

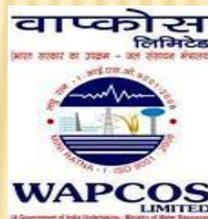
WATER RESOURCES DEPARTMENT

(GOVERNMENT OF CHHATTISGARH)



ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR ARPA BHAISAJHAR BARRAGE PROJECT, DISTRICT-BILASPUR, CHHATTISGARH

EXECUTIVE SUMMARY REPORT



WAPCOS LIMITED

(A Government of India Undertaking)

76 C, Sector 18, Gurgaon - 122015, Haryana, INDIA

Tel. 0124 2397396, Fax. 0124 2397392

Email: environment@wapcos.gov.in

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY REPORT OF CEIA STUDY FOR ARPA-BHAISAJHAR BARRAGE PROJECT, CHATTISGARH

1. GENERAL

The proposed Arpa-Bhaisajhar Barrage project envisages construction of barrage near village Bhaisajhar on river Arpa in district Bilaspur, Chattisgarh . The catchment area up to the barrage site is 1693.86 sq. km. The irrigation potential of the proposed project is 25,000 ha which is envisaged only for kharif paddy cultivation. The project location map is enclosed as Figure-1.

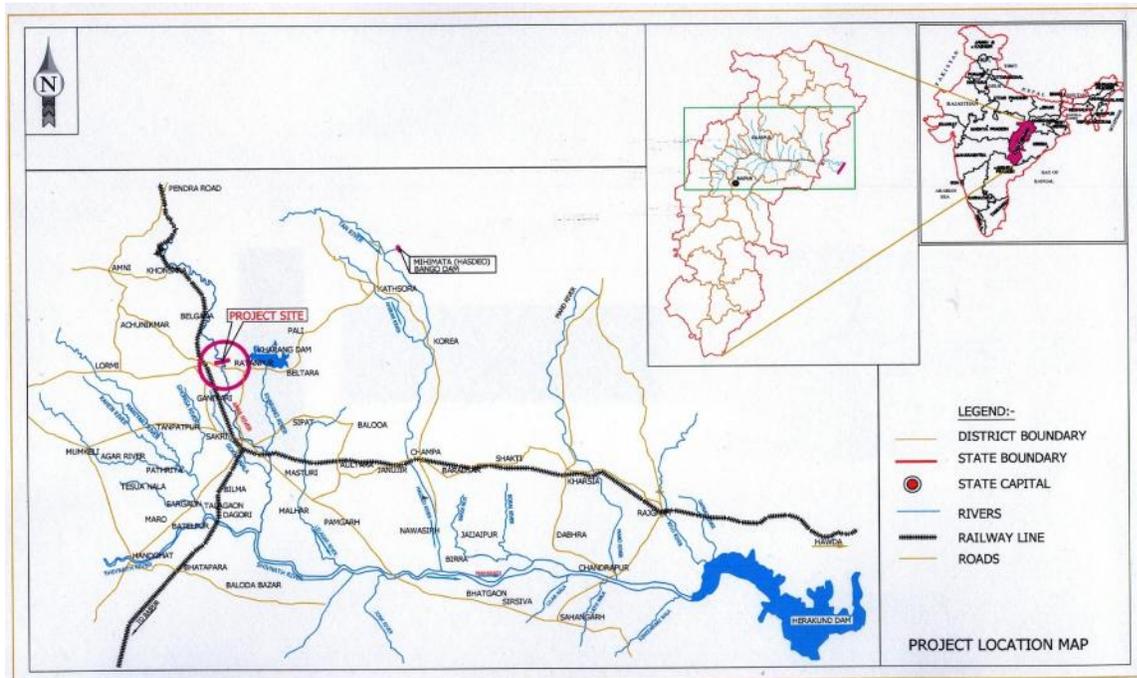


Figure-1: Project Location Map

2. PROJECT DESCRIPTION

The proposed project includes construction of a 147 m long and 12.35 m high barrage near the village Bhaisajhar on river Arpa along with guide bund 880 m long on right side and 330 m long on left side. The length of main canal and Branch canal is 56.6 km and 27.00 km respectively. The length of distributaries and minors is 303.30 km.

The total cost of the project is estimated as Rs. 606.43 crores .

The Full Tank Level (FTL) of barrage is 302.00 m, and submergence area at FTL will be 653.59 ha. The barrage structure will be about 12.35 m height. The deepest foundation level will be 8m below the river bed level. The gross storage capacity at RL 302m of barrage is 22.168 Mm³ with live storage capacity 16.409 Mm³. The length of the reservoir is about 13 km. The Project Layout Map is enclosed as Figure-2.



Figure-2: Project Layout Map

The tentative total land required for various project components is of about 1890.09 ha. The details are given in Table-1. About 377.35 ha of revenue/government land, 1070.39 ha of private land and 442.35 ha of forest land is to be acquired.

Table-1: Details of land to be acquired for the project

Component	Forest (ha)	Govt. /Revenue land (ha)	Private (ha)	Area (ha)
Head Work	442.35	154.78	56.46	653.59
Canal network		222.57	1013.93	1236.5
Total	442.35	377.35	1070.39	1890.09

3. STUDY AREA

The study area covered as a part of the EIA study is described as below (Refer Figure-3).

