

Terms of References for Environmental Impact Assessment Studies for Development of Command Area and Canal System in North Bihar proposed to be brought under irrigation through Sapta Kosi High Dam Multipurpose Project and Sun Kosi Storage-cum-Diversion Scheme, Nepal

1.0 INTRODUCTION

As per EIA Notification of 1994 and its subsequent amendments, it has been made mandatory to get environmental clearance for river valley and hydro electric projects. The objective of this study is to prepare comprehensive Environmental Impact Assessment to get environmental and other mandatory clearances from Ministry of Environment and Forests and any other concerned Authorities of Government of India.

2.0 SCOPE OF WORK

The broad scope of the work is to carry out Environment Impact Assessment for Development of Command Area and Canal System in North Bihar proposed to be brought under irrigation through Sapta Kosi High Dam Multipurpose Project and Sun Kosi Storage-cum-Diversion Scheme in Nepal and making assessment of positive impacts with its economic evaluation and prepare Environmental Management Plan (EMP) to mitigate the adverse effects, including the socio-economic aspects and Rehabilitation & Resettlement (R&R) Plan for project affected people. The scope also includes preparation of monitoring plan for implementation of EMP.

3.0 BRIEF DESCRIPTION OF THE PROJECT

As per the understanding reached between India and Nepal during the visit of Honorable Prime Minister of Nepal to India in December, 1991, it was agreed by two countries to prepare jointly the Detailed Project Report of Sapta Kosi High Dam Multipurpose Project and Sun Kosi Storage-cum-Diversion Scheme located in Nepal Scheme to meet the following objectives in terms of fulfilling the requirements of both countries from the point of view of their development:-

- Hydropower Generation;
- Irrigation Development;
- Flood Control/Management;
- Navigation;

The studies related to Irrigation Development constitute an important part of whole work, which is required to be carried out for the preparation of Detailed Project Report of both the projects. The Irrigation Studies of Command Area in

Indian Territory are proposed to be carried out through a Reputed and Experienced Indian Consultant as per prevailing norms and guidelines of GOI.

Sapta Kosi High Dam Project envisages the construction of a 269 m high Storage Dam on river Sapta Kosi in Nepal about 50 Km upstream of existing Kosi Barrage on river Kosi at Hanuman Nagar near Indo-Nepal border and releasing the water from the dam as per irrigation, power generation and navigation requirements. A re-regulating barrage at Sisauli in Nepal about 12 Km downstream of Sapta Kosi Dam is proposed for re-regulating the water released from the dam as per irrigation and navigation requirements. Two canals, one from each bank, would off take from the Sisauli Barrage for conveying the water for irrigation for both Nepal and India. Sapta Kosi High Dam Project was investigated by Indian Experts during the period from 1946 to 1952 for a 269 m concrete dam and based on these investigations; a Feasibility Report of the project was prepared by Central Water Commission in the Year 1981. As per said Feasibility Report, a new Gross Command Area of 9.76 Lakh hectares in India (North Bihar) and 5.46 Lakh hectares in Nepal is likely to be brought under irrigation through this project. During the irrigation studies for Indian Territory carried out recently by M/S WAPCOS Limited has revised the Gross Command Area in India to 10.53 lakh hectare. The relevant abstract of the said Feasibility Report are at Annexure-I and Salient Features of said Irrigation study are at Annexure-II for reference.

Kamala River has very little water during lean season, which cannot even meet the irrigation requirement of Nepal. Nepal is having an irrigation scheme, already under operation on river Kamala at Bandipur for a Gross Command Area of 25,000 hectares. India is also having an irrigation scheme on river Kamala at Jaynagar. However, very little water is available during lean season.

Japan International Cooperation Agency (JICA) in its Master Plan Study of Kosi River Basin in Nepal has recommended that lean season flow of river Kamala should be augmented by diverting water from river Sun Kosi through a diversion tunnel by constructing a diversion dam on river Sun Kosi near Kurule and constructing a storage dam on River Kamala. This dam will not only store natural flow of river Kamala but would also store the diverted water from Sun Kosi River and regulate the flow from the dam as per irrigation requirement. JICA has proposed in its report that a Gross Command Area of 1,75,000 hectare in terai area of Nepal can be brought under round the year irrigation by diverting 72 Cumecs of water from river Sun Kosi through this project. The studies presently being carried out by Joint Project Office of two countries, it is proposed to meet the irrigation requirement of Bihar at its Jaynagar barrage on river Kamala through the above project. Salient features of Sapta Kosi High Dam Multipurpose Project including Sisauli Barrage is given in Appendix.

