species as fruit bearing trees which have got economic importance. These species are proposed to be planted very near the villages. The upkeep and maintenance of the fruit bearing trees be handed over to the gram panchayats of nearby villages.
- **Period of Plantation:** Plantation will be completed in 4 years period with maintenance period of 3 years after the 1st year of plantation. Maintenance and protection measures after the initial period of plantation will be entrusted to village level SHGs / Village Committees who may engage some needy people. It will be a source of their earning from the sale proceeds of fruits.

2. Colony plantation:

- Total colony Area identified for Green belt plantation is about 10 ha.
- Plantation is proposed @ 1600 plants/ ha in 10ha
- Number of Seedlings required for plantation is estimated at 16000 nos.

3. Plantation Quantity (Physical):

Main Canal Bank Plantation	**86664**
Branch canal/distributary Plantation	**151332**
Colony Plantation	**16000**
Total No. of Trees to be planted	**253996**

4. Funds budgeted for plantation (Financial):

For plantation Management, the project authorities have provided Rs.62.00 lakhs in their project cost estimate.

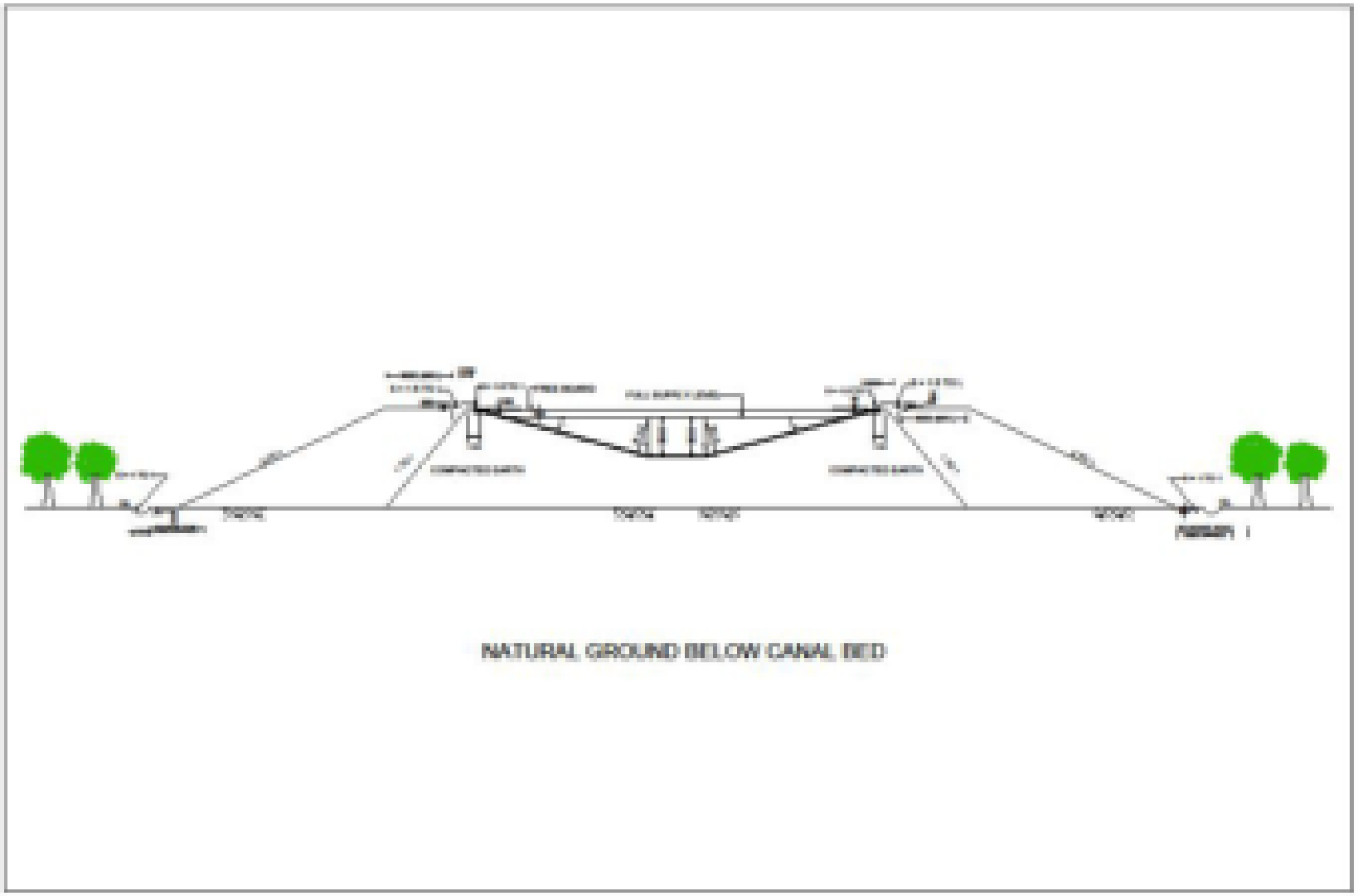


Fig. No. C4.1: Plantation details shown along the side of main canal

4.9.21 Fisheries Conservation And Management Plan:

Important rivers in north Bihar districts are Mahananda, Ganga, Kosi and Righa provide abundant opportunities for piscicultural activities. The ponds of the affected people in the project area can be selected for pisciculture and adequate training should be given to pond owners on pisciculture with project assistance for enhancing their livelihood. Necessary support for pisciculture may be extended in filling up the ponds from excess canal water in a judicious manner.

4.9.22 Reservoir Rim Treatment Plan:

This project is only an extension of East Kosi Main Canal from RD 43.30 km to RD 117.50 km. As such the scope is limited to canal work only. However, to reduce the sediments inflow to Hanuman Nagar Barrage (Birpur) thereby to East Kosi canal necessary plantation to be taken up in the rim of reservoir which can be supported by this project. Accordingly, the species for plantation can be decided with the consultation of Forest Department. In view of above, funding arrangement made under M- Plantation head can also be utilized for this purpose.

4.9.23 Local Area Development Plan:

Local Skill development scheme will be formulated in consultation with revenue officials and village panchayats. Besides vocational training and farmers training may be taken off. Other local area developments are mentioned in chapter-7.

4.9.24 Environmental safeguard plan:

Safety Measures Against Risks & Hazards

- To ensure safe construction in the temporary accesses during construction, lighting devices and safety sign boards will be installed.
- Safety of workers undertaking various operations during construction will be ensured by providing helmets, masks, safety goggles, etc
- At every camp site, a readily available first aid unit including an adequate supply of dressing materials, a mode of transport (ambulance), para medical staff and an attending doctor will be provided.
- Road safety education will be imparted to drivers running construction vehicles. In case of negligent driving, suitable action will be taken.
- Traffic rules and regulations will be strictly adhered to.
- Adequate signage, barriers and persons with flags will be provided to control the traffic during construction
- Speed restrictions shall be imposed on project vehicles.
- Speed Breakers and Signboards should be displayed.
- Barriers (e.g. Pillars with fencing) shall be installed at construction areas to prevent pedestrian access to the freight corridor except at designated crossing points.

- The general public/local residents shall not be allowed in high-risk areas, e.g., excavation sites and areas where heavy equipment is in operation and the spill channel.
- All lifting tools will be periodically checked & certified

Occupational Health Safety:

- Comply with the requirements of the Environmental, Health and Safety (EHS), Guidelines and the statutory norms of safety during construction.
- Provide adequate good quality Personal Protective Equipments (PPE) to all the workers working at construction zones and Plant sites and will ensure that these PPEs are used by workers at all time during works.
- Adequate drainage, sanitation and waste disposal will be provided at workplaces.
- Proper drainage will be maintained around sites to avoid water logging leading to various diseases.
- A health care system will be maintained at construction camp for routine check-up of workers and avoidance of spread of any communicable disease.
- Readily available First Aid kit will be provided at all the work sites and should be regularly maintained.
- Organize awareness program on HIV aids and sexually transmitted diseases (STDs) for workers on periodic basis at least once in a quarter
- Welders will be provided with eye shields and gloves.
- Ear plugs will be provided for workers working in high noise zones.
- Workers shall be provided with potable water supply at site.
- Provision of distinguishing clothing or reflective devices or otherwise conspicuously visible material when there is regular exposure of workers to danger from moving vehicles.
- Monitoring and control of the working environmental and planning of safety and health precautions should be performed as prescribed by national laws and regulations

4.9.25 Risks of canal failure and breaching of section of canal and prevention:

Safe operation of canal is one of the foremost responsibilities of the engineers of the organization. There must be code of practice for safe operation, inspection and safety standards of up keep of canal system.

Training of Engineer in Charge:

The Chief Engineer of the organization must ensure to prepare a maintenance manual for guidance for upkeep of canal. Accordingly training programme for Engineers in Charge of operation, maintenance be held once in a year preferably in pre-monsoon month.

Inspection of C.D. works:

This will ensure to inspect all cross drainage works with gated arrangement for its smooth operation and management before monsoon by engineers in charge as well as compliance to higher authority.

Inspection of canal Embankment:

A team of engineers are to physically inspect the canal embankment to identify any weak spot and to take up proper remedial measures.

Inspection of lining of canal Section:

A canal lining with drainage and joint system are potential areas which need to be monitored and remedial actions are to be taken before monsoon.

Inspection of Escape system of canal:

The escape system of canal is vital component which must effectively function. In case a breach is noticed, canal shut down with proper functioning of escape to be ensured.

CHAPTER – 5
ANALYSIS OF ALTERNATIVES

5.0 INTRODUCTION:

The River Kosi is an international river originating from Tibet and flowing through Nepal in Himalayan Mountains and the lower portion through plains of North Bihar. During 25th April 1954 an agreement was signed between His Majesty's Government of Nepal and the Government of India for implementation of Kosi project. The Kosi project includes namely Hanuman Nagar Barrage (Birpur) across river Kosi, canal head works, Western Kosi Main Canal (WKMC) system in Nepal and Eastern Kosi Main Canal (EKMC) system in India.

The present proposal is to extend the EKMC system from 41.30 km to 117.50 km. After a meeting held between officers of WRD, Govt. of Bihar and NWDA in January 18, 2010, NWDA took up the work of preparation of DPR for the extended canal project of EKMC. The DPR was submitted to CWC by Govt. of Bihar during October 2012 for detail examination. The comments from various Directorates of CWC were duly complied by Govt. of Bihar as well as by NWDA and submitted to CWC in May 2014 for final scrutiny and appraisal. The Kosi-Mechi Intrastate link project was duly considered in the Advisory Committee of MoWR and Techno-Economic Clearance was accorded on 4th August 2016 with due condition to obtain all statutory clearance before execution. The Details of project are described as below.

The proposed gross command area of the project and culturable command area are 2.75 lakh ha and 214812 ha (CCA 2.15 lakh Ha) respectively spread over in the districts of Araria, Purnia, Katihar and Kishanganj in the state of Bihar.

Under **Kosi-Mechi intrastate link project**, it is proposed to construct New canal of length 76.20 km on the existing constructed barrage on river Kosi beyond the existing Eastern Main Kosi Canal (41.30 km) to irrigate 2.15 lakh ha command area with a total water requirement of 2050 MCM for irrigation in Kharif season.

The above proposal was considered by the Expert Appraisal Committee of MoEF&CC. (EACs for River Valley & Hydro Electric Projects in its 96th meeting held during 11-12th August 2016 and approved for further action)

5.1 ALTERNATIVE STUDY FOR THE PROJECT

5.1.1 Concept of the Kosi-Mechi Link Project:

The Ministry of Environment, Forest and Climate Change have rightly kept the option open to take up the study of new schemes with an aim to take up alternate studies to minimise negative environment impacts.

In the instant case, the present proposal is binding on its present scope and alignment as primarily the project is an extension of existing scheme.

5.1.2 Existing Project:

The Hanuman Nagar barrage (Birpur) project was taken up as per agreement signed between Govt. of India and His Majesty Governor of Nepal in 1954. The barrage was constructed as a component of Kosi project. After due survey and other preliminaries the barrage works started in 1959 and completed in March 1963. The barrage is located about 8.5 km upstream of Hanuman Nagar town in Nepal and 6.0 km upstream of Birpur in India. The barrage with both East and West canal is functioning successfully since 1964.

The basic purpose of the barrage is:

1. To raise the water level in the barrage sufficiently to cause flattening the slope of river bed.
2. To create such a pond level so as to enable flow irrigation water through the eastern and Western main canal offtaking from the Head regulators situated at both ends of the barrage.
3. To generate hydroelectric power with a plant constructed at RD 3.66km in EKMC having a power generation capacity of 19.20 MW utilizing a fall of 3.96m.
4. A silt settling tank has been built at RD 1.06 Km to arrest the sediments into EKMC and take up desilting work in non-monsoon months.

   As such presently, the project is functioning with a canal offtaking from left head regulator styled as East Kosi Main Canal and already built up to 41.30 km with an ayacut of 4.40 Lakhs hectare.

   The new proposal is fully binding in remodeling of EKMC up to 41.30 km and extending the EKMC up to river Mechi, a tributary of river Mahananda having a length of 117.50 km and will be executed fully within the state of Bihar.
5. The existing East Kosi Main Canal up to 41.30 km and its extension up to 117.50 km will be contour canal having ayacut on the southern side i.e. on the right side of canal with suitable provision of branch canals and distributaries. The ayacut in new link system will cover four districts of Bihar i.e. Araria, Purnia, Katihar and Kishanganj.

5.2 NEW PROPOSAL:

The new proposal has two important options.

1. Remodeling of existing EKMC from barrage to 41.30 km.
2. To built a new contour canal from RD 41.30 km to 117.50 km to have ayacut boundaries between river Parman and Mechi both tributaries of river Mahananda lying fully on Bihar state.

5.3 MOST VIABLE AND ECONOMICAL OPTION:

- The most advantage of this project is that no storage facility is required because there already exists a barrage and 40 km long canal namely EKMC.
- This project involves an extension of canal from EKMC up to River Mechi to provide irrigation facility to water scarce area of Mahananda basin. Similarly this projected additional cultivable land available for irrigation is not covered under any other project.
- Thus the Link irrigation scheme has been designed to provide irrigation to an ayacut of 2.15 lakh ha which will cover a part of agricultural land of Araria, Purnia, Katihar and Kishanganj districts of Bihar state.
- As it is already stated above that it is a contour canal, there is an advantage of gravity flow.
- As per the guidelines of MoEF&CC, the study of alternatives by the project proponent takes into cognizance to explore the alternative on matters related to technology, capacity moderation and location so as to ascertain that the present proposal is the most ideal in environmental consideration as well as economically viable and sustainable in overall consideration.
- In the instant case, the East Kosi-Mechi link canal project is an extension from RD 41.30 km to 117.50 km of the existing EKMC project and there can be no alternative to the present proposal.
- Further under the present scenario the proposed canal project is economically most viable and environmentally sustainable.
- As such, the proposed project is Site specific. **Hence there is no viable alternative for this project.**

CHAPTER – 6
ENVIRONMENTAL MONITORING PROGRAM

6.0 NECESSITY FOR ENVIRONMENTAL MONITORING:

It is unanimously viewed that monitoring activity form an essential component in a sustainable water resources development project. Equally monitoring constitutes an integral part of its environmental assessment process.

The development activities introduce complex new inter-relationships in the project area between people, various natural resources, biota and many development forces as a result a new environment is created. Because of these complexities and uncertainties and lack of adequate knowledge in the implementing strategy environmental monitoring and evaluation need to be carried out regularly to ensure effectiveness of the management plan.

It is thus imperative that environmental monitoring is to be integrated with the management plan within an overall framework of sustainable water resources development of the project. Monitoring activities in the specific areas are to be carried out regularly by the designated unit and the results evaluated by the project management authority to take appropriate corrective measures.

The basic requirement of environmental monitoring programme include the following,

1. Timeliness
2. Cost effectiveness
3. Maximum coverage
4. Absence of bias
5. Identification of users of information

These requirements are project specific. The type of variables to be monitored; the frequency of monitoring of any variable at any specific site & number of sites etc vary from project to project.

Therefore, environmental monitoring provides an essential tool to make necessary recommendations and adopt suitable control strategies so that menace of rising environmental degradation could be minimized and a relief be extended to the people including labours in case of any damage caused under occupational health hazards. The monitoring is necessary for the following reasons:

- To see what impacts have occurred;
- To evaluate the performance of mitigation measures proposed in the EMP;
- To ensure that the conditions of approval are adhered to;
- To suggest improvements in management plan, if required;
- To see that benefits expected from the EA are achieved as the project proceeds; and
- To satisfy the legal and community obligations.

6.1 PERFORMANCE INDICATORS:

The physical, biological and social components, which are significant in affecting the environment at critical locations, have been suggested as Performance Indicators. The following specific environmental parameters can be qualitatively and quantitatively measured and compared over a period of time and therefore selected as Performance Indicators for monitoring due to their regulatory importance and the availability of standardized procedures and relevant expertise.

- Air quality - Temporary period
- Noise levels around sensitive locations - Temporary period
- Water quality
- Construction camp management
- Soil Quality
- Drainage Congestion
- Waterlogging
- Effect on Aquatic Life
- Weed effect in canal
- Human Health due to Transmission of vector on canal eater
- Re-plantation success /survival rate
- Restoration of borrow pits
- Sedimentation in the ponds and Reservoir
- Safety at Work
- Waste Management & Debris Removal
- Gender participation in works
- Site Restoration
- Awareness programme on HIV/AIDS

6.2 MONITORING OF PERFORMANCE INDICATORS:

Ambient Air Quality (AAQ) Monitoring:

Ambient air quality parameters which are recommended for monitoring are PM_{10} (Particulate Matter having less than 10 micron size) or $PM_{2.5}$ (Particulate Matter having less than 2.5 micron size), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NOx) and Carbon Monoxide (CO) and Hydrocarbon (HC). These parameters are to be monitored at selected locations such as plant and machinery sites, crusher sites, excavation work sites, etc. starting from the commencement of construction activity. Data should be generated once in a season at the selected monitoring locations in accordance with National Ambient Air Quality (NAAQ) Standards 2009. This monitoring is to be done strictly during peak construction period.

Ambient Noise Monitoring:
The measurement for monitoring the noise levels to be carried out at sensitive locations and at construction sites along the canal embankment in accordance to the Ambient Noise Standards formulated by Central Pollution Control Board (CPCB). Sound pressure level would be monitored on twenty-four hourly basis. Noise shall be recorded using digitized noise monitoring instrument.

Water Quality:
Water quality of local water resources that is used by local community shall be monitored. The monitoring of the water quality will be carried out at all locations identified during baseline data collection along the canal during construction and operation phase. Monitoring parameters will be as per IS-10500 for ground water quality and for surface water quality as per CPCB Guidelines for used based surface water classification.

Soil Quality:
The soil quality of the surround fields close to the construction site and plant site will be monitored to understand the impact of soil quality. The physico-chemical parameters recommended for analysis are physical Parameter: Texture, Gravel, Sand, Silt and Clay and Chemical Parameter: pH, Conductivity, phosphorus, potassium, Sodium, Nitrogen and sodium Absorption Ratio, etc. as well as concentration of chlorides due to due to water logging.

Tree Survival Rate:
To ensure the proper maintenance and monitoring of the compensatory plantation, a regular maintenance and monitoring of the survival rate of the planted trees is being proposed up to a period of 5 years after plantation operation of the project. Visual observation of the tree survival will be recorded at every quarter. This will be monitored by the Project Authority till their demobilization and then by implementing agency with the help of Forest Department.

Construction camp management:
The visual inspection of site will be done every month to check the facilities provided in the camp.

Gender Participation in works:
A genuine integration of gender and their participation into projects activities needs to be done at each stage of the project cycle, i.e. from participatory planning to implementation, monitoring and evaluation.

The project authority should explore the approach taken at getting involvement of women in different activities. Furthermore, the project authority should observe that women were under represented or over represented in various activities and what constrains or facilitates their participation by the agency? Verification of Labour records followed by random checking at site will be conducted to analyse the gender participation mainly with respect to female workers.

HIV/AIDS Awareness Programme:
The records of conducted programme as per agreed schedule by the Contractor and list of participants will be checked. The representative of Project Authority must witness each programme and maintain the records of it.

Safety at Works:
Monthly Auditing of safety at works including supply and use of Personal Protective Equipments (PPE), Safe working conditions, first Aid facilities, incidence report, safety trainings, etc will be carried out by the Project Authority to check the effectiveness of safety measures at site.

Site Restoration:
Visual observation will be made to verify the site restoration activities after completion of works by Project Authority before recommending completion of works.

Restoration of Borrow Pits:
Visual inspection of completed borrow area will be carried out to check the status of restoration of borrow area and the effectiveness of the restoration works will be verified by the Project Authority in accordance with the guidelines provided in EMP and MoEF&CC. All the borrow areas must be restored after operation.

Waste Management and Debris Removal:
Visual observation on management of waste and debris at different site will be made on regular basis by the Project Authority.

Drainage Congestion:
The visual inspection of drains will be done before monsoon every year to check the congestion in drains.

Waterlogging:
The visual inspection of site will be done every month during flow of water in canal and measurement of water level in wells needs to be ascertained during monsoon to check the rise of water level in the area.

Weed infestation:
One of the major concerns in the canal system is clogging of canal by growth of weeds and vegetation. This needs regular monitoring. Every year weeding and cleaning of canal is to take up in non-monsoon months.

6.3 ENVIRONMENTAL MONITORING ACTION PLAN (EMoAP):

An Environmental Monitoring Plan (EMoAP) has been framed for both implementation and post-implementation phases covering monitoring of major pollution parameters, frequency, methods, indicators and institutional arrangements pertinent to the above EMoAP is furnished in Table No.C6-1 below.

Table No. C6-1: Summary table for Environmental Monitoring Action Plan (EMoAP):

Sl. No.	Performance Indicators	Monitoring Parameters	Standards	Location (s)	Frequency	Monitoring method	Action Plan in case parameters exceeds the standard limit or adverse impact observed	Responsible organisation	
								Implementation	Supervision
A. During Construction stage									
1.	**Air quality**	PM_{10}, $PM_{2.5}$, SO_2, NO_X and CO.	National Ambient Air Quality Standard (CPCB, 18th Nov, 2009)	• Construction site, • Approach roads • Sensitive receptors. • Plant and machinery sites • Crusher sites • excavation works	24 hourly sample once in month throughout the construction period except rainy season.	Analysis Reports Visual Observation	Check and modify dust control device like bag filter/ cyclones of hot mix plant, covers and water sprinklers	Project Authority through NABL approved Environmental Laboratory	Project Authority/ IA
2.	**Surface Water quality**	pH, Temperature, DO, BOD, COD, Oil & Grease, Total Suspended Solid, turbidity, Total Hardness, Chlorine, Iron, etc. fertiliser, pesticide, Total Coliform, vector of disease	Tolerance Limit as per IS 2296 : Class C	• Ponds near construction site. • D/s of River Kosi	Grab sampling once in 3 months excluding the monsoon period	Analysis Reports Visual Observation	Check and modify Oil interceptors, silt fencing devices and corrective measures	Project Authority through NABL approved Environmental Laboratory	Project Authority/ IA
3.	**Ground Water quality**	pH, Temperature, TSS, TDS, Total hardness, Chlorine, Iron, Sulphate, Nitrate, heavy metals, etc.	Ground Water Quality Standard as per IS: 10500, 1991	• Near habitations • D/s of River Kosi	Grab sampling once in 3 months excluding the monsoon construction period	Analysis Reports Visual Observation	Take corrective measures by applying available technology to reduce the excess concentration of any parameter	Project Authority through NABL approved Environmental Laboratory	

Sl. No.	Performance Indicators	Monitoring Parameters	Standards	Location (s)	Frequency	Monitoring method	Action Plan in case parameters exceeds the standard limit or adverse impact observed	Responsible organisation	
								Implementation	Supervision
4.	**Noise level**.	Leq dB (A) (Day and Night) Average and Peak values	Ambient Noise Standard (CPCB, 2000)	- At construction site. - At sensitive receptors - At nearby habitations	24 hourly recording of Leq once in 3 months till construction period	Analysis Reports Visual Observation	Check and modify equipment and devices used to protect noise level	Project Authority through NABL approved Environmental Laboratory	
5.	**Soil quality**	**Physical Parameters**: Texture, Grain Size, Gravel, Sand, Silt, Clay; **Chemical Parameters**: pH, Calcium Conductivity, , Magnesium, Sodium, Nitrogen, Sodium Absorption Ratio, heavy metals, trace of salt due to rise of groundwater		- In and around construction site. - Near the dumping yards. - Inside ayacut area.	Twice a year, once in pre-monsoon and other during post-monsoon till construction period	Analysis Reports Visual Observation	Check and modify the arrangement of containment of oil, drainage to protect soil quality	Project Authority through NABL approved Environmental Laboratory	
6.	**Safety at Works**	Use of PPE, Health conditions, First aid and ambulance, Training Awareness programme on HIV/AIDS	100% compliance with worker Safety	- Work site - Labour camp	Daily observations for PPEs and Safe access to working platform, and first Aid Kits during	Purchase records Daily safety records Issue records	Immediate supply of adequate numbers of PPEs, enforcement of use of PPEs by workers during works, repair of damaged access & working platforms and replacement of first aid	Contractor	Project Authority

Sl. No.	Performance Indicators	Monitoring Parameters	Standards	Location (s)	Frequency	Monitoring method	Action Plan in case parameters exceeds the standard limit or adverse impact observed	Responsible organisation	
								Implementation	Supervision
					construction period. Quarterly for health, safety training, HIV/AIDS awareness programme training	Visual observation	kits		
7	**Survival rate of plants**	Growth rate with respect to time.	90% Survival Rate	Alongside main canal embankment and other canal roads	Quarterly till 5 years Quarter.	Plant Growth records Visual Observation	Replacement of dead tree with healthy saplings of same species, repairing of tree guards, fencing etc.	Contractor & Project Authority till Defect liability Period then Project Authority	Project Authority
8.	**Public & Traffic safety arrangement**	No. and type of vehicles, PUC Certificate Vehicles, Fitness certificates - Driving licences, - Safety Signages, Barricading	-	- Approach roads, - Village roads adjacent to project site and near habitation area	Monthly during construction period.	Accident Record checking of Safety/ caution signboards, barricading around work zones, Public complaints	Vehicle having valid permits and PUC to ply on road. Replacement of all damaged signboards and barricading	Contractor's safety officer	Project Authority
9.	**Debris clearance**	Volume and type of solid wastes	Periodical removal of debris and other waste	- Work site	Weekly during construction period.	Vehicle log book Direct observation	Removal of Debris to disposal sites	Contractor's safety officer and Project Authority	Project Authority

Sl. No.	Performance Indicators	Monitoring Parameters	Standards	Location (s)	Frequency	Monitoring method	Action Plan in case parameters exceeds the standard limit or adverse impact observed	Responsible organisation	
								Implementation	Supervision
10.	**Labour & Gender participation**	Involvement of women worker	--	- Work site	Monthly	Muster roll & Wages Register Labour Statement	Wages as per Minimum Wages Act	Contractor and Project Authority	Project Authority
11.	**Labour camp Standards**	Basic Facility at labour camp and general hygienic conditions	As per BOCW Act, 1996	Labour Camp	Monthly	Visual observation	Restoration of labour facilities at labour camp	Contractor	Project Authority
12.	**Site Restoration**	Restoration of all temporary sites to original or better conditions and as per approved plan		Borrow area, quarry site, Plant site, camp site and other associated sites	Once after completion of each activities at site	Visual observation, Record checking	Restoration to be completed for all the sites before issuing completion certificate	Contractor & Project Authority	Project Authority
13.	**HIV/AIDS Awareness Programme**	Awareness programme	As per Schedule	Project site	Once in 3 months	Visual observation Posters, Record checking		Contractor	Project Authority
B. Post Construction/ Operation Stage									
1.	**Surface Water quality**	pH, Temperature, DO, BOD, COD, Oil & Grease, Total Suspended Solid, turbidity, Total Hardness, Chlorine, Iron, pesticides, Total Coliform	Tolerance Limit as per IS 2296 : Class C	Ponds/ water bodies in ayacut, D/s of Kosi river	Twice a year, once in pre-monsoon and other in post-monsoon.	Analysis Reports Visual Observation	Regulating the water flow into the ponds and application of pesticides & Fertiliser	Project Authority through NABL approved Environmental Laboratory till defect liability period after that Project Authority till 3 years (if no	Project Authority

Sl. No.	Performance Indicators	Monitoring Parameters	Standards	Location (s)	Frequency	Monitoring method	Action Plan in case parameters exceeds the standard limit or adverse impact observed	Responsible organisation	
								Implementation	Supervision
								change in water quality else continue till quality remains within limit)	
2.	**Ground Water quality**	pH, Temperature, TSS, TDS, Total hardness, Chlorine, Iron, Sulphate, Nitrate, heavy metals, etc.	Ground Water Quality Standard as per IS: 10500, 1991	Wells/ tubewells in and around ayacut and nearby habitations.	Twice a year, once in pre-monsoon and other in post-monsoon.	Analysis Reports Visual Observation		Project Authority through NABL approved Environmental Laboratory till defect liability period after that Project Authority till 1 years (if no change in water quality else continue till quality remains within limit)	Project Authority
3.	**Water logging**	Visual inspection as well as measurement of groundwater level.	-	- In ayacut area	Once pre-monsoon and once post-monsoon	Water level record	Conjunctive use of water. Make short supply of water to water logged area.	Contractor and Project Authority till defect liability period after that Project Authority till 1 years	Project Authority
4.	**Survival of plants**	Growth rate with respect to time.	90%	- plantation area	At least one year of gestation period	Survival Record	Replacement of dead plants with healthy plants, investigation for diseases and accordingly application of pesticides or	Contractor and Project Authority till defect liability period after that Project Authority till 1 years	Project Authority

Sl. No.	Performance Indicators	Monitoring Parameters	Standards	Location (s)	Frequency	Monitoring method	Action Plan in case parameters exceeds the standard limit or adverse impact observed	Responsible organisation	
								Implementation	Supervision
							medicines will be done.		

6.4 ENVIRONMENTAL MONITORING BUDGET:

In the pre-implementation/ planning stage, a monitoring has to be drawn up considering various environmental and social components. The estimate should include expenditure on account of manpower engaged, sampling, laboratory testing and supervision of environmental and social parameters. A sample estimate is indicated in **Table No. C6-2**.