- Submergence area
- Area to be acquired for other project appurtenances

- Area within 10 km of various project appurtenances including i.e. canal network, etc.
- Gross Command Area
- Catchment Area intercepted at Barrage site

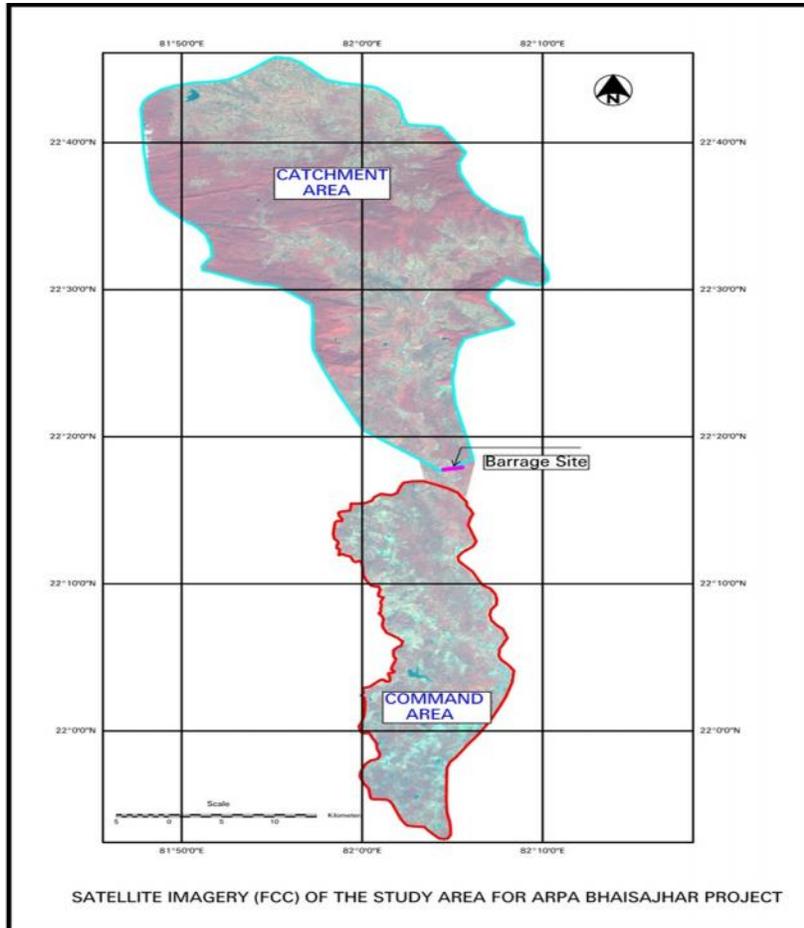


Figure 3: Study Area Map

4. ENVIRONMENTAL BASELINE STATUS

The baseline status for the above referred categories has been described in the following sections.

4.1 PHYSCIO-CHEMICAL ASPECTS

4.1.1 Meteorology

The climate of Bilaspur district is sub-tropical, semi arid, continental and monsoon type. Thus, it has hot summers, cool winters and small rainy season. The winter season starts towards the later half of November and extends till about the middle of March followed by summer, and dust storms are common. The area comes under the influence of

southwest monsoon from mid June. The climate of the Arpa sub-basin is humid and tropical. Climatologically, the year can be decided into the following four seasons:

- Winter ranging from November to February
- Summer ranging from March to mid-June
- Pre-monsoon ranging from mid-June to mid-September
- Post-Monsoon ranging from mid-September to October.

4.1.2 Soils

The pH in various soil samples ranged from 6.27 to 8.23. The Electrical Conductivity (EC) ranged from 11 to 294 $\mu\text{S}/\text{cm}$. The EC level indicates the non-saline nature of soil. The concentration of available nitrogen ranged from 410 to 580 kg/ha. The nitrogen levels in various soil samples indicate that in terms of available nitrogen, soils in the project area have low moderate (280 to 560 kg/ha) to high (>560 kg/ha) productivity. The concentration of available potassium ranged from 190 to 250 kg/ha. The potassium level indicate that soils in the command area have medium (110 to 280 kg/ha) productivity. The available phosphorus level ranged from 12 to 21 kg/ha. The phosphorus level indicate that the soils in the command area have low (<10 kg/ha) to moderate (10-25 kg/ha) in productivity. The organic carbon ranged from 0.1 to 2.16% to medium (0.5 - 0.75%) to high (>0.75%) productivity.

4.1.3 Surface Water Quality

The pH level in various seasons ranged from 7.6 to 7.9 indicating neutral nature of water. The pH level is within the permissible limit of 6.5 to 8.5, specified for meeting irrigation and domestic water requirements.

The TDS level ranged from 189 to 212 mg/l, 172 to 188 mg/l and 187 to 198 mg/l in pre-monsoon, monsoon and winter seasons respectively. The TDS levels were well below the permissible limit of 500 mg/l specified for meeting drinking water requirements. The EC levels were well below the permissible limit of 2250 $\mu\text{S}/\text{cm}$ specified for irrigation water requirements as per IS: 2296.

The hardness level in pre-monsoon, monsoon and winter seasons ranged from 72 to 80 mg/l, 64.5 to 68 mg/l and 68 to 73 mg/l respectively. The river water is soft in nature, which is reflected by low calcium and magnesium level. The fluorides level was marginally lower than the permissible limit of 1.0 mg/l specified for meeting drinking requirements.

The BOD values are well within the permissible limits, which indicates the absence of organic pollution loading. This is mainly due to the low population density and absence

of industries in the area. The low COD values also indicate the absence of chemical pollution loading in the area. The concentration of various heavy metals was below the detectable limits, indicating the suitability of water for meeting domestic requirements. The concentration of cyanides and phenolic compounds was also below the detectable limits.

4.1.4 Ground Water Quality

The pH level ranges from 6.67 to 7.81, 7.46 to 8.4 and 7.11 to 8.14 in winter, pre-monsoon, and monsoon seasons covered as a part of the study. This indicates neutral nature of the water, and are within the permissible limit specified for meeting drinking water requirements .

The chlorides level ranged from and 8.76 to 167.65 mg/l in winter season 3.37 to 202.49 mg/l in pre-monsoon season and 6.58 to 130.60 mg/l in monsoon season. The chlorides level in groundwater samples was mostly below the permissible limit of 200 mg.

Sulphates ion is one of the major anions occurring in natural water. It is an important parameters because of its cathartic affect, when it is present in higher concentration. The sulphates level ranged from 3.24 to 75.67 mg/l, 6.66 to 18.78 mg/l and 11.71 to 55.11 mg/l in winter, pre-monsoon and monsoon seasons respectively.

The BOD values are well within the permissible limits, which indicates the absence of organic pollution loading. This is mainly due to the low population density and absence of industries in the area. The concentration of various heavy metals was below the detectable limits, indicating the suitability of water for meeting domestic requirements.

