

EXECUTIVE SUMMARY REPORT

1. GENERAL

The Upper Narmada Project is the first of the series of projects proposed by the Government of Madhya Pradesh, across river Narmada. The project is located in district Dindori in the state of Madhya Pradesh. The project envisages construction of a dam of 30.64 m height, near village Rinatola. The coordinates of the dam site are 22°51'50"N and 81°23'20"E. The site is approachable by a fair weather road of 12 km length from village Garasarai, located on Dindori-Amarkantak State Highway No. 27. The site is also connected by a 86 km metalled road upto Rinatola from Pendra Road Railway station (Katni – Bilaspur Broad Gauge Line). The project location map is appended as Figure-1.

2. PROJECT DESCRIPTION

The Culturable Command Area (CCA) proposed from the project is 3879 ha in Rajendragram tehsil of Anuppur district (Earlier Shahdol district) and 17397 ha in Dindori tehsil of Dindori district (Earlier Mandla district). The project thus envisages an overall CCA of 21276. The Gross Command Area (GCA) and Irrigated Command Area (ICA) of the project are 21,276 ha and 18,616 ha respectively. The various appurtenances envisaged under the proposed Upper Narmada Project include:

- Construction of composite dam of 2,120 m long in the earthen barrage across river flanks and central spillway of maximum height of 30.64 m.
- Construction of canals on both flanks for irrigating a services area of 18616 ha. The length of the right bank canal is 65.5 km and left bank canal is 86.5 km.

The map showing submergence, canal network and command area is given in Figure-2.

3. ENVIRONMENTAL BASELINE STATUS

The baseline status has been categorised into the following categories:

- Physico-Chemical Aspects
- Ecological Aspects
- Socio-Economic Aspects

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

3.1 PHYSICO-CHEMICAL ASPECTS

3.1.1 Meteorology

The climate of the project area is a sub-tropical climate characterized by an oppressive hot summer, high humidity and well-distributed rainfall during the

monsoon season and moderate winter. The year can be chiefly divided into four seasons. The summer season lasts from April to June and the area receives rainfall from June to September under the influence of the south-west monsoons. The months of October and November constitute the post-monsoon season and the winter season lasts from December to March.

3.1.2 Geology

In the project area, Deccan trap rock formations are formed. These are hard and compact. The Deccan trap consists of horizontally deposited basaltic area flow with occasional inter-trapping of sedimentary beds, occupying a large part of the area. The surface is covered by a thick layer of black cotton soil in part of the command area.

3.1.3 Soils

The soil texture varies from clay to clay loam in the command area. A small portion of the command has sandy clay loam. In the uplands, the soils are coarser in texture due to excess loss of fine soil material than the information. On the midland, the soils have medium texture, while in the low land, the texture is finer due to deposition of finer materials which were washed from upper and middle portion of the command area.

3.1.4 WATER RESOURCES

As per the Central Water Commission (CWC) study, the runoff of the Upper Narmada Project for catchment area 1243.0 sq. km. has been adopted. The runoff at the present site for the catchment area 1174.83 sq. km (intercepted at Dam site) has been calculated by interpolation method. The inflow studies done by Coutagne's approach. The yield of Upper Narmada with catchment area 1243 sq.km. and 1174.83 sq. km. at different dependabilities are given in Table-1.

TABLE-1
Estimation of dependable flow (Unit : Mm³)

Catchment area (sq.km.)	Yield with dependability		
	50%	75%	90%
1243	588.16	476.53	289.54
1174.83	555.90	450.40	273.66

50%, 75% and 90% dependable yields have been estimated as 559.90 Mm³, 450.40 Mm³ and 273.66 Mm³ respectively. The 100 year flood has been taken as design flood. The value of design flood has been taken as 12,960 cumecs.

3.1.5 Water quality

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 indicates 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 requirement. The concentration of various cations and anions (except for one ground water sample) is well within the permissible limits.