Table No. C6-2: Environmental Monitoring Budget:

Sl. No.	Parameter	Items to be monitored	No. of locations	Frequency per annum	Rate per location/ Sample (Rs.)	Amount (Rs.) per annum
A.	**Construction Phase**					
i.	Air quality	Parameters as per Monitoring Plan	6	9 (24 hourly sample once in a month except for rainy season)	8000	4,32,000
ii.	Surface water quality	Parameters as per Table No.C3-16	4	Twice a year (once in post monsoon, once in Pre monsoon)	5500	44,000
iii.	Ground water quality and level	Water quality Parameters as per Table No.C3-17	4	Twice a year (once in post monsoon, once in Pre monsoon)	7500	60,000
iv.	Noise level	Noise level	6	12 (24 hours recording Once in a month)	2500	1,80,000
v.	Soil quality	Parameters as per Table No.C3-5	4	Twice a year (once in pre-irrigation, once in Post irrigation)	7500	60,000
B.	**Other** Performance Indicators	• Survival rate of plants • Traffic safety arrangement • Debris clearance and site restoration • Safety arrangement for workers • Gender participation and HIV AIDS • Labour camp facility • Water logging			300000 lump sum	3,00,000
					Total	**10,76,000**
					Monitoring cost for five years	**53,80,000**

Sl. No.	Parameter	Items to be monitored	No. of locations	Frequency per annum	Rate per location/ Sample (Rs.)	Amount (Rs.) per annum
C	**Post-Implementation Phase**					
(i)	Surface water quality	Parameters as per Table No.C3-16	2	4	5500	44,000
(ii)	Soil quality	Parameters as per Table No.C3-5	2	4	6000	48,000
(ii)	Ground water quality and level	Water quality Parameters as per Table No.C3-17	2	4	7500	60,000
					Total	**1,52,000**
					Monitoring cost for three years	**4,56,000**

Note: In post implementation phase the air quality monitoring has not been considered because of its insignificant effect. The water quality, groundwater level and soil quality monitoring may be continued for at least three years to ascertain change of quality and groundwater level. In case pollution is noticed at any time during this period then necessary remedial measures may be taken up. Similarly, precautionary measures are to be taken if the water level reaches less than 2m BGL. The weed growth in canal is to be monitored regularly. Weeding and removal of debris and spoils are also to be monitored.

CHAPTER-7
ADDITIONAL STUDIES

7.0 PUBLIC CONSULTATION:

The MoEF&CC has given highest importance for Public consultation while considering in taking up a new project for execution. In Public consultation it is a process to involve project affected people as well as beneficiaries in decision making of all development project. The results of Environmental impact assessment study, particularly the negative impacts its connected mitigation measures and proposed management plan etc as well as the projected benefits should be made transparent before the public. The public consultation procedure is therefore intended to obtain comments, suggestions and concurrence for project implementation. The procedure deserves to be encouraged on the grounds of ethics and pragmatism.

The ministry of Environment & Forests (MoEF) have given much importance on the public consultation process vide their Notification No. 1533 (E), dt 14th September 2006 and amendment 1st December 2009 while considering the Environmental Clearance of projects.

The public consultation normally involves two components, Comprising of

I. Holding Public Hearing at the project site or in its close proximity to understand concerns of all local affected persons and others who have plausible stake in the environmental impacts of the project and project activities.

II. To obtain response from the participants and record environmental concerns comments; suggestions and concurrence in writing by the State Pollution Control Board authority so that the project proponent may make appropriate changes in the Draft EIA report.

The draft EIA document comprising of project objectives, anticipated consequences of implementation, environmental issues and management plan etc. along with its executive summary in two languages i.e. English and Hindi /(Local Language) have been brought out to public; stakeholders and other in the locality through State Pollution Control Board (SPCB) Bihar.

For this, four numbers of Public Hearing were conducted separately. The recommendations of Public Hearing of all four districts were incorporated in final EIA report.

7.0.1 Public Consultation of Kishanganj District:

The Public Consultation meeting for Kishanganj District was organized at Thakurganj Block campus of Kishanganj District on 26th Feb 2018 and facilitated by Bihar State Pollution Control Board. The meeting was presided by Mr. Ramji Sah District ADM in the presence of Mr. Suresh Prasad Roy, Regional Officer,

State Pollution Control Board, Bihar and Mr. Arvind Kumar Singh Executive Engineer, Advance planning Investigation and Project preparation Division, Anishabad, Patna and Mr. Abhinandan Kumar Assistant Engineer Irrigation Division Araria.

(a) At first Sri Suresh Prasad Roy, Regional Officer, Bihar State Pollution Control Board, welcome to the participants present in the meeting and described about the need of this consultation meeting.

(b) Then Sri Arvind Kumar Singh, Executive Engineer, Advance planning Investigation and Project Preparation Division, Anishabad, Patna, has explained about the proposed project along with its technical aspects, explained the salient features and location of the project.

(c) Then Sri Ramji Sah, The Additional District Magistrate, Kishanganj has explained about the proposed project and given confidence about all possible/ permissible support and proper grievance to the Project Affected Persons.

Issues raised by participants and clarification		
Sl. No	**Name & queries**	**Compliance**
1.	**Mr. Ganesh Prasad** According to him the low lying area from Gallia to Talle along the Mechi river is always inundated by flood water during rainy season; so with the addition flood water by canal may aggravate flood situation. He also pointed that dam is not at right place so before this project a brief study should be done.	The department authority intimated that guide bundh will be constructed to reduce the inundation in the area. There is no provision of Dam construction.
2.	**Md. Saukat Ali** According to him during khariff period water is as such available in plenty; so if additional water is supplied during this period, then people will face problems. This point is to be kept in mind.	The department authorities present intimated that release of water in main canal will be done as per requirement of crop. However excess water will not be released to create problem of local population.

The Public Hearing proceeding and attendance sheet of Kisanganj were attached in this report as annexure 7.

Photographs of Public Hearing at Thakurganj, Kishanganj

7.0.2 Public Consultation of Purina District:

The Public consultation meeting for Purina District was organized at Kala Bhawan of Purina District on 27th Feb 2018 and facilitated by Bihar State Pollution Control Board. The meeting was presided by Dr. Ravindranath, District ADM in the presence of Mr. Suresh Prasad Roy, Regional Officer, State Pollution Control Board, Bihar and Mr. Arvind Kumar Singh Executive Engineer, Advance planning Investigation and Project preparation Division, Anishabad, Patna, and Mr. Kameshwar Das, Assistant Engineer Irrigation Division Banmakhi.

(a) At first Sri Suresh Prasad Roy, Regional Officer, Bihar State Pollution Control Board, welcome to the participants present in the meeting and described about the need of this consultation meeting.

(b) Then Sri Arvind Kumar Singh, Executive Engineer, Advance planning Investigation and Project preparation Division, Anishabad, Patna, has explained about the proposed project along with its technical aspects, explained the salient features and location of the project.

(c) Then Sri (Dr.) Ravindranath, The Additional District Magistrate, Kishanganj has explained about the proposed project and given confidence about all possible/ permissible support and proper grievance to the Project Affected Persons and Families going to be displaced.

Issues raised by participants and clarification		
Sl. No	**Name & queries**	**Compliance**
1.	**Md. Sekh Anwar** According to him existing canal system near Baisi, Dagarua, Dalkola villages have already been silted up. This area is facing problem since 2008. He also pointed that existing canal has been silted up so that water is not coming up in the canal system for which de-silting work may be	There is no existing canal network in the area of interest of this proposed project. Release of water in main canal will be as per requirement of crop.

	intensified. Due to this project the water availability in Mahananda basin will increase, which may leads to sever flood. Due to above flood control programme in this area be strengthened.	
2.	**Mr. Ghanshyam yadav** According to him Dewari and other existing canals have been silted up and water is not available in canal. De-siltation work may please be made a part of project so that project will be successful.	There is no existing canal network in the area of interest of this project. Release of water in main canal will be as per requirement of crop.

The Public Hearing proceeding and attendance sheet of Purnia were attached in this report as annexure 8.

Photographs of Public Hearing at Kala Bhawan, Purnia.

7.0.3 Public Consultation of Katihar District:

The Public consultation meeting for Purina District was organized at Kala Bhawan of Purina District on 28th Feb 2018 and facilitated by Bihar State Pollution Control Board. The meeting was presided by Mr. Swaymbhu Priya, District ADM in the presence of Mr. Suresh Prasad Roy, Regional Officer, State Pollution Control Board, Bihar and Mr. Arvind Kumar Singh Executive Engineer, Advance planning Investigation and Project preparation Division, Anishabad, Patna, and Mr. Abhinandan Kumar Assistant Engineer Irrigation Division Araria.

(a) At first Sri Suresh Prasad Roy, regional Officer Bihar State Pollution Control Board, welcome to the participants present in the meeting and described about the need of this consultation meeting.

(b) Then Sri Arvind Kumar Singh, Executive Engineer, Advance planning Investigation and Project preparation Division, Anishabad, Patna, has explained about the proposed project along with its technical aspects, explained the salient features and location of the project.

(c) Then Sri Swaymbhu Priya, the Additional District Magistrate, Katihar has explained about the proposed project and given confidence about all possible/ permissible support and proper grievance to the Project Affected Persons.

Issues raised by participants and clarification		
Sl. No	**Name & queries**	**Compliance**
1.	**Mr. Nawal Kanodia** According to him the area is already flood prone and by reducing flow in canal system, the problem of farmers will be minimized. He also pointed that the private land acquired for the canal purpose should be compensated as per R & R policy 2013 within one year. which is normally not done	The land acquisition and compensation will be made as per R&R policy 2013 and effort will be made to settle the claim at the earliest.
2.	**Mr. Amarnath jha** According to him Water is not available in existing canal due to encroachment which may be suitably addressed so that flow is restored.	This question is not revenant to this project.
3.	**Mr. Mithilsh kumar Gupta** He intimated that this canal project is beneficial and just. It may be please be ensured further that compensation of land acquisition cost may please be reimbursed properly.	The reimbursement of land acquisition payment will be done as per Govt. of Bihar R & R policy and will be implemented in affective manner.

The Public Hearing proceeding and attendance sheet of Katihar were attached in this report as annexure 9.

Photographs of Public Hearing at Kosi colony, Katihar.

7.0.4 Public Consultation of Araria District:

The Public consultation meeting for Purina District was organized at Kala Bhawan of Purina District on 28th Feb 2018 and facilitated by Bihar State Pollution Control Board. The meeting was presided by Mr. Swaymbhu Priya District ADM in the presence of Mr. Suresh Prasad Roy, Regional Officer, State Pollution Control Board, Bihar and Mr. Arvind Kumar Singh Executive Engineer, Advance planning Investigation and Project preparation Division, Anishabad, Patna, and Mr. Abhinandan Kumar Assistant Engineer Irrigation Division Araria.

(d) At first Sri Suresh Prasad Roy, regional Officer Bihar State Pollution Control Board, welcome to the participants present in the meeting and described about the need of this consultation meeting.

(e) Then Sri Arvind Kumar Singh, Executive Engineer, Advance planning Investigation and Project preparation Division, Anishabad, Patna, has explained about the proposed project along with its technical aspects, explained the salient features and location of the project.

Then Sri Amod Kumar Sharan, The Additional District Magistrate, Araria has explained about the proposed project and given confidence about all possible/ permissible support and proper grievance to the Project Affected Persons.

Issues raised by participants and clarification		
Sl. No	**Name & queries**	**Compliance**
1.	**Mr. Santosh Kumar Thakur** He asked what the scope of employment under this project.	Executive Engineer informed that employment will be provided by this project through contractors during construction and maintenance phase.
2.	**Mr. Theknath Ojha** He asked expected about the benefit of the project in the area of flood control.	Although this project is not a flood control project, but proper care will be ensured for flood mitigation.
3.	**Mr. Satanand Thakur** He intimated that during flood there are instance of cutting of embankment which results flooding in neighboring areas. Step may be taken to prevent the same in future.	The canal embankment will be used as road communication and steps will be taken to prevent cutting of embankment in future and thereby preventing of flooding in the locality.
4.	**Mr. Gopal Goyal** He intimated that the problem in this area related to irrigation. During flood there is plenty of water and subsequently no water is available in canal system. Necessary step may be taken to address the situation.	It was confirmed by the authorities that canal water will be reduced during flood. However after flood water in canal will be made available as per requirement in the command area.

The Public Hearing proceeding and attendance sheet of Araria were attached in this report as annexure 10.

Photographs of Public Hearing at Forbesganj College, Araria.

7.1 ENVIRONMENTAL RISK MANAGEMENT:

It is presumed that the proposed irrigation project would be designed and engineered with all possible safety measures and standard code of practices of engineering. In spite of this, there may be some design deficiency which may lead to accidents or events causing damage to the life and property. This chapter presents an overview of environmental risks associated with the irrigation facilities, suggested remedial measures and a model outline of the emergency preparedness plan.

7.1.1 Objectives:

The objectives of environmental risk assessment are governed by the following:

- To identify the areas having potential hazards so that necessary design of safety measures can be adopted to minimize the probability of accidents and events causing damage.
- To identify the potential areas of environmental disaster, that can be prevented by safe and controlled operation.
- To manage the emergency situation or a disastrous event, if any.

Managing a disastrous event will obviously require prompt action by the Engineers in Charge and the crisis management personnel using all their available resources like alerting the people. Minimize the immediate consequences of hazardous event which include evacuation, medical assistance and giving correct information to the families of the affected persons and local public for avoiding rumors and panic.

Lastly, an expert committee is required to probe the cause of such events and the losses encountered and suggest remedial measures for implementation so that in future such events or similar events do not recur. The above committee will be formed by the project proponents.

7.1.2 Definition of Environmental Risks:

The following terms related to environmental risks are defined before reviewing the environmental risks:

Table No.C7-1: Definitions of terms related to environmental risks

Sl. No.	Terms	Definitions
1.	Harm	Damage to the person, property or environment.
2.	Hazard	Something with the potential to cause harm; this could be due to negligence and inappropriate operations. An environmental hazard is thus going to be a set of circumstances, which leads to the direct or indirect degradation of environment and damage to the life and property.
3.	Risk	The probability of the harm or likelihood of harmful occurrence. Environmental risk is a measure of the

		potential threat to the environment, life and property.
4.	Consequence	Effect due to occurrence of the event, which may endanger the Environment permanently or temporarily and or loss of life and property due to the risk and hazardous described above.
5.	Environmental Disaster	The consequence is so severe that it can extensively damage a one or all the four components of the environment, namely, ➢ Physico-chemical ➢ Biological ➢ Human and ➢ Aesthetics

All these items as described above will have severity in risks due to canal failure, flooding in a fairly populated villages and towns thereby permanently damaging property with risk of life and silting of the cultivated land for a temporary or permanent period with loss of cultivation.

7.1.3 Identification of Risks:

7.1.3.1 Environmental Risks during Design & construction phase:

Objectives	Reviews and suggestive improvements
Design Stage	
Structural design considerations • Design of the structures should be safe from stability considerations.	• The structural design will be undertaken in the state Designs organization in due consideration of codes and standard procedure.
Construction Stage	
• Utilizable materials in the structure should not disturb the ecology. • Prevent excessive soil erosion during construction phase which may transport the sediment load to the downstream.	• Quarry location has been identified far away from the present canal worksite; whereas sand will be quarried from nearby rivers. • The canal structures will be of concrete and masonry structures to be founded in solid rock having negligible erosion.
	• Soil erosion will be minimized through implementation of soil conservation & Biological measures under a Management plan.

• During construction of canals, the spoil piles should be properly shaped.	• Apart from re-use of the excavated earth materials in the canal bank, the rest will be used for construction of ancillary works.
Landscape Consideration • Damages to the Vegetative cover due to construction of approach roads should be minimum. • Quarried operations should be minimum conforming to requirement.	• The existing access route will be renovated with road side plantation. • Quarry operation by agencies shall be regulated as per guidelines.

7.1.3.2 Potential Hazardous and Mitigation during Construction Period:

Risks and Hazards involved during the construction process should have minimum magnitude and are proposed to be minimized through proper mitigation measures.

These are broadly discussed below in **Table No.C7-2.**

Table No.C7-2: Potential Hazards and Mitigation Measures (During Construction Period)

Sl. No	Activities	Impact	Hazard Potential	Remarks	Proposed Mitigation measures
1.	Earth Excavation	Noise, Dust & Accident	Moderate Pollution	Occurs for temporary period	• Excavation through machinery
2.	Disposal of solid waste, construction debris	- Dust pollution - Land degradation	Moderate	For temporary period	• Carriage/ Transportation of mucks by covered transport vehicles (Trucks) • Sprinkling of water over the dumping yard and Haul roads.
3.	Water Pockets in borrow pits	Water/Land pollution	Breeding of disease vectors	For a temporary period	• Bigger pits to be fairly leveled connected to drains and slopes turfed. Wherever possible small, medium borrow pits top are to be vegetated with grass and plantation.

4.	Migration of labour force	Occupational Health problem	Moderate	For a temporary period	• Labour camps will be properly maintained. • Ensure health delivery to labourers free of fees.
5.	Pollution of flow water source	Unsuitable for domestic use	Moderate	For Temporary period	• Dirking water of accepted quality will be supplied to workers at the construction site as well as in labour camps.
6.	Other Manmade disaster/Risks	Accident	Occasional	Rare occurrences	• Fire extinguishers will be kept ready for electric fires. • Safety measures for vehicular traffic.
7.	Drainage Congestion in the ayacut.	Risks to crops and human users	Moderate	Brief period during monsoon	• Over flooding of the cultivated land – loss of crops. • Pollution effect due to washout of residual salts & pesticides to the main drain. • Ensure periodic cleaning of gully drain from Ipomoea growth & other unwanted vegetations.

7.1.3.3 Environmental Risks due to Natural calamities during operation phase:

The project may be subjected to risks of extreme natural calamities like high cloud burst, Cyclones, Landslides and Earth quake etc. Mitigation measures against these extreme meteorological events are highlighted below.

Table No.C7-3: Risks & Mitigation measure (During operation Period)

Sl. No.	Potential Indicators	Period of Occurrence	Likely Risk & Disasters	Mitigation Measures Proposed
1.	Strom Rainfall Cloud burst Historic	Rare Occurrence	- Very high Floods - Submergence of area	• Considered in the study of river hydrology • Barrage structure is designed to pass 100 yrs Design Flood

	Flood		- Likely loss of property	
2.	Cyclone	Periodic Occurrence	• No risks to structures • Moderate risks for electric towers & other installations	• No severe cyclone recorded in past decades. • Use stand by electricity supply (Generators) • Alternative arrangement for water supply to colony
3.	Earth quake	Rare Occurrence	Moderate Risks to above ground structures	• The structures will be designed with recommended seismic coefficient. • Check structures for any damage/ deformity in the post quake period

7.1.4 Disaster due to Structural failure:

- Disaster due to failure of Cross drainage works, aqueducts, bridges, head and cross regulators structures is a remote possibility as they will be constructed with concrete and masonry over competent rock foundation.
- However, risks of operation of cross regulators and aqueducts are to be safeguarded.
- If such an event ever occurs, there may be flooding devastations to the downstream areas involving loss of property and concurrently some human lives.
- The Environment Ministry as well as the State Government have attached greater emphasis on Disaster Risk Reduction (DRR) planning and management interventions.

Disaster Prevention due to Structural failure:

Although the canal structures like Cross drainage works, aqueducts will be designed with adequate factor of safety, and construction works to be carried with professional precision, it may exhibit some minor damage either during operation or after hit by severe natural calamities. The project authorities should conduct visual inspection of the site through safety experts so as to prevent periodical structural failure due to manmade causes.

Reporting Procedure:

- The level at which each situation/ event reaches and emergency status shall be specified. This shall include the stages at which the surveillance requirement should be increased both in time & level.
- Whenever the possibility exists that the flood water could rise above the designed stipulations, the Engineer in charge should report the apprehensions to the project head (Chief Engineer) seeking corrective action.

- Simultaneously issue warning signals to the villages downstream regarding passing of an unexpected flood or breach of canal section due to natural calamity.
- Establish contact with Key personnel of project level disaster management committee as well as State level disaster Management Committee and request for quick remedial action plan.

7.1.5 Disaster Management Plan:

- The Engineer in charge should adhere to and Emergency Action Plan (EAP) which is to be prepared much ahead of any likely disaster.
- The full-proof EAP should be prepared and approved by the District level Emergency Action Committee.
- The Emergency Action Committee (EAC) is to be constituted with the District collector as the chair person of such Committee.
- The structure of an EAC should have the following members:
  - I) District Collector - Chairman
  - II) Chief Engineer of the Project
  - III) Superintending Engineer in charge
  - IV) Executive Engineer in charge
  - V) Superintendent of Police
  - VI) Representatives from line units such as Transport authority, Electricity authority, P.W.D., Public Health Department, Forest Department and Public relation Department etc.

There should be a coordinated effort by the members for implementation of Emergency Action plan.

Much importance should be given to activities like

- Strengthen disaster warning mechanism.
- Restoration of communication – safe route.
- Identification of likely distressed areas.
- Demarcation of areas for evacuation and temporary shelter locations.
- Establish joint Control Room.
- Ensure immediate Corrective measures

7.1.6 Institutional Infrastructure:

(i) SDMA: State Disaster Management Authority at the state Level of Govt. of Bihar. It takes Care of Disaster Risk Reduction (DRR) activities and undertakes appropriate mitigative measures.

(ii) SDSC: State Dam Safety Cell under Chief Engineer Designs, Department of water Resources Govt. of Bihar. It undertakes Inspection of Dams monitors Dam Safety and suggests corrective action.

7.1.7 Identification of Potential Problems in Construction of Kosi-Mechi Link Project and introducing additional studies to this project:

Some of the specific potential problems and its cause and specific management required during execution have been discussed and action suggested.

Geology and Geotechnical Studies:
The project primarily consists of canal from RD 41.30 km to 117.50 km. The main head works i.e. the Hanuman Nagar Barrage (Birpur) has been built since 1963. As such structural soundness of failures is not a concern.

Works by GSI Kolkata:
Even though there are no potential structural problems in canal works there will be heavy cutting of earth in deep section where geological mapping is required.
The Geological Survey of India (GSI), Kolkata was entrusted with the geological mapping along link canal alignment and important CD/CM structures. The design organisation has duly considered the findings and suggestions of GSI in designing structures. However, it is recommended to incorporate the following items into consideration.

I. To identify the spots where deep open excavation for the canal may lead to slope failure and suggest protection measures for cut slope.

II. Geotechnical investigation to evaluate foundation strata of CD/CM structures and to assist the same for design purpose.

Works by Central Soil and Material Research Station, New Delhi (CSMRS):
The CSMRS was entrusted with geotechnical investigations; borrow area survey, construction material survey, testing of soil samples etc. The quality of materials available in various quarries has also been tested. However, for this project the construction material available in the quarries for coarse and fine aggregates available in Burhi-Gandak project will be utilized. The same have already been tested earlier for other ongoing project.

Canal Structures:
10 nos. of cross regulators and 27 Head regulators are provided in the canal. The following parameters are checked for effective functioning of structures.

I. The cross regulators should cause minimum head loss.
II. The Head Regulators to dissipate energy satisfactorily.
III. The cross regulators should be able to withstand uplift pressure.
IV. The cross regulators should be able to prevent piping.

Details of lining of canal:
The extension of canal from 41.30 km to 117.50 km will be fully lined. The thickness of 100 mm of lining of canal is as per provision IS-3873. It is also proposed to deploy a HDPE geo-membrane as per provision of IS-9698. The pressure release arrangement as per is 4558:1995 where 30% of canal length will have such arrangement. The above arrangement will have high technical

support as loss of water and failure of lined section will create severe adverse situation in functional component of canal system.

Canal escape:

Eight nos. of canal escapes are proposed in the Kosi – Mechi link project at various reaches. The escapes are provided to avoid surging of water level. These escapes will help to release the excess water into the nearest river or nalla so as to prevent further damage in canal embankment.

Settling basin for trapping of silt:

River Kosi is considered as the highest silt carrying river in India. In the initial reach that RD 1.067 a settling basin is being provided to trap silt for effective functioning of link canal. The velocity flow will be maintained at 0.4m/sec against silt dropping velocity of 0.5m/sec. the settling basin will have a dimension of 1517 X 292m. This is a very important component and its function will be closely monitored and de-silting process will be taken in non-monsoon months when canal flow will be suspended. There is a need to improve the technology further so that trapping of sediment will be effective and the sediment flow into the canal will be minimum.

Command area development (25% Pressurised Irrigation):

The entire ayacut of contour link canal from RD 41.30 km to 117.50 km will be on southern side covering four districts such as Araria, Purnia, Katihar and Kishanganj. In order to reduce the land requirement for distribution system, 25% of ayacut will have pressurized irrigation. The concept of pressurized irrigation will call for latest technology in irrigation. The irrigation water is provided through underground pipe system where certain head at offtaking point is maintained for which meticulous engineering planning will be required.

7.2 SOCIAL IMPACT ASSESSMENT:

Changing land-use patterns are a common cause of problems. Small plots, community land-use rights, and conflicting traditional and legal land rights all create difficulties when land is converted to irrigated land. Access improvements and changes in the infrastructure are likely required some field layout changes and a loss of some cultivated land. The 'loosers' will need to be compensated suitably. The Water Users Association (WUA) as a component of Participatory Irrigation Management (PIM) will be introduced in this project. The local farmers who will be the main beneficiaries will take active role in operation and management in functioning of the Participatory Immigration Management (PIM). This was also recommended by the Advisory Committee of MOWR.

7.2.1 Regional effects of the proposed project:

The socio-economic impacts of the irrigation project will be significant around the project area. A new project will both place demands on the region (marketing, migration, physical infrastructure) and contribute to regional development.

7.2.2 Corporate social Responsibility:

The project intends to participate in the corporate social responsibility programme. 'Corporate' in the instant case, is Government of Bihar who is keen

to improve the socio-economic standard of districts through implementation of a number of development activities. The project will contribute to such beneficial programmes either in operation or activities proposed in future, through funding assistance in its environmental management activities.

Accordingly the irrigation project will be linked to the corporate social Responsibility programme of the State Government in the following areas.

- **Communication Network:**
  This will be developed along the main canal embankment which will be connected to state highways, district roads, village roads and provide a boon to villagers who will have access from main communication network to their villages enroute the road available in Branch canal and distributaries. The total length of new road will be around 448 km.
- **Development of plantation:**
  Canal Bank Plantation, Road side plantation and Greenbelt plantation around the staff colony will be developed which will enhance the aesthetics of the area. The total no of trees to be planted around 253996 nos which will improve aesthetics of area considerably.
- **Farmers Training Programme:**
  Such training programmes through WUA will be conducted for farmer societies of ayacut area regarding operation and maintenance of canal and for proper use of Fertilizers and pesticides. Farmers' participation through WUA will take suitable steps to involve farmers in management by suitable acts/laws drafted in Govt. mechanism.
- **Improvement of Dairy Industry:**
  The livestock population will be immensely benefited due to increased fodder production. This will ensure in increase in milk production and help to set up new dairy industries.
- **Water supply to village Tanks:** A provision will be kept in the budget for assisting pisciculture in project area ponds by releasing excess water from canal to village tanks from its distributaries system.
- **Improvement of overall economic scenario in the region:**
  The trading and marketing facilities will be enhanced due to higher output of food grains as well as demand of fertilizers and pesticides. Necessary support for setting up of market complex and extending trading facilities can be done through CSR support.

CHAPTER-8
PROJECT BENEFITS

8.0 PROJECT BACKGROUND:

The objective of the project is to provide irrigation to the water scarcity areas of Mahananda Basin which is not covered by any project so far except some tubewells. With this objective and strategy for improving agriculture in water scarced areas of Mahananda Basin the Kosi-Mechi intrastate link Project was expedited and expected to be implemented after getting environmental clearance and other clearances from the statutory authorities. Once the project gets environmental clearance as well as other statutory clearances, project implementation will be started. The people of the habitations coming under Mahananda Basin will be covered under this project in Bihar state will certainly be immensely benefitted after completion of this project.

8.1 BENEFIT FROM THE PROJECT:

8.1.1 Increase in Crop Production and Financial Receipt by Farmers:

As per the study conducted for the project it is be seen that all the four districts namely i.e. Araria, Purnia, Katihar and Kishanganj will be immensely benefited from this project. Most of the rural population either farmers or agricultural labourers have taken cultivation as their primary livelihood. From the economic analysis it is seen that cultivation to an assured irrigation potential up to 2.15 lakh ha in Kharif will ensure additional gross crop yield. The detail of extra food grain production and farm receipt are as per below:

Table No.C8-1: Crop wise yield under pre and post project scenarios

S. No.	Name of crop	Pre-Project Scenario			Post Project Scenario		
		Area (ha)	Yield (quintal /ha)	Gross Yield (quintal)	Area (ha)	Yield (quintal/ ha)	Gross Yield (quintal)
A	**Summer**						
B	**Kharif**						
i)	Paddy	101325	18	1823850	103110	50	5155500
ii)	**Pulses:**						
A	Moong	0	0	0	0	0	0
B	Urad	0	0	0	0	0	0
C	Arhar	1123	18	20214	24703	25	617575
Total pulses		1123	18	20214	24703	25	617575
iii)	Vegetables	0	0	0	17185	70	1202950
iv)	Maize(Hybrid)	19581	20	391620	54777	75	4108275

v)	Fodder/Jowar	0	0	0	8592	1000	8592000
vi	Oil seeds & others crops	1111	10	11110	2148	10	21480
	Jute	30451	15	456765	0	0	0
Total kharif		**161688**		**2703559**			**19697780**
D	**Perennial**						
	Pineapple	**1103**	**50**	**55150**			
Total Annual				**2758709**			**19697780**
Total food grain including pineapple				**2301944**	**Total food grain**		**11105780**
Jute				**456765**	**Fodder/Jowar**		**8592000**

Note: The cropping pattern adopted above as per B.C. Ratio. The agriculture Dept. of Bihar have recommended Rabi crop, but the same will be considered subsequently after proposal of Dam is finalized at later stage.

Food security /Crop benefit:

Before irrigation- The total food grain production including perennial pineapple crop comes to 23,01,944 quintal i.e. 230,194.4 MT and Jute crop of 45676.5 MT.

After irrigation- The total food grain production comes to 111,05,780 quintal i.e. 11,10,578 MT and fodder of 8,59,200 MT. Thus the net increase in food grain production after project is 8,80,383.6 MT and fodder of 8,59,200 MT totally 17,39,583.6 MT.