4.1.5 Ambient Air Quality

As a part of the field studies, various ambient air quality locations were monitored. Based on the findings of the ambient air quality survey, conducted for various seasons, it can be concluded that the ambient air quality is quite good in the area.

4.1.6 Noise Environment

The day time equivalent noise level at various sampling stations were observed to be well within permissible limits specified for residential area.

4.1.7 Land use pattern

The land use pattern of the Gross Command Area is outlined in Table-2.

Table-2: Landuse pattern of Gross Command Area of Arpa Bhisajhar project based on satellite data

S.No	Category	Area(ha)	Area(%)
1	Forest/ Vegetation	446	1.78
2	River	1224	4.89
3	Agricultural Land	9928	39.71
4	Scrubs	5773	23.09
5	Barren Land	7258	29.03
6	Settlements	371	1.48
	Total	25000	100.00

The major landuse category in the GCA of Arpa Bhisajhar project is agriculture land, as it accounts for about 36.49% of the gross command area. The area under barren land is 28.79% of the GCA. The area under vegetation is about 6.47% of the gross command area. Open Vegetation/Scrub account for about 27.18% of the GCA. Settlements account for about 0.01% of the GCA. The area under water bodies is only 1.05% of the GCA.

Land use pattern of study area

The land use pattern of the Study Area is outlined in Table-3.

Table-3 : Landuse pattern of the Study Area of Arpa Bhisajhar project based on satellite data

S.No	Category	Area(ha)	Area(%)
1	Forest/ Vegetation	53226	35.74
2	River	3368	2.26
3	Agricultural Land	28167	18.91
4	Scrubs	31037	20.84
5	Barren Land	32397	21.75
6	Settlements	746	0.50
	Total	148941	100.00

The major landuse category in the study area of Arpa Bhisajhar project is agriculture land, as it accounts for about 35.33% of the study area followed by Open Vegetation/Scrub (29.25%). The area under vegetation is 12.27% of the study area. Barren land accounts for about 22.21% of the study area. Settlements account for about 0.14% of the study area. The area under water bodies is only 0.79% of the study area.

4.2 ECOLOGICAL ASPECTS

4.2.1 Vegetation

As per Champion and Seth (1968) classification, following forest types were observed in the study area:

Group 5. Tropical dry deciduous forest

Sub group 5B/C2 Northern Tropical dry mixed deciduous forest

- i) Dry deciduous mixed forest (5B/C2)
- ii) Dry deciduous *Boswellia* forest (5B/C2/E2)

Group 3. Tropical moist deciduous forest

Sub group 3C, Northern Tropical moist deciduous forest

- i) Moist Peninsular low level Sal forest (3C/C2e)
- ii) Moist deciduous mixed forest (3C/C3)
- iii) Dry scrub forest (5B/DS).

Floristic diversity

A total of 211 plant species belonging to 187 genera and 67 families of higher plants were recorded. Out of 211 higher plants, the herbaceous group of species contributed maximum 86 species (40.76%) which is followed by trees with 49 species (23.22%), shrubs with 32 species (15.16%), grasses with 25 species (11.85%), climbers with 11 species (5.22%), sedges with 5 species (2.37%), epiphytes with 2 species (0.95) and single species of parasite (0.47). The results of the present study are given in the Table-4.

Table-4: Vegetation composition of the study area in various seasons

Plant habit	No. of species	Percentage of species
Herbs	86	40.76
Trees	49	23.22
Shrubs	32	15.16
Grasses	25	11.85
Climbers	11	5.22
Sedges	5	2.37
Epiphytes	2	0.95
Parasite	1	0.47
Total	211	100%

During the floristic survey in winter season, a total of 157 plant species were recorded from the project area. Of these, 49 species are trees, 32 shrubs, 52 herbs, 16 grasses, 5 climbers and 3 sedges. No epiphytic, parasites and gymnosperm species were recorded from the Study Area in this season. In summer season, a total of 145 plant species were recorded from the proposed project project area. Of these, 49 species are trees, 32 are shrubs, 41 herbs, 12 grasses, 6 climbers, 4 sedges and 1 epiphyte. No parasites and

gymnosperm species were recorded from the study area in this season. In monsoon season, a total of 193 plant species were recorded from the Arpa Bhaisajhar irrigation project area which is the maximum number of plant diversity in the project area. Of these, 49 species are trees, 32 are shrubs, 62 72, 22 grasses, 10 climbers 5 sedges, 2 epiphytes and single species of parasite. No gymnosperm species was recorded from the study area in this season.

4.2.2 Fauna

The commonly occurring monkey *Macaca* spp, Langoor sp, Jackal, Fox and Wolf species has been reported. The presence of Leopard is noticed from locals and from the forest records. The domestic animals are mainly mammals. A total number of 98 species of birds were encountered during the present survey. Dominant bird species observed during the survey are Blue jay, dove, myna, house crow, house sparrow, lapwing, little egret and grey wagtail etc. The agriculture fields in the study area provide an ideal habitat for many snakes and reptiles. Reptiles such as cobra, and python were found occasionally in the dense vegetation areas as per-narrated by local people. Monitor Lizard was observed along the roadside during the survey. Out of Seven species of reptiles record, three species of lizard i.e *Hemidactylis* sp.(House lizards) and *Calotes* sp.(Garden lizard) are common in occurrence.

4.2.3 Fisheries

The fish species which are present in river Arpa are *Catla* sp, *Notopterus* sp, *Labeo* sp, *Puntius* spp, *Cirrhinus mrigala*, *Channa* spp and *Rasbora* spp reported during the study period.

4.3 DEMOGRAPHIC PROFILE

The total population in the Command Area Villages is about 209346 residing in 43584 households. It is observed from Census 2011 that the male and female population in the command area villages comprise of 51.10% and 48.90% respectively of the total population. Whereas Population below the age of six years is 15.80% of total population The overall sex ratio (i.e. no. of females per 1000 males) in the command Area Villages is about 957 and average family size (persons per household) is 5.

It is observed that the maximum percentage of population belongs to the General Category population which comprises of 65.59% followed by the Schedule Caste population comprising of 23.80% of the total population in the submergence area. Only 11.61% of the total Command area population belongs to the Schedule Tribe Population.