3.1.6 Ambient air quality

As a part of the field studies, three Ambient Air Quality Monitoring (AAQM) locations were monitored. The frequency of monitoring at each station was for two days in a week four consecutive weeks. The parameters monitored were Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur dioxide (SO₂) and Oxides of Nitrogen (NO_x). The concentration of various parameters was much lower than the permissible limits specified for residential, rural and other areas.

3.1.7 Noise Environment

The day time equivalent noise level at various sampling stations ranged from 41.9 to 43.3 dB(A) and 41.9 to 42.9 dB(A) in winter and summer seasons respectively. In post-monsoon season, the day time equivalent noise level at various sampling stations ranged from 41.8 to 43.3 dB(A). The noise levels were observed to be well within permissible limits specified for residential area.

3.1.8 Land use pattern

The land use pattern of the command area is given in Table-2.

TABLE-2
Land use pattern of the command area

Land use category	Area (ha)
Water bodies	208.38 (1.00)
Agricultural land	15351.46 (73.53)
Open vegetation	77.38 (0.37)
Dense vegetation	2866.7 (13.73)
Grassland	323.55 (1.55)
Barren land	208.38 (1.00)
Built up area	12.55 (0.06)
Total	20878.43 (100)

Note : Figure in brackets indicate percentage

The GCA has maximum area under agriculture (73.53%) followed by area under vegetation (14.10%). Grassland account for about 1.55% of the total command area. The area under water bodies within the command area is quite low, i.e. (1.0%).

3.2 ECOLOGICAL ASPECTS

3.2.1 Vegetation

The major forest type observed in the command area is Dry Mixed forests. These forests comprise an admixture of a large number of species. The major tree species reported in the command area are Sal, Teak, Bamboo, Salai, Arjun, Rohan, Dhaora, etc. The forests in the command area have been degraded to a large extent. Depending on the mode of degradation, fire or grazing, the forests show two types of deterioration. The first one is savanna type, which are affected by leading stimulation of grass growth. The other type is affected by heavy browsing which leads to a scrub and thicket type of degradation. In the category palatable grass species disappear and only thorny elements are remnant as grass cover.

3.2.2 Fauna

No forest is coming under submergence and due to increased human interferences in the area, the faunal population in the command area is nearly absent. However, within the catchment area, where dense patches of forests are observed, wildlife population is observed. However, within the command area, no major faunal species are observed. This is mainly because of the fact that forests are largely degraded in the command area.

3.2.3 Fisheries

River Narmada is the largest river in the project area. The main commercially important fish species cultured in the river are *Labeo rohita*, *Cirrhina mrigala*, *Catla catla*, *Cyprinus carpio*, *Cepenopherinodon idella*, and *Thirmethrex molitrex*.

3.3 SOCIO-ECONOMIC ASPECTS

3.3.1 Demographic profile

The total population in the command area is 18,754. The number of females per 1000 males is 979. The dominant caste category is Scheduled Tribes who account for 61.2% of the total population. The next dominant caste category is General Caste accounting for 33.6% of the total population. Scheduled castes account for 5.2% of the total population. The literacy rate is only 28.1%, which indicates the socio-economic backwardness of the area.

3.3.2 Occupational profile

The main workers account for about 39% of the total population. The percentage of marginal and non-workers is 6.4% and 54.6% respectively. About (90.6%) of the main workers are involved in agriculture as cultivators (68.9%) or as agriculture labour (21.7%).

3.3.3 Agriculture

The major crops grown in the command are paddy followed by wheat. Currently, the intensity of irrigation is very low in the command area, which is responsible for low agricultural productivity in the command area.

3.3.4 Public health

The major water borne disease reported in the project area is Diarrhea. In the years 2003 and 2004, 6 & 16 deaths respectively occurred due to Diarrhea. The incidence of jaundice is very low in the command area blocks. The incidence of Diarrhea indicates that in some areas, drinking water is contaminated. This aspect needs to be looked into by the State Public Health Engineering Department.

3.3.5 Industries

In the command area only few small scale agro-based industries. These are mainly rice or flour mills. The production from these units is consumed locally. No medium and major industries are present in the command area.

4. PREDICTION OF IMPACTS

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

4.1 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 8,000 and 1,000 respectively. The total increase in population shall be of the order of 26,500. 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 crushers, batching plant, drillers, 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 (6 years).

The site for storage of construction material and equipment should be selected that it causes minimum adverse impacts on various aspects of environment. Such land requirements are temporary in nature ranging from 3 to 6 years. Efforts shall be made that such facilities are located on government or panchayat land only and to the extent possible away from human population, so that hardships caused as a result of land acquisition, though temporarily on this account are minimized to the extent possible.

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 land coming under submergence is 2952.15 ha. The details are given in Table-3. In addition, land will also be required for canal networks (including distributaries, minors, etc.) approach road, contractor's working space, etc.

TABLE-3
Details of land coming within submergence area

S. No.	District	Tehsil	Block	Villages	Submergence area	
					Private land (ha)	Government land (ha)
1.	Dindori	Dindori	Bajag	Shobhapur	162.04	37.72
2.	--"--	--"--	--"--	Paraswah	191.75	49.88
3.	--"--	--"--	--"--	Patharkucha (M)	244.91	53.99
4.	--"--	--"--	--"--	Patharkucha (R)	157.75	22.38
5.	Dindori	Dindori	Karangiya	Mohtara	86.56	49.11
6.	--"--	--"--	--"--	Bamhani	79.1	9.27
7.	Balaghat	Baihar	Baihar	Musamundi (M)	23.61	4.08
8.	--"--	--"--	--"--	Musamundi (R)	61.55	40.10
9.	--"--	--"--	--"--	Gorakhpur (M)	40.85	13.09
10.	--"--	--"--	--"--	Gorakhpur (R)	13.13	6.23
11.	--"--	--"--	--"--	Bhalkhoha	26.65	9.77
12.	--"--	--"--	--"--	Manikpur (R)	2.63	3.66
13.	--"--	--"--	--"--	Sunpuri	30.86	3.00
14.	--"--	--"--	--"--	Patangarh (M)	38.68	10.26
15.	--"--	--"--	--"--	Patangarh (R)	54.28	19.89

S. No.	District	Tehsil	Block	Villages	Submergence area	
					Private land (ha)	Government land (ha)
16.	--"--	--"--	--"--	Rehangi (R)	12.47	4.43
17.	--"--	--"--	--"--	Pakri (R)	-	3.21
18.	Anuppur	Rajendragram	Rajendragram	Khetgaon	359.30	39.75
19.	--"--	--"--	--"--	Thadpathar	269.74	34.44
20.	--"--	--"--	--"--	Ghata	180.95	11.20
21.	--"--	--"--	--"--	Rosarkhar	41.77	-
22.	--"--	--"--	--"--	Devri	162.22	23.16
23.	--"--	--"--	--"--	Damari	109.73	14.77
24.	--"--	--"--	--"--	Koelari	72.65	24.89
25.	--"--	--"--	--"--	Paraswah	9.78	7.91
26.	--"--	--"--	--"--	Seoni Sangam	4.68	11.97
27.	--"--	--"--	--"--	Purga	-	6.29
				Total	2437.70	514.45

Change in land use pattern

The proposed project envisages irrigation intensity of 143%, i.e. 81% in Kharif and 62% in Rabi cropping seasons. The pre-project cropping intensity is 75% which includes 50.8% in Kharif and 24.2% in Rabi season respectively. Thus the project area would increase the cropping intensity by almost 1.9 times, which is a significant positive impact. It also implies that a part of the command which is presently fallow, would be brought under agriculture, which is a positive impact.

4.2 IMPACTS ON WATER RESOURCES AND QUALITY

a) Construction Phase

Impacts due to sewage generation from labour camps

The major sources of water pollution during project construction phase are the sewage generated from the labour camps/colonies. The increase in the population is expected to be of the order of 26,500. It is proposed to construct residential, non-residential facilities and buildings near Sijhora dam site Bichhiya and Mandla.

The total domestic water requirements of the labour population (including families) is expected to be of the order of 1.31 mld @ 70 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 1.04 mld. The total BOD load contributed by various labour camps/colonies will be about 169 kg/day. It is recommended that an Oxidation ditch be commissioned at various labour colonies.

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 irrigation in the command area is 80.39 Mm³. The details are given in Table-4.

TABLE-4
Irrigation water requirements in the command area

Tehsil	District	Service area (ha)	Crop water requirement (Mm ³)		
			Kharif	Rabi	Total
Dindori	Dindori	9169	34.90	27.60	62.50
Rajendragoon	Anuppur	2618	9.97	7.88	17.85
Total			44.87	35.48	80.35

Source : DPR

The diversion of water for irrigation in the command area could lead to adverse impacts on the downstream flow regime. The diversion of water in the dry season from October to March could lead to drying of river. Thus, in these months, the minimum releases should always be maintained to avoid adverse impacts on the river water quality and riverine ecology.

Impacts on waterlogging and soil salinity

The increase in groundwater recharge is expected to be about 178.93 Mm³/year. This entails an increase in average groundwater rise of 961 mm/year spread over an area of 18,616 ha. If the ground water levels increase as per the above mentioned rate, the area could face water logging problems in few years. The severity of impacts is however, expected to be much lower as part of the ground water recharge would flow out from the command due to transverse movement.

The vertical drainage may neither be necessary nor possible in the command area. However as regards use of ground water within the command area, it will be utilized from April to June to irrigate the crops like fruit orchard and summer crops such as vegetable, moong, fodder etc. as no surface water from canals will be supplied during this season. This in turn will help to keep water table below the root zone. Government provides 100% subsidy on open wells, 75% subsidy or Rs. 15000/- whichever is less, on digging of tube wells to scheduled caste and scheduled tribes only. For all farmers 75% subsidy or Rs. 9000/- whichever is less, for installation of pump on successful tube wells. Govt. also provides 50% subsidy on laying pipe line from the source of irrigation to field or Rs. 7900/- whichever is less, 50% subsidy or

Rs. 6000/- whichever is less on sprinkler set, and 50% subsidy or Rs. 6000/- whichever is less. All the villages of the command area have been electrified.

On the basis of topography of the command and trend of ground water flow and the use of ground water during hot-weather, it can be concluded that there would be no water logging even after introduction of irrigation in the proposed command area.

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.

Impacts on downstream water quality

The reduction in flow as a result of diversion of water for irrigation would lead to significant reduction in downstream discharges. There are no major rivers confluencing with river Narmada, just downstream of the project site. In the intervening stretch, there are quite a few villages, along both the banks of river Narmada. In these villages, generally open defecation is practiced, and there is no sewerage system which conveys sewage/domestic waste upto the river. However, during monsoon months, runoff from initial rains is bound to have high BOD and other pollution loads. But during monsoons, the river also carries significant flows which provide adequate dilution to prevent any adverse impact on downstream water quality.

4.3 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, community kitchens or fuel depot has been recommended.

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

Loss of forests

The proposed project envisages submergence of 2952.15 ha and the break up is given as below:

- Private land : 2437.70 ha
- Government land : 514.45 ha

No forest land is to be acquired, hence, no adverse impacts are envisaged.

Impacts on wildlife

It has been reported based on the interaction with locals, etc., no major fauna is reported. The project area does not appear to be on the migratory routes of animals and therefore, the construction of project will not affect migration of animals as well. The river even, in the pre-project phase, acts as a