Crops	**Farm produce in MT**		
	Pre-project	**Post- project**	**Increase In Food grain**
Food grains	230194.4	1110578.0	880383.6
Fodder/jowar	-	859200.0	859200.0
Total	230194.4	1969778.0	1739583.6

[Source- DPR]

The Govt. of Bihar in a major boost for upliftment of rural economy attaches higher importance to increase in food production by taking up irrigated agriculture. Thus there will be additional food grain to the tune of 8,80,383.6 MT by this project and fodder to the tune of 8,59,200 MT.

Upliftment of economic status:

Due to increase in food grain production, the socio-economic condition of farmers will improve in general. Agricultural labourers will get employment in the nearby area. Situation of livestock will improve. Farmers will try to establish agro-based industries in the area. The farmers will have monetary gains of about eleven fold compared to prior irrigations.

8.1.2 Income from other sources:

1. Improvement of Livestock population:

Agriculture is the main source of income of the project area. After sufficient increase in grain production there will be enough fodder for livestock population. There will be additional fodder production of 8,59,200 MT by this project. The rural population maintains a large population of livestock for agriculture activities as well as to sustain milk production in rural areas. The improvement in agriculture will enhance substantial increase of milk production.

2. Improvement in fishery production:

Besides agriculture, fisheries are also a source of income in the command area. There are a number of tanks in rural areas for fish production. The link canal ensures certain amount of water to ponds through canal escape and from distribution system. The agricultural development will largely benefit the fishing communities; thereby enhance the income status of rural population.

8.1.3 Development of Communication to Rural Area:

This project will provide new communication as given below:

- Canal bank road i.e. service road will be constructed in the main canal. As per Fig.No.C4-1, the top width in the canal bank is shown as 6.0m. it is suggested to increase the width to 8m. in the right bank, so that the top of the canal bank can serve as service road which can immensely help as communication link to villages in the ayacut.
- Approach road & connecting roads, will also be built new.
- The communication net work will improve immensely in the inaccessible rural areas due to implementation of the project. Significant village roads will be interconnected and linked to the newly created road on canal Bank.
- The total length of new road will be as

  1. Main canal road : 76.20 km.
  2. Branch and distributaries : 277.00 km.
  3. In approach road and colony : 100 km

There will be 28 no. of new road bridges in the extended link canal, of which 3 will be State Highways, 11 no. will be district and other important roads & 17 no. will be village road bridges. All these road bridges will immensely improve the communication system in road areas by linking to the new service road of the East Kosi-Mechi Link Canal System.

8.1.4 Green belt development:

Canal bank plantation will be taken up on both side of canal with two rows of plantation in each side in the link canal project i.e. from RD 41.30 km to 117.50 km covering a length 76.20 km. There will be 86664 no. of new trees in the canal banks

which will improve the greeneries considerably. Besides, plantation will be taken up along the branch canal and distributaries also. Additional plantation will be developed along approach road in new colonies. The new plantation will be covered with suitable species which will ultimately help rural population as well as improve the ecosystem by enhancing greeneries in rural & semi-urban areas.

8.1.5 Water for miscellaneous need:

It is stated that concerned four districts of Bihar state experience water shortage for irrigation as well as for other ancillary need. The project proposal envisages supplementation of water from the canal supply for augmentation of water to drying ponds where pisciculture is practised. The water quality being compatible for bathing and human utilization purposes, a part may be used for domestic utilization. Besides in rural areas the water can be used in sustaining cattle population also.

8.1.6 Employment Generation:

- The project activities will require man power for meeting temporary requirement during construction phase and some skilled persons during the operation phase.
- Most unskilled labourers will get engagement during the construction phase for a period of five years.
- Some unemployed youth with educational background and training experience will be engaged by the project authorities during the operational phase.
- Nevertheless this project will open up avenues for ancillary development like commercial activities.
- Apart from cultivation and agricultural activities some tribal population may adhere to Fish Farming around the command area.
- With enhanced income due to higher crop production, there would be upliftment of social standard. This will encourage people for sending their children for higher education both in the general and technical discipline.
- It would thus provide better employment opportunities.
- There will be increase in trading and commercial activities by marketing of crop production in rural and urban market areas.
- There will be increase in demand of fertilizer and pesticides and rural market centres will be developed for marketing of fertilizers.
- The rice mill in above four districts will be set up to produce finished agri-products like rice and other food grains.
- The rural economy will be considerably benefitted by way of increased food products and ancillary business related to agri-business.

CHAPTER-9

ENVIRONMENTAL COST

9.0 PROJECT COST ESTIMATE:

The total estimated cost of Kosi-Mechi link project works out to Rs. 4900 crore at the price level of the year 2015-16 which includes the cost of Unit-II Canal and canalization including remodeling of EKMC. The budgetary allocation under various subheads has been reflected in the '**Project Cost Estimates**' is given in **Table No**.**C9-1**.

Table No.C9-1: Project Cost Estimate (General abstract of cost)

Sl. No.	**Item(s)**	**Amount Rs. in lakh**
	Direct charge	
I.	Works	
	'A' – Preliminary	6277.80
	'B' – Land	106004.11
	'D' – Regulator	31015.24
	'F' – Cross Drainage Works	50926.54
	'G' – Bridges	101180.71
	'H' – Escape	1696.37
	'K' – Buildings	3186.00
	'L' – Earthwork including canal lining	166156.35
	'M' – Plantation	62.00
	'O' – Miscellaneous	990.00
	'P' – Maintenance	2949.60
	'Q' – Special T and P	378.00
	'R' – Communications	16654.96
	'U' – Distributaries, minors and sub-minors	10311.00
	'V' – Water courses	4833.00
	'W,X' – Environment and ecology including drainage	16126.00
	Total I – Work	427747.68
II.	Establishment	32174.36
III.	Ordinary Tools and Plants	4277.48
IV.	Deduct receipt and recoveries	(-)736.41
	Total direct charges	463463.10
V.	Indirect charges	26525.23
	Grand total	**489988.33 Say 4900 CRORE**

[Source- DPR]

9.1 BENEFIT COST RATIO:

This is an exercise normally undertaken to ensure the economically viability of project. The EKMC project being designed as Irrigation project, the project is being executed solely to provide irrigation and thereby enhance crop production. It has been established as per calculation below that crop production after irrigation will increase substantially compared to pre-irrigation. The benefit cost ratio thus works out as 2.4.

	Receipt& expenses	**Rs. In Lakhs**
After irrigation	Gross receipt	226104.40
	Dung receipt	6783.13
	Total	**232887.53**
	Expenses	(-) 72474.52
	Net benefit	**160413.01**
Before irrigation	Gross receipt	45263.65
	Dung receipt	1357.91
	Total	**46621.56**
	Expenses	(-) 32356.23
	Net benefit	**14265.33**

[Source- District Census Handbooks]

Note: The benefit before irrigation of Rs.14265.33 lakhs will increase to Rs.160413.01 lakhs i.e. about 11 times in monetary value.

The net gain for this project:

Value after irrigation= Rs. 160413.01

Value before irrigation = Rs. 14265.33

Net benefit =Rs. 160413.01 - Rs. 14265.33

=Rs. 146147.68

Total Annual Cost (like interest, depreciation, maintenance) = Rs. 61008.28

Hence, the **Benefit Cost Ratio**= Rs. 146147.68 / Rs. 61008.28 = **2.3955**

The computed BC Ratio of Kosi-Mechi intra link project is 2.4.

9.2 ENVIRONMENTAL COST ESTIMATE:

The environmental cost estimate has been framed on the basis of budgetary allocation made in the relevant subheads. Estimate of Environmental cost is a strategic imperative for amelioration of environment. This forms as a guideline for monitoring of activities both during the construction stage as well as post project implementation period. The environmental cost includes projected expenditure for environmental management; up-gradation and safeguard measures discussed in various chapters and are furnished in **Table No.C9-2**, charted out below.

It is agreed that tangible environmental benefits and costs cannot be accurately translated in to economic terms due to absence of appropriate methodologies. Hence estimation of cost for environmental appraisal includes cost involved for implementing the Management plans, monitoring activities and environmental safeguard measures.

The amount estimated for various environmental issues are mostly provided in the budgetary allocations.

Table No. C9-2: Estimation of cost for Amelioration of environment

Sl.No.	Item	Qty.	Unit	Rate (Rs.)	Amount (Rs. in Lakh)
1	**Provision of free fuel to Labourers**				
	Labour engaged departmentally, fuel is to be supplied at subsidized rates to avert biological loss			L.S.	16.35
2	**Ground Water Management**				
	Digging of tube wells	200	No.	40,865	81.73
	Cost of tube wells including motor & other equipment				
	Modelling and conjunctive use studies			L.S.	4.09
3	**Implementation of Public health Management**				
	Labour camps proposed at link canal 6 Nos.				
	Sanitation facilities to camps			L.S.	14.71
	Sewage & Waste water Management			L.S.	49.04
	Protected drinking water supply measures along link canal			L.S.	817.34
	Protected drinking water supply to labour camps			L.S.	24.52
	Mobile unit and sanitary measures			L.S.	81.73
	STD/HIV/AIDS control			L.S.	24.52
	Cooking sheds			L.S.	14.71
	Public health and health delivery system			L.S.	490.40
	Baby care centres			L.S.	9.81
4	**Environmental Monitoring Programme during construction phase (5 years):**				53.80
	Training of project staff & contractor's staff				7.50
	On site Farmers training				2.00
	Drainage				12751.09
	Environmental Monitoring Programme during construction phase (3 years)				4.56

Sl.No.	Item	Qty.	Unit	Rate (Rs.)	Amount (Rs. in Lakh)
5	**Environmental Monitoring Programme during (Operation Phase):**				
	Land use pattern (operation phase)				8.17
	Soil erosion and siltation (operation phase)				40.87
6	**Management in Irrigated Area**				
(a)	Borrow area management				**1628.52**
(b)	Weed inspection management				
(c)	Fertiliser pesticide management				
	Total Environment and Ecology Cost (Ref W,X of above table)				**16126.0**

Grand Total estimation of cost for Amelioration of Environment

Sl.No.	Item	Qty.	Unit	Rate (Rs.)	Amount (Rs. in Lakh)
1	**Provision of free fuel to Labourers**				
	Labour engaged departmentally, fuel is to be supplied at subsidized rates to avert biological loss			L.S.	16.35
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	Digging of tube wells	200	No.	40,865	81.73
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Sl.No.	Item	Qty.	Unit	Rate (Rs.)	Amount (Rs. in Lakh)
4	**Environmental Monitoring Programme during construction phase (5 years):**				53.80
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	Land use pattern (operation phase)				8.17
	Soil erosion and siltation (operation phase)				40.87
	Environmental Monitoring Programme during construction phase (3 years)				4.56
6	**Management in Irrigated Area**				
(a)	Borrow area management				**1628.52**
(b)	Weed inspection management				
(c)	Fertiliser pesticide management				
Total Environment and Ecology Cost (Subtotal (A))					**16126.00**
	Plantation				62.00
	Escape				1696.37
	Communication				16654.96
	Subtotal (B)				**18413.33**
	Grand Total estimation of cost for Amelioration of Environment (Subtotal (A) +(B))				**34539.33/-**

Analysis

- The Project Cost is **Rs. 489988.00 Lakhs**
- Estimated Cost for amelioration of environment **Rs. 34539.33 Lakhs**
- Percentage of Environment Cost is to total Project Cost works out to be **7.05%**

CHAPTER-10
ENVIRONMENTAL MANAGEMENT PLAN

10.0 INTRODUCTION:

For Environmental Management Plan (EMP), prepared against potential environmental and social impacts, this study document equips the project proponent to effectively address the environmental concerns of the project spread throughout the project cycle i.e. planning, execution and operational phases. For better effectiveness of the project Management, a well developed Environmental Management Plan [EMP] has been prepared after adequately strengthened by a carefully structured Environmental Monitoring Action Plan [EMoAP]. The plan formulation, associated approach and methodology as well as implementation strategy etc are described in the following paragraphs.

10.1 POLICY & LEGAL SUPPORT FOR ENVIRONMENTAL MANAGEMENT PLAN:

In a broader perspective in preparation of Environmental Management Plan, all the action and activities must confirm to the National Environment Policies, as any violation of above may have serious implication in execution. The project authorities must acquaint and converse themselves with few important National Policies as well as some important Bihar State Policies while executing the project.

National Environment Policy & Act

1. Environment Protection Act - 1986
2. Environment Protection Rules - 1999
3. National Environmental Policy, 2006 and amended there after
4. Formation of Expert Appraisal Committee (EAC) at MoEF&CC for category "A" schedule project & formation of SEIAA for Category "B" schedule project.

Further this project will be guided by Forest Conservation Act' 1980 and amendment there after & Wildlife Conservation Act' 1972, in case forest & wildlife component is involved.

For land acquisition & Rehabilitation National Policy' 2003 along with State Policy of R&R Bihar need to be addressed to look after loss of land & rehabilitation if required.

All the Environment Management Plans prepared for this project have also been duly examined that all activities remains within the framework of the above policies.

10.2 OBJECTIVE OF THE ENVIRONMENTAL MANAGEMENT PLAN [EMP]:

The objective of the Environmental Management Plan [EMP] is to minimise the stress on the existing eco-system while ensuring the Socio-Economic living standards of the people especially the poor & vulnerable groups.

In the present context, a site specific management plan has been prepared not only to improve the environmental conditions but also to mitigate the adverse

impacts on quality of life of affected families. Thus the EMP is designed by taking Design stage, Construction Stage and Operation Stage into consideration. Those considerations at each stage are given below;

Design Stage

- To keep land acquisition at a minimum
- To provide maximum safety to the communities
- To develop a design that incorporates environmental safeguards and
- To provide mitigation measures to all expected environmental degradation

Construction Stage

- To prevent and reduce the negative environmental impacts of the project by implementable mitigation measures, to be carried out by the executing agencies.
- To ensure that the provisions of the EMP are strictly followed and implemented by strengthening implementation arrangements.

Operation Stage

- To prevent deterioration of environment components of air, water, soil, noise etc.

Environmental Management Plan (EMP) thus comprises of two distinct components.

- Formulation of EMP
- Implementation of EMP

10.2.1 FORMULATION OF EMP:

This part takes care of the following initiatives/activities.

1. Preparation of the Management Plan:

- The engaged team of experts from Environmental disciplines have acted to transcribe baseline information's into positive and reduce negative impacts, followed with appropriate mitigation measures.
- Care has been taken to chart out the management methods in due compliance with the policy, Acts and Local legislation of the state.
- Most management methods, especially against critically impacted areas are quantitatively enumerated as far as practicable with frequency of occurrence and estimated cost.
- The project authorities are required to rationally incorporate the environmental and social management costs in the project cost estimate and ensure budgetary provision/annual outlay for subsequent implementation action.
- In the process, all management interventions are to be scrupulously integrated with the items of work inter-alia execution of works either through private contract agency or departmentally.

- The critical environmental components of the project were identified on the basis of the assessment of the potential impacts due to the proposed project and activities. These issues are addressed carefully in the Environmental Management Plan.

2. Components Considered in the EMP:

Based on the Identification of Environmental Impacts during EIA study and their mitigations measures a site specific Environmental Management Plan has been developed.

In the process the management interventions are considered for three recognised phases of the project cycle; i.e.

- EMP for Design and preconstruction Phase
- EMP for Construction Phase
- EMP for Post-construction/Operation Phase

[A] EMP Components Design and Preconstruction Phase:

- Acquisition of Private Land, confirming to the Bihar Land Acquisition Act and providing compensation or otherwise as detailed in law.
- Tree felling in the areas where from the canal work will start and take cognisance of Forest Act.
- Establishment of construction workers camp
- Establishment & Operation of Concrete Batching plants, etc.

[B] EMP Components of Implementation/ Construction Phase:

- Borrow area operations
- Quarry operations
- Land Contamination
- Soil erosion, Loss and contamination of Top Soil
- Management of Water Environment
- Management of Air Environment
- Management of Noise Pollution
- Monitoring of Environmental Attributes
- Waste Management (Solid Waste & Effluent from site)
- Management of Ecology
- Risks, Accidents & Safety Management
- Occupational Health & Safety Management
- Camp site management
- Restoration of impacted public utility services

[C] EMP Components of Post Implementation/ Operation Phase

- Performance Monitoring
- Safety during Project Operations
- Operation in canal safety and management
- Effective communication network

10.2.2 Implementation of EMP:

Implementation part of the management Plan includes the following considerations.

- Organisational Support
- Implementation Strategy

10.2.2.1 Organisational Support:

Conforming to the Policy Guidelines, the Project Authority (SWRD) is required to consult the line departments of state for preparation of the management plan.

Some such instances of associations are:

Issues	Line Departments
• For Land Acquisition matters associated with EMP	- The District Collector, Rehabilitation Resettlement Officer as well as other District Law & Order Authorities.
• For pollution control issues	- State Pollution Control Board.
• For health delivery in workers colony, labour camp and resettlement colony.	- Department of Health. - District Health Officer.
• For fishery development	Directorate of Fisheries District level officers

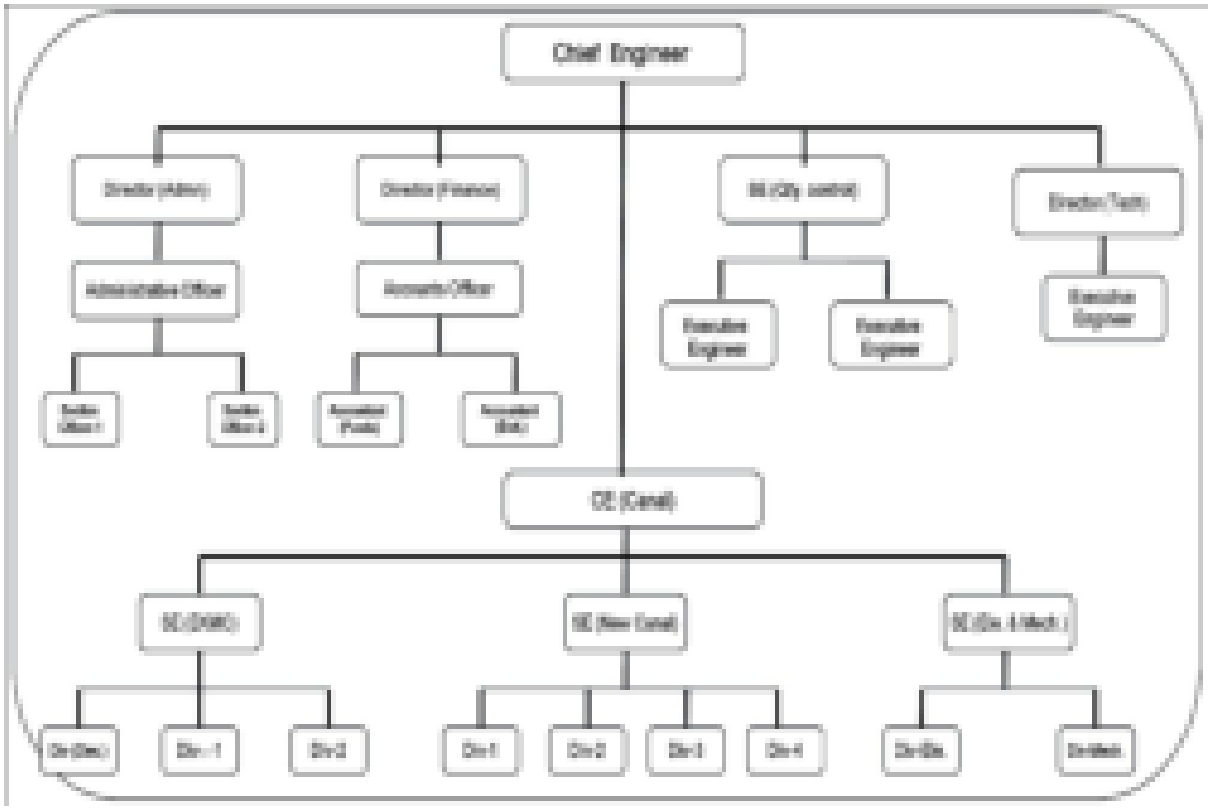
I. Institutional Arrangement for Implementation of EMP:

The project will be implemented by robust organisational setup of the State comprising of the administrative authorities of State Water Resources Department (SWRD) and Technical experts – Chief Engineer and Engineers of EKMC Project.

II. Organogram of the Project Authority:

The present Organisational structure of Kosi-Mechi Intra-State link project is furnished below.

Organisation chart of Kosi-Mechi Intra State link project



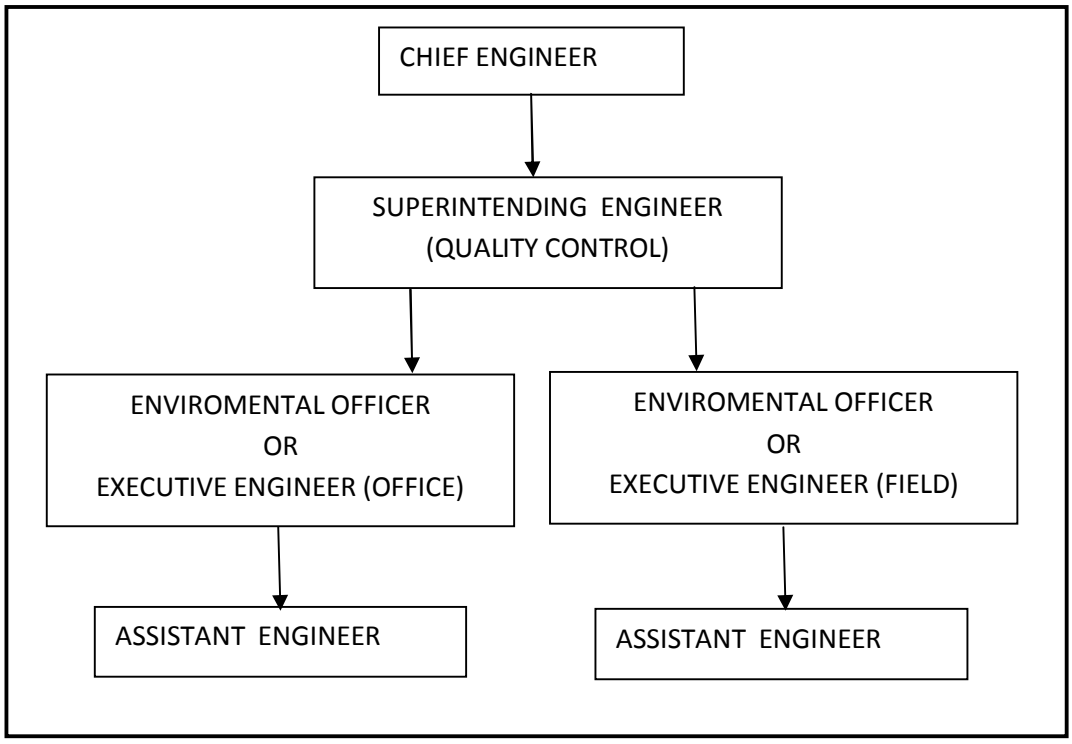
III. Administrative Setup for Monitoring Work:

Formation of monitoring Unit:

- For implementation of EMP, it is recommended to set up a separate and independent unit at the project level under direct control of the Chief Engineer of the Project. This unit hereafter is mentioned as Environmental and Social Management Cell (**ESMC**).
- The cell will be responsible for overall Implementation of EMP, coordinating and liaisoning with government organization with respect to different environmental and social issues and also responsible for progress of monitoring of Environmental safeguards during project execution and submission of quarterly/ annual report on EMP.
- The project authorities may place an officer of Superintending Engineer (SE) rank for overall supervision of implementation of environmental and social management plan, who is familiar with the project activities as well as environmental and social issues.
- In the event of implementation of the project, in the present organogram the Superintending Engineer (Quality Control) will head the ESMC with addition of two Environmental Officers of Executive Engineer cadre or Divisional Engineers having adequate knowledge in environment or to be trained on environment and staff to Monitor Environmental Management Plan & Pursue the Resettlement Action Plan (RAP). One of these Environmental Officers or Executive Engineers will look after office work and the other will be responsible for field. Each of them will be assisted with Assistant Engineer to carry out the monitoring task.

- The **ESMC** may include officials from external agencies/ other line departments of different disciplines who may carry out monitoring of environmental and social aspects independently and report to the supervising head. The officials of the **ESMC** should be adequately trained about the programme structure, social and environment activities associated with the project.
- Indicators for monitoring and evaluation should be charted out from the proposed **Environmental Monitoring Action Plan (EMoAP)** concerning implementation and post-implementation stages.

IV. Structure of ESMC:



Placement of an Environmental and safety Officer by the Contractor: The Contractor has to recruit an environment and safety officer.

V. The Roles and responsibility:

The Roles and responsibility of implementation and Supervision Agencies at different levels have been defined in **Table No. C10-1.**

Table No. C10-1: Roles and Responsibility of Implementing Agency /Organisations

Project Authority	ESMC	Contractor
• Obtain statutory clearances. • Liaisoning with different regulatory authorities • Joint verification to be carried out by Project Authority with ESMC, Contractor Env. Officer. • Overall Supervision of implementation of EMP • Review of all the records and keeping records of all consents/ permits/ licenses obtained by contractor. • Compilation of Data relating to implementation of EMP. • Approval of plans prepared by contractor	• Assist and advise the Project Authority in matters relating to environment and social matters. • Environmental monitoring through approved Laboratory. • Part of Joint Verification Exercise to be carried out such as Third Party Auditing, review of EMP for modification (if required) • Supervise implementation of EMP by contractor • Develop Good Practices of construction guidelines to assist contractor in implementation of EMP • Conduct Consultations programs with the stakeholders on regular basis to get first hand information on the inconvenience caused due to contractor's activities such as noise, debris disposal etc. • Maintain Environmental reporting system	• Joint Verification Exercise including, ESMC/ Project Authority for review of EMP • Interaction with ESMC • Contractor's Environment & Safety officer will be primarily responsible for implementation of EMP • Filling of Reporting Format and submitting to ESMC • Monitoring through approved agency. • Preparation of various plans for effective implementation of EMP as detailed out in EMP and submitting it for approval to ESMC • Identification of Sites for Labour camps, Batch Mix Plant, debris disposal etc • Day to day monitoring of implementation of Environmental Safeguards.

The role and responsibilities of Environmental personnel at different levels will be as follows:

Table No. C10-2: Roles and Responsibilities of Environmental personnel at different level

Position	Roles & Responsibilities
ENVIROMENTAL OFFICER OR EXECUTIVE ENGINEER (OFFICE) of ESMC	• Co-ordinate, formulate all action required for Environmental activities conforming to National & Bihar State Policies & Law. • Do liaison with MoEF&CC & Bihar Pollution Control Board for compliance. • Coordinate and organise the training and capacity building initiatives. • Participate and facilitate in consultations with stakeholders • Participate in project meetings and report on the issues related to environmental management to provide for any mid-course corrections that may be required based on situation on the ground. • Addressal of environmental grievances received from public or other stakeholder. • Review contract documents to ensure that EMP provisions related to works are included in the contract documents. • Assist the Project Authority to follow-up with state government departments. • Prepare checklists/formats/reports, etc. for implementing each of the activities as per the EMP and share with team members. • Conduct regular monitoring of the implementation of the EMP by the Contractor and will prepare monthly or quarterly and annual monitoring reports on EMP implementation in compliance with environmental clauses of Contract Agreement. • Responsible for record keeping, providing instructions to the field representatives for corrective actions. • Ensure compliance of various statutory and legislative requirements and monitor the entire system and report to Superintending Engineer.

Position	Roles & Responsibilities
ENVIROMENTAL OFFICER OR EXECUTIVE ENGINEER (FIELD) of ESMC	• To ensure that all actions in pre-construction, construction and post construction phases are confirm to environment standard. • Liaison with executing agencies to ensure all activities confirm to Environmental Policies & Law. • Inspect periodically all important structures to prevent failure & accidents. • Will be in charge of execution and supervision & inspect all activities at the field to confirm to the Environmental Guidelines. • Coordinate and organise the training and capacity building initiatives. • Develop project specific EMP for the entire project. • Oversee and report to the Project Authority on implementation of EMP provisions included in the works contract for each sub-project. • Act as a resource person in trainings, based on experience on implementing this project and previous relevant work. • Responsible for providing technical guidance to the Contractor for implementation of the EMP
Contractors' Environmental and Safety Officer	• Carry out the implementation of EMP measures included in the Contract. • Report on progress and shortcomings of the measures implemented to Environmental Specialist of ESMC. • Provide monthly compliance to Superintending Engineer and reporting about Environmental activities at field. • Shall be directly responsible for implementation of environmental safeguards at different locations of construction. • Shall ensure compliance of the instructions given by the head of ESMC. • Shall maintain close interaction with ESMC and his Field Representative and seek instructions and guidance from ESMC's Environmental Expert on any issue related to implementation of environment and safety measures. • Shall be responsible for record keeping, and reporting to the ESMC.

Position	Roles & Responsibilities
	• Shall also give in-house training to the workers on environment and safety maintaining the record of day to day monitoring of environmental and safety issues at site.

VI. The Reporting System of Environmental Monitoring:

Monitoring and evaluation are important activities in implementation of all projects. Monitoring involves periodic checking to ascertain whether activities are going according to the plans. It provides the necessary feedback for project management to keep the programme on schedule.

The contractor's Environment & Safety Officer will prepare monthly report of environmental safeguards and safety data along with monthly progress report which will be verified by concern Assistant Engineers and forward to the executive Engineer. The Executive Engineer or Environmental Officer OF ESMC in the field will prepare quarterly and annual environmental monitoring reports for onwards submission to Superintending Engineer which shall be recorded in standard format for convenience of review.

The reporting system will operate linearly from Environment & Safety Officer of the Contractor to the Assistant Engineer, who will submit to the Executive Engineer, ESMC. The Executive Engineer will pass on the report to the Superintending Engineer, Quality Control who will then forward the reports to the Project Authority or Chief Engineer.

Reports derived from analysis of monitored results, appropriate suggestions should be discussed in the project level Environmental Management Committee and appropriate action suggested for implementation.

10.2.2.2 Implementation Strategy:

It is already stated that, implementation of Environmental Management Plan against environmental degradation and disaster risks are to be integrated with the sustainable development frame work and to be carried out conjunctively. Besides the organisational preparedness, the approach technique prioritises the following few aspects:

- Availing of approval / clearances from competent authorities.
- Ensuring smooth fund flow with adequate budgetary support.
- Public consultation (Project Affected People and stakeholders).