The literacy Rate is 59.4%. The overall male and female literacy rates are 69.5% and 49.5% respectively.

5. PREDICTION OF IMPACTS

The impacts on various aspects of environment are briefly described in the following sections.

5.1 IMPACTS ON LAND ENVIRONMENT

a) Construction Phase

Environmental degradation due to immigration of labour population

The peak labour and technical staff congregation would be of the order of 800 and 100 respectively. The total increase in population shall be of the order of 2,200. Separate accommodation and related facilities for workers, service providers and technical staff are to be provided as a part of the project. The congregation of labour force is likely to create problems of sewage disposal, solid waste management and felling of trees for meeting fuel requirements, etc.

Operation of construction equipment

During construction phase, various types of equipment will be brought to the site. These include batching plant, earth movers, etc. The siting of these construction equipment would require significant amount of space. In addition, land will be required for storage of various construction material as well. However, land for this purpose will be temporarily acquired, i.e. for the duration of project construction phase.

Efforts must be made for proper siting of these facilities. Various criteria for selection of these sites would be:

- Proximity to the site of use
- Sensitivity of forests in the nearby areas
- Proximity from habitations
- Proximity to drinking water source

Soil erosion

The runoff from various construction sites, will have a natural tendency to flow towards along with the natural drainage. Thus, the disposal of drainage effluent with such high turbidity levels is bound to affect the water quality, especially in the lean season. The drains/nallahs close to various construction sites along the canal alignment are seasonal in nature. Normally in such rivers biological productivity is not high. Hence, the increase in turbidity levels are not expected to be significant in nature.

b) Operation Phase

Acquisition of land

The tentative total land required for Submergence of project(Head works) is of about 653.57 ha. About 154.776 ha of revenue/government land, 56.446 ha of private land and 442.3509 ha of forest land is to be acquired. Compensation as per ownership status of land shall be provided.

Change in land use pattern

The introduction of irrigation will not only increase the cropped area, but would also increase the agriculture productivity as well. This would increase the agriculture production in the command area and is a significant positive impact.

5.2 IMPACTS ON WATER RESOURCES AND QUALITY

a) Construction Phase

Impacts due to sewage generation from labour camps

The construction phase also leads to mushrooming of various allied activities to meet the demands of the immigrant labour population in the project area. The increase in the population is expected to be of the order of 2,200. The labour population is likely to be congregated at three to four labour colonies.

The total domestic water requirements of the labour population (including families) is expected to be of the order of 0.3 mld @ 135 lpcd. It is assumed that about 80% of the water supplied will be generated as sewage. Thus, the total quantum of sewage generated is expected to be of the order of 0.24 mld. The total BOD load contributed by various labour camps/colonies will be about 99 kg/day. The above pollution loading is likely to be spread over 3 to 4 labour camps. The disposal of sewage without treatment could lead to adverse impacts on land environment or water environment in which the effluent from the labour camps/colonies are disposed. Thus, the sewage will be treated prior to disposal.

Impacts due to runoff from construction sites

Substantial quantities of water would be used in the construction activities. With regards to water quality, waste water from construction activities would mostly contain suspended impurities. Adequate care should be taken so that excess suspended solids in the wastewater are removed before discharge into water body.

b) Operation Phase

Impacts on downstream users

The total water requirement for ArpaBhaisajhar Barrage project is 266.38 Mm³. The break-up of various water uses is given in Table-5.

Table-5: Break-up water uses

Sr. No	Purpose	Quantity (Mm ³)
1	Providing irrigation facility to 25000 ha of lands in Kota, Takhatpur and Bilhatalukas	167.38
2	Upstream Committed Utilization	75.00
3	Downstream Committed Utilization	24.00
Total		266.38

The downstream water requirements are 24 Mm³, which includes water requirement for environmental and ecological balance. 75% Net yield at project location after deduction of upstream and downstream committed utilization is 237.0 Mm³. The water required for irrigation is 167.38 Mm³. So sufficient water is available for irrigation.

Impacts on waterlogging and soil salinity

The total water requirement during Kharif seasons is 164.209 Mm³ over an irrigated command of 25,000 ha. This works out to an average water depth of 657 mm. The irrigated water not being utilized in ponded irrigation is (0.5 *25,000 ha*0.669m) 82.125 Mm³. For an irrigated command of 25,000 ha, the average depth of water being wasted works out to an average water depth of 328 mm. The quantum of water not being utilized is quite small and is not expected to cause any significant problem of waterlogging.

Changes in water quality due to increased use of fertilizers

With the introduction of irrigation, use of fertilizers is likely to increase, to maintain the increased levels of production. The drainage system (natural or man-made) is likely to contain much higher level of nutrients. The climatic conditions in the project area too is suitable for the proliferation of eutrophication in the project area. Thus, in the project operation phase, there will be increased probability of eutrophication in the water bodies receiving agricultural runoff. As a part of Environmental Management Plan, appropriate control measures have been recommended.

Impacts due to effluent from project colony

It is proposed to provide biological treatment facilities including secondary treatment units for sewage so generated from the project colony. This will ensure that there are no adverse impacts due to disposal of effluents from the labour colony.

5.3 IMPACTS ON TERRESTRIAL ECOLOGY

a) Construction Phase

Flora

Workers and other population groups residing in the area may use fuel wood (if no alternate fuel is provided) for whom firewood/coal depot could be provided. In absence of alternative source of fuel, the labour population would resort to cutting of trees and vegetation in areas close to various construction sites. Hence, to minimize such impacts, it shall be mandatory for the contractor to provide fuel to labour population.

Fauna

During construction phase, a large number of machinery and construction labour will have to be mobilized. This activity may create some disturbance to the wildlife population. The forest area shall not be covered for irrigation. The area which is to be irrigated, and comprises mainly of agriculture land interspersed with settlement. As a result of absence of forest or vegetal cover in the command area and increased level of human interferences in the area, wildlife is generally absent in the area.

b) Operation Phase

Impacts on vegetal cover

As a part of field studies, ecological survey was conducted at three locations in the submergence area, which is spread over an area of 653.59 ha. The forest area to be acquired is about 442.35 ha. The details of floral total species at various sampling sites in submergence area are given in Tables-6 and 7.