3.1 STUDY AREA

The project area (i.e. Command Area in North Bihar) for present study lies between River Mahananda in the East to River Burhi Gandak in the West, Indo-Nepal Border in north and river Ganga in south in Bihar state of India.

An index map showing command area as well as the command area of existing Kosi Project is enclosed as Plate.

The tentative Gross Command Area (GCA) in Indian Territory excluding command area already being served by existing irrigation projects has been estimated to be about 10.53 Lakh hectare based on command area map made available by the Water Resources Department, Government of Bihar. The entire command area under this project is the study area for the purpose of EIA study. However, for the purpose of assessing the Resettlement & Rehabilitation, an area of 1000 m on either side of the Branch canal and an area of 500 m on either side of Major Distributaries shall be considered. Further plant and animal diversity within 10 km radius of the project sites for three seasons shall also be considered.

4.0 AVAILABLE INFORMATION

A Feasibility Report of Sapta Kosi High Dam Multipurpose Project was prepared by Central Water Commission, Govt. of India in 1981 based on investigations carried out by Indian Experts during the period from 1946 to 1952.

Japan International Cooperation Agency (JICA) carried out Master Plan Study on Kosi River Water Resources Development in Nepal and prepared a Report in the Year 1985 for and on the behalf of Government of Nepal. The said report has identified the Sun Kosi Storage-cum-Diversion Scheme a priority Scheme for developing irrigation in Eastern Terai Area of Nepal by diverting water from river Sun Kosi to river Kamala for augmenting its lean season flow.

The detailed field investigations and studies for the preparation of Detailed Project Report (DPR) of Sapta Kosi High Dam Multipurpose Project and Sun Kosi Storage-cum-Diversion Scheme, both located in Nepal, are being carried out by JPO-SKSKI, a joint project office of Government of India and Government of Nepal. The development of irrigation both in India and Nepal through these projects is an important component of studies. The status of ecological and environmental impacts and lesson learnt from the existing projects in the command area shall also be examined.

The consultant is required to assess the adequacy of the data and information contained in the existing reports as well as studies being presently carried out by JPO. Based on the adequacy check, the requirement of collection of any additional data is to be identified and shall be collected as part of the preparation of EIA report.

5.0 PLANNING AND DEVELOPMENT OF DATA BASE

- Consequent upon the collection of environmental and socioeconomic data, desk studies shall be carried out so as to undertake preliminary planning and development of a comprehensive data base. The data base shall be in such a format that can be used in web based GIS portal also.
- The data base shall be generated with provisions of data inputs from multiple sources and shall be capable of generating outputs in the form of tables, graphs, reports & data files. The output files shall be used in conjunction with software, spreadsheets, word processors and statistical software.

6.0 ENVIRONMENTAL IMPACT ASSESSMENT

The Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) Report shall be prepared considering all the relevant notifications issued by Ministry of Environment and Forest (MOEF), GOI or any other competent authority (viz. EIA Notification, 1994 and subsequent notifications/ amendments issued time to time) and in accordance to all the other relevant guidelines issued by MOE&F or any other competent authority. The EIA report shall be prepared considering all these notifications/ guidelines required for obtaining Environmental Clearances from the regulatory/ statutory authorities.

As outlined in the notification cited above, Public hearing shall be carried out as per the requirements of the fulfillment of EIA notification as a part of consultation with civil society.

Details pertaining to the Environmental and Ecological Aspects are furnished below:

The sequence of steps to be followed for consideration and assessment of Environmental and Ecological aspects shall be as follows:

- Study '**No Project**' option;
- Compare between future status with project and without this project;
- Legal status of the proposed project site with respect to various applicable Environmental Legislations;
- Baseline Environmental Data;
- Environmental Impact Assessment;
- Environmental Management Plan; and

6.1 BASELINE ENVIRONMENTAL DATA

Consultant will collect primary data for three seasons (pre-monsoon, monsoon and post monsoon) from the project sites, based on the base line data, and also collect secondary data from various Government Agencies / organizations, Census Department, Central and State Ministries, District gazetteers, Published Reports, authentic and reliable reports / literature / documents on similar studies

and other such sources. With respect to the soil and water related baseline data, sampling may be done on a grid basis. Considering the large size of the command area, the usual grid size suggested for other irrigation project will lead to an unmanageable extent of field work and therefore that areas under distinct soil series may be identified and data will be collected from three random locations from the areas under each soil series. Baseline Environmental Status of the project shall be established in consideration of baseline survey carried out in accordance to the MOE&F requirements for all the following elements:

- Air Environment;
- Water Environment (Surface as well as ground water);
- Land Environment;
- Biological Environment (Aquatic and Terrestrial); and
- Socioeconomic Environment.