(i) Obtaining approval/clearances from Competent Authorities:

In conformity with Acts Rules & Regulations, prior permission/clearance from the appropriate / competent authorities is necessary before commencement of the construction activities. Some of the important items are mentioned below in **Table No. C10-3**:

Table No. C10-3: Statutory permissions and clearance on Environmental Issues applicable in the project

SL No.	Activities / Issues	Clearance/Permits/ Licenses Required	Regulatory Authority
1.	Identification of Govt. Land for Solid waste disposal	• Land alienation • Authority from local administration	• Tahasildar of the Locality • State pollution control Board
2.	Land required for some project activities like approach Road Haul road etc.	• Acquisition of land as per standard procedure	Revenue Authority (Collector) of the district
3.	Establishment of Batching Plant	• NOC (Consent to Establish and Consent to Operate)	State pollution control Board
4.	Engagement of Labours	Labour License	District Labour Commissioner

I. Institutional Strengthening:

For successful implementation of EMP, Institutional strengthening becomes an essential requirement. The implementation of EMP starts from the smallest unit i.e. at project site workers group and spreads upward to the Division level. The Project Authority should properly coordinate at all operative levels so as to improve the management efficiency. Institutional strengthening may be done through capacity building.

II. Environmental Awareness and Capacity Building:

Effective implementation of the project with social and environmental compliance would largely depend on the Institutional/Organisational capacity building as well as Training of the engineers and associated resource personnel for skill development. In this score, cultural sensitivity, Group dynamics, conflict resolution skill and ability to work with the user population are as important as the engineering proficiency already held by the state officials.

In this respect, the State Water Resources Department (SWRD) needs to associate other line departments, institutions and some social, environmental specialists.

Awareness development and training of personnel involved in the project implementation thus would ensure capacity building, an essential component of the management plan.

The following activities are required to be incorporated in the Management procedure along with its cost and scheduling.

A. Awareness Programmes:

It is to develop awareness for need of environmental compliance while executing the project activities; understand properly the socio-economic dynamics prevalent in the region and communicate message through larger cooperation from people in the effective implementation of EMP.

The engineering personnel of the water Resources Department, associated staff of the Line Departments, stakeholders of the project as well as the elected representatives needs to be sensitized regarding the importance of social and environmental issues.

The State Government in the Department of Water Resources should arrange number of workshops to propagate urgency and awareness of the project requirements. It should be linked with site visit and deliberations by Social and environmental specialists from recognized institutions/ credible organisations. Such programme would eradicate doubts of the people ease out stringent attitude of project affected people and ensure better co-operations.

B. Capacity Building/ Training:

Systematic training initiative is the key input for enhancing the capacity of human resources. Engineering personnel and staff to be deployed for the project implementation need to undergo training for upgrading their knowledge and technical skills for performance innovation. Simultaneously, effective training programmes should be opted for organisation motivation.

Approach:

- It thus entails a training module that comprises;
  - Training of the DoWR field staff
  - Training of the existing administrative personnel
  - Training of the Contractor and Project staff
- ESMC to organise Training of Trainers Programmes in the existing training centres of the State.
- The trained officials would arrange number of training programme for junior level field officers and staff at the Divisional level.
- Expenditure for conducting Awareness and Training programme would be incorporated in the appropriate subhead of Project cost estimate.

Strategy for capacity building:

- The training and capacity building strategy should form an integral part of the management procedure.
- Such activities should commence from the planning stage and evenly spread during the implementation phase.
- A schedule for capacity building activities should be drawn to facilitate effective implementation.

However, a sample schedule is proposed below for different official involve in project implementation.

Table No. C10-4: Schedule for Training & Capacity Building Strategy:

Module	Title	Objectives	Time of Training	Duration (Day)	Level	Participants	Budgetary Provision (Rs.)
1	Concept of Environmental and Social Management	• Brief on latest environmental legislations • Implementation, Supervision and Monitoring Mechanism • Provision made in Contract Documents	Before awarding contracts	2	State	Project authority and line units of EIC (WR)	250000
2	Orientation Workshop on Environment and Social Management	• Environment and Social Management requirements • Implementation, Supervision and Monitoring Mechanism • Roles and Responsibilities of Contractors and Engineers of Project Authority • Identification of Environmental and social issues • Preparing mitigation plans	Pre-construction stage (when contractors are mobilized)	2	State	Project Authority, Executive Engg. /AEE/AE, Contractors and Third Party Monitoring Agency	250000

3	Focused Training on Specific Issue/s	• Analyzing problems, referring stipulations in Contract and EMP and agreed to feasible solution within specified timeframe • Procedure for implementation of EMP provisions during construction stage • Procedures for record keeping and reporting on status of EMP compliance • Issues relating to wage parity, child labour, etc.	During construction, as and when needed.	1	Project	Project Authority, Contractors and Third Party Monitoring Agency	150000
4	EMP Implementation during construction stage	To understand the requirement of EMP and its implementation during construction stage of the project road. Good and bad practice of EMP during construction stage of the project	During Construction stage	1	Project	Contractor's staffs.	100000

10.3 RECOMMENDATIONS:

- Training and awareness programme on effective management of EMP should be extended to officials of the administrative department including representatives from the line department in limited workshops.
- All field engineers of the project irrespective of the rank and positions should attend the training and capacity building programmes.
- Public and stakeholders participation should be encouraged on the ground of ethics and pragmatism, if nothing else.
- The budget for monitoring activities, training and capacity building aspects should be reviewed for upgradation, if necessary.

CHAPTER – 11
SUMMARY & CONCLUSION

11.0 PROJECT BACKGROUND:

The Govt. of India took a very important decision in the year 2004 to make a comprehensive study of interlinking of rivers in India, to harness the Water resources potential of the country to benefit the areas which have immense potential to develop agricultural activities significantly to the Food production as well as development of under developed areas. The Govt. of Bihar readily consented to the proposed and accordingly NWDA took up the detailed study of extending the interlinking of EKMC canal from 41.30 km to 117.50 km joining River Kosi with Mechi which flows within Bihar state. After completion of NWDA Report and subsequent compliance to CWC comments, the project was put up in the advisory committee of MoWR where in the project was duly approved for implementation after getting approval from all statutory organization. Subsequently the project was put up before the 96th meeting of Expert Appraisal Committee of MoEF&CC on 11th-12th Aug 2016, where the project was favorably considered and approved ToR was communicated to Govt. of Bihar on 23rd Sept' 2016 for taking further action in the matter. The preparation of EIA & EMP report is a primary requirement for taking up of necessary action like Public Hearing and submitting final EIA document with observation of Public Hearing to MoEF&CC for obtaining Environment Clearance.

Project Proponent:

The proposed project will be developed by Water Resource Department Government of Bihar and the project falls under Water Resources Department Government of Bihar. The Project Proponent is Engineer-in-Chief (HQ), Water Resources Department, Government of Bihar.

Project Location:

The Kosi-Mechi Intrastate link project, an extension of EKMC is located in northern part of Bihar state and more or less parallel and close to Indo-Nepal international border. This canal runs through the Supaul, Araria and Kisanganj districts up to river Mechi running for a distance of 117.5 km. It originates from Kosi river in west and merge with Mechi river on east. The link canal forms the northern boundary of ayacut while river Parman and river Mahananda form the western and eastern boundaries. In south it is spread up to river Ganga. This project will provide irrigation to water scarced Supaul, Araria, Purnia, Katihar & Kishanganj districts of Bihar. Nearest Town from the head works (Existing Hanuman Nagar Barrage) is Hanuman Nagar in Nepal and Birpur in India and distance is approximately 8.50 & 6.0 Km respectively.

11.1 THE PROJECT SUMMARY:

- The Kosi-Mechi Link canal Project envisages diversion of part of surplus water of Kosi river through existing Hanuman Nagar barrage (Birpur) to Mahananda basin. Main components of the project involve remodeling of existing EKMC up to 41.30 km and

construction of a new canal from RD 41.30 km to 117.50 km long. The FSL of link canal at head is 74.371 m and at tail end is 54.239 m.

- The water available at Hanuman Nagar barrage (Birpur) will be diverted through a 117.50 km long link canal to Mahananda basin and for enroute utilization. In this entire length of the canal 14 syphon aqueduct, 9 canal syphon, 10 cross regulator, 27 head regulator, 9 pipe culverts, 1 settling basin and 43 road bridges and 8 escapes are required to be constructed.
- The aim of extension of EKMC up to Mechi river is mainly to provide irrigation benefits to Gross Command Area of 275135 ha. (2.75 lakh ha), of which Culturable Command Area is 214812 ha (2.15 Lakhs ha) in the water scarce Mahananda basin command in the districts of Araria, Purnia, Katihar and Kishanganj during kharif season depending upon the pondage available in Hanuman Nagar barrage (Birpur).
- Since river Kosi is an international river, an agreement was signed between the then His Majesty's Government of Nepal and The Government of India signed an agreement on 25th April 1954 for implementation of Kosi project. So Indo-Nepal treaty will not be affected.
- The agreement between Govt. of Bihar and Govt. of West Bengal is also not violated by this interlinking project as water resources of Kosi river is being utilised.
- The river Kosi is a tributary of river Ganga. There is an agreement between Govt. of India and Govt. of Bangladesh on Ganga water sharing and to maintain a minimum flow in Ganga at Farakka in lean season. Since the diversion of Kosi water through Kosi – Mechi intra state link canal is proposed only in kharif season, therefore the Indo-Bangla treaty will not be affected.
    - **Projected crop Benefits**
        - Pre-project Farm produce =230194.4 Tonnes/Annum
        - Post-project Farm produce =1969778 Tonnes/Annum
        - Crop benefit =1739583.6 Tonnes

11.2 SUMMARY OF ENVIRONMENTAL IMPACT ASSESSMENT:

1) **Submergence:** No submergence is caused due to the project, as water will be lifted from the existing Hanuman Nagar Barrage (Birpur).
2) **Displacement of population**: There is no displacement of population as no new submergence is caused.
3) **Displacement of Tribal population:** There is no displacement of tribal population by this project.
4) **R&R problem**: This project does not attract any R&R problem.
5) **Land Acquisition**: Total private land of 1396.81 ha is required. Out of this 632.23 ha has already been acquired and rest 764.58 ha will be acquired from villages for canal construction spread over in a length of 117.50 km of canal.

Thus there will be no concentrated patch of land for acquisition but spread over in large number of villages. However, the land required for branch canal, distributaries & watercourse will be finalized after the survey on the area is finalized.

6) **Forest loss**: No forest land is involved in this project.

7) **Flora & Fauna**: As no forest is involved no concentrated felling of trees will be undertaken. No endangered flora species will be affected. No disturbance of fauna will be caused due to the project. No rare, endangered and threatened species of flora and fauna will be affected.

8) **Encroachment to sanctuary, wildlife reserve & migratory path corridor etc:** No encroachment to any sensitive areas being taken up as project is located far beyond the permissible distance. There are no migratory paths of animals in the alignment of proposed canal project.

9) **Air & Noise pollution**: This being a canal project, no emission or noise disturbance is caused due to the project. Some noise may occur in construction site during limited period of construction.

10) **Water quality**: There is no danger of pollution of water quality as no effluent is generated. However in the long run effect of fertilizers and pesticides may appear on the water stream and these effects may be marginal.

11) **Soil quality**: Due to use of excess fertilizers and pesticides soil quality may marginally undergo change.

12) **Drainage:** As the main canal runs for a length of 117.5 Km, there is some impact due to interception of large number streams, nallas and River on its alignment. But Natural course of the drains will be maintained through construction of Cross drainage structures.

13) **Health:** There will be certain impact on health during two periods i.e. during construction & post implementation. However, the effect may be marginal and necessary safeguard measures will be taken up to minimize the effect.

    a. **Construction:** There may be certain impact due to insanitation and spread of viral diseases/malaria by laboures engaged in works.

    b. **Post implementation**: There is likelihood of spread of malaria and gastro entities diseases.

11.3 ENVIRONMENTAL MANAGEMENT PLAN:

A. Management Plan: Based on above impact studies the following management plan has been incorporated in the environmental report of the project.

1. **Water Quality**: 15 nos. of samples have been collected from different water bodies. The test report can be seen in chapter 3 Table No. C-3.16 & C-3.17. .No parameters exceed the permissible limit.

2. **Air & noise quality**: Air and noise quality tests have been conducted and results are shown in Table No.C-3.13 & 3.19 respectively. All are within permissible limit. Certain precautions are to be taken during construction period to maintain ambient air and noise quality.

3. **Soil quality**: Soil samples have been tested in different locations. The results have been shown in Table No.C3-5. This suggests addition of nutrients (NPK) as well as use of FYM, Green manure and bio-fertilizers.

4. **Drainage management**: The main canal will cross many Rivers for which siphon aqueducts have been provided. Including these aqueducts, 113 nos. C.D works will be executed to allow free flow of water.

5. **Fertilizers & pesticides Management**: The problem arising out application of fertilizers and pesticides can be addressed under CADA programme for which farmers training programme as well as soil testing activities will be organized and expert's advice will be made available at Panchayat and village level.

6. **Health Management Plan**: As there is likelihood of some incidence and spread of malaria and diarrhea diseases, the primary health centers and dispensaries need to be strengthened.

7. **Weed Management Plan**: It is likely that certain weed infestation may occur in the main canal. Weed management plan will be taken up for weeding of canal promptly.

8. **Soil Conservation Programme**: Though the project is limited to the water received from Hanuman Nagar Barrage (Birpur) reservoirs, still some treatment in the rim of reservoir can be taken up by way of plantation, with a limited funding.

9. **Plantation programme along the canal bank and in colony area**: There may be certain trees coming in the alignment of main canal which need to be felled. However to add greeneries and improve vegetation to the area three main plantation activities will be undertaken (i) Plantation in vacant areas of existing colony (ii) Canal bank plantation from RD 41.30 km to RD117.50 km and along branch and distributaries canal (iii) colony plantation.

10. **Communication Management**: the main canal length of 117.5 km will improve the communication network for the inaccessible rural areas. Besides village road bridges and foot bridge will be provided in large numbers to accommodate existing crossing of road and for use by nearby villages.

11. **Water logging & command area management**: After introduction of irrigation, there may be water logging in some areas which are prone to higher ground water table. Necessary drainage improvement along with

conjunctive use of irrigation will be introduced in areas prone to water logging.

12. **Borrow area and muck disposal system**: Proper steps will be taken for management of borrow area as well as disposal of muck and solid waste at safe zone.

11.4 PROJECT BENEFIT:

1. **Crop benefit:** There will be substantial increase in crop production after irrigation is introduced. Thus there will be net increase of 1739583 MT of food grain annually. The benefit cost ratio will be 2.4 which is significant monetary management as well as incentive for implementation of this project.

2. **Communication facilities:**
   - There will be newly constructed service road over the Canal embankments. This road will be connected to the existing state highways, district road, village roads where ever the Canal would cross them enroute. Due to this, 76.20 km of new road in canal alignment will be provided.
   - The communication network will improve immensely in the inaccessible rural areas due to implementation of the project. Significant village roads will be interconnected and linked to the newly created road on canal Bank.

3. **Fisheries Development:** Fisheries development can be taken up in some ponds in ayacut area with the help of fisheries Department.

4. **Livestock development:** Due to substantial production of fodder, livestock population will be immensely benefitted.

5. **Training programme for farmers:** Training programme to be imparted to farmers which will educate the farming communities for proper utilization of Fertilizers and Pesticide towards development of agriculture and food production.

6. **Socio-Economic:** The positive impacts of this project are very significant, particularly the increase in food production, communication improvement in rural areas and employment opportunities for the local people.

7. **Plantation programme:** The necessary plantation programme will be taken up as per the present practice alongside the road and around the colony.

8. **Improvement to Trading; setting up industries & employment generation:** The additional crop production will generate rural trading and employment facilities. The setting up of rice mills and fodder units will help to revive the agrarian economy to a great extent.

11.5 CONCLUSION:

Kosi-Mechi intrastate link Irrigation Project is basically a River Valley development project of the state of Bihar. The project envisages construction of a long canal and provides irrigation facilities to 2.15 lakh ha of rain fed and under developed land in the district of Araria, Purnia, Katihar and Kishanganj of the state at an investment of **Rs. 4899.00 Crores.**

No major/medium water resources development projects so far exists in these areas. In absence of assured irrigation water supply, the high yield verity of paddy is not attempted by the farmers. There has been persistent demand from the people of this region to implement the Irrigation project at the earliest which would save them from further economic disaster. Further as no forest land is involved, the project can be implemented early.

There will be no displacement of population and require no exhaustive Resettlement proposals. Private land will be acquired for construction of canals for which appropriate compensation packages according to state R & R policy will be charted out for the owners of such private lands.

From the already briefed summary of EIA and EMP, it is evident that this project will not cause any significant environmental degradation when implemented with its management plan but will provide immense benefit to the backward region of Bihar State.

CHAPTER-12
DISCLOSURE OF CONSULTANTS ENGAGED

M/s. Centre for Envotech and Management Consultancy Pvt. Ltd. (CEMC) is a multi disciplinary & knowledge based company located at Bhubaneswar with specialization in Environmental Clearance, Forest & Biodiversity clearance and GIS application. CEMC has been accredited by NABET in the category "A" vide accreditation committee meeting for Re-accreditation held on 8th September, 2017 and has got eleven sectors and all twelve Functional Areas.

CEMC is competent to carry out all environmental assignments duly with its highly skilled manpower & in-house expertise in the field and in-house environmental laboratories.

EC'S AND FAE'S INVOLVED IN THE PROJECT

Name of the Project: Kosi-Mechi Intrastate Linked Project

EIA COORDINATOR

Name	Sector No.	Yrs. of Experience	Signature
Er. S. S. Pattnaik	3	42	

FUNCTIONAL AREA EXPERTS

IN-HOUSE			
Name	**Sector**	**Yrs. of Experience**	**Signature**
Dr. B. N. Das	AP, AQ, WP	38	
Er. A.P. Barik	SHW, R&H	38	
Dr. Nihar Ranjan Das	SE, LU	11	
Mr. Debashis Mishra	EB	10	
Mr. Ashutosh Kanungo	Geo, Hg	29	
EMPANELLED			
Er. Sanjeev Sharma	N & V	20	
Dr. Rabindra Kumar Mishra	EB, SC	16	

ANNEXURES

Annexure-1

J-12011/22/2016-IA-I (R)
Ministry of Environment, Forest & Climate Change
Government of India
IA.I Division

Indira Paryavaran Bhawan
3rd Floor, Vayu Wing
Jor Bagh Road, Aliganj
New Delhi – 110003

Dated: 23rd September, 2016

To

Indu Bhushan Kumar
E-In-C (HQ)
Water Resources Department
Sinchai Bhawan
Patna, Bihar - 800 015

Subject: **Kosi-Mechi intrastate link project (Construction of 76.20 km long canal (76.20 km) on the existing barrage beyond eastern Kosi main canal (41.30 km) for irrigation purpose under Kosi- Mechi intrastate link project in the state of Bihar by M/s. Water Resources Department, Govt. of Bihar for fresh Scoping/ ToR – regarding.**

Sir,

This is with reference to your letter No. PMC-4(NADI JODE)16-09/2016-87 dated 15.07.2016 on the above mentioned subject.

2. The said proposal was considered by the Expert Appraisal Committee (EAC) for River Valley and Hydroelectric Projects in its 96th Meeting held during 11-12th August 2016. The comments and observations of EAC may be seen in the Minutes of the meeting are available on the Ministry's web-site.

3. The proposed gross command area of the project and culturable command area are 2.75 lakh ha and 2,14,812 ha (CCA 2.15 ha), respectively spread over in the districts of Araria, Kishanganj, Purnea and Katiharin the state of Bihar. The Kosi-Mechi Link Project envisages diversion of part of surplus water of Kosi River through existing Hanuman Nagar barrage to Mahananda basin. Main components of the project involve remodeling of existing EKMC upto 41.30 km and construction of a new canal from RD 41.30 km to 117.50 km long. The FSL of link canal at head is 74.371 m and at tail end is 54.238 m. The total project cost is about Rs. 4900.00 Crores.

4. Based on recommendations of the EAC, the Ministry of Environment & Forests hereby accords a fresh clearance for pre-construction activities at the proposed site as per the provisions of the Environment Impact Assessment Notification, 2006 and subsequent amendment, 2009 along with following Terms of Reference (TOR) for preparation of EIA/EMP report. The EIA/EMP report should contain the information in accordance with provisions & stipulations as given in **Annexure-I**. While preparing the EIA/EMP report prevailing norms should be followed with respect to environmental flows and muck disposal sites.

5. The consultant engaged for preparation of EIA/EMP report has to be registered with Quality Council of India/ NABET under the scheme of Accreditation &Registration of MoEF. This is a per-requisite.

6. Consultants shall include a "Certificate" in EIA/EMP report regarding portion of EIA/EMP prepared by them and data provided by other organization(s)/ laboratories including states of approval of such laboratories.

7. The draft EIA/EMP report prepared as per the above Terms of References should be submitted to the State Pollution Control Board/Committee concerned for conducting public Hearing/Consultation as per the provisions stipulated in EIA Notification of 2006. The draft EIA/EMP report is to be submitted to SPCB etc sufficiently before the expiry of the ToR validity so that necessary amendments in EIA/EMP can be undertaken based on public hearing and the same is submitted to MoEFCC before expiry of validity.

8. All issues discussed in the Public Hearing/Consultations should be addressed and incorporated in the EIA/EMP report. Final EIA/EMP report should be submitted to the Ministry for Environmental Clearance only after incorporating these issues before the expiry of validity of ToR.

9. The ToR will remain valid for a period of 4 years from the date of issue of this letter. The ToR will stand lapsed on completion of 4 years time in case final EIA/EMP is not submitted and the validity is not renewed.

10. In case of any change in the scope of the Project such as capacity enhancement, shifting of dam site/ powerhouse and change in submergence etc., fresh scoping clearance has to be obtained by the project proponent.

11. Information pertaining to Corporate Environmental Responsibility and Environmental Policy shall be provided in the EIA/EMP Report as per this Ministry's OM No. J-11013/25/2014-IA-I dated 11.8.2014.

12. The EIA/EMP Report must contain an Index showing details of compliance of all ToR conditions. The Index will comprise of page No. etc., vide which compliance of a specific ToR is available. It may be noted that without this index, EIA/EMP report will not be accepted.

13. The scoping/ToR clearance is being considered by MoEF & CC subject to the outcome of the court order and the project proponent shall be bound by the decision of the MoEFCC arising out of such outcome of court order.

14. In case the validity is to be extended, necessary application is to be submitted at least 3 months before expiry of validity of ToR.

15. This has approval of the competent authority.

(Dr. S. Kerketta)
Director (IA-I)

Copy to:

1. The Secretary, Ministry of Water Resources, RD & GR, Shram Shakti Bhawan, Rafi Marg, New Delhi.
2. The Principal Secretary, Water Resources Department, Government of Bihar, Vidyut Bhawan, Bailey Rd, Patna, Bihar - 800 001.
3. The Chief Engineer, Project Appraisal Directorate, Central Water Commission, Sewa Bhawan, R.K. Puram, New Delhi – 110 066.
4. The Addl. PCCF(C), Ministry of Environment, Forest and Climate Change, Regional Office (ECZ), Bungalow No. A-2, Shyamali Colony, Ranchi – 834 002
5. Member Secretary, Bihar State Pollution Control Board, Beltron Bhawan, Shastri Nagar, Jawahar Lal Nehru Marg, Patna, Bihar - 800 023.
6. PPS to JS(GB)
7. NIC Cell – for uploading in MoEFCC's website.
8. Guard File.

(Dr. S. Kerketta)
Director (IA-I)
Tel # 24695314

TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR 'A' CATEGORY RIVER VALLEY PROJECTS AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

(1) Scope of EIA Study

The EIA Report should identify the relevant environmental concerns and focus on potential impacts that may change due to the construction of proposed project. Based on the baseline data collected for three (3) seasons (Pre-monsoon, Monsoon and Winter seasons), the status of the existing environment in the area and capacity to bear the impact on this should be analysed. Based on this analysis, the mitigation measures for minimizing the impact shall be suggested in the EIA/EMP study.

(2) Details of the Project and Site

- General introduction about the proposed project.
- Details of Project and site giving L-Sections of all U/S and D/S Projects with all relevant maps and figures. Connect such information as to establish the total length of interference of Natural River and the committed unrestricted release from the site of Dam/Barrage into the main river.
- A map of boundary of the project site giving details of protected areas in the vicinity of 25 km of project location.
- Location details on a map of the project area with contours indicating main project features. The project layout shall be superimposed on a contour map of ground elevation showing main project features (viz. location of dam, Head works, main canal, branch canals, quarrying etc.) shall be depicted in a scaled map.
- Layout details and map of the project along with contours with project components clearly marked with proper scale maps of at least 1:50,000 scale and printed at least on A3 scale for clarity.
- Existence of National Park, Sanctuary, Biosphere Reserve etc. in the study area, if any, should be detailed and presented on a map with distinct distances from the project components. Drainage pattern and map of the river catchment up to the proposed project site. Delineation of critically degraded areas in the directly draining catchment on the basis of Silt Yield Index as per the methodology of Soil and Land use Survey of India.
- Soil characteristics and map of the project area.
- Geological and Seismo-tectonic details and maps of the area surrounding the proposed project site showing location of dam site and canal sites.
- Remote Sensing studies, interpretation of satellite imagery, topographic sheets along with ground verification shall be used to develop the land use/land cover pattern of the study using overlaying mapping techniques viz. Geographic Information System (GIS), False Color Composite (FCC) generated from satellite data of project area.
- Land details including forests, private and other land.
- Demarcation of snow fed and rain fed areas for a realistic estimate of the water availability.
- Different riverine habitats like rapids, pools, side pools and variations in the river substratum - bedrocks, rocks, boulders, sand/silt or clay etc. need to be covered under the study.

(3) Description of Environment and Baseline Data

To know the present status of environment in the area, baseline data with respect to environmental components air, water, noise, soil, land and biology & biodiversity (flora & fauna), wildlife, socioeconomic status etc. should be collected within 10 km radius of the main components of the project/site i.e. dam site and power house site. The air quality and noise are to be monitored at such locations which are environmentally & ecologically more sensitive in the study area. **The baseline data should be collected for 1 season.** The old data available for the existing shall be used preparation of EIA/EMP report of the project. Flora-Fauna in the catchment and command area should be documented. The study area should comprise of the following:

- Catchment area up to the dam/barrage site.
- Submergence Area.
- Project area or the direct impact area should comprise of area within 10 km radius of the main project components like dam, canals etc.
- Downstream upto 10 km from the tip of the reservoir.

(4) Details of the Methodology

The methodology followed for collection of base line data along with details of number of samples and their locations in the map should be included. Study area should be demarcated properly on the appropriate scale map. Sampling sites should be depicted on map for each parameter with proper legends. For Forest Classification, Champion and Seth (1968) methodology should be followed.

(5) Methodology for Collection of Biodiversity Data

- The number of sampling locations should be adequate to get a reasonable idea of the diversity and other attributes of flora and fauna. The guiding principles should be the size of the study area (larger area should have larger number of sampling locations) and inherent diversity at the location, as known from secondary sources (e.g. eastern Himalayan and low altitude sites should have a larger number of sampling locations owing to higher diversity).

- The entire area should be divided in grids of 5kmX5km preferably on a GIS domain. There after 25% of the grids should be randomly selected for sampling of which half should be in the directly affected area (grids including project components such as reservoir, dam, powerhouse, tunnel, canal etc.) and the remaining in the rest of the area (areas of influence in 10 km radius form project components). At such chosen location, the size and number of sampling units (e.g. quadrates in case of flora/transects in case of fauna) must be decided by species area curves and the details of the same (graphs and cumulative number of species in a tabulated form) should be provided in the EIA report. Some of the grids on the edges may not be completely overlapping with the study area boundaries. However these should be counted and considered for selecting 25% of the grids. The number of grids to be surveyed may come out as a decimal number (i.e. it has an integral and a fractional part) which should be rounded to the next whole number.

- The conventional sampling is likely to miss the presence of rare, endangered and threatened (r.e.t.) species since they often occur in low densities and in case of faunal species are usually secretive in behaviour. Reaching the conclusion about the absence of such species in the study area based on such methodology is misleading. It is very important to document the status of such species owing to their high conservation value. Hence likely presence of such species should be ascertained from secondary sources by a proper literature survey for the said area including referring to field guides which are now available for many taxonomic groups in India. Even literature from studies/surveys in the larger landscapes which include the study area for the concerned project must be referred to, since most species from adjoining catchments is likely to be present in the catchments in question. In fact such literature form the entire state can be referred to. Once a listing of possible r.e.t. species form the said area is developed, species specific methodologies should be adopted to ascertain their presence in the study area which would be far more conclusive as compared to the conventional sampling. If the need be, modern methods like camera trapping can be resorted to, particularly for areas in the eastern Himalayas and for secretive/nocturnal species. A detailed listing of the literature referred to, for developing lists of r.e.t. species should be provided in the EIA reports.
- The R.E.T. species referred to in this point should include species listed in Schedule I and II of Wildlife (Protection) Act, 1972 and those listed in the red data books (BSI, ZSI and IUCN).

(6) <u>Components of the EIA Study</u>:

Various aspects to be studied and provided in the EIA/EMP report are as follows:

A. Physical and Chemical Environment

Geological & Geophysical Aspects and Seismo- Tectonics:

Physical geography, Topography, Regional Geological aspects and structure of the Catchment.

- Tectonics, seismicity and history of past earthquakes in the area. A site specific study of the earthquake parameters will be done. The results of the site specific earthquake design shall be sent for approval of the NCSDP (National Committee of Seismic Design Parameters, Central water Commission, New Delhi for large dams.
- Landslide zone or area prone to landslide existing in the study area should be examined.
- Presence of important economic mineral deposit, if any.
- Justification for location & execution of the project in relation to structural components (dam / barrage height).
- Impact of project on geological environment.

Meteorology, Air and Noise:

- Meteorology (viz. Temperature, Relative humidity, wind speed/direction etc.) to be collected from nearest IMD station of Ambient Air Quality, all the

parameters vide Notification dated 18.09.2009 of CPCB, in the study area at 6 locations.

- Existing Noise Levels and traffic density in the study area at 5-6 Locations.

Soil Characteristics:

- Soil classification, physical parameters (viz., texture, Porosity, Bulk Density and water holding capacity) and chemical parameters (viz. pH, electrical conductivity, magnesium, calcium, total alkalinity, chlorides, sodium, potassium, organic carbon, available potassium, available phosphorus, SAR, nitrogen and salinity, etc.) at @ one sample/ha of command area.