Table-6 : Details of floral species at various sampling sites in submergence area

S.No.	Site	Dominant species		
		Trees	Shrubs	Herbs
1	Submergence site-I	<i>Shorearobusta</i> , <i>Tectona grandis</i> , <i>Terminalia arjuna</i> ,	<i>Woodfordia fruticosa</i> , <i>Lantana camara</i> , <i>Ipomoea carnea</i>	<i>Hyptis suaveolens</i> , <i>Imperata cylindrica</i> , <i>Alternanthera asensis</i> , <i>Cassia tora</i> , <i>Cynodon dactylon</i>
2.	Submergence site-II	<i>Terminalia arjuna</i> , <i>Buchnanian lanzan</i> , <i>Butea monosperma</i>	<i>Lantana camara</i> , <i>Randia dumetorum</i> , <i>Phoenix acaulis</i>	<i>Cymbopogon martini</i> , <i>Cassia tora</i> , <i>Eragrostis tenella</i> , <i>Tridax procumbens</i> , <i>Parthenium hysterophorus</i>
3.	Barrage Site	<i>Butea monosperma</i> , <i>Madhuca indica</i> ,	<i>Woodfordia fruticosa</i> , <i>Tamarix</i>	<i>Parthenium hysterophorus</i> , <i>Cymbopogon martini</i>

S.No.	Site	Dominant species		
		Trees	Shrubs	Herbs
		<i>Acacia nilotica</i>	<i>ericoides</i> , <i>Jatropha curcas</i>	<i>Vetiveria zizanooides</i> , <i>Cassia tora</i>

Table-7: Details of density of tree species at various sampling sites in submergence area

S. No.	Site	Tree density (no/ha)	No. of tree species
1	Submergence site-I	468	117
2.	Submergence site-II	308	77
3.	Barrage Site	328	82

It can be seen from Tables-6 and 7, that *Tectona grandis*, *Butea monosperma*, *Madhuca indica*, *Terminalia arjuna*, *Shorea robusta* and *Buchnanian lanzan* were the dominant tree species. Amongst shrubs, *Woodfordia fruticosa*, *Lantana camara*, *Ipomoea carnea*, *Tamarixericoides*, *Jatropha curcas* and *Randiadumetorum* were the dominant species. The dominant herbaceous species in the submergence area were *Partheniumhisterophorus*, *Cassia tora*, *Hyptissuaveolens*, *Imperata cylindrical*, *Alternantherasessilis*, *Cymbopogon martini*, *Tridax procumbens* and *Vetiveria zizanooides*.

No Rare, Endangered or Threatened species are reported in the project area. Thus, it can be observed that the tree density at various sampling sites in the forest area to be acquired range from 308 to 468 trees/ha. The number of tree species observed at various sites ranged from 77 to 117. Normally in a dense forest, tree density is of the order of 1000-1200 trees/ha. Thus, in forest land to be acquired for the project, the tree density is moderate.

The introduction of irrigation in the area will increase the agriculture production of the area, leading to the increased availability of fodder as a result of increased agricultural by products and residues. The increased level of fodder availability would reduce the presence on existing pasture and vegetal cover, which is a significant positive impact.

Impacts on wildlife

The area to be brought under irrigation within the command area shall be devoid of forests. The project area is interspersed with settlements and agricultural land. In such settings large scale faunal population is not observed. Thus, no significant impact on wildlife is anticipated due to the project.

The increase in vegetal cover would improve the organic content of the soils. As a result microbial activity would improve, leading to increase in the type and number of micro-organisms observed in the soils of the command area. This in the long run is expected to improve the soil fertility.

Impacts due to excavation of construction material from river bed

During the construction phase a large quantity of construction material like stones, pebbles, gravel and sand would be needed. Significant amount of material is available in the river bed. It is proposed to extract construction material from borrow areas in the river bed. The extraction of construction material may affect the river water quality due to increase in the turbidity levels.

5.4 IMPACTS ON NOISE ENVIRONMENT

a) Construction Phase

Noise due to construction equipment

In water resource projects, the impacts on ambient noise levels are expected due to operation of construction equipment. Based on experience in similar projects, there could be marginal impacts on the population residing in proximity to the canal alignment during construction phase as a result of various activities. However, based on past experience in similar projects, the impact however, is not expected to be significant.

5.5 IMPACTS ON AIR QUALITY

a) Construction Phase

Pollution due to fuel combustion in various equipment

The operation of various construction equipment requires combustion of fuel. Normally, diesel is used in such equipment. The major pollutant which gets emitted as a result of diesel combustion is SO₂. The SPM emissions are minimal due to low ash content in diesel. The short-term increase in SO₂, even assuming that all the equipment are operating at a common point, is quite low, i.e. of the order of less than 1µg/m³. Hence, no major impact is anticipated on this account.

Fugitive Emissions from various sources

During construction phase, there will be increased vehicular movement. Lot of construction material like sand, fine aggregate is stored at various sites, during the project construction phase. Normally, due to blowing of winds, especially when the environment is dry, some of the stored material can get entrained in the atmosphere.

However, such impacts are visible only in and around the storage sites. The impacts on this account are generally, insignificant in nature.

5.6 INCREASED INCIDENCE OF WATER-RELATED DISEASES

a) Construction Phase

During construction phase or for permanent settlement, if adequate precautions are not taken, the vector-borne disease epidemiology may show sudden or long lasting change. Many of the immigrant population could be reservoir of infection for various communicable diseases. Once they settle in labour camps/colonies, there could be increased incidence of various diseases. This aspect needs to be looked into with caution, and efforts must be made to ensure that a thorough check up of the labour population congregating in the area is conducted. Those affected by any ailments need to be properly quarantined depending on the ailment with which they are suffering.

b) Operation Phase

Increased incidence of water-related diseases

The association between irrigation development and the incidence of water related diseases such as malaria, etc is well established. The available data clearly indicates that the major water related diseases prevalent in the project area are malaria and gastroenteritis. The preferred environmental setting for vectors is fresh water open to sunshine or moderate shade. The habitats for larvae growth are permanent or semi-permanent standing fresh water such as small ponds, pools, standing agricultural water, permanent or semi-permanent fresh water such as open stretches or canals. Thus, the project may create favorable conditions for breeding of new pathogens or vectors such as mosquitoes, etc. Most of the water-borne diseases can largely be prevented by adequate hygiene. The experience of various project confirms the above mentioned hypothesis. In the project area, a sudden spurt in the incidence of malaria is expected, if adequate control measures are not taken up.