I. Air Environment

- Meteorology for dispersion of air pollutant during construction activities
- Air Quality
- Noise

II. Water Environment

This will cover all the aspects of surface as well as ground water. This shall include but not limited to:

- Surface Water Quality and flow including nutrient levels
- Ground water regime (ground water table, aquifers)
- Ground water quality

III. Land Environment

- Land use and land cover (e.g. Forest, agriculture, wasteland etc.) using satellite imagery
- Mineral resources
- Water use
- Water logging
- Details on drainage system- This will cover (i) Present waterlogged area, if any (ii) Mapping of Specific Area with GIS (III) Causes of water logging (iv) Drainage classification of pre-project situation and (v) Ground water depth
- Ameliorative measures to obviate drainage congestion in post project situation.

IV. Biological Environment

This shall include but not limited to:

- Forest cover, forest type, species structure, its area and abundance of species. The preliminary data on this aspects has been obtained from Forest Department, Government of Bihar under which the project area falls and is appended with the TOR.
- Plant and animal diversity within 10 km radius of the project sites for three seasons
- Rare and endangered species
- Species which require management
- Species of economic significance
- Species of special interest to local population or tourists
- Aquatic fauna of commercial/ recreational value and migratory fish species along with their spawning ground
- Studies of micro flora & micro fauna and its economic significance
- Habitat including breeding ground and access corridor for food and shelter
- Biodiversity and Biodiversity indices-**Shannon Index** in the project areas

Biodiversity is a broad concept, so a variety of objective measures have been created in order to empirically measure the biodiversity. Each measure relates to a particular use of the data. The **Shannon index**, H' , is one of several diversity indices used to measure diversity in categorical data. It is simply the Information entropy of the distribution, treating species as symbols and their relative population sizes as the probability.

Shannon index=

Where,

S = The number of species (also called species richness)

p_i = The relative abundance of each species, calculated as the proportion of individuals of a given species to the total number of individuals in the community

=

n_i =The number of individuals in each species

N = The total number of all individuals

Maximum evenness maximizes the index i.e. any given population will have a maximum Shannon Index if and only if each species represented is composed of the same number of individuals.

Under such a situation

$$n_i = \frac{N}{S},$$

and so,

$$p_i = \frac{1}{S}$$

Therefore,
the maximum value of Shannon Index

The above value of Shannon Index will give maximum evenness.

V. Socioeconomic Environment

- Demography
- Population
- In and out migration
- Literacy
- Economy
- Market
- Development activities
- Employment, skills
- Social, cultural, religious resources and practices
- Historical and archeological sites
- Education, health, communal resources
- Agriculture production and practices
- Energy consumption, livestock
- Tourism
- Gender and vulnerable group
- Local institutions
- Land, houses and infrastructure acquisition
- Law & order, community forest, etc

6.2 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Environmental Impact Assessment (EIA) shall be carried out for construction and operation phases using qualitative or quantitative methods (wherever possible) and using predictive modeling techniques.

The EIA study shall cover all the relevant environmental issues that have impact due to the proposed project including the following:

- Air Environment
- Water Environment (Surface as well as ground water)
- Land Environment

- Biological Environment (Aquatic and Terrestrial)
- Socioeconomic Environment

I. Air Environment

- Impact on air quality due to construction
- Changes in microclimate
- Impact on ambient Noise level specially during construction period

II. Water Environment

- Impact due to change in hydrological cycle
- Impact due to spread of contamination due to agro-chemicals and organic/heavy metals
- Impact due to transportation of fluorides, Nitrates, toxic chemicals, heavy metals
- Impact due to acidification of lakes and water bodies due to presence of soils with rich minerals
- Impact on water quality (surface/ground)
- Impact on ground water levels and recharge potential
- Impact on ground water pollution due to seepage from canal system and reservoir (ground water level and quality)
- Impact on drainage system and existing water bodies in the project area (Assessment by using GIS tools and satellite imageries)

III. Land Environment

- Impact on land use/ land cover and change in designated land use in the project area. The assessment can be made using the GIS tools and satellite imageries of the area. However, it will have to be confirmed by ground verification.
- Impact due to irrigation induced salinity and water logging

IV. Biological Environment

Terrestrial Environment

- Impact on forest area and National park and wildlife sanctuaries and other sensitive ecosystem.
- Impact on biota and biodiversity loss particularly with special reference to the rare and threatened species, endemic species of both animals and plants.