Remote Sensing and GIS Studies:

- Generation of thematic maps viz, slope map, drainage map, soil map, land use and land cover map, etc. Based on these, thematic maps, an erosion intensity map should be prepared.
- New configuration map to be given in the EIA Report.

Water Quality

- History of the ground water table fluctuation in the study area.
- Water Quality for both surface water and ground water for [i] Physical parameters (pH, Temperature, Electrical Conductivity, TSS); [ii] Chemical parameters (Alkalinity, Hardness, BOD, COD, NO3, PO4, Cl, So4, Na, K, Ca, Mg, Silica, Oil & grease, phenolic compounds, residual sodium carbonate); [iii] Bacteriological parameter (MPN, Total coliform); and [iv] Heavy Metals (Pb, As, Hg, Cd, Cr- 6, Total Cr, Cu, Zn, Fe) at minimum 10 Locations, however, the sampling numbers should be increased depending on the command area.

- Delineation of sub and micro watersheds, their locations and extent based on the Soil and Land Use Survey of India (SLUSOI), Department of Agriculture, Government of India. Erosion levels in each micro-watershed and prioritization of micro-watershed through Silt Yield Index (SYI) method of SLUSOI.

B. Water Environment & Hydrology

- Hydro-Meteorology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-meteorological studies in the catchment area should be established along-with real time telemetry and data acquisition system for inflows monitoring.
- Run off, discharge, water availability for the project, sedimentation rate, etc.
- Basin Characteristics.

- Catastrophic events like cloud bursts and flash floods, if any, should be documented.
- For estimation of Sedimentation Rate, direct sampling of river flow is to be done during the EIA study. The study should be conducted for minimum one year. Actual silt flow rate to be expressed in ha-m km-2 year-1.
- Set-up a G&D monitoring station and a few rain gauge stations in the catchment area for collecting data during the investigation.
- Flow series, 10 daily with 90%, 75% and 50% dependable years discharges.
- Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.
- A site specific study on minimum environment flow should be carried out.

C. Biological Environment

Besides primary studies, review of secondary data/literature published for project area on flora & fauna including RET species shall be reported in EIA/EMP report.

Flora

- Characterization of forest types (as per Champion and Seth method) in the study area and extent of each forest type as per the Forest Working Plan.
- General vegetation profile and floral diversity covering all groups of flora including Bryophytes, Pteridophytes, Lichens and Orchids. A species wise list may be provided.
- Assessment of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index [IVI], Shannon Weiner Index etc. of the species to be provided. Methodology used for calculating various diversity indices along with details of locations of quadrats, size of quadrats etc. to be reported within the study area in different ecosystems.
- Existence of National Park, Sanctuary, Biosphere Reserve etc in the study area, if any, should be detailed.
- Economically important species like medicinal plants, timber, fuel wood etc.
- Details of endemic species found in the project area.
- Flora under RET categories should be documented using International Union for the Conservation of Nature and Natural Resources (IUCN)

criteria and Botanical Survey of India's Red Data list along with economic significance. Species diversity curve for RET species should be given.

- Cropping pattern and Horticultural Practices in the study area.
- Biodiversity study shall be carried out by associating a reputed organization as per the list of such institutes is available on MoEFCC website.

Fauna

- Fauna study and inventorisation should be carried out for all groups of animals including reptiles and nocturnal animals in the study area. Their present status along with Schedule of the species.
- Information (authenticated) on Avi-fauna and wild life in the study area.
- Status of avifauna their resident/migratory/ passage migrants etc.
- Documentation of butterflies, if any, found in the area.
- Details of endemic species found in the project area.
- RET species- voucher specimens should be collected along with GPS readings to facilitate rehabilitation. RET faunal species to be classified as per IUCN Red Data list and as per different schedule of Indian Wildlife (Protection) Act, 1972.
- Existence of barriers and corridors, if any, for wild animals.
- Compensatory afforestation to compensate the green belt area that will be removed, if any, as part of the proposed project development and loss of biodiversity.
- For categorization of sub-catchments into various erosion classes and for the consequent CAT plan, the entire catchment (Indian Portion) is to be considered and not only the directly the draining catchment.

D. Aquatic Ecology

- Documentation of aquatic fauna like macro-invertebrates, zooplankton, phytoplanktons, benthos etc.
- Fish and fisheries, their migration and breeding grounds.
- Fish diversity, composition and maximum length & weight of the measured populations to be studied for estimation of environmental flow.
- Conservation status of aquatic fauna.

E. Irrigation and Cropping Pattern

- Cropping pattern and Horticultural practices in the study area.
- Collection of primary data on agricultural activity, crop and their productivity and irrigation facilities component.
- Component of pressurized/drip irrigation and micro irrigation.
- Details of Conjunctive use of water for irrigation.

F. Socio-Economic

- Collection of Baseline data on human settlements, health status of the community and existing infrastructure facilities for social welfare including sources of livelihood, job opportunities and safety and security of workers and surrounding population.
- Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project proponent.
- Collection of information on sensitive habitat of historical, cultural and religious and ecological importance.
- The Socio-economic survey/profile within 10 Km of the study area for Demographic profile; Economic Structure; Development Profile; Agricultural Practices; Infrastructure, education facilities; health and sanitation facilities; available communication network etc.
- Documentation of Demographic, Ethnographic, Economic structure and development profile of the area.
- Information on Agricultural practices, Cultural and aesthetic sites, Infrastructure facilities etc.
- Information on the dependence of the local people on minor forest produce and their cattle grazing rights in the forest land.
- List of all the Project Affected Families with their names, education, land holdings, other properties, occupation, source of income, land and other properties to be acquired, etc.
- In addition to Socio-economic aspects of the study area, a separate chapter on socio-cultural aspects based upon study on Ethnography of the area should be provided.

(7) **Impact Prediction and Mitigation Measures**

The adverse impact due to the proposed project should be assessed and effective mitigation steps to abate these impacts should be described.

Air Environment

- Changes in ambient and ground level concentrations due to total emissions from point, line and area sources.
- Effect on soils, material, vegetation and human health.
- Impact of emissions from DG sets used for power during the construction, if any, on air environment.
- Pollution due to fuel combustions in equipments & vehicles.
- Fugitive emissions from various sources.
- Impact on micro climate.

Water Environment

- Changes in surface & ground water quality.
- Steps to develop pisci-culture and recreational facilities.
- Changes in hydraulic regime and down stream flow.
- Water pollution due to disposal of sewage.
- Water pollution from labour colony/camps and washing equipment.

Land Environment

- Adverse impact on land stability, catchment of soil erosion, reservoir sedimentation and spring flow (if any) [a] due to considerable road construction/widening activity [b] interference of reservoir with the inflowing streams [c] blasting for excavation of canals and some other structures.
- Changes in land use/land cover and drainage pattern.
- Immigration of labour population.
- Quarrying operation and muck disposal.
- Changes in land quality including effects of waste disposal
- River bank and their stability
- Impact due to submergence.

Biological Environment

- Impact on forests, flora, fauna including wildlife, migratory avi-fauna, rare and endangered species, medicinal plants etc.
- Pressure on existing natural resources
- Deforestation and disturbance to wildlife, habitat fragmentation and wild animal's migratory corridors
- Compensatory afforestation-Identification of suitable native tree species for compensatory afforestation & green belt.
- Impact on fish migration and habitat degradation due to decreased flow of water
- Impact on breeding and nesting grounds of animals and fish.

Socio-economic Aspects

- Impact on local community including demographic profile.
- Impact on socio-economic status.
- Impact on economic status.
- Impact on human health due to water / vector borne disease.
- Impact on increases traffic.
- Impact on Holy Places and Tourism.
- Impacts of blasting activity during project construction which generally destabilize the land mass and lead to landslides, damage to properties and drying up of natural springs and cause noise pollution will be studied. Proper record shall be maintained of the base line information in the post project period.

- Positive as well as negative impacts likely to be accrued due to the project are to be listed.

(8) Environment Impact Analysis

Environmental Impact Analysis due to the project on the above mentioned components should be carried out for construction and operation phases using qualitative or quantitative methods.

(9) Environment Management Plan (EMP)

Environmental Management Plan aimed at minimizing the negative impacts of the project should be given in detail. The mitigation measures are to be presented for all the likely adverse impacts on the environment. The following suggestive mitigating plans should be included:

1. **Catchment Area Treatment (CAT) Plan** should be prepared micro-watershed wise. Identification of area for treatment based upon Remote Sensing & GIS methodology and Silt Yield Index (SYI) method of SLUSOI coupled with ground survey. Areas/watersheds falling under 'very severe' and 'severe' erosion categories are required to be treated. Both biological and engineering measures should be proposed in consultation with State Forest Department. Year-wise schedule of work and monetary allocation should be provided. CAT plan is to be completed prior to reservoir impoundment. Mitigations measures to check shifting cultivation in the catchment area with provision for alternative and better agricultural practices should be included.
2. **Command Area Development (CAD) Plan** giving details of implementation schedule with a sample CAD plan.
3. Compensatory Afforestation in lieu of the forest land required for the project needs to be proposed. Choice of plants should be made in consultation with State Forest Department including native and RET species, if any.
4. **Biodiversity and Wild Life Conservation & Management Plan** for conservation and preservation of endemic, rare and endangered species of flora and fauna to be prepared in consultation with State Forest Department.
5. **Resettlement and Rehabilitation (R&R) Plan** need to be prepared with due consultation with Project Affected Families (PAFs). The provision of the d R&R plan should be according to the National Resettlement and Rehabilitation Policy (NRRP-2007) as well as State Resettlement and Rehabilitation Policy. Detailed budgetary estimates are to be provided. Resettlements sites should be identified.
6. **Plan for Green Belt Development** along theperiphery of reservoir, colonies, approach road, canals etc. to be prepared in consultation with the State Forest Department. Local plant species suitable for greenbelt development should be selected.
7. **Reservoir Rim Treatment Plan** for stabilization of land slide/land slip zones if any, around the reservoir periphery to be prepared. Suitable engineering and

biological measures for treatment of the identified slip zones to be provided with physical and financial schedule.

8. **Plan for Land Restoration and Landscaping** of project sites.
9. **Fisheries Conservation & Management Plan**-Fish fauna inhabiting the affected stretch of river, a specific fisheries management plan should be prepared for river and reservoir.
10. **Muck Disposal Plan**- suitable sites for dumping of excavated material should be identified in consultation with the State Pollution Control Board and Forest Department. All Muck disposal sites should be minimum 30 m away from the HFL of river. Plan for rehabilitation of muck disposal sites should also be given. The L- section/ cross section of muck disposal sites and approach roads to be given. Financial out lay for this may be given separately.
11. **Plan for Restoration** of quarry sites and landscaping of colony areas, working areas, roads, etc.
12. **Study of Design Earthquake Parameters**: A site specific study of earthquake parameters should be done. The results of the site specific earth quake design parameters should be approval by National Committee of Seismic Design Parameters, Central Water Commission (NCSDP), New Delhi.
13. **Dam Break Analysis and Disaster Management Plan**: The outputs of Dam Break Model should be illustrated with appropriate graphs and maps clearly bringing out the impact of Dam break scenario. Provision for early warning systems should be provided.
14. **Water and Air Quality & Noise Management Plans** to be implemented during construction and post-construction periods.
15. Mitigating measures for impacts due to Blasting on the structures in the vicinity.
16. Ground Water Management Plan.
17. **Public Health Delivery Plan** including the provisions for drinking water facility for the local community.
18. **Labour Management Plan** for their Health and Safety.
19. **Sanitation and Solid Waste Management Plan** for domestic waste from colonies and labour camps etc.
20. **Local Area Development Plan** to be formulated in consultation with the Revenue Officials and Village Panchayats. Local skill development schemes should be given. Details of various activities to be undertaken along with its financial out lay should be provided.
21. Environmental safeguards during construction activities including Road Construction.
22. Energy Conservation Measures.
23. **Environmental Monitoring Programme** with physical & financial details covering all the aspects of EMP. A summary of cost estimate for all the plans, cost for implementing all Environmental Management Plans including the cost for implementing environmental monitoring programme should be given. Provision for an Environmental Management Cell should be made.

24. In the EMP, also include a sample CAD plan for a distributary outlet command. Such a plan is to show the alignment of irrigation and drainage channels. The components of the OFD works to be undertaken may be clearly mentioned along with a time schedule for their completion vis-à-vis the progress of irrigation development.

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28/7/2008

Annexure - 2

DPR of Kosi-Mechi Intra State link project

Construction schedule

Sl. No.	Task name	Duration	Year 1	Year 2	Year 3	Year 4	Year 5
			J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
1	**Preconstruction investigation survey**	181 days					
2	**Infrastructure works**	365 days					
	Access roads widening	273 days					
	Project roads	303 days					
	Office & residential complex	334 days					
	Costruction of power line	303 days					
3	**Detailed design & drawing**	365 days					
4	**Tendering & award of contract**	485 days					
5	**Link canal**	1460 days					
a	**Existing EKMC (Remodelling)**	730 days					
	Excavation	699 days					
	Filling of soil	671 days					
	Concreting	699 days					
b	**K-M link canal (New)**	1460 days					
	Excavation	1429 days					
	Concreting	1429 days					

Task duration

Working period

Monsoon period

Gross Annual Yield Series of river Kosi at Hanuman Nagar Barrage

Unit: MCM

S.No.	Years	Monsoon Yield	Non-Monsoon Yield	Annual Yield	Years	Annual Yield in descending order
1	1965 - 1966	35801	9994	44995	1971 - 1972	68870
2	1966 - 1967	40770	6366	47136	1968 - 1969	62840
3	1967 - 1968	35645	6685	42330	1970 - 1971	62736
4	1968 - 1969	50723	12120	62840	1987 - 1988	61354
5	1969 - 1970	39593	7925	47518	1989 - 1990	60449
6	1970 - 1971	54319	8438	62756	1988 - 1989	57718
7	1971 - 1972	57817	11053	68870	1991 - 1992	57697
8	1972 - 1973	41762	11170	52932	1990 - 1991	56164
9	1973 - 1974	45585	9972	55557	2010 - 2011	56038
10	1974 - 1975	46667	9250	55916	1975 - 1976	55987
11	1975 - 1976	46569	9419	55987	1974 - 1975	55916
12	1976 - 1977	46163	8846	55009	1973 - 1974	55557
13	1977 - 1978	39482	10508	49990	1978 - 1979	55494
14	1978 - 1979	47387	8108	55494	1976 - 1977	55009
15	1979 - 1980	39997	8916	48914	1985 - 1986	54958
16	1980 - 1981	38228	8953	47181	1998 - 1999	53849
17	1981 - 1982	43362	7229	50592	2000 - 2001	53169
18	1982 - 1983	30530	8082	38613	1972 - 1973	52932
19	1983 - 1984	37326	8048	45374	1999 - 2000	52733
20	1984 - 1985	42770	7537	50307	1996 - 1997	50993
21	1985 - 1986	46422	8536	54958	1981 - 1982	50592
22	1986 - 1987	39488	8214	47702	1984 - 1985	50307
23	1987 - 1988	51517	9836	61354	1993 - 1994	50192
24	1988 - 1989	47983	9735	57718	1977 - 1978	49990
25	1989 - 1990	51146	9304	60449	1995 - 1996	49771
26	1990 - 1991	47759	8405	56164	2007 - 2008	49607
27	1991 - 1992	51166	6532	57697	2003 - 2004	49263
28	1992 - 1993	33281	8622	41903	1979 - 1980	48914
29	1993 - 1994	41799	8393	50192	2002 - 2003	48347
30	1994 - 1995	34040	8772	42811	2004 - 2005	47884
31	1995 - 1996	40646	9124	49771	1986 - 1987	47702
32	1996 - 1997	43821	7171	50993	1969 - 1970	47518
33	1997 - 1998	32907	7736	40643	1980 - 1981	47181
34	1998 - 1999	46696	7144	53840	1966 - 1967	47136
35	1999 - 2000	43828	8905	52733	2011 - 2012	46939
36	2000 - 2001	43568	9602	53169	1983 - 1984	46374
37	2001 - 2002	34657	10326	44983	1965 - 1966	44995
38	2002 - 2003	40819	7529	48347	2001 - 2002	44983
39	2003 - 2004	42753	6510	49263	2012 - 2013	43372
40	2004 - 2005	39298	8585	47884	2006 - 2007	42955
41	2005 - 2006	33125	6914	40039	1994 - 1995	42811
42	2006 - 2007	34229	8726	42955	1967 - 1968	42330
43	2007 - 2008	41841	7766	49607	1992 - 1993	41903
44	2009 - 2010	33484	8047	41531	2009 - 2010	41531
45	2010 - 2011	46569	9470	56038	1997 - 1998	40643
46	2011 - 2012	36935	10004	46939	2005 - 2006	40039
47	2012 - 2013	35389	7983	43372	1982 - 1983	38613
Annual yield at 50% dependability						**49990**
Annual yield at 75% dependability						**45374**
Average (MCM)		42018	8649			

BASE MAP OF AYACUT AREA

Kosi-Mechi Intrastate Linked Project Bihar India

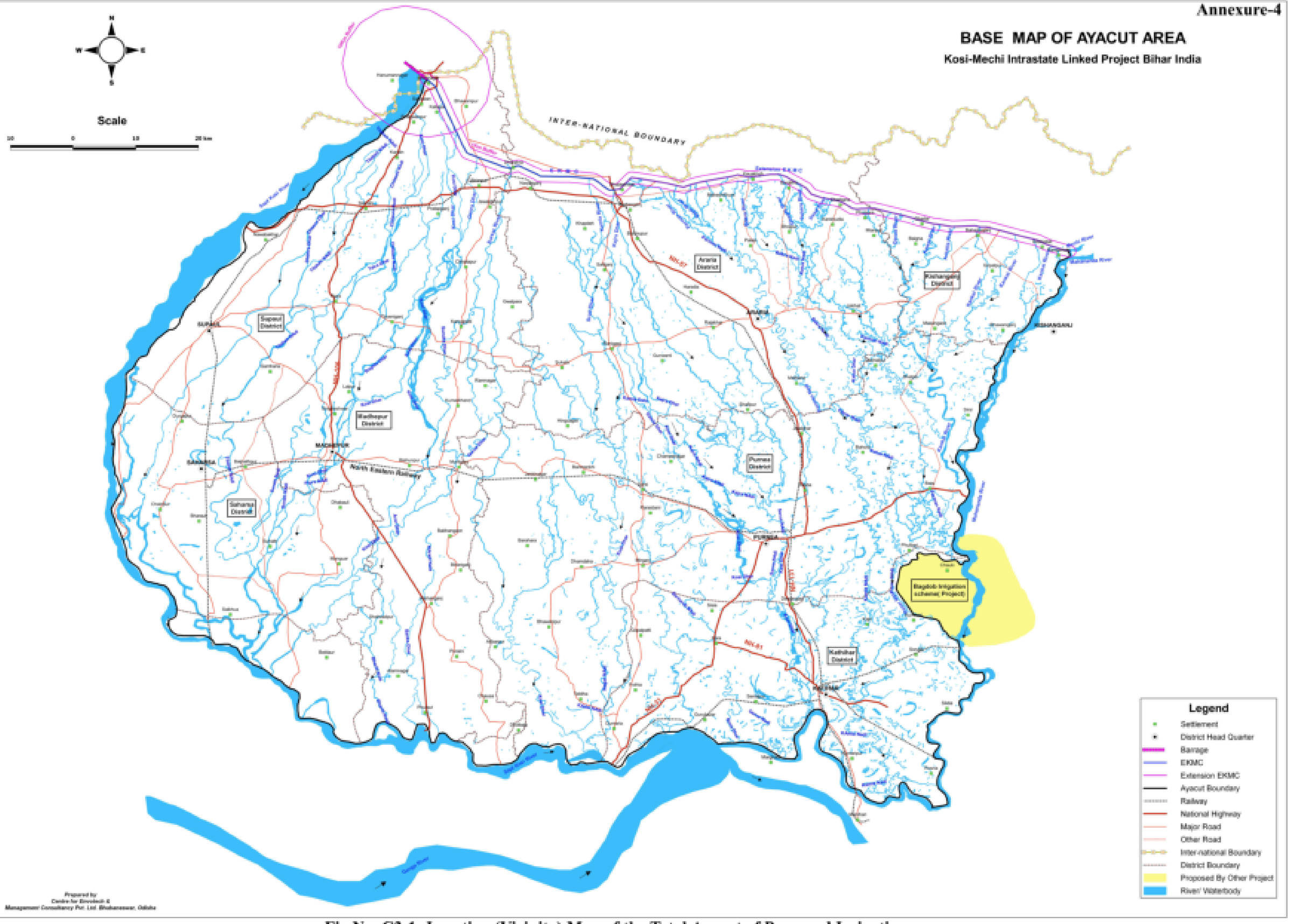


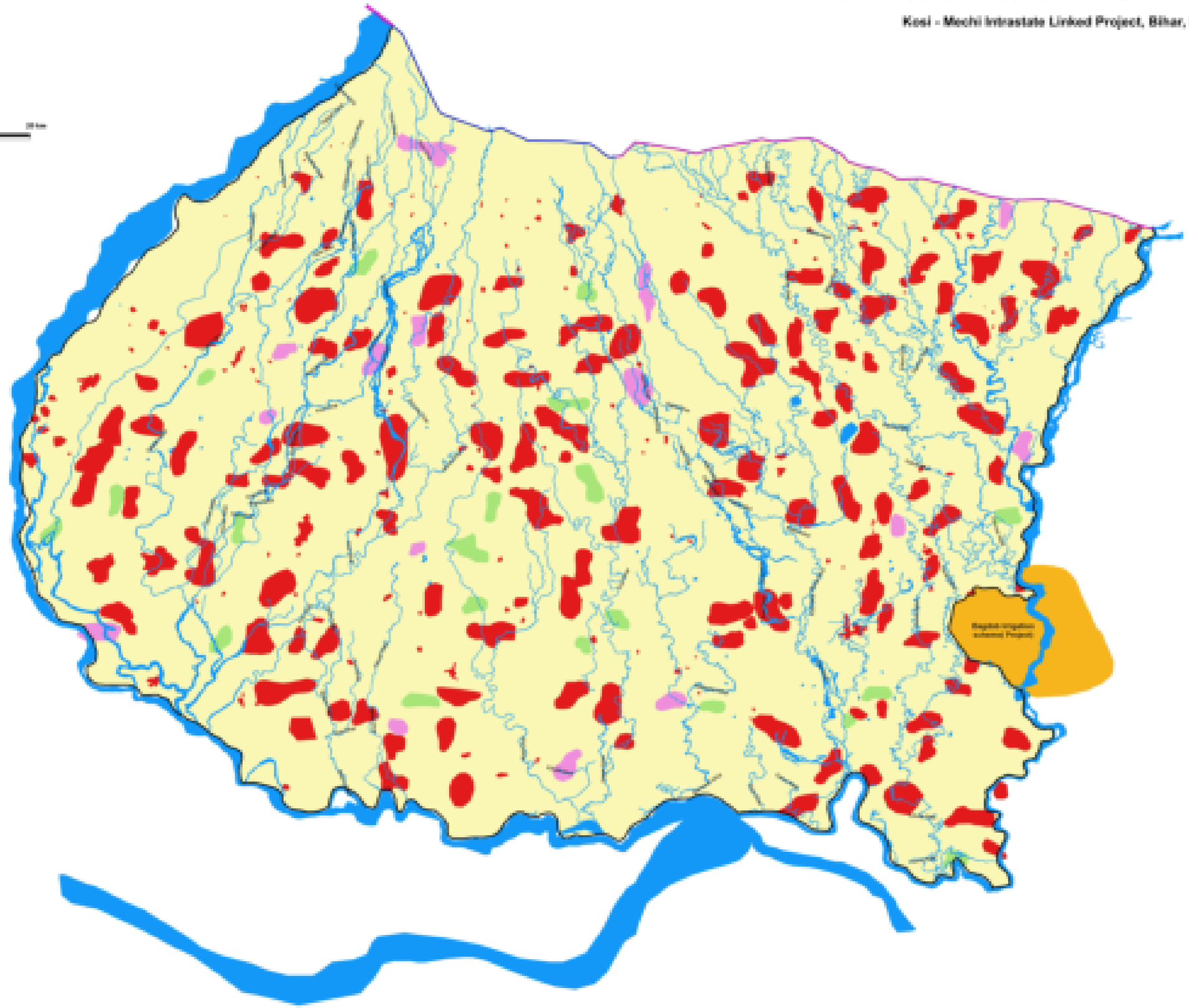
Fig.No. C3-1: Location (Vicinity) Map of the Total Ayacut of Proposed Irrigation area

Annexure-5

LANDUSE/ LAND COVER MAP OF AYACUT AREA

Kosi - Mechi Intrastate Linked Project, Bihar, India

Scale



Source:
National Bureau of Soil Survey and Land Utilisation Planning

Prepared by:
Cauvery Neo Enviro Pvt. Ltd.
Management Consultancy Pvt. Ltd. Environmentalists / Advisors

Fig. No. C3-3: Map Showing Land Use & Land Cover of Total Ayacut Area

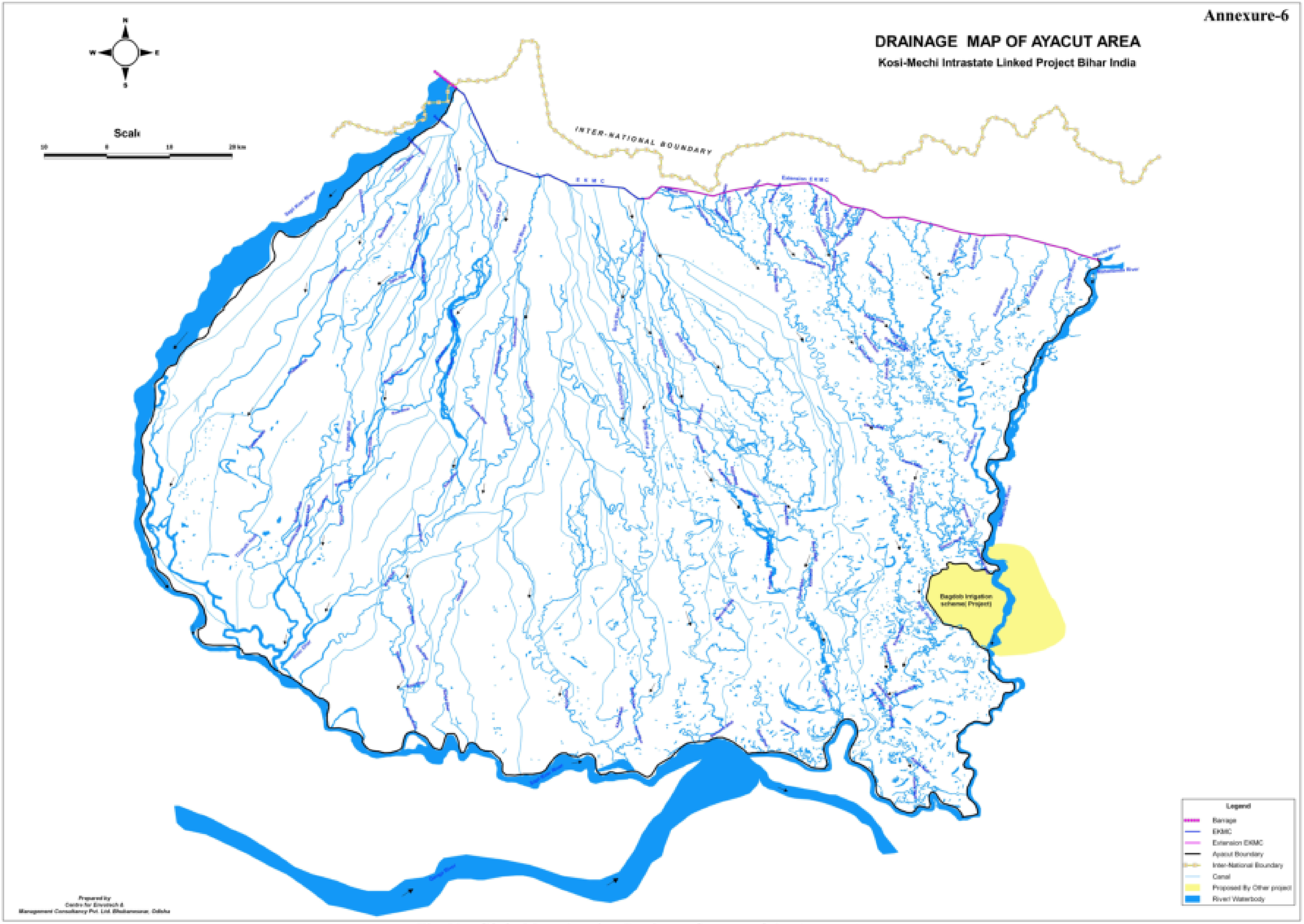


Fig. No. C3-9: Map showing Drainage System of the Ayacut Area

लोक-सुनवाई वृत

बिहार सरकार के जल संसाधन विभाग द्वारा प्रस्तावित **कोशी-मेची अन्तर्राज्यीय नदी लिंक सिंचाई परियोजना** के पर्यावरणीय स्वीकृति के दृष्टिकोण से **किशनगंज जिलांतर्गत** परियोजना प्रभाव क्षेत्र के लोगों के लिए लोक-सुनवाई दिनांक: 26.02.2018 (सोमवार) को डाकुरगंज प्रखण्ड परिसर के सामुदायिक भवन में आयोजित किया गया। इस लोक-सुनवाई की सूचना अंग्रेजी समाचार पत्र "द टाइम्स ऑफ इंडिया" तथा हिन्दी समाचार पत्र "हिन्दुस्तान" एवं "दैनिक जागरण" में दिनांक: 25.01.2018 को प्रकाशित कराया गया था। पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार के पत्र J-12011/ 22/2016-IA-I(R), दिनांक: 23 सितम्बर, 2016 द्वारा निर्गत टी.ओ.आर. के आलोक में इस योजना का ई.आइ.ए. रिपोर्ट तैयार किया गया है। इस योजना का ई.आइ.ए. रिपोर्ट एवं इसका सार प्रतिवेदन पर्षद् कार्यालय के साथ-साथ जिला पदाधिकारी, जिला परिषद्, जिला उद्योग केन्द्र एवं कार्यपालक अभियंता, जल संसाधन के कार्यालयों में आमजनों के अवलोकन हेतु उपलब्ध थे। लोक-सुनवाई की कार्यवाही निम्न है:-