Improvement in availability of water for various uses, increased agricultural production, availability of diversified food, strengthening of educational and health facilities significantly improves public health in the project area. On the other hand, water resources development also has negative impacts, since, it could increase the habitat of certain vectors like mosquitoes. Thus, poorly planned and managed water resources projects could increase the prevalence of vector-borne diseases like malaria and filariasis.

5.7 IMPACTS DUE TO COMMAND AREA DEVELOPMENT

Increased income Level

Thus, the project will play a significant role in poverty alleviation in the project area. The increased income levels will have a quantitative effect on the quality of demand for various facilities, which will facilitate improvement in the infrastructure sector. The increased income levels would lead to demands for better communication, health, education and other services. The increased income levels would also provide an impetus for development of these facilities.

Improvement in livestock

During project operation phase, food grain production will increase. The increase in agriculture byproducts would increase the availability of fodder. This will reduce the pressure on the existing forests or vegetation of the area, which is a significant positive impact.

Employment generation

The introduction of irrigation requires a greater amount of labour in fields. This would improve the employment scenario not only for the local farmers, but would also increase the demand for agricultural labour. On an average, labour demand in irrigated and unirrigated field is 200 mandays/year/ha and 100 mandays/ha/year. The employment potential would thus improve, on account of the project implementation.

6. ENVIRONMENTAL MANAGEMENT PLAN

6.1 ENVIRONMENTAL MEASURES DURING CONSTRUCTION PHASE

Facilities in Labour Camps

It is proposed that it should be made mandatory for the contractor involved in the construction activities to provide adequate facilities for water supply and sanitation. It is recommended that the contractor provides living units of 30-40 m² to each of the labour family involved in the construction activities. The unit should have proper ventilation.

Water supply

Appropriate water supply sources need to be identified. Proper infrastructure for storage and if required treatment e.g. disinfection or other units, should also be provided.

Sewage treatment

The labour population is proposed to be situated in existing colonies. One community toilet needs to be provided for 20 persons. The sewage from the community toilets shall

be treated in a sewage treatment plant comprising of aerated lagoon and secondary settling tank.

Provision of community kitchen and Free Fuel

A community kitchen could be provided where workers have their meals. The fuel used in such community kitchens could be LPG or diesel. The project contractor in association with Water Resource Department, state government of Madhya Pradesh shall make necessary arrangements for supply of fuel to labour population for which provision shall be kept in the cost estimate.

Solid waste management

The labour colonies will generate substantial amount of municipal wastes. Adequate facilities for collection, conveyance and disposal of solid waste needs to be developed. For solid waste collection, masonry storage vats, each of 2 m³ capacity shall be constructed at appropriate locations in various labour camps. These vats shall be emptied at regular intervals and the collected waste can then be transported to landfill sites. One covered truck to collect the solid waste from common collection point and transfer it to the disposal site shall be put to service. A suitable landfill site shall be identified and designed to contain municipal waste from various project township, labour colonies, etc.

Restoration of construction sites

Normally the construction sites are left unreclaimed, with construction waste being left without being properly disposed. In the proposed project, it is proposed to collect the construction waste from various construction sites, and disposed off at sites identified in consultation with the district administration. The various construction sites would be properly levelled. The levelling or reclamation of various construction sites, should be made mandatory for the contractor, hence, no additional cost has been earmarked as a part of the cost to be earmarked for implementation of EMP.

6.2 MAINTENANCE OF WATER QUALITY

In the project operation phase, a colony is likely to be set up. It is proposed to provide sewage treatment plant in the project colony, cost of which shall be included in the contract for constructing the project colony.

6.3 HEALTH DELIVERY SYSTEM

The various measures for control of Public Health are listed as below:

- The site selected for habitation of workers should not be in the path of natural drainage.

- Adequate drainage system to dispose storm water drainage from the labour colonies should be provided.
- Adequate vaccination and immunization facilities should be provided for workers at various construction sites.
- The labour camps and resettlement sites should be at least 2 to 3 km away from quarry areas.

It is proposed to develop one dispensary in the proposed project area. The staffing details are given in Table-8.

Table-8 : Details of staff in the dispensary

Para medical staff	Number
Doctors	2
Auxiliary Nurse	2
Attendant	2
Driver	1
Total	7

A first-aid post shall be provided at the major construction sites. These posts will have the following facilities:

- First aid box with essential medicines including ORS packets
- First aid appliances-splints and dressing materials
- Stretcher, wheel chair, etc.

6.4 SUSTENANCE & ENHANCEMENT OF FISHERIES POTENTIAL

The commissioning of the proposed Arpa Bhisajhar Barrage Project will increase the water availability in the project command area. It is proposed to stock the reservoir with fingerlings. Adequate infrastructure in terms of nurseries, rearing ponds, etc. shall be commissioned.

6.5 CONTROL OF WEEDS ON AGRICULTURE LANDS

Measures against weeds comprise mechanical (cultivation and mowing), cultural or cropping, biological and chemical means. These include:

- hand weeding
- adopting farming practices that change the conditions in such a way as to enable plants to compete with weeds
- use of weedicides.

6.6 PESTS CONTROL

Integrated pest management strategy should be followed to reduce the use of pesticides. In this method, a limited number of insecticidal sprays are undertaken and

simultaneously bio-control agents like pheromones, etc. are used. The pheromones are organic compounds developed specifically for each type of pest which are commercially synthesized in the laboratories and sold in the market.