- Impact on habitat loss particularly with special reference to the rare and threatened species, endemic species of both animals and plants.
- Impact due to habitat change having effect like corridor loss and loss of migratory path for wildlife including birds.
- Impacts on the breeding grounds of species and on access of animals to food and shelter.

Aquatic Environment

- Impact on sensitive ecosystem
- Impact due to bio-accumulation and bio-magnification in aquatic life and biota
- Impact on growth of aquatic weed
- Impacts on fish spawning and migration including impact on their breeding ground.

V. Socioeconomic Environment

- Impact on public health due to vector borne diseases
- Impact on sensitive locations like archeological sites and places of worship etc.
- Impact on change in occupational pattern
- Impact on tourism
- Impact on human settlement
- Impact on Migration of Labour force from Bihar to Punjab.
- Impact on small scale industries particularly in command area.

VI. Geological and Other Aspects

- Geology, Physiography and Topography of the area

6.3 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Based on environmental impact assessment, the mitigation / enhancement measures need to be specified in the form of Environmental Management Plan. The components of the EMP will inter-alia deal with the following as may be relevant to the project site:

- Environmental safeguards (management) during construction activities

- Plan for restoration of quarry areas/borrow areas and areas for dumping excavated material.
- Management to arrest salinity/ alkalinity in the wake of recharge of water in the canals.
- Problems associated with transportation of silt in the canal and utilization thereof in environmentally/ecologically benign manner
- Compensatory Afforestation plan along with cost benefit analysis
- Tree plantation along canal banks;
- Comments/ observations/ recommendations of Chief Wild Life Warden in case wild life habitants/ migratory paths exist within 1000 m on either side of the Branch canal and an area of 500 m on either side of Major Distributaries.
- Conservation plan for affected flora/ fauna including rehabilitation plan for rare/endangered species including action plan for alternate breeding ground and access corridor for food and shelter.
- Action plan for control of irrigation induced water logging, salinity etc including strategies and policies with choice of species/ crop for optimum use of water for agriculture to reduce adverse impacts of excessive irrigation including water logging.
- Action plan for command area development in respect of irrigation potential.
- Ground water management including harnessing of ground water in conjunction with surface water.
- Land use management with special emphasis on water logging problem
- Management of flora and fauna in the Command Area as well as along the Canals including action plan for alternate breeding grounds.
- Alien flora and aquatic weeds management
- Protection of sensitive and archeological monument sites
- Action plan for health delivery systems
- Post project environmental monitoring plan
- Provision of free fuel to labours
- Dam break analysis and Disaster Management Plan (DMP)

Dam break floods can be of larger magnitude and behave differently than natural floods. The reservoir behind the dam of Sapta Kosi High Dam Multipurpose Project is of significant size. The wave of water that will surge down, below the dam, will be of considerably higher order larger than any natural flood and most likely consequences will be catastrophic. It is, thus, essential to assess the magnitude and timing of the dam break flood for the purposes of dam safety, evacuation planning and forecasting.

Dam break studies, in general, are carried out by either (a) Scaled Physical Hydraulic Models or (b) Mathematical Simulation with use of computer. 'Dam Break

Analysis' through 'Mathematical Simulation' with use of computer programs such as DAMBRK developed by D. L. Fread with National Weather Service (NWS) or HEC-1, a program developed by U.S. Army Corps of Engineers (COE) is needed to be carried out.

Valley widens considerably downstream of dam and large area is likely to be flooded, thus two dimensional analysis is considered more purposeful.

Dam Break Analysis will broadly encompass-

- (a) Estimation of Dam Break Dimensions
- (b) Estimation of Dam Break Peak Discharge
- (c) Downstream Routing of Dam Break Flood
- (d) Computational Method used for Routing of Dam Break Flood
- (e) Dam Break Inundation Analysis and Downstream Hazard Assessment
- (f) Inundation Mapping
- (g) Capital Value of Project
- (h) Population at Risk
- (i) Property Damage and Economical Losses
- (j) Environmental Damages
- (k) Current Downstream Development (Industries and Utilities) and Consequences of Dam Break Flood
- (l) Projects with Multiple Dams (Consequence of Failure of Upstream Dam on Downstream Dam)
- (m) Evacuation Plan

7.0 **SOCIO-ECONOMIC ASPECTS AND PREPARATION OF R&R**

A detailed socio-economic study of project affected people will be carried out.