1. लोक-सुनवाई में उपस्थित पदाधिकारियों एवं स्थानीय लोगों की उपस्थिति (**अनुलग्न-I**)
2. लोक-सुनवाई कार्यवाही को अध्यक्षता जिला पदाधिकारी, जिला-किशनगंज के प्रतिनिधि श्री रामजी साह, अपर समाहर्ता, जिला-किशनगंज द्वारा किया गया। बैठक में उपरोक्त कृषि पदाधिकारी, सिंचाई विभाग के मुख्यालय एवं स्थानीय स्तर के अभियंतागण, ग्राम पंचायतों के मुखिया एवं उनके प्रतिनिधि उपस्थित थे।

कार्यवाही के प्रारंभ में बिहार राज्य प्रदूषण नियंत्रण पर्षद् के क्षेत्रीय पदाधिकारी द्वारा लोक-सुनवाई के प्रयोजन से संबंधित एक परिचय प्रस्तुत किया गया। इसके तहत् खरीफ मौसम में अररिया, पूर्णियाँ, कटिहार एवं किशनगंज जिलों में महानंदा बेसिन के पानी के कमी वाले क्षेत्र में सिंचाई प्रदान करने का प्रस्ताव है। प्रत्येक संबंधित जिलों में लोक-सुनवाई आयोजित किया गया। सभा में उपस्थित लोगों से प्रस्तावित परियोजना के पर्यावरणीय दृष्टिकोण से सुझाव, प्रतिक्रिया एवं मंतव्य से सभा से अवगत कराने के प्रयोजन को बताया गया। सिंचाई विभाग के कार्यपालक अभियंता द्वारा परियोजना के मुख्य बातें प्रस्तुत किया गया, जो निम्नवत् है:-

इस परियोजना के तहत् परिचय में कोशी नदी एवं पूरब में मेची नदी को जोड़ने का कार्य प्रस्तावित है। इसके तहत् खरीफ मौसम में अररिया, पूर्णियाँ, कटिहार एवं किशनगंज जिलों में महानदी बेसिन के पानी के कमी वाले क्षेत्र में सिंचाई प्रदान करने का प्रस्ताव है, जो हनुमाननगर क्षेत्र में उपलब्ध जल संभव पर निर्भर होगा। नई विस्तारित नहर के तहत् सिंचाई के लिए सकल नियंत्रण क्षेत्र (जी.सी.ए.) 2,75,135 हेक्टेयर तथा कृषिम नियंत्रण क्षेत्र (सी.सी.ए.) 214812 हेक्टेयर होगा। कोशी नदी का जल भारत-नेपाल सीमा के पास हनुमान नगर के नजदीक बीरपुर, जो भारत में है, स्थित बराज से 117.5 किलोमी० लंबी नहर के माध्यम से मेची नदी में प्रवाहित किया जायेगा। मेची नदी महानदी की एक सहायक नदी है। इस प्रस्ताव में 41.3 किलोमी० का नहर पहले से मौजूद है, क्षेत्र के विस्तारीकरण की योजना है। यह नहर भारत-नेपाल सीमा के समानान्तर संरेखित किया गया है। इस लिंक नहर का कुल नियंत्रण क्षेत्र 2,75,135 हेक्टेयर है जिसमें से 52150 हेक्टेयर किशनगंज जिलांतर्गत पड़ता है जो कुल नियंत्रण क्षेत्र का लगभग 19% है। इसके तहत् कुल 26.2 किलोमी० मुख्य नहर सड़क, 227 किलोमी०

सासा एवं वितरण सड़क का निर्माण होगा। इसके तहत् 28 नई सड़क पुल का निर्माण होगा जिससे बिहार में कोसी का प्रकोप कम होने के साथ-साथ ग्रामीण क्षेत्रों में सिंचाई, आवागमन व्यवस्था में सुधार होगा। इस परियोजना के क्रियान्वयन में आबादी का विस्थापन नहीं है। इस परियोजना के प्रभाव क्षेत्र में कोई संवेदनशील क्षेत्र एवं कोई वन क्षेत्र नहीं है। इस परियोजना को पर्यावरणीय स्वीकृति के उद्देश्य से पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार द्वारा टी.ओ.आर. निर्गत किया गया जिसके आधार पर पर्यावरणीय प्रभाव मूल्यांकन (ई.आई.ए.) रिपोर्ट तैयार किया गया है जिसमें संभावित पर्यावरणीय दुष्प्रभाव के निवारण हेतु व्यवस्था दर्शाये गये हैं।

<u>लोक-सुनवाई के दौरान लोगों के द्वारा किये गये सुझाव / प्रतिक्रिया निम्नवत् है:-</u>

1. श्री गणेश प्रसाद राय द्वारा कहा गया कि मेची नदी से गलगलिया से सटले गांव के क्षेत्र को काफी परेशानियों का सामना करना पड़ रहा है। इसमें अतिरिक्त पानी देने से समस्या बढ़ने की संभावना है। इसके जवाब में प्रस्तावक द्वारा सूचित किया गया कि इसके लिए गाईड बांध का निर्माण कराकर परेशानी को कम किया जायेगा। श्री राय द्वारा यह भी सूचित किया गया कि पूर्व में बांध गलत जगह बनाने से बिहार के लोगों को काफी परेशानियों का सामना करना पड़ रहा है। अब ऐसे प्रोजेक्ट बनाने से पहले इस पर विशेष रूप से अध्ययन कराने का सुझाव दिया गया है जिससे भविष्य में ऐसी समस्या न हो सके।
2. श्री मौकल अली, कनकपुर मुखिया प्रतिनिधि एवं अन्य के द्वारा शंका प्रकट किया गया कि खरीफ फसल के दौरान इस क्षेत्र में प्राकृतिक रूप से पानी अधिक रहता है। इस दौरान में अतिरिक्त पानी आने से क्षेत्र के लोगों को समस्या बढ़ सकती है। इस संबंध में ध्यान रखने की आवश्यकता पर जोर दिया जाय। प्रस्तावक द्वारा सूचित किया गया कि इसके लिए आवश्यकतानुसार मुख्य नहर में पानी छोड़ा जाएगा जिससे ग्रामीणों को समस्या न हो।

लोक-सुनवाई की कार्यवाही के दौरान अपर समाहर्ता, किशनगंज द्वारा अध्यक्षीय संबोधन में कोसी-मेची नदी लिंक परियोजना को पर्यावरणीय स्वीकृति हेतु सार्थक बैठक आयोजित कराने के लिए धन्यवाद दिया गया। साथ ही कहा गया कि परियोजना के प्रतिवेदन एवं प्रस्तुतीकरण से स्पष्ट है कि इस परियोजना से कोई गांव, वन प्रभावित नहीं हो रहा है। यह एक स्वच्छ परियोजना है जिसमें किसानों को सुविधा प्रदान करने के उद्देश्य निहित है। इस संबंध में सभा के दौरान सार्थक सुझाव प्राप्त हुए है जिसे पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार को अवगत कराया जायेगा। लोक-सुनवाई के दौरान इस प्रस्ताव की पर्यावरणीय स्वीकृति हेतु अनुशंसा करने के लिए सभी लोगों को धन्यवाद देते हुए लोक-सुनवाई की कार्यवाही की समाप्ति की घोषणा की गई।

(एस.पी.राय)
क्षेत्रीय पदाधिकारी
बि.रा.प्र.वि.पर्षद्, पटना

(रामजी सोह)
अपर समाहर्ता
किशनगंज

उपस्थिति सूची

बिहार सरकार द्वारा प्रस्तावित कोशी-मेची लिंक सिंचाई परियोजना के पर्यावरणीय स्वीकृति हेतु सामुदायिक भवन, प्रखण्ड परिसर, ठाकुरगंज, जिला-किशनगंज में दिनांक: 26.02.2018 (सोमवार) को पूर्वाह्न 11.00 बजे आयोजित लोक-सुनवाई की उपस्थिति:-

क्रमांक	नाम/पदनाम	पता	हस्ताक्षर
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20	Nawshad Alam	C.P. Thakuri Mahavidyalaya	
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31	Md. Shahnawaz		
32	Manjay Kumar	Bhalwara, Saraiya	
33			
34	Sunil Vijaydev	Thakurganj, Kishanganj (N.B)	Sunil Vijaydev
35	Pradeep Jha	T.K.G (Ripter)	
36	Ashok Kr. Yadav	K.G Thakurganj	
37	Nitish Kumar Singh	"	
38	Hariom Kr. Ganesh	Thakurganj	
39	Md. Shahnawaz Alam	K.G Thakurganj	

40	[illegible]	[illegible]	[illegible]

41	[illegible]	[illegible]	[illegible]
42	[illegible]	[illegible]	[illegible]
43	[illegible]	[illegible]	[illegible]
44	[illegible]	[illegible]	[illegible]
45	[illegible]	[illegible]	[illegible]
46	[illegible]	[illegible]	[illegible]
47	[illegible]	[illegible]	[illegible]
48	[illegible]	[illegible]	[illegible]
49	[illegible]	[illegible]	[illegible]
50	[illegible]	[illegible]	[illegible]
51	[illegible]	[illegible]	[illegible]
52	[illegible]	[illegible]	[illegible]
53	[illegible]	[illegible]	[illegible]
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लोक–सुनवाई वृत

बिहार सरकार के जल संसाधन विभाग द्वारा प्रस्तावित कोशी–मेची अन्तर्राज्यीय नदी लिंक सिंचाई परियोजना के पर्यावरणीय स्वीकृति के उद्देश्य से **पूर्णियाँ जिलांतर्गत** परियोजना प्रभाव क्षेत्र के लोगों के लिए लोक–सुनवाई दिनांक: 27.02.2018 (मंगलवार) को कला भवन, पूर्णियाँ में आयोजित किया गया। इस लोक–सुनवाई की सूचना अंग्रेजी समाचार पत्र "द टाइम्स ऑफ इंडिया" तथा हिन्दी समाचार पत्र "हिन्दुस्तान" एवं "दैनिक जागरण" में दिनांक: 25.01.2018 को प्रकाशित किया गया था। पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार के पत्र J-13011/22/2006-IA-II(I), दिनांक: 23 सितम्बर, 2016 द्वारा निर्गत टी.ओ.आर. के आलोक में इस योजना का ई.आइ.ए. रिपोर्ट तैयार किया गया है। इस योजना का ई.आइ.ए. रिपोर्ट एवं इसका सार प्रतिवेदन पर्षद् कार्यालय के साथ–साथ जिला पदाधिकारी, जिला परिषद्, जिला उद्योग केन्द्र एवं कार्यपालक अभियंता, जल संसाधन के कार्यालयों में आमजनों के अवलोकन हेतु उपलब्ध थे।

लोक–सुनवाई की कार्यवाही निम्नवत है:–

1. लोक–सुनवाई में उपस्थित पदाधिकारियों एवं स्थानीय लोगों की उपस्थिति **(अनुलग्न–I)**
2. लोक–सुनवाई कार्यवाही की अध्यक्षता जिला पदाधिकारी, जिला–पूर्णियाँ के प्रतिनिधि डॉ0 रवीन्द्रनाथ, अपर सलाहकार, जिला–पूर्णियाँ द्वारा किया गया। बैठक में स्थानीय लोगों के साथ सिंचाई विभाग के मुख्यालय एवं स्थानीय अभियंतागण, ग्राम पंचायतों के मुखिया एवं उनके प्रतिनिधिगण उपस्थित थे।

कार्यवाही के प्रारंभ में बिहार राज्य प्रदूषण नियंत्रण पर्षद् के क्षेत्रीय पदाधिकारी द्वारा लोक–सुनवाई के प्रयोजन से संबंधित एक परिचय प्रस्तुत किया गया। सभा में उपस्थित लोगों से प्रस्तावित परियोजना के पर्यावरणीय दृष्टिकोण से सुझाव, प्रतिक्रिया एवं मंतव्य अवगत कराने के प्रयोजन को बताया गया। सिंचाई विभाग के कार्यपालक अभियंता द्वारा परियोजना के मुख्य बिन्दु प्रस्तुत किया गया, जो निम्नवत् है:–

इस परियोजना के तहत् पश्चिम में कोशी नदी एवं पूरब में मेची नदी को जोड़ने का कार्य प्रस्तावित है। इसके तहत् खरीफ सीजन में अररिया, पूर्णियाँ, कटिहार एवं किशनगंज जिलों में महानंदा बेसिन के पानी के कमी वाले क्षेत्र में सिंचाई प्रदान करने का प्रस्ताव है, जो हनुमाननगर बाँध में उपलब्ध जल संचय पर निर्भर होगा। नई विस्तारित नहर के तहत् सिंचाई के लिए सकल नियंत्रण क्षेत्र (जी.सी.ए.) 2,75,135 हेक्टेयर तथा कृषिम नियंत्रण क्षेत्र (सी.सी.ए.) 214812 हेक्टेयर होगा। कोशी नदी का जल भारत–नेपाल सीमा के पास हनुमान नगर के नजदीक बीरपुर, जो भारत में है, स्थित बराज से 117.5 कि0मी0 लंबी नहर के माध्यम से मेची नदी में प्रवाहित किया जायेगा। मेची नदी महानन्दा की एक सहायक नदी है। इस प्रस्ताव में 41.3 कि0मी0 का नहर पहले से मौजूद है शेष के विस्तारीकरण का योजना है। यह नहर भारत–नेपाल सीमा के समानान्तर संरेखित किया गया है। इस लिंक नहर का कुल नियंत्रण क्षेत्र 2,75,135 हेक्टेयर है जिसमें से 65885 हेक्टेयर पूर्णियाँ जिलांतर्गत पड़ता है जो कुल नियंत्रण क्षेत्र का लगभग 24% है। इसके तहत् कुल 76.2 कि0मी0 मुख्य नहर सड़क, 227 कि0मी0 शाखा एवं वितरण सड़क का निर्माण होगा। इसके तहत् 28 नई सड़क पुल का निर्माण होगा, जिससे बिहार में कोशी का प्रकोप कम होने के साथ–साथ ग्रामीण क्षेत्रों में सिंचाई, आवागमन व्यवस्था में सुधार होगा। इस परियोजना के

क्रियान्वयन में आबादी का विस्थापन नहीं है। इस परियोजना के प्रभाव क्षेत्र में कोई संवेदनशील क्षेत्र एवं कोई वन क्षेत्र नहीं है। इस परियोजना को पर्यावरणीय स्वीकृति के उद्देश्य पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार द्वारा टी.ओ.आर. निर्गत किया गया जिसके आधार पर पर्यावरणीय प्रभाव मूल्यांकन (ई.आई.ए.) रिपोर्ट तैयार किया गया है जिसमें संभावित पर्यावरणीय दुष्प्रभाव के नियंत्रण हेतु व्यवस्था दर्शाये गये हैं।

लोक–सुनवाई के दौरान लोगों के द्वारा दिये गये सुझाव/प्रतिक्रिया निम्नवत् है–

1. मो0 शेख अनवर द्वारा सूचित किया गया कि डाकरी, अगरूआ, डालकोला के क्षेत्र में सिल्टेशन हो गया है। इस क्षेत्र को वर्ष 2008 से भारी तबाही का सामना करना पड़ा है। इस परियोजना से महानन्दा बेसिन में पानी बढ़ेगा, जिससे इस क्षेत्र में बाढ़ की समस्या बढ़ने की संभावना है। इसके लिए महानन्दा के बाढ़ नियंत्रण योजना को प्रभावी करने की आवश्यकता पर जोड़ दिया गया। साथ ही सूचित किया गया कि इस क्षेत्र में पूर्व से निर्मित सिंघाई कनाल में सिल्टेशन के कारण पानी नहीं आता है, जिसके दुरूस्त करने का सुझाव दिया गया।
2. श्री घनश्याम यादव, बेहटी एवं अन्य द्वारा भी पूर्व से निर्मित कैनाल, जिसमें पानी नहीं आता है, की व्यवस्था सुदृढ़ीकरण करने का जोड़ दिया गया, जिससे यह योजना सफल हो सकेगा।

लोक–सुनवाई की कार्यवाही के दौरान अपर समाहर्ता द्वारा अध्यक्षीय संबोधन में कोसी–मेची नदी लिंक परियोजना को पर्यावरणीय स्वीकृति हेतु सार्थक बैठक आयोजित करने के लिए धन्यवाद दिया गया। साथ ही कहा गया कि परियोजना के प्रस्तुतीकरण एवं उपस्थित लोगों के चर्चा से स्पष्ट है कि इस क्षेत्र में बाढ़ की समस्या पहले से है। इस बाढ़ की सुरक्षा व्यवस्था सुदृढ़ीकरण के साथ इस योजना की स्वीकृति दी जा सकती है। इस प्रस्ताव की पर्यावरणीय स्वीकृति हेतु अनुशंसा करने के लिए सभी लोगों को धन्यवाद देते हुए कार्यवाही समाप्ति की घोषणा किया गया।

(एस.पी.राय)
क्षेत्रीय पदाधिकारी
बि.रा.प्र.नि.पर्षद्, पटना

(डॉ0 रवीन्द्रनाथ)
अपर समाहर्ता
पूर्णियाँ

उपस्थिति सूची

बिहार सरकार द्वारा प्रस्तावित कोशी-मेची लिंक सिंचाई परियोजना के पर्यावरणीय स्वीकृति हेतु जल भवन (एस.बी.आई. मेन ब्रांच के पास), पूर्णियाँ, जिला-पूर्णियाँ में दिनांक: 27.02.2018 (मंगलवार) को पूर्वाह्न 11.00 बजे आयोजित लोक-सुनवाई की उपस्थिति:-

क्र०सं०	नाम/पदनाम	पता	हस्ताक्षर
1	[illegible]	[illegible]	[illegible] 27.2.18
2	[illegible]	[illegible]	[illegible] 27.2.18
3	[illegible]	[illegible]	[illegible] 27.2.18
4	[illegible]	—	[illegible]
5	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible] 27/2/18
7	[illegible]	[illegible]	[illegible] 27/2/18
8	[illegible]	[illegible]	[illegible] 27/2/18
9	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible] 27/2/18
14	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible] 27/2/18
16	[illegible]	[illegible]	[illegible] 27/2/18
17	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]

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20			23.2.18
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22			
23	V. C. Singh		22.02.18
24	Dilip Kr. Mishra	Industry Extn. Offr.	
25	Anil Kr. Rajna		
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33	Bishwajit Das	Belcuri	
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40			K. L. Sah

41	MD SHAHRIQUE ALAM	Line Bazar Purnea	
42	Arvind Kumar Singh	B.I.B. Aau PE L.P Division-I Aziziabad	
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लोक-सुनवाई वृत

बिहार सरकार के जल संसाधन विभाग द्वारा प्रस्तावित **कोशी-मेची अन्तर्राज्यीय नदी लिंक सिंचाई परियोजना** के पर्यावरणीय स्वीकृति के उद्देश से **कटिहार जिलांतर्गत** परियोजना प्रभाव क्षेत्र के लोगों के लिए लोक-सुनवाई लोक-सुनवाई दिनांक: 28.02.2018 (बुधवार) को कोशी कॉलोनी मैदान, कटिहार में आयोजित किया गया। इस लोक-सुनवाई की सूचना अंग्रेजी समाचार पत्र ''द टाइम्स ऑफ इंडिया'' तथा हिन्दी समाचार पत्र ''हिन्दुस्तान'' एवं ''दैनिक जागरण'' में दिनांक: 25.01.2018 को प्रकाशित किया गया था। पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार के पत्र J-12011/22/2016-IA-I(I), दिनांक: 23 सितम्बर, 2016 द्वारा निर्गत टी.ओ.आर. के आलोक में इस योजना का ई.आइ.ए. रिपोर्ट तैयार किया गया है। इस योजना का ई.आइ.ए. रिपोर्ट एवं इसका सार प्रतिवेदन पर्षद् कार्यालय के साथ-साथ जिला पदाधिकारी, जिला परिषद्, जिला उद्योग केन्द्र एवं कार्यपालक अभियंता, जल संसाधन के कार्यालयों में आमजनों के अवलोकन हेतु उपलब्ध थे। लोक-सुनवाई की कार्यवाही निम्न है:-

लोक-सुनवाई की कार्यवाही निम्नवत है:-

1. लोक-सुनवाई में उपस्थित पदाधिकारियों एवं स्थानीय लोगों की उपस्थिति (**अनुलग्नक-I**)
2. लोक-सुनवाई कार्यवाही को अध्यक्षता जिलापदाधिकारी, जिला-कटिहार के प्रतिनिधि श्री स्वयम्भू सिंह, अपर समाहर्ता (स्था.नि.वि.)-सह-जिला लोक शिकायत निवारण पदाधिकारी, जिला-कटिहार के द्वारा किया गया। बैठक में जिला भू-अर्जन पदाधिकारी, सिंचाई विभाग के मुख्यालय एवं स्थानीय अभियंतागण एवं स्थानीय लोगों के साथ जनप्रतिनिधि उपस्थित थे।

कार्यवाही के प्रारंभ में बिहार राज्य प्रदूषण नियंत्रण पर्षद् के क्षेत्रीय पदाधिकारी द्वारा लोक-सुनवाई के प्रयोजन से संबंधित एक परिचय प्रस्तुत किया गया। इसके तहत् खरीफ मौसम में अररिया, पूर्णियाँ, कटिहार एवं किशनगंज जिलों में महानंदा बेसिन के पानी के कमी वाले क्षेत्र में सिंचाई प्रदान करने का प्रस्ताव है। प्रत्येक संबंधित जिलों में लोक-सुनवाई आयोजित किया गया। सभा में उपस्थित लोगों से प्रस्तावित परियोजना के पर्यावरणीय दृष्टिकोण से सुझाव, प्रतिक्रिया एवं मंतव्य से सभा से अवगत कराने के प्रयोजन को बताया गया। सिंचाई विभाग के कार्यपालक अभियंता द्वारा परियोजना के मुख्य बातें प्रस्तुत किया गया, जो निम्नवत् है:-

इस परियोजना के तहत् पश्चिम में कोशी नदी एवं पूरब में मेची नदी को जोड़ने का कार्य प्रस्तावित है। इसके तहत् खरीफ मौसम में अररिया, पूर्णियाँ, कटिहार एवं किशनगंज जिलों में महानंदी बेसिन के पानी के कमी वाले क्षेत्र में सिंचाई प्रदान करने का प्रस्ताव है, जो हनुमाननगर बांध में उपलब्ध जल संसय पर निर्भर होगा। नई सिंचाधित नहर के तहत् सिंचाई के लिए सकल नियंत्रण क्षेत्र (जी.सी.ए.) 2,75,135 हेक्टेयर तथा कृषित नियंत्रण क्षेत्र (सी.सी.ए.) 214812 हेक्टेयर होगा। कोशी नदी का जल भारत-नेपाल सीमा के पास हनुमान नगर के नजदीक बीरपुर, जो भारत में है, स्थित बराज से 117.5 किलोमी० लंबी नहर के माध्यम से मेची नदी में प्रवाहित किया जायेगा। मेची नदी महानंदी की एक सहायक नदी है। इस प्रस्ताव में 41.3 किलोमी० का नहर पहले से मौजूद है शेष के विस्तारीकरण का योजना है। यह नहर भारत-नेपाल सीमा के समानान्तर संरेखित किया गया है। इस लिंक नहर का कुल

नियंत्रण क्षेत्र 2,75,135 हेक्टेयर है जिसमें से 69100 हेक्टेयर कटिहार जिलान्तर्गत पड़ता है जो कुल नियंत्रण क्षेत्र का लगभग 25% है। इसके तहत् 76.2 कि0मी0 मुख्य नहर सड़क, 227 कि0मी0 रक्षण एवं वितरण सड़क का निर्माण होगा। इसके तहत् 28 नई सड़क पुल का निर्माण होगा जिससे बिहार में कोसी का प्रवाह कम होने के साथ-साथ डाबरी क्षेत्रों में सिंचाई, आवागमन व्यवस्था में सुधार होगा। इस परियोजना के क्रियान्वयन में आबादी का विस्थापन नहीं है। इस परियोजना के प्रभाव क्षेत्र में कोई संवेदनशील क्षेत्र एवं कोई वन क्षेत्र नहीं है। इस परियोजना को पर्यावरणीय स्वीकृति के उद्देश्य पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार द्वारा टी.ओ.आर. निर्गत किया गया जिसके आधार पर पर्यावरणीय प्रभाव मूल्यांकन (ई.आई.ए.) रिपोर्ट तैयार किया गया है जिसमें संभावित पर्यावरणीय दुष्प्रभाव के नियंत्रण हेतु व्यवस्था दर्शाये गये हैं।

लोक-सुनवाई के दौरान लोगों के द्वारा किये गये सुझाव / प्रतिक्रिया निम्नवत् है:-

1. श्री नवल कनोडिया द्वारा कहा गया कि बाढ़ क्षेत्र होने के कारण अगर नहर के माध्यम से पानी का दबाव कम होगा तो किसानों को समस्या घटेगी। जिन किसानों को भू-अर्जित की जाती है 2013 भू-अर्जन के नियमानुसार एक वर्ष के भीतर भू-स्वामियों को भुगतान हो जाना चाहिये जो सामान्यतः नहीं हो पाता है।
2. श्री अमरनाथ झा द्वारा सूचित किया गया कि अतिक्रमण के कारण पुराना नहरों में पानी नहीं आता है। इसमें सुधार सुनिश्चित कराया जाय।
3. श्री विश्लेश कुमार गुप्ता द्वारा सूचित किया गया कि यह योजना उचित है। इससे होने वाले भूअवाप्त राशि का वितरण समुचित तरीके से कराया जाना सुनिश्चित किया जाय।

लोक-सुनवाई की कार्यवाही के दौरान अपर समाहर्ता महोदय द्वारा अन्तर्वीय संबोधन में कोसी-मेची नदी लिंक परियोजना को पर्यावरणीय स्वीकृति हेतु सार्थक बैठक आयोजित करने के लिए धन्यवाद दिया गया। साथ ही कहा गया कि परियोजना के विश्लेषण एवं प्रस्तुतीकरण से स्पष्ट है यह एक स्वच्छ परियोजना है जिसमें किसानों को सुविधा प्रदान करने का उद्देश्य निहित है। इस संबंध में सभा के दौरान सार्थक सुझाव प्राप्त हुए है जिसे पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार को अवगत कराया जायेगा। लोक-सुनवाई के दौरान इस प्रस्ताव को पर्यावरणीय स्वीकृति हेतु अनुशंसा करने के लिए सभी लोगों को धन्यवाद देते हुए कार्यवाही समाप्ति की घोषणा किया गया।

28.3.18

(एस.पी.राय)
क्षेत्रीय पदाधिकारी
बि.रा.प्र.वि.पर्षद्, पटना

23/03/18

(स्वयम्भू प्रिय)
अपर समाहर्ता (लो.शि.नि.)-सह-
जिला लोक शिकायत निवारण पदाधिकारी,
जिला-कटिहार

उपस्थिति सूची

बिहार सरकार द्वारा प्रस्तावित कोशी-मेची लिंक सिंचाई परियोजना के पर्यावरणीय स्वीकृति हेतु कोशी खांलोची मैदान, कटिहार, जिला-कटिहार में दिनांक: 28.02.2018 (बुधवार) को पूर्वाहन 11.00 बजे आयोजित लोक-सुनवाई की उपस्थिति:-

क्रमांक	नाम/पदनाम	पता	हस्ताक्षर
1			
2			
3	परमानन्द कुमार		
4			
5			
6			
7			
8	Pankhuri Singh	Minchai bori, Katihar 9431077105	
9	NIRMAL KISHORE DOKANIA	SONAILI (KATIHAR)	
10	Piyush Kumar	Amla Tola, Katihar 8271475771	
11	Pinku Kumar Jaiswal	Katihar 9973153228	
12	Abhishek Kumar Sinha	Khariya Hat	
13			
14			
15			
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17			

18	डी नारि वा	पटना	डी नारि वी
19	Jitendra Kumar	9771568115 Kasba Jagaun	Jitendra Kumar
20	विनोद मुखी	7542865539 दरभंगा	विनोद मुखी
21	Abdul Majid	Purnea	Abdul Majid
22	बादल सिंह	पटना 9661012086	बादल सिंह
23	[illegible]	कटिहार 8084327	[illegible]
24	किशन महतो	[illegible]	किशन महतो
25	उमेश कुमार राय	[illegible] 9931298053	उमेश कुमार राय
26	मनोज	मुजफ्फर	मनोज
27	गौरव चौधरी	मुजफ्फर 7903656028	गौरव चौधरी
28	संतोष कुमार	मुजफ्फर	Santosh Kumar
29	उमेश यादव 9931536046	मुजफ्फर	उमेश यादव
30	MANISH KUMAR	DIGHRI	Manish
31	[illegible]	[illegible]	[illegible]
32	राजेश कवि	पटना	राजेश कवि
33	[illegible]	[illegible]	[illegible]
34	[illegible]	[illegible]	[illegible]
35	उमेश कुमार [illegible]	कटिहार	उमेश कुमार [illegible]
36	[illegible]	कटिहार	[illegible]
37	Sanjay Kumar Mandal	कटिहार	Sanjay Kumar Mandal
38	[illegible]	[illegible]	[illegible]
39	[illegible]	कटिहार	[illegible]

40	विजय शर्मा	कारीहार	विजय शर्मा
41	सैयद रहीम	कारीहार	सैयद रहीम
42	ना.मु.शर्मा	कारीहार	ना.मु.शर्मा
43	सिद्धनाथ राय	कारीहार	सिद्धनाथ राय
44	त्रिवेणी शर्मा	कुदना	त्रिवेणी शर्मा
45	राजेश कुमार मंडल	पिपरी	राजेश कुमार मंडल
46	नंद कुमार	हरकांत	नंद कुमार
47	[illegible]	[illegible]	[illegible]
48	[illegible]	[illegible]	[illegible]
49	विनोद कुमार झा	रामेश्वर ISS दरभंगा	विनोद कुमार झा
50	नागेन्द्र झा	[illegible]	नागेन्द्र
51	[illegible]	[illegible]	[illegible]
52	[illegible]	[illegible]	[illegible]
53	[illegible]	[illegible]	[illegible]
54	[illegible]	[illegible]	[illegible]
55	[illegible]	[illegible]	[illegible]
56	[illegible]	[illegible]	[illegible]
57	[illegible]	[illegible]	[illegible]
58	[illegible]	[illegible]	[illegible]
59	[illegible]	[illegible]	[illegible]
60	[illegible]	[illegible]	[illegible]
61	[illegible]	[illegible]	[illegible]