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6.7 TRAINING AND EXTENSION COURSES FOR FARM.ERS

The change from rainfed to irrigated cropping requires extension, training and demonstration programmes for farmers. Considering these aspects it is proposed that the project authorities needs to provide adequate training to farmers. The training shall include the following aspects of environmental protection:

- Prevention of spread of water related diseases;
- Safe use of agro-chemicals, and
- Environmental conservation programmes.

6.8 CONTROL OF AIR POLLUTION

The following measures are recommended:

- The contractor will be responsible for maintaining properly functioning construction equipment to minimize exhaust.
- Construction equipment and vehicles will be turned off when not used for extended periods of time.
- Unnecessary idling of construction vehicles to be prohibited.
- Effective traffic management to be undertaken to avoid significant delays in and around the project area.
- Road damage caused by sub-project activities will be promptly attended to with proper road repair and maintenance work.
- When necessary, stockpiling of excavated material will be covered.
- Excessive soil on paved areas will be sprayed (wet) and/or swept and unpaved areas will be sprayed and/or mulched.
- Contractors will be required to cover stockpiled soils and trucks hauling soil, sand, and other loose materials (or require trucks to maintain at least two feet of freeboard).

- Contractor shall ensure that there is effective traffic management at site. The number of trucks/vehicles to move at various construction sites to be fixed.
- The construction area and vicinity (access roads, and working areas) shall be swept with water sweepers on a daily basis or as necessary to ensure there is no visible dust.

6.9 NOISE CONTROL MEASURES

The contractors will be required to maintain properly functioning equipment and comply with occupational safety and health standards. The construction equipment will be required to use available noise suppression devices and properly maintained mufflers.

The effect of high noise levels on the labour population involved in construction activities is to be considered as likely to be particularly harmful. To prevent these effects, it has been recommended by international specialist organisations that the exposure period of affected persons be limited as specified in Table-9. Alternatively, they should be provided with effective personal protective measures such as ear muffs or ear plugs to be worn during periods of exposure.

Table-9 : Maximum Exposure Periods specified by OSHA

Maximum equivalent continuous noise level dB(A)	Unprotected exposure period per day for 8 hours per day for 5 days per week
90	8
95	4
100	2
105	1
110	0.5
115	0.25
120	No exposure permitted at or above this level

The other measures to control noise could be as follows:

- Equipment and machineries should be maintained regularly to keep the noise generation
- Silencers and mufflers of the individual machineries to be regularly checked;
- Yearly audiometric survey on workers exposed to high noise levels should be undertaken.

7. CATCHMENT AREA TREATMENT PLAN

Silt Yield Index (SYI) method has been used to prioritize sub-watershed in a catchment area for treatment. The area under very high and high erosion categories is to be treated at the project proponent cost. In the catchment of the proposed Kundalia Irrigation Project, there is no area under very high erosion category. Hence, CAT plan

has been suggested for high erosion category as a part of the present EIA study, the expenses of which have to be borne by project proponents. The area under high erosion category is 97,563 ha. The details are given in Table-10.

Table-10 : Area under different erosion categories

Category	Area (ha)	Percentage
Low	38367	22.65
Medium	33520	19.79
High	97513	57.56
Total	169400	100.00

Following Engineering and Biological measures have been suggested for the catchment area treatment.

1. Engineering measures

- Brushwood check dams
- Silt retention dams
- Contour Bunding
- Angle iron barbed wire fencing

2. Biological measures

- Development of nurseries
- Plantation/afforestation
- Pasture development
- Social forestry

8. RESETTLEMENT AND REHABILITATION PLAN

The compensation for acquisition of private land would be paid to the respective land owners/ land titleholders within the provisions of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. In the proposed project, no homesteads are being acquired, thus, no resettlement is required and only rehabilitation plan is being suggested.

The following measures are suggested to be extended as rehabilitation measures to the PAFs losing land under reservoir submergence.

- Compensation for Land acquisition as per the provisions of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013
- One-time financial assistance of a minimum of Rs. 25,000/- to each affected family of an artisan, small trader or self-employed person or an affected family which owned non-agricultural land or commercial, industrial or institutional structure in the affected area, and which has

been involuntarily displaced from the affected area due to land acquisition

- One person from each affected family shall be offered necessary training facilities for development of entrepreneurship, technical and professional skills for self-employment.
- For families losing land under canal network, Compensation for Land acquisition as per the provisions of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 shall be given.

The total budget earmarked for implementation of Rehabilitation Plan shall be Rs.307.48 lakh The details are given in Table-11.

Table-11: Provisions for Rehabilitation Plan for families losing land

S. No	Description	Unit	Assumed Provision#	Cost (Rs. lakh)
1	Total Market Value of Project Affected Villages	ha	(Refer Tables-5.3 to 5.10)	30466.662
2	Rural artisans / Self-employed			
	One-time financial assistance of a minimum of Rs. 25,000/- to each affected family of an artisan, small trader or self-employed person or an affected family which owned non-agricultural land or commercial, industrial or institutional structure in the affected area, and which has been involuntarily displaced from the affected area due to land acquisition	85	85 PAFs x Rs.25000/P AF	21.25
3	Choice of Annuity or Employment			

S. No	Description	Unit	Assumed Provision#	Cost (Rs. lakh)
	<p>a) At least one member per affected family will be provided job (either in the project or arrange for a job in such other project), after providing suitable training and skill development in the required field</p> <p>Or</p> <p>b) Onetime payment of Rs. 500,000 per affected family</p> <p>Or</p> <p>c) Annuity policies that shall pay not less than Rs. 2000 per month per family for 20 years, with appropriate indexation to the Consumer Price Index for Agricultural Labourers</p>			Livelihood plan been prepared for each PAF losing land. An amount of Rs. 5127.25 lakh has been earmarked for this purpose. The details are given in Chapter-6 of this report.
4	Affected persons shall be offered the necessary training facilities for development of entrepreneurship, technical and professional skills for self-employment	85	85 PAFs x Rs.1000/month x 6 months for each PAF	5.100
Total				30747.362

9. LOCAL AREA DEVELOPMENT PLAN

The area development activities proposed as a part of the plan given in following paragraphs:

Upgradation of educational facilities

The following activities are proposed under Local Area Development Plan:

- Up-gradation of school fixtures, equipment
- Improvement of drinking water and sanitation facilities
- School bus service
- Scholarship to students

Improvement of Public Health Facilities

- Furniture, Beds and other items
- Up-gradation of Pathological laboratory
- Up-gradation of operation theater (labor room)

An amount of Rs. 303.0 lakh is being made for implementation of the LADP Activities. The details are shown in Table-12.