7.1. **SOCIO-ECONOMIC SURVEY**

In order to perform the socio-economic studies, on-site socio-economic survey shall be carried out covering socio-economic profile of the region. The region shall include the command area, the area en-route the canal where there could be secondary displacement. The following aspects shall be covered in the socio-economic surveys

- Demographic profile with social categories, number of households/families, type of housing, health and educational profile, migration patterns, if any.
- Land ownership and operational holding
- Existing cropping pattern of the project area and changes thereof due to commissioning of the project
- Agricultural practices including traditional knowledge on endemic species.
- Improvement in crop production and productivity

- Possible improvement in surface and ground water availability and benefits accrued to irrigated agriculture, drinking water use, industries and thermal power plants.
- Agricultural input pattern
- Economics of cultivation
- Non-agricultural Practices such as poultry, cattle raising etc
- Employment profile
- Income profile with sources of income
- Expenditure profile
- Other economic activities prevailing in the region
- Availability of social infrastructure
- Availability of economic infrastructure
- Gender issues

7.2 Secondary Data

Before start of the on-site socio-economic survey, the available secondary information from various government agencies shall be collected. Relevant information from concerned state government and Census of India about infrastructure availability etc. at district/ block/ village level and from Survey of India on topography maps and satellite Imageries from NRSA are other sources of useful information to be collected before launching of on-site survey. Based on said information, design of questionnaire and methodology of field surveys shall be finalized.

The consultant shall make every effort to obtain the required information from various Govt. agencies. However, JPO-SKSKI shall extend help in issuing authorization letters etc. whenever required by the Consultant.

7.3 Sample Design

The survey shall cover both project affected (displaced) and project influenced (benefiting) areas. Sample shall be distributed between project affected and influenced households on the basis of length of branch canal and distributaries.

7.4 Questionnaire

Different mode of data collection such as sample survey, Participatory Rural Appraisal (PRA)/ Rapid Rural Appraisal (RRA) and focus group discussions shall be used in evaluating impact of the project.

Questionnaire shall take into account all the relevant aspects mentioned above. Current Land prices and wages prevailing in the area is another important factor on which data shall be collected in socio-economic survey. This shall help in assessment of cost of land acquisition for implementation of envisaged developments.

7.5 Resettlement & Rehabilitation(R&R) Aspects

While studying Resettlement and Rehabilitation (R&R) issues, techniques such as Rapid Rural Appraisal (RRA)/ Participatory Rural Appraisal (PRA) and focus group discussion should be used to find out present situation in the area. This shall also involve collection of photographic records of the area likely to be affected.

Information on following aspects should also to be collected.

- (a) Peoples own perception on the settlement aspects and kind of facilities they expect in the area where they will be settled after displacement.
- (b) Preferences of affected population about the compensation package, whether it should be in cash or kind.
- (c) What is the location preference for settlement by affected population, whether they want to be settled closer to their existing place of residence or at a distance?
- (d) Participation of affected people in construction of canals should also be probed in.
- (e) Migration patterns into and out of the project area.

A detailed R&R package shall be prepared and National Policy on Resettlement & Rehabilitation for Project Affected Families-2007 (NPRR-2007) formulated by Ministry of Rural Development (MORD) shall form basic minimum criteria for devising the R&R package. Due weightage should also be given to the R&R Policy / Act of Bihar State. However, in line with the Section 1.6 of the NPRR-2007, the R&R package should not limit itself to the National R&R Policy-2007 and should look for a wider horizon with millennium development goals and Planning Commission targets. Also, the various schemes of the govt. for rural development and welfare should be combined to make R&R package attractive enough. The R&R Policy should clearly come out with the kind of infrastructure required to achieve these goals. While preparing the R&R package, the past practices and difficulties experienced in implementation of various provisions of R&R package should be kept in mind. In case 70 % or more land of any family is taken then that family shall be counted as fully affected family.

The consultant shall suggest a layout of modal village for resettlement of Project Affected Peoples (PAPs).