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63			
64	Anil Kumar 9430937831		
65			
66	Sandip Kumar 9760183363		Sandip Kumar
67			
68			Rajesh Jha 9801039176
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72	9930472146		
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लोक-सुनवाई वृत

बिहार सरकार के जल संसाधन विभाग द्वारा प्रस्तावित कोसी-मेची अन्तर्राज्यीय नदी लिंक सिंचाई परियोजना के पर्यावरणीय स्वीकृति के उद्देश्य से **अररिया जिलांतर्गत** परियोजना प्रभाव क्षेत्र के लोगों के लिए लोक-सुनवाई दिनांक: 28.03.2018 (बुधवार) को फारबिसगंज कॉलेज, फारबिसगंज के परिसर, अररिया में आयोजित किया गया। यह दिनांक: 25.02.2018 को प्रस्तावित था परंतु अररिया जिला में आमन्न लोक सभा उपचुनाव, 2018 के मद्देनजर जिला पदाधिकारी, अररिया के द्वारा स्थगित किया गया। तदोपरांत दिनांक: 28.03.2018 को लोक-सुनवाई कार्यक्रम की संशोधित सूचना अंग्रेजी समाचार पत्र "द टाइम्स ऑफ इंडिया" तथा हिन्दी समाचार पत्र "हिन्दुस्तान" एवं "दैनिक जागरण" में दिनांक: 21.02.2018 को प्रकाशित किया गया था। पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार के पत्र J-12011/22/2016-IA-I(E), दिनांक: 23 सितम्बर, 2016 द्वारा निर्गत टी.ओ.आर. के आलोक में इस योजना का ई.आइ.ए. रिपोर्ट तैयार किया गया है। इस योजना का ई.आइ.ए. रिपोर्ट एवं इसका सार प्रतिवेदन पर्यट् कार्यालय के साथ-साथ जिला पदाधिकारी, जिला परिषद्, जिला उद्योग केन्द्र एवं कार्यपालक अभियंता, जल संसाधन के कार्यालयों में आमजनों के अवलोकन हेतु उपलब्ध थे। लोक-सुनवाई की कार्यवाही निम्न है:-

लोक-सुनवाई की कार्यवाही निम्न है:-

1. लोक-सुनवाई में उपस्थित पदाधिकारियों एवं स्थानीय लोगों की उपस्थिति (**अनुलग्नक-I**)
2. लोक-सुनवाई कार्यवाही की अध्यक्षता जिलापदाधिकारी, जिला-अररिया के प्रतिनिधि श्री अरविंद कुमार शरण, अपर समाहर्ता, जिला-अररिया द्वारा किया गया। बैठक में स्थानीय लोगों के साथ सिंचाई विभाग के मुख्यालय एवं स्थानीय अभियंतागण, ग्राम पंचायतों के प्रतिनिधिगण उपस्थित थे।

कार्यवाही के प्रारंभ में बिहार राज्य प्रदूषण नियंत्रण पर्षद् के क्षेत्रीय पदाधिकारी द्वारा लोक-सुनवाई के प्रयोजन से संबंधित एक परिचय प्रस्तुत किया गया। सभा में उपस्थित लोगों से प्रस्तावित परियोजना के पर्यावरणीय दृष्टिकोण से सुझाव, प्रतिक्रिया एवं मंतव्य से सभा से अवगत कराने के प्रयोजन को बताया गया। सिंचाई विभाग के कार्यपालक अभियंता द्वारा परियोजना के मुख्य बिन्दु प्रस्तुत किया गया, जो निम्नवत् है:-

इस परियोजना के तहत् पश्चिम में कोसी नदी एवं पूरब में मेची नदी को जोड़ने का कार्य प्रस्तावित है। इसके तहत् खरीफ मौसम में अररिया, पूर्णियाँ, कटिहार एवं किशनगंज जिलों में महानंदा बेसिन के पानी के कमी वाले क्षेत्र में सिंचाई प्रदान करने का प्रस्ताव है, जो हनुमाननगर बांध में उपलब्ध जल संचय पर निर्भर होगा। नई विस्तारित नहर के तहत् सिंचाई के लिए सकल नियंत्रण क्षेत्र (जी.सी.ए.) 2,75,135 हेक्टेयर तथा कृषिय नियंत्रण क्षेत्र (सी.सी.ए.) 214812 हेक्टेयर होगा। कोसी नदी का जल भारत-नेपाल सीमा के पास हनुमान नगर के नजदीक बीरपुर, जो भारत में है, स्थित बराज से 117.5 कि0मी0 लंबी नहर के माध्यम से मेची नदी में प्रवाहित किया जायेगा। मेची नदी महानंदा की एक सहायक नदी है। इस प्रस्ताव में 41.3 कि0मी0 का नहर पहले से मौजूद है शेष के विस्तारीकरण का योजना है। यह नहर भारत-नेपाल सीमा के समान्तर संरेखित किया गया है। इस लिंक नहर का कुल नियंत्रण क्षेत्र 2,75,135 हेक्टेयर है जिसमें से 88000 हेक्टेयर अररिया जिलांतर्गत पड़ता है जो कुल

नियंत्रण क्षेत्र का लगभग 32% है। इसके तहत् कुल 76.2 कि0मी0 मुख्य नहर सड़क, 227 कि0मी0 लाइन एवं वितरण सड़क का निर्माण होगा। इसके तहत् 28 नई सड़क पुल का निर्माण होगा जिससे बिहार में कोसी का प्रकोप कम होने के साथ-साथ प्रभावित क्षेत्रों में सिंचाई, आवागमन व्यवस्था में सुधार होगा। इस परियोजना के क्रियान्वयन में अंचलों का विस्थापन नहीं है। इस परियोजना के प्रभाव क्षेत्र में कोई संवेदनशील क्षेत्र एवं कोई वन क्षेत्र नहीं है। इस परियोजना को पर्यावरणीय स्वीकृति के उद्देश्य पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार द्वारा टी.ओ.आर. निर्गत किया गया जिसके आधार पर पर्यावरणीय प्रभाव मूल्यांकन (ई.आई.ए.) रिपोर्ट तैयार किया गया है जिसमें संभावित पर्यावरणीय दुष्प्रभाव के नियंत्रण हेतु व्यवस्था दर्शाये गये हैं।

लोक-सुनवाई के दौरान लोगों के द्वारा किये गये सुझाव / प्रतिक्रिया निम्नवत् है:-

1. श्री संतोष कुमार ठाकुर, सिसपुर पंचायत द्वारा पूछा गया कि इस योजना से काम का सृजन होगा अथवा नहीं। इस संबंध में सूचित किया कि इस कार्य योजना के क्रियान्वयन में ठिकेदारों के माध्यम से रोजगार मिलेगा।
2. श्री देवकान्त ओझा द्वारा सूचित किया गया कि पिछले दशक में इस क्षेत्र में बाढ़ के नियंत्रण की संभावना के बारे में जानकारी हेतु पृच्छा किया गया। इस संबंध में परियोजना के प्रस्तावक सिंचाई विभाग के कार्यपालक अभियंता द्वारा बताया गया कि इस योजना में बाढ़ नियंत्रण का उद्देश्य को समाहित किया गया है। इस योजना के क्रियान्वयन से बाढ़ की समस्या में कमी आयेगी। इससे जल जमाव की समस्या में भी कमी आयेगी।
3. श्री सत्यानन्द ठाकुर, बेलाई, चौरिया द्वारा बाढ़ के समय में नहर के बांध को काटे जाने से बगल के गांव में बाढ़ आ जाती है। इसे रोकने के व्यवस्था के संबंध में किये जा रहे प्रयास के संबंध में सूचना की मांग की गयी।
4. श्री गोपाल गोयल, फारबिसगंज द्वारा सूचित किया गया कि क्षेत्र में सिंचाई की समस्या है। बाढ़ के दिनों में स्वतः काफी पानी रहता है तथा उसके बाद नहर में पानी नहीं रहता है। इसके लिए आवश्यक उपाय किये जाने का सुझाव दिया गया है।

सभा में आये सभी लोगों द्वारा परियोजना को स्वीकृति दी गयी। लोक-सुनवाई की कार्यवाही के दौरान अपर समाहर्ता महोदय द्वारा अन्यकीय संबोधन में कोसी-मेची नदी लिंक परियोजना को पर्यावरणीय स्वीकृति हेतु सार्वजनिक बैठक आयोजित करने के लिए धन्यवाद दिया गया। साथ ही कहा गया कि परियोजना के प्रस्तुतीकरण एवं उपस्थित लोगों के चर्चा से स्पष्ट है कि इस क्षेत्र में बाढ़ की समस्या पहले से है। इस बाढ़ की सुरक्षा व्यवस्था सुदृढ़ीकरण के साथ इस योजना को स्वीकृति दी जा सकती है। इस प्रस्ताव को पर्यावरणीय स्वीकृति हेतु अनुशंसा कराने के लिए सभी लोगों को धन्यवाद देते हुए कार्यवाही समाप्ति की घोषणा किया गया।

12.4.18

(एस.पी.राव)
क्षेत्रीय पदाधिकारी
बि.रा.प्र.नि.पर्षद्, पटना

(श्री अमरेंद्र कुमार शरण)
अपर समाहर्ता
अररिया

उपस्थिति सूची

जल संसाधन विभाग, बिहार सरकार द्वारा प्रस्तावित कोशी–मेची लिंक सिंचाई परियोजना की पर्यावरणीय स्वीकृति हेतु फारबिसगंज कॉलेज प्रांगण फारबिसगंज, जिला–अररिया में आयोजित लोक सुनवाई दिनांक 28.03.2018 के दौरान उपस्थित महानुभावों की सूची:

क्र० सं०	नाम	पता	हस्ताक्षर
1.	अमोद कुमार झा मो.+ 9473191366	अवर अभियंता अररिया	28.3.18
2.	ई॰ डी॰ यादव 9431023951	कार्यपालक अभियंता, बिहार राज्य लघु सिंचाई निगम लि॰	28.3.18
3.	अर्क॰ [illegible] 9431042532		[illegible]
4.	[illegible] कार्यालय अधिशासी अभियंता	[illegible] अधिशासी अभियंता	[illegible] 28/3/18
5.	अभिमन्यु कुमार यादव वि॰ स॰ अररिया 9431837420	सहा॰ अभि॰ वि॰ स॰ अररिया	28/3/18
6.	अजित कुमार सिंह 9934411411	कार्यपालक अभियंता, बी॰सी॰के॰ डी॰सी॰ई॰-2 पटना	28/3/2018
7.	Nagendra Pd. Gubta 9471666150	Pabusaguj, W.No. 24 Araria	[illegible]
8.	विनोद कुमार गुप्ता 9931463727	village - बोलाई, पोस्ट- फारबिसगंज	विनोद कुमार गुप्ता
9.	[illegible] 9771241971	do	[illegible]
10.	धनेश्वर कुमार ऋषि 9801410910	ग्राम-बेलाई, पोस्ट+पंचायत- फारबिसगंज अररिया	धनेश्वर कुमार ऋषि
11.	Amit Kumar Singh 9939258413	At+Po- Nandlal gunj Dist. Araria	[illegible]
12.	Dinesh Ku. Yadav 9931461263	At+P.O- Barharwaha Dist- Araria	[illegible]
13.	Dambarudhar Roy 9631363624	At- Nandlalganj Po- Araria (Forbesganj)	[illegible]
14.	Mahendra Poddar 9931715141	Koshi Colony Bakhorama	[illegible]

15.	[illegible] 9661053861	[illegible]	[illegible]
16.	[illegible] 9931885918	[illegible]	[illegible]
17.	[illegible] 8969038403	[illegible]	[illegible]
18.	[illegible] 8757984708	[illegible]	[illegible]
19.	[illegible] 9323595569	[illegible]	[illegible]
20.	[illegible] 9955618324	[illegible]	[illegible]
21.	[illegible] 8003877388	[illegible]	[illegible]
22.	[illegible] 8969928092	[illegible]	[illegible]
23.	[illegible] 9546343708	[illegible]	[illegible]
24.	Mathanjha Kumar 9939960893	[illegible]	Mathanjha Kumar
25.	[illegible] 8637311495	[illegible]	[illegible]
26.	[illegible] 9771613800	[illegible]	[illegible]
27.	[illegible] 6201713110	[illegible]	[illegible]
28.	[illegible] 9592211357	[illegible]	[illegible]
29.	[illegible] 8809015828	[illegible]	[illegible]
30.	[illegible]	[illegible]	[illegible]
31.	[illegible] 9955668138	[illegible]	[illegible]
32.	[illegible] 9801311355	[illegible]	[illegible]
33.	[illegible] 9955668138	[illegible]	Jagat Kumar
34.	[illegible] 9472832015	[illegible]	[illegible]

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45.			
46.	Adarsh Goyal	M.L Goyal, Forbesganj	
47.			
48.	Nishant Goyal	Chartered Accountant Goyal & Associates	
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Annexure-11

Executive Summary

1.0 Introduction

The present proposal is an extension of Eastern Kosi Mechi Canal (EKMC) system up to river Mechi, a tributary of river Mahananda. The Government of Bihar proposed to extend the existing EKMC beyond its tail end RD 41.30 km up to 117.50 km so that rivers Kosi and Mechi which flow through Bihar itself after crossing Indo-Nepal border, can be linked within Bihar State by taking off the link canal from existing Hanuman Nagar barrage (Birpur) and out falling in river Mechi at suitable point while running the canal adjacent to Indo-Nepal border.

1.1 Identification of Project

The proposed Irrigation Project of Kosi-Mechi Intrastate Link Project (CCA 214812 Ha) which according to the environmental notification 14th September, 2006 at project identification schedule read at 1(c) "River Valley Projects", comes under category 'A' projects.

The Kosi-Mechi Intrastate Link Project with its extended ayacut beyond 41.30 km originates from existing Hanuman Nagar Barrage (Birpur) located on Kosi river and proposed to be continued up to river Mechi, for providing irrigation to Araria, Purnia, Katihar and Kishanganj districts of Bihar more or less parallel Indo-Nepal border. In its extended portion the canal from 41.30 km to 117.50 km to the outfall point in river Mechi, a tributary of Mahananda basin between river Parman and Mechi lies within the state of Bihar.

The proposed project will be developed by Water Resource Department Government of Bihar and the project falls under Water Resources Department Government of Bihar.

1.2 Purpose of the Project

The project is proposed to meet the irrigation water demands for Kharif season in four districts of Bihar i.e., Araria, Purnia, Katihar and Kisanganj. Since this region of Bihar lies in North East which is more fertile has considerable significance for irrigation. The Cultural Command Area (CCA) has been worked out using latest 5 years land use statistics for the period 2006-07 to 2009-10. The culturable area being highest in the year 2006-07, the Gross Command Area (GCA) under the new extended canal is worked out as 2,75,135 ha and CCA works out to 2,14,812 ha (2.15 lakh ha). The details of CCA in four districts are as below.

Sl. No.	Particulars	District wise area (in ha)				Total area in ha
		Araria	Purnia	Katihar	Kishanganj	
1.	Gross Command Area	88000	85750	49235	52150	2,75,135
2.	Culturable Command Area	69642	69970	35653	39548	2,14,812

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1.3 Location of the Project

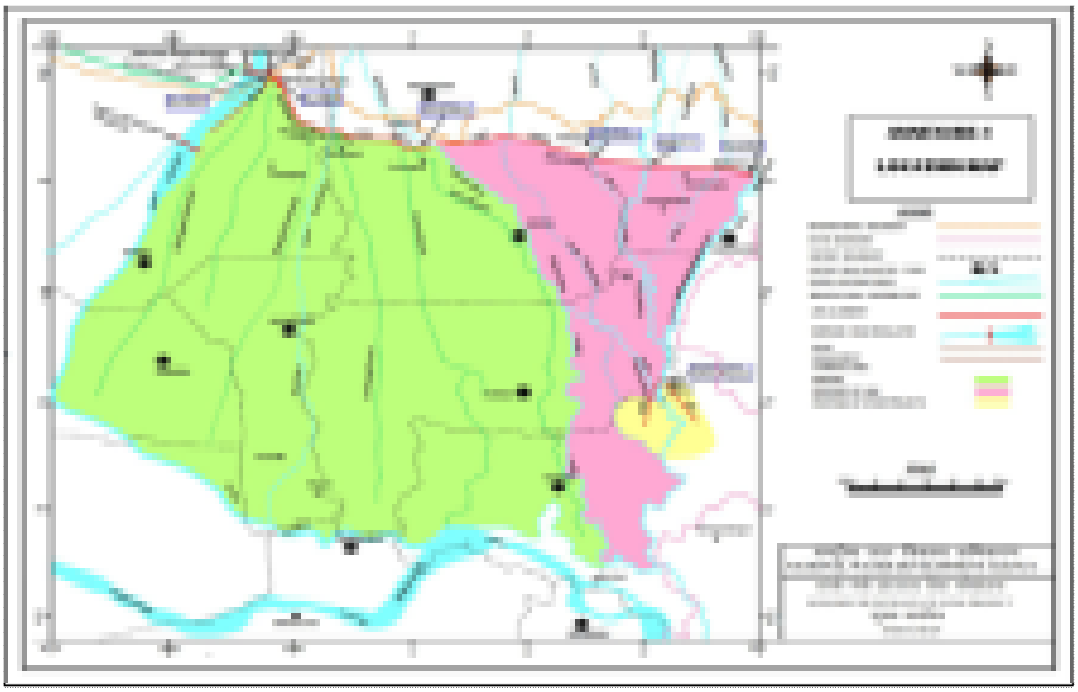

Figure 1. Location map of the project

1.4 Salient Features of the Project

1. Name of Project : Kosi-Mechi Intrastate Link Project
2. Purpose : Irrigation
3. River/ Basin : Kosi\Ganga
4. Sub-Basin : Kosi-Mechi
5. Project area reference to degree sheet : 72J, 72N, 72O
6. Location : Supaul, Araria, Purnia, Kishanganj and Katihar (Bihar)
7. Headworks Name : Existing Hanuman Nagar Barrage
8. Latitude : $26^0 31'27.4"N$
9. Longitude : $86^0 55'40.3"E$
10. River : Kosi
11. Nearest town : Hanuman Nagar (Nepal) Birpur (India)
12. Catchment Area of Kosi basin up to existing Hanuman Nagar barrage (Birpur) : 61792 Sq. km
13. Design flood of the existing barrage : 26900 cumec
14. Annual yield at 75% dependability at Hanuman Nagar barrage (Birpur) : 45374 MCM
15. Length of canal : 117.50 km
    a. Existing Eastern Kosi Main Canal (EKMC) : 41.30 km
    b. New canal beyond EKMC : 76.20 km
    c. Total (a+b) : 117.50 km

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16. Flow : Gravity
17. Lining : Concrete lining
18. Design discharge at head : 573 cumec
19. Design discharge at tail : 27 cumec
20. Full supply depth at head : 3.50 m
21. Full supply depth at tail : 2.00 m
22. Bed width at head : 131.50 m
23. Bed width at tail : 15.00 m
24. Sideslopes : 1: 1.5
25. Bed slope : 1 : 11,000 and 1:12,000
26. FSL of canal at head : 74.371 m
27. FSL of canal at tail end : 54.239 m
28. Number of structures : 113 No.
    a. Road bridge : 43 No.
    b. Syphon aqueduct : 14 No.
    c. Canal siphon : 09 No.
    d. Cross regulator : 10 No.
    e. Head regulator : 27 No.
    f. Hume pipe culvert : 9 No.
    g. Settling basin : 1 No.
    h. Canal escape : 8 No.
29. Water needs of link canal
    I. Culturable command area (CCA)
    II. Existing CCA of EKMC : 4.40 lakh ha
    III. Proposed CCA : 2.15 lakh ha
    IV. Area under irrigation in new command
        a. Kharif : 2,10,516 ha
        b. Rabi : -
        Total : 2, 10,516 ha
        c. Intensity of irrigation (proposed) : 98%
30. Water requirement
    A. Existing utilization of EKMC : 5740.37 MCM
    B. Enroute water requirement for new command
        a. Irrigation : 2050.15 MCM
31. Cost of the project : 4900 crores

1.5 Presentation of the Project before EAC in 16th EAC Meeting Held on 27/7/2018

The detailed EIA/EMP report was prepared for this project and along with that the entire project was presented in 16th EAC meeting held on 27th July 2018 where project was discussed in detail and after presentation proposal was deferred by the committee with recommendation for a site visit by a Sub-committee consisting of four members from EAC. In the EAC Meeting following six points

were required to be complied by the project proponent i.e. Water Resource Department (WRD) Gov. of Bihar in next presentation.

i. EMP cost be revised based on the mitigative measures suggested including re-appropriation of capital budgets on different heads of the EMP.
ii. Environmental matrix provided in the EMP be revisited and revised accordingly.
iii. PP may consider conjunctive use of water.
iv. Information on fish species from secondary sources be collected and included in the EIA report. The species may be categorized on the level of conservational importance as per standard Ref. like IUCN and NBFGR. Correspondingly, EMP should be developed for the VC, NT, EN and CR species. Migratory path may be delineated and should be protected under EMP.
v. Plan be prepared to irrigate minimum 10% of CCA through pressure irrigation technique
vi. CAD plan be revised based on the actual ground reality and accordingly the EIA/EMP report be revised and submitted.

1.6 The committee of MoEF&CC visited the Kosi Project from 28/9/2018 to 30/9/2018.

The committee constituted the following esteemed members from MoEF&CC to visit the project site

1. **Dr. D.M More (Chairman)**
2. **Dr. S. Kerketta (Member Secretary)**
3. **Dr. A.K. Sahoo (Member)**
4. **Mr. Manmeet Singh (Consultant)**

The committee visited the Kosi Barrage and Canal on 29th/9/2018. A brief review meeting was held at Purnia and following points were discussed for compliance by project proponent at the earliest.

1.7 Compliance Report

Compliance report considering above points was prepared and submitted by Water Resource Department (WRD) Gov. of Bihar vide letter no 01/YO.MU.S./Kosi-Mechi-10/16-1117 dated 23.10.2018.

1.8 Broad Concept of the Points Covered in Summary are as below.

(a) Compliance to the minutes of meeting of 16th EAC held on 27th /July/2018.
(b) Compliance to the observations pointed out by EAC members after site visit on 29th/Sept/2018.

Annexure-11

Compliance to EAC meeting held on 27th July 2018

Item (i):EMP cost be revised based on the mitigative measures suggested including re-appropriation of capital budgets on different heads of the EMP.

Project Cost Estimate (General abstract of cost)

Sl. No.	Item(s)	Amount Rs. in lakh
	Direct charge	
I.	Works	
	'A' – Preliminary	6277.80
	'B' – Land	106004.11
	'D' – Regulator	31015.24
	'F' – Cross Drainage Works	50926.54
	'G' – Bridges	101180.71
	'H' – Escape	1696.37
	'K' – Buildings	3186.00
	'L' – Earthwork including canal lining	166156.35
	'M' – Plantation	62.00
	'O' – Miscellaneous	990.00
	'P' – Maintenance	2949.60
	'Q' – Special T and P	378.00
	'R' – Communications	16654.96
	'U' – Distributaries, minors and sub-	10311.00
	'V' – Water courses	4833.00
	'W,X' – Environment and ecology	16126.00
	Total I – Work	427747.68
II.	Establishment	32174.36
III.	Ordinary Tools and Plants	4277.48
IV.	Deduct receipt and recoveries	(-)736.41
	Total direct charges	463463.10
V.	Indirect charges	26525.23
Grand total		**489988.33 Say 4900 CRORE**

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Estimation of cost for Amelioration of Environment

Sl.No.	Item	Qty	Unit	Rate (Rs.)	Amount (Rs. in Lakh)
1	**Provision of free fuel to Labourers**				
	Labour engaged departmentally, fuel is to be supplied at subsidized rates to avert biological loss			L.S.	16.35
2	**Ground Water Management**				
	Digging of tube wells	200	No.	40,865	81.73
	Cost of tube wells including motor & other equipment				
	Modelling and conjunctive use studies			L.S.	4.09
3	**Implementation of Public health Management**				
	Labour camps proposed at link canal 6 Nos.				
	Sanitation facilities to camps			L.S.	14.71
	Sewage & Waste water Management			L.S.	49.04
	Protected drinking water supply measures along link canal			L.S.	817.34
	Protected drinking water supply to labour camps			L.S.	24.52
	Mobile unit and sanitary measures			L.S.	81.73
	STD/HIV/AIDS control			L.S.	24.52
	Cooking sheds			L.S.	14.71
	Public health and health delivery system			L.S.	490.40
	Baby care centres			L.S.	9.81
4	**Environmental Monitoring Programme during construction phase (5 years):**				53.80
	Training of project staff & contractor's staff				7.50
	On site Farmers training				2.00
	Drainage				12751.09
	Environmental Monitoring Programme during construction phase (3 years)				4.56
5	**Environmental Monitoring Programme during (Operation Phase):**				
	Land use pattern (operation phase)				8.17
	Soil erosion and siltation (operation phase)				40.87
6	**Management in Irrigated Area**				
(a)	Borrow area management				**1628.52**
(b)	Weed inspection management				
(c)	Fertiliser pesticide management				
	Total Environment and Ecology Cost (Ref W,X of above table)				**16126.0**

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Grand Total estimation of cost for Amelioration of Environment

Sl.No.	Item	Qty	Unit	Rate (Rs.)	Amount (Rs. in Lakh)
1	**Provision of free fuel to Labourers**				
	Labour engaged departmentally, fuel is to be supplied at subsidized rates to avert biological loss			L.S.	16.35
2	**Ground Water Management**				
	Digging of tube wells	200	No.	40,865	81.73
	Cost of tube wells including motor & other equipment				
	Modelling and conjunctive use studies			L.S.	4.09
3	**Implementation of Public health Management**				
	Labour camps proposed at link canal 6 Nos.				
	Sanitation facilities to camps			L.S.	14.71
	Sewage & Waste water Management			L.S.	49.04
	Protected drinking water supply measures along link canal			L.S.	817.34
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	Mobile unit and sanitary measures			L.S.	81.73
	STD/HIV/AIDS control			L.S.	24.52
	Cooking sheds			L.S.	14.71
	Public health and health delivery system			L.S.	490.40
	Baby care centres			L.S.	9.81
4	**Environmental Monitoring Programme during construction phase (5 years):**				53.80
	Training of project staff & contractor's staff				7.50
	On site Farmers training				2.00
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	Land use pattern (operation phase)				8.17
	Soil erosion and siltation (operation phase)				40.87
	Environmental Monitoring Programme during construction phase (3 years)				4.56

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Sl.No.	Item	Qty	Unit	Rate (Rs.)	Amount (Rs. in Lakh)
6	**Management in Irrigated Area**				
(a)	Borrow area management				**1628.52**
(b)	Weed inspection management				
(c)	Fertiliser pesticide management				
Total Environment and Ecology Cost (Subtotal (A))					**16126.00**
	Plantation				62.00
	Escape				1696.37
	Communication				16654.96
	Subtotal (B)				**18413.33**

Cost for Plantation, Escape and Communication is around Rs. 18413.33./- lakhs has been considered under environmental costand *cost of Drainage has been reduced from Rs.14448.00/- lakhs to Rs. 12751.09/- lakhs*.

Grand Total of estimation of cost for Amelioration of Environment will be Rs. 34539.33/- lakhs

* [P.S. there is calculation mistake in Table for Cost Estimate for implementation of EMP in Minutes of Meeting issued by MoEF&CC, total cost estimate is Rs.32910.81/- lakhs which has been further revised to Rs. 34539.33/- lakhs, however in Minutes it is given as Rs. 12439/- lakhs, which may please be revised to Rs. 34539.33/- lakhs.

Item (ii): Environmental matrix provided in the EMP be revisited and revised accordingly.

Sl. No.		Features likely to be affected (Env. Parameter)						
		Roads & communication	**Colony construction**	**Borrowing of materials**	**Importing of labour**	**Canal construction**	**Soil conservation & landscaping**	**Irrigation**
A.	**Forestry & vegetation**	-1P	+2P		-1T	-1P	+3P	+3P
B.	**Sedimentation & erosion**	-1T	-1T	-2T		+2P	+3P	-1P
C.	**Communication**	+3P	+2P			+2P		
D.	**Land Area Development.**	-2P	+2P			+2P	+2P	+3P
E.	**Agriculture**	+2P	+1P			-1P	+2P	+4P
F.	**Food Production**	+2P	+1P			-1P		+4P
G.	**Public Revenue & Income**	+2P	+2P			+2T	+2P	+4P
H.	**Water quality**			-1T	-2T			+1P
I.	**Air quality**	-1T		-1T			+1P	+1P
J.	**Climate**						+1P	+1P

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Sl. No.		Features likely to be affected (Env. Parameter)						
		Roads & communication	Colony construction	Borrowing of materials	Importing of labour	Canal construction	Soil conservation & landscaping	Irrigation
K.	Ground water table							+2P
L.	Employment	+1T	+1T			+1T		+2P
M.	Health and Safety			-1T	-2T	-1T	+2P	+2P

*** Notes – Likely effect is symbolized as follows Notation used:**
P=Permanent Effect T=Temporary Effect

	Mild	Considerable	High	Very high
Beneficial	+1	+2	+3	+4
Detrimental	-1	-2	-3	- 4

Source: Food and AgriculturalOrganisation of United Nations and Overseas Development Administration of UK

Item (vi):CAD plan be revised based on the actual ground reality and accordingly the EIA/EMP report be revised and submitted.

Command Area Development Plan

The EKMC canal will extend from 41.30km to 117.50 km. The ayacut will cover about 2.15 lakh Ha. in four districts i.e. Araria, Purnia, Kathiar and Kisanganj districts of Bihar. Following locations of branch and distributaries and off take locations havefinalized.

Branch Canal 4nos. (RD in km)

1. R.D 61.00
2. R.D 80.60
3. R.D 100.400
4. R.D 111.00

Distributary Canal 6nos. (RD in km)

1. R.D 57.890
2. R.D 65.515
3. R.D 70.940
4. R.D 92.975
5. R.D 106.800
6. R.D 112.600

The branch and distributaries will have minor and sub-minors with field channels and water courses which will spread out in entire ayacut.

The Water Resource Department, Gov. of Bihar have entrusted a specialized agency to take up the ayacut survey to finalize the alignment of above canal system and will be ready within 3 months.

The improvement in command area management will help to increase the existing yield of the paddy a dominant crop and will improve the financial status of the farmers, besides developing trading, marketing and business activities in the rural areas of Bihar.

(i) Participatory Irrigation Management Plan (PIM)

This PIM is an important administrative arrangement where the farmers are involved in management of canal system. The Govt. of Bihar have already enacted the PIM system in command area management in irrigation ayacut where farmers are directly involved in the management activity of the canals. This will ensure the maintenance of minor and sub-minors in a better way so that distribution of irrigation water is properly managed and water from head to tail end.

Overall command area development plan in the new ayacut will be from 41.30 km to 117.50 km.

The main feature of irrigation management as below:

Water logging and Soil Salinity

In most of the area in Araria, Purnia and Katihar district, the depth of water remains between 2 to 5 m bgl in post monsoon period. However in Katihar District the water remains 2 to 5 m bgl except southern portion where ground water remains below 5 m.

The management of handling of water logging principally will depend on reducing the supply of irrigation water and drawing of ground water by digging tube well and pumping ground water. There is a provision of Rs 85.52 lakh (this is discussed in item 3 of compliance of EAC observation) water amelioration of Environment.

Fertilizer Management Integrated Nutrient Management

The agriculture department of Govt. of Bihar will assist soil testing in new canal and command close of chemical fertilizer. N, P, K are the most common chemical fertilizer. Besides along chemical fertilizers other components of integrated nutrient includes organic manure, green manure and bio-fertilizers for sustainable development plan integrated nutrient management is proposed in new command area with the experience of existing command up to 41.30 km. Added in item 6 (c) of estimation of cost for amelioration of environment, total cost for fertilizer and pesticide management is 1628.52 lakhs.

Integrated Pest Management Plan

The agriculture department will educate the farmers about correct dose of chemical pesticides to control pest. This includes improving farmers awareness about health hazards due to pesticide use. The awareness programme will help to train farmers about adverse effect due to use of overdose of chemical pesticides and help to use for bio-pesticides. Neem based products. For item above there is a provision of onsite farmer training of Rs2.00 Lakh.

Annexure-11

Prevention and Management Plan against Possible Weed Infestation

This is one of the greatest hindrance in the efficiency of drainage system and flow in canal water by the growth of aquatic plant and other item like water hyacinth and ipomoea in water bodies. The integrated control refers to the application of combined actions like physical, chemical and biological methods are used to control weed. The aquatic plant thus removed from canal and water bodies are used for composted which is helpful to increase the organic and nutrient content as well as the microbial activity and texture of soils.

There is a provision of Rs. 4.56lakhs for environmental monitoring during post implementation where farmers will be trained on overall management of ayacut against possible of environment deterioration. Rs. 4.56 lakhs has been kept under environmental monitoring

Item (v):Plan be prepared to irrigate minimum 10% of CCA through pressurized irrigation.

Command area survey work in 10% of CCA has been done and survey plan has also been enclosed in DPR of this project.

Further course of action be initiated at the time of implementation of the project.

Govt. of Bihar will take necessary steps to introduce pressurised irrigation as demonstrative steps so that pipelines can be laid underground.

Item (iii):PP may consider conjunctive use of water.

Hydrology of the project reveals that presently sufficient water is available to feed the existing command area and as well as additional command area due to extension of canal from 41.30 km to 117.50 km.

However the necessary steps can be taken due to reduction of water availability, if any in future, then use the ground water by digging tube wells, installing suitable no of pumps at different locations.

Amount of Rs. 85.85 lakhs has been provided for ground water management which includes digging of tube wells, modelling and conjunctive use studies.

Annexure-11

Item (iv): Information on fish species from secondary sources be collected and included in the EIA report. The species may be categorized on the level of conservational importance as per standard Ref. like IUCN and NBFGR. Correspondingly, EMP should be developed for the VC, NT, EN and CR species. Migratory path may be delineated and should be protected under EMP.

Information on fish species from secondary sources

Sl.No.	Name of fish	IUCN STATUS
1.	*Anabus testudinous*	Data deficient
2.	*Anabus cobojious*	Data deficient
3.	*Badis badis*	LC
4.	*Barbonymous gonionotus*	LC
5.	*Barilius barna*	LC
6.	*Botia lohachata*	-
7.	*Botia dario*	LC
8.	*Cabdio maror*	LC
9.	*Canthophrys gongota*	LC
10.	*Catla catla*	LC
11.	*Chaca chaca*	LC
12.	*Chagunius chagunio*	LC
13.	*Chanda nama*	LC
14.	*Channa gachuwa*	LC
15.	*Channa orientalis*	-
16.	*Channa punctatus*	LC
17.	*Channa striatus*	LC
18.	*Chela cachieus*	LC
19.	*Cirrhinus mrigala*	LC
20.	*Cirrhinus reba*	LC
21.	*Clarias batrachus*	LC
22.	*Clupisoma garuwa*	LC
23.	*Clupisoma montana*	LC
24.	*Ctenopharyngodon idella*	-
25.	*Crossocheilus latius*	LC
26.	*Danio rerio*	LC
27.	*Eutropichthys vacha*	LC
28.	*Gagata cenia*	LC
29.	*Glossogobius giuris*	LC
30.	*Glyptothorax telchitta*	LC
31.	*Glyptothorax boitus*	LC
32.	*Heteropneustes fossilis*	LC
33.	*Hypothalmichthys nobilis*	Data deficient
34.	*Hara hara*	LC
35.	*Labeo bata*	LC
36.	*Labeo calbasu*	LC
37.	*Labeo fimbriatus*	LC
38.	*Labeo rohita*	LC

Annexure-11

Sl.No.	Name of fish	IUCN STATUS
39.	*Labeo gonius*	LC
40.	*Leiodon cutcutia*	-
41.	*Lepidocephalichthys guntea*	LC
42.	*Lepidocephalichthys menoni*	Data Deficient
43.	*Macrognathus aral*	LC
44.	*Macrognathus pancalus*	LC
45.	*Mastacembelus armatus*	LC
46.	*Monopterus cuchia*	LC
47.	*Mystus cavasious*	LC
48.	*Mystus tengara*	LC
49.	*Mystus vittatus*	LC
50.	*Nandus meni*	-
51.	*Nandus nandus*	LC
52.	*Nangra assamensis*	LC
53.	*Notopterus notopterus*	LC
54.	*Nemacheilus beavani*	LC
55.	*Nemacheilus corica*	LC
56.	*Nangra nangra*	LC
57.	*Puntius conchonius*	LC
58.	*Puntius sophore*	LC
59.	*Puntius terio*	LC
60.	*Puntius sarana*	-
61.	*Psillorbyncbus sucatio*	-
62.	*Raiamas guttatus*	LC
63.	*Salmophasia bacaila*	LC
64.	*Sperata aor*	LC
65.	*Sisor rheophilus*	Data Deficient
66.	*Sisor rhabdophorus*	LC
67.	*Trichogaster fasciata*	LC
68.	*Xenentodon cancilla*	LC

N.B.DD-Data Deficient, **LC**-Least Concern/Lower Risk, **VN**-Vulnerable, **EN**-Endangered, **NT**-Near Threatened, **(-)** Not yet been assessed for the IUCN Red List (**IUCN Red List of Threatened Species**).

Nearly Threatened Species as per IUCN

S.No.	Name of Fish	Status
1.	*Hypothalmichthys molitrix*	NT
2.	*Ompok bimaculatus*	NT
3.	*Parambassis lala*	NT
4.	*Parambassis ranga*	NT
5.	*Tor tor*	NT
6.	*Wallago attu*	NT

Annexure-11

Endangered Species as per NBFGR

S.No.	Name of Fish	Status
1.	*Chaca chaca*	EN
2.	*Chagunius chagunio*	EN
3.	*Devario acuticephala*	EN
4.	*Hemibagrus menoda*	EN
5.	*Sisor rhabdophorus*	EN

Vulnerable Species as per NBFGR

S.No.	Name of Fish	Status
1.	*Ctenops nobilis*	VN
2.	*Danio dangila*	VN
3.	*Glypthothorax telchitta*	VN
4.	*Rhinomugil corsula*	VN
5.	*Silonia silondia*	VN

***Tor tor* (Mahsheer)**

It grows better in rivers with a rocky bottom. It breeds during August-September and continues up to December. After spawning, downstream migration occurs in large shoals. It's a benthopelagic and potamodromous species found in depth range of 3-4 metres. The species travel toward headwaters at the start of the rainy season and downstream at the end of the rainy season. It's an omnivorous fish, which feeds on filamentous algae, chironomid larvae, water beetles and crustaceans. It spawns from March to September, over stones and gravel. It is reported to reach 150 cm TL and gain a maximum weight of 68 kg and is considered a long- living species.

Spawning habitat is increased when the stream flow is high enough to cover suitable gravels but is decreased when velocity becomes too high for successful spawning activities. Adequate water depth and flow will be maintained for the survival of migratory fish species *Tor tor*.

Apart from fish species found during primary survey and site visit, it was observed that fresh water prawns also forms major catch in the upstream of the canal.

References

1. ***Additions to the Ichthyofauna of Nepal, with a re-description of Neoeucirrhichthys maydelli (Teleostei: Cobitidae)*** *by David R. Edds* and Heok Hee Ng***

2. ***ON A COLLECTION OF FISH FROM NORTH BENGAL*** *by K. C. JAYARAM (Zoological Survey of India, Southern Regional Station, Madras) and K. P. SINGH (Zoological Survey of India, Gangetic Plains Regional Station, Patna).*

3. ***ON A SMALL COLLECTION OF FISHES FROM NORTH BIHAR*** *by K. P. SINGH Gangetic Plains Regional Station, Zoological Survey of India, Patna.*

4. ***Threatened Fresh Water Fishes in India****, NATIONAL BUREAU OF FISH GENETIC RESOURCES, Lucknow (Indian Council of Agricultural Research).*

Annexure-11

Compliance to item 19.1 of minutes of 19th EAC meeting held on 26th October 2018

1. **There appears to be no problem from the design and construction point of view in taking up of the works of canal system in the extended portion. The activity seems to be conventional one.**

   The detailed design of remodeling upto 41.30 km and extended have been duly prepared and available in Vol-I and Vol-II of DPR prepared by NWDA.

2. **Fisheries activities were observed in the proposed canal just downstream of the Lock gate. Indigenous fish species were collected through different fishing gears as shown in the pictures. This indicates livelihood of poor fishermen is dependent on this canal. Further, during site visit, it was noticed that freshwater prawn forms major catch in the upstream of the canal which has not been reported in the EIA report submitted for EC clearance consideration. During market survey, it was recorded that migratory fish species such as Tor sp. (Mahseer) distant migrant, Eutropiichthysvacha local migrant and other commercial important fish species such as Bagarius Sp. list were not mentioned.**

   Has been covered above in Item-iv of compliance to minutes of meeting of 16th EAC held on 27/07/2018.

3. **The existing canal is unlined one and passes through soft soil (may be sandy silt) mostly in cutting. The excavated stuff is dumped on both sides of the canal just adjacent. The carrying capacity of the canal is to be increased from 425 cumecs to 573 cumecs in the head reaches. At RD 41.3 km, carrying capacity is to be enhanced to 235 cumecs. From the information given in the booklet and the discussions with the field officers, it was learnt that the capacity was proposed to be enhanced by widening the canal section. For such a venture, the problems to be faced at full cutting, partial cutting and full banking canal sections will be different.**

   The discharge of the barrage will increase from 425 cumec to 573 cumec. This discharge will pass through 7 nos. of gates of the Head Regulator of barrage and each gate with discharge of 85 cumecs.

   The existing design parameters will be maintained upto 4.57 km to protect canal power house at R.D 3.66 km. The discharge will increase due to enhancing the bed width as well as lining of entire canal system. The necessary action will be taken to reuse canal system from full cutting to full banking wherever necessary.

Annexure-11

Existing EKMC and Proposed Remodelled Canal Parameters

Sl. No.	RD	Particulars	Existing Design	Proposed Design
1	0.0	Design discharge	425 cumec	573 cumec
		Bed width	110 m	131.50 m
		Canal depth	3.5 m	3.50 m
		Bed slope	1:11000	1:11000
		Canal section	Unlined	Lined
2	4.57	Design discharge	302.54 cumec	490 cumec
		Bed width	79.24 m	79.50 m
		Canal depth	3.35	4.25 m
		Bed slope	1:11000	1:11000
		Canal section	Unlined	Lined
3	13.35	Design discharge	236.17 cumec	444 cumec
		Bed width	67.06 m	72.00 m
		Canal depth	3.35 m	4.25 m
		Bed slope	1:11000	1:11000
		Canal section	Unlined	Lined
4	23.9	Design discharge	139.14 cumec	331 cumec
		Bed width	44.20	59.00 m
		Canal depth	2.9 m	4.00 m
		Bed slope	1:11000	1:11000
		Canal section	Unlined	Lined
5	30.93	Design discharge	131.71 cumec	331 cumec
		Bed width (m)	44.20 m	59.00 m
		Canal depth	2.75 m	4.00 m
		Bed slope	1:19000	1:19000
		Canal section	Unlined	Lined
6	39.99 to 41.3	Design discharge	41 cumec	235 cumec
		Bed width	20.11m	52.50 m
		Canal depth	2.13 m	3.50 m
		Bed slope	1:75000	1:11000
		Canal section	Unlined	Lined

Source- Pg. No. 84, Vol-I of DPR prepared by NWDA.

Annexure-11

4. **By providing lining to the existing canal section over the entire length, the carrying capacity of the canal section could be enhanced sizably. If required, FSD of the canal could be raised by raising the bank work suitably. For sections in cutting, there may not be any problem. For better operation of the canal, the FSD could be regulated through the intervention of cross regulators. The extended canal for its entire length of 76.2 km is going to be lined one.**

   The carrying capacity of the canal will be increased

   (a) By lining of the canal

   (b) Increasing Bed width

   (c) Enhancing depth of canal

   The details are shown in item 3 of above table (Existing EKMC and Proposed Remodeled Canal Parameters).

5. **The critical issue will be of increasing the carrying capacities of the existing siphon conduits. This has to be dealt with very carefully.**

   The canal syphon design have been duly prepared by NWDA and available in Vol-II. Various engineering details have been prepared with meticulous details.

   The list of head regulator upto 4.57km and bridges parallel to syphon will not be changed. However additional bridge spans will be provided for the bridge to cover the extra width of canal.

   The following structures are without remodelling.Additional spans provided as per bed width

S. No.	Reach (km)	Type of Structure	Location
1	2	3	4
1	0.000	Head Regulator	Left Bank HR of Hanuman Nagar Barrage
2	2.657	Head Regulator	Shivanagar Distributary
3	3.353	Head Regulator	Phulkaha Distributary
4	3.658	Canal Power House	
5	4.572	Head Regulator	Escape
6	6.744	Bridge Parallel to Syphon	Sanjay Dhar
7	11.143	Bridge Parallel to Syphon	Haya Dhar
8	17.922	Bridge Parallel to Syphon	Bochaha Dhar
9	23.243	Bridge Parallel to Syphon	Sursar Nadi
10	27.241	Bridge Parallel to Syphon	Kharra Dhar
11	30.945	Bridge Parallel to Syphon	Gerua Dhar
12	36.768	Bridge Parallel to Syphon	Kajra Dhar
13	40.945	Bridge Parallel to Syphon	Sita Dhar

   In a specific case for design of syphon at Sanjay Dhar, the following designs are available in DPR Vol-II prepared by NWDA.

   (a) Hydraulic Design of link canal section for Reach-I (from R.D 4.570km to 13.350 km) (Page no.- 74)

   (b) Design of Syphon across river Sanjay Dhar at R.D 6.744 km (Pg.No. 123)

Annexure-11

6. **It would be advisable to observe the performance of the remodeled section with various alternatives on a hydraulic model.**
   This is one of the important item which needs careful consideration. The W.R.D of the Gov. of Bihar proposes to carry out a hydraulic modelling study at the Central Water and Power Research Station (CWPRS) Pune to validate the engineering design and analysis already proposed for remodeling work.

7. **The excavated muck from the canal section is dumped on either side in a haphazard way. It is anormal practice. A proper shape to the spoil banks/ landscaping improves the surroundings and environment. This is to be taken care of.**
   This aspect has been duly considered and immediate priority action has been initiated.
8. **The up-keeping of the canal portion was not to the expected level. Bushes and shrubs were seen growing at rampant on the canal sides.**

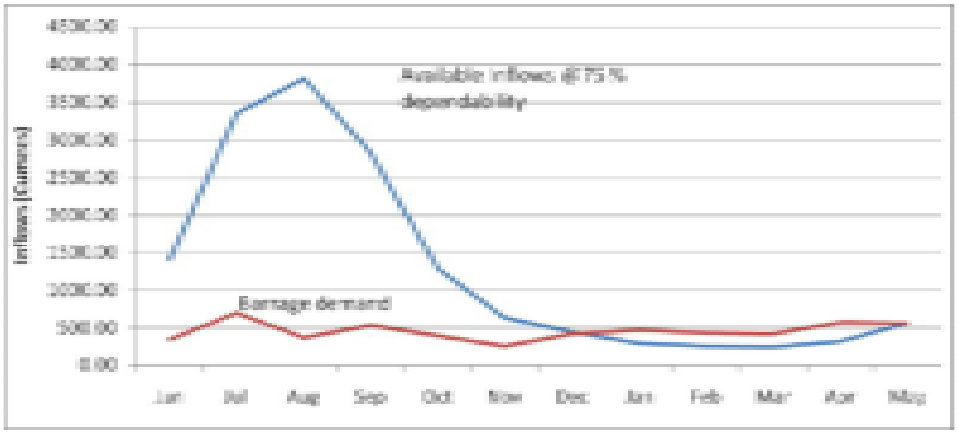
   Proper Maintenance of Canal System
   The chief engineer of the project has already taken necessary steps to attend to re-sectioning of canal under fund based programme. However in remodelling work some of the bed width of canal will be changed. Till such time maintenance work will proceed.
   Maintaining of banks, silt removal, weed clearance, laying good earth on bank, rooting out shrubs, maintaining of service road, providing catch drain and slope drain on bank slope and oiling and greasing of gates of regulator and other would be done as per norms and guidelines of WRD, Gov. of Bihar where ever/ whenever required as per site condition.

   Disposal of Excavated Silt
   As regards disposal of excavated silt at R.D 1.6 km from silt chamber, the same will be disposed in depressed low land, in command area in an orderly manner and this is considered under priority. Further landscaping along the canal will be improved both from safety and aesthetics point of view.

9. **The average rainfall in the area is around 1,500 mm and therefore, the proposed irrigation during kharif is going to remain as protective irrigation only. There is no dearth of groundwater. There are shallow bamboo tube wells (of 10 to 15 feet) and groundwater could be utilized for rabi and summer crops. The river Koshi carries sizable discharge even during summer season. The existing irrigation (up to RD 41.3 km) is practiced for Kharif and rabi seasons. It was not understood as to why they have put ban on Rabi irrigation for the extended command. Alternatively small village tanks, farm ponds could be developed in the entire command of the EKMC and Koshi-Mechi canal and decentralized storages could be created in the kharif season with canal water. This stored water could be used for doing irrigation in rabi and hot weather seasons with micro irrigation method. There is ample groundwater at the command of the farmers. The area at places was seen water logged. This will take care of water requirement of perennial crops like banana,**

sugarcane and so on. With this background in the days to come the system could be converted to perennial one.

During site visit to the project the Chairman of the committee brought to the knowledge of members that adequate ground water is available which needs to be utilized and in the context of this, NWDA have carried out the hydrological study of the surface water and indicates deficiency after December and CWC have duly examined this aspect. The extract is given in figure below (Pg. No. 73, DPR Vol-I).



Further any utilization of the non-monsoon water of Kosi is also likely to affect **Indo-Bangladesh Agreement**on Ganga River. This imposes a minimum flow to be maintained inGanga at the Farakka in lean season **(Ref. pg.73, item 5.9 of DPR Vol-I) & pg. no. 50 of DPR Vol-II)**

Impact on D/s proposed project installed capacity 26X5=130 MW at Baghmara-30km D/S of barrage on Kosi river. So presently the project is restricted to Kharif season only.

Availability of Abundant Ground Water

However very persistently the point raised will be duly considered to utilize ground water which is available in plenty. The groundwater of Araria, Purina and Kathiar remains between 2 to 5 m bgl. The conjuctive use will be duly considered as it will reduce water logging and help farmers to develop like some rabi crop and perineal crop like Banana and sugarcane.

10. **In the extended command, about 20% area has been proposed to be developed under micro irrigation system. It is basically for enhancing the productivity and quality of the agri-produce, in addition, it saves plenty of water. More and more area canbe planned to be brought under micro irrigation in the days to come and water could be saved. The water stored in the secondary storages in the command, use of groundwater and also the water saved in micro irrigation could help to transform the entire command into a perennial farming. Additional area from the Mahananda basin (left over as un-irrigated) could also be brought under irrigation with the help of the increased water availability as explained**

above. The land holding in this area is very small and therefore, it will be very much necessary to support farmers with irrigation facility.

As discussed under Item 9, ground water will be used. The micro-irrigation consists of localized irrigation, low flow irrigation. This is also discussed under pressurized irrigation which have proper underground covering different diameters.

This is discussed in details under Item V of EAC compliance of minutes of 16thEAC meeting. This will help farmers with small land holding as night suggested.

11. The project involves remodeling of existing EKMC upto R.D. 41.30 km and construction of new canal upto RD 117.50 km.The discharge of canal will increase from present 425 cumecs to 573 cumecs.This will also involve remodeling of existing structure like canal siphons and head regulators of the branch canal, distributaries with cross regulators and escapes. PP (WRD, Govt. of Bihar) shall submit their programme to undertake such remodeling work.

Remodelling of canal work

The Kosi-Mechi link project is one of the prestigious project of Water Resource Department of Gov. of Bihar. The Entire Project DPR has been prepared by NWDA, a reputed organisation of MoWR, Gov. of India, New Delhi.

In the DPR the NWDA has worked out the detailed design of remodelling work from 0.00 to 41.30 km as well as upto 117.50km.

The discharge of the barrage will increase from 425 cumec to 573 cumec. This discharge will pass through 7 nos. of gates of the Head Regulator of barrage and each gate with discharge of 85 cumecs.

The existing design parameters will be maintained upto 4.57 km to protect canal power house at RD 3.66 km. However the existing canal will be lined to carry higher discharge.

Locations where Bed Width Increases.

Water Resource Department, Gov. of Bihar has proposed to take up modernization of existing canal from RD 0.00 TO 41.30 km. Under this programme one of the important items is to increase the existing bed width to accommodate higher discharge, following are few locations were considerable increase in bed width will take place and consequently the design of canal system will be revised.

RD in Km	Existing Bed Width in m.	Proposed increased bed width in m.
0.00	110	131.50
13.35	67.06	72.00
23.90	44.20	59.00
39 to 41.30	20.11	52.50

Annexure-11

The remodeling of canal from 00 km to 41.30 km is under active consideration of government of Bihar.

It is proposed to continue the remodeling without affecting the existing system as far as practicable. However it is proposed to curtail the rabi irrigation partly and to avail 5 to 6 months in winter and summer months for remodeling works.
The WRD, Gov. of Bihar will fully involve NWDA as well as a highly competent organization to workout modalities and time scheduling without much disruption of the work.

12. The maintenance of canal needs improvement. Particular attention should immediately be given in head reaches where the canal needs proper re-sectioning as well as proper dumping of excavated silt with landscaping wherever.

Disposal of Excavated Silt

As regards disposal of excavated silt at R.D 1.6 km from silt chamber, the same will be disposed in depressed low land, in command area in an orderly manner and this is considered under priority. Further landscaping along the canal will be improved both from safety and aesthetics point of view.

13. Water quality particularly variation of water temp., DO, pH, TDS and alkalinity, Phosphate, Nitrate at the site of joining of Kosi with Mechi (Upstream and downstream of joining point), E.coli data to be provided.

Sl. No.	Test Parameters	Unit	Max. Tolerance Limit as per IS 2296 : Class C	Kosi – River Surface water	Parman River Surface Water	Mechi River Meeting Point	Mechi River Down Stream	Mechi River Up Stream
1	pH	--	6.5 to 8.5	7.34	7.49	7.33	7.31	7.28
2	Temperature	°C	--			29.2	29.3	29.2
3	Electrical Conductivity	µS/cm	--	128.5	133.8	120.4	112.2	128.6
4	Total Suspended Solids	mg/l	--	19.2	16.1	12.4	13.1	11.9
5	Total Alkalinity as $CaCO_3$	mg/l	--	36	38	32	30	28
6	Total Hardness as $CaCO_3$	mg/l	--	34	34.6	30.7	30.7	30.2
7	Calcium as Ca	mg/l	--	8.02	8.26	7.18	8.2	8.8
8	Magnesium as Mg	mg/l	--	3.4	3.4	3.11	2.48	2.0
9	Iron as Fe, Max.	mg/l	50	0.19	0.21	0.16	0.15	0.13
10	Chloride as Cl, Max.	mg/l	600	10.1	11.3	5.87	5.87	5.6
11	Phosphate	mg/l	--	0.14	0.16	0.12	0.13	0.11

Annexure-11

	as PO_4							
12	Sodium as Na	mg/l	--	4.9	4.7	4.2	4.1	4.4
13	Potassium as K	mg/l	--	1.1	0.9	0.8	0.7	0.84
14	Dissolved Oxygen, Min.	mg/l	4	6.3	6.9	6.6	6.4	6.1
15	BOD: 3 days at 27^0C, Max.	mg/l	3	2.4	2.5	2.2	2.3	2.1
16	COD	mg/l	--	10	12	09	10	08
17	Silica as Si	mg/l	--	5.9	5.5	5.8	5.7	5.6
18	Oil & Grease, Max.	mg/l	0.1	ND	ND	ND	ND	ND
19	Copper as Cu, Max.	mg/l	1.5	<0.03	<0.03	<0.03	<0.03	<0.03
20	Sulphate as SO_4, Max.	mg/l	400	<5	<5	<5	<5	<5
20	Residual Na_2CO_3	mg/l	--	ND	ND	ND	ND	ND
21	Nitrate as NO_3, Max.	mg/l	50	5.4	5.3	5.1	5.2	4.8
22	Cadmium as Cd, Max.	mg/l	0.01	<0.003	<0.003	<0.003	<0.003	<0.003
23	Mercury as Hg	mg/l	--	<0.001	<0.001	<0.001	<0.001	<0.001
24	Total Chromium as Cr	mg/l	--	<0.05	<0.05	<0.05	<0.05	<0.05
25	Arsenic as As, Max.	mg/l	0.2	<0.001	<0.001	<0.001	<0.001	<0.001
26	Phenolic compound as C_6H_5OH, Max.	mg/l	0.005	ND	ND	ND	ND	ND
27	Lead as Pb, Max.	mg/l	0.1	<0.05	<0.05	<0.05	<0.05	<0.05
28	Zinc as Zn, Max.	mg/l	15	<0.05	<0.05	<0.05	<0.05	<0.05
29	Hexavalent Chromium as Cr^{+6}, Max.	mg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
30	Total Coliform, Max.	MPN/l00ml	5000 MPN/100ml	240	140	124	130	120
31	Faecal coliform Max	MPN/100ml	5000MPN/100ml	16	24	20	22	19

The Surface water analysis report of Mechi river with respect to Kosi-River shows a slightly variation of four parameters (Cl, Na, K, COD). These variations are accompanied by the mixing for surrounding water to rivers system during monsoon period.

Besides this the result of these four parameters are within permissible limit for aquatic life survival. Therefore there is less possibility of aquatic life variation from Kosi to Mechi River by these sight changes in aforesaid parameters.

Annexure-11

13. Fish species available upstream and downstream of joining point in Mechi river to be provided.

Silonia silondia (LC)

Pampusa Chinensia (LC)

Big head Carp (LC)

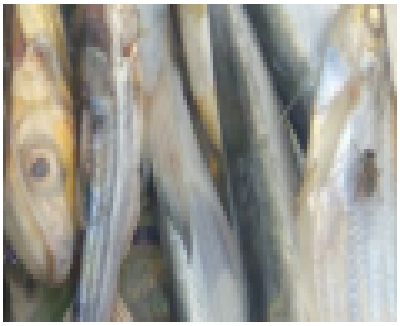
Magur clarias (LC)

Common carp (LC)

Mystus (LC)

Channa Punctate (LC)

Wallago attu (LC)



Gagata cenia (LC)

Labeo rohita (LC)

Catla catla (LC)

N.B. Least Count (LC) for the IUCN Red List (**IUCN Red List of Threatened Species**

Annexure-11

15. Possibility of fish pass in the Kosi canal (if possible) for efficient migration of Tor sp. to be explored.

The Hanuman Nagar Barrage head regulators of EKMC have 7 Nos. of gates discharging 85 cumec each. The 7 Nos. of gates will remain fully open in kharif and partly open in rabi season which will act as fish pass, however separately, fish pass may be considered later.

16. Inventorization of fish species available in the Kosi canal to be revisited.

Has been covered above in Item-iv of compliance to minutes of meeting of 16th EAC held on 27/07/2018.

ACCREDITATION AND EMPANELMENT

Centre for Envotech and Management Consultancy Pvt. Ltd.

An ISO : 9001: 2015 , OHSAS 18001: 2007 & ISO: 14001: 2015 Certified Company.

Empanelled with:

- State Pollution Control Board (SPCB), Odisha as Environment Consultant under category –'A'.
- Orissa Construction Corporation Limited (OCCL) as Associated Consultant for carrying out EIA, FDP, Preparation of Wildlife Management Plan, GIS map, Socioeconomic survey, DGPS & ETS survey.
- Orissa Space Application Centre (ORSAC) for carrying out DGPS & ETS survey.
- Office of the Principal Chief Conservator of Forest (Wildlife) & Chief Wildlife Warden [PCCF (Wildlife) & CWLW], Odisha for preparation of Site Specific Wildlife Management Plans.

Accredited by:

- NABET, QCI for EIA Studies as 'A' Category Consultant Organization.

Enlisted in:

- Construction Industry Development Council (CIDC) established by the Planning Commission (Govt. of India) for carrying out EIA, Waste Management & Audit, Turnkey solution of ETP & STP, Site Specific Wildlife Conservation Plan & Forest Diversion Proposals.

CEMC Environment Laboratory got recognition by MoEF&CC, Govt. of India, under Environment (Protection) Act, 1986 and also accredited by NABL.