Table 12: Budget for implementation of Local Area Development Plan

S. No.	Items	Budget (Rs. lakh)
1	Construction/Up-gradation schools in Study Area	155.0
2	Scholarships to students in the Study Area	91.8
3	Improvement of Public Health Facility	56.0
	Total	302.8 Say 303 lakh

10. DISASTER MANAGEMENT PLAN

The following measures have been suggested as a part of the Disaster Management Plan:

- Dam Safety and Maintenance Manual
- Emergency Action Plan (EAP)
- Administration and Procedural Aspects
- Preventive Action
- Communication System
- Notifications
- Evacuations Plans and Evacuation Team
- Public Awareness for Disaster Mitigation
- Management after receding of Flood Water

11. ENVIRONMENTAL MONITORING PROGRAMME

The summary of environmental monitoring programme during construction and operational phase of the Arpa Bhisajhar project are given in Tables-13 and 14 respectively.

Table 13: Environmental Monitoring Programme during Construction Phase

S. No.	Particulars	Parameters	Frequency	Location
1.	Treated waste water from STPs	pH, BOD, COD, TSS and Oil & Grease	Once every month	Before and after treatment from the STPs at various labour camps
2.	Ambient Air quality	SPM, RPM, SO ₂ , NO _x and CO	Once every season	At major construction sites
3.	Noise	Equivalent noise level (Leq)	Every month	At major Construction sites.
4.	Soil Erosion	Soil erosion rates, stability of bank embankment, etc.	Every month	Various sites in the catchment area.

S. No.	Particulars	Parameters	Frequency	Location
5.	Water-related diseases	Identification of water related diseases, adequacy of local control and curative measure, etc.	Once every season	Labour camps and nearby settlements

Table 14: Environmental Monitoring Programme during Project Operation Phase

S. No.	Particulars	Parameters	Frequency	Location
1.	Water	pH, Turbidity, Total Dissolved Solids, Calcium, Magnesium, Chlorides, Sulphate, Nitrates, Iron, DO, BOD, COD etc.	Pre monsoon Season and Post monsoon season	Reservoirs.
2.	Treated Waste Water from STP	pH, BOD, COD, TSS, and Oil & Grease.	Once every month	Before and after treatment from STP
3.	Drinking quality water	pH, Turbidity, Hardness, Alkalinity, Chlorides, Iron, Nitrates and Fluorides	Once every month	Various villages served with drinking water from the project
4.	Erosion & Siltation	Soil erosion rates, stability of bank embankment, etc.	Twice a year (pre & post monsoon Season)	--
5.	Ecology	Status of afforestation programmes	Once in 5 years	--
6.	Fisheries	Phytoplanktons, zooplanktons, benthic life, fish composition	Twice a year	Reservoirs.
7	Incidence of water-related diseases	Cause and control measures for various diseases.	Once in a year	Settlements around Reservoirs and in command areas
8	Meteorological Parameters	Temperature, rainfall, humidity, cloud cover, wind speed	Continuous	At a location close to barrage site

S. No.	Particulars	Parameters	Frequency	Location
		and direction, Solar Insolation, Evaporation Rate		

12. COST ESTIMATES

12.1 COST FOR IMPLEMENTING ENVIRONMENTAL MANAGEMENT PLAN

The total amount to be spent for implementation of Environmental Management Plan (EMP) is Rs. 394.72 crore. The details are given in Table-15

Table-15: Cost for Implementing Environmental Management Plan

S. No.	Item	Cost (Rs. crore)
1.	Compensatory Afforestation and Bio-diversity conservation	44.36
2.	Fisheries Management	3.94
3.	Environmental Management in labour camps	5.52
4.	Public health delivery system	1.61
5.	Restoration and Landscaping of construction sites	1.61
6.	Greenbelt development	0.18
7.	Energy Conservation measures	0.20
8.	Catchment Area Treatment Plan	21.33
9.	Environmental Monitoring during construction phase (Refer Table-16)	0.75
10.	Purchase of noise meter	0.015
11.	Purchase of meteorological instruments	0.07
12.	Water Quality Testing Kits	0.085
13.	Resettlement and Rehabilitation Plan	307.48
14.	Livelihood Plan Plan	2.09
14.	Local Area Development Plan	3.03
15.	Monitoring and Evaluation Aspects	0.45
16.	Disaster Management Plan	2.00
	Total	394.72

12.2 COST FOR IMPLEMENTING ENVIRONMENTAL MONITORING PROGRAMME

The cost required for implementation of the Environmental Monitoring Programme is of the order of Rs.0.75 crore @ Rs. 22.68 lakh / year. A 10% annual price increase may be considered for every year. The construction period for estimation of cost for implementation of Environmental Monitoring programme during construction phase has been taken as 3 years. The details are given in Table-16. The cost required for implementation of the Environmental Monitoring Programme in operation phase is of the order of Rs. 26.0 lakh/year. The details are given in Table-17.

Table-16: Cost for implementing Environmental Monitoring Programme during construction phase

S. No	Item	Cost (Rs. lakh/year)	Total cost for construction period of 3 years with 10% escalation per year (Rs. lakh)
1	Water quality	1.44	4.8
2	Ambient Air quality	4.80	15.9
3	Erosion and Siltation	1.44	4.8
4	Ecology	10.00	33.1
5.	Incidence of water-related diseases	5.00	16.6
	Total	22.68	75.2 or Rs. 0.75 crore

Table-17: Cost for implementing Environmental Monitoring Programme during operation phase

S. No	Item	Cost (Rs. lakh/year)
1	Water quality	0.96
2	Ecology	10.0
3	Fisheries	10.0
4	Incidence of water related diseases	5.0
	Total	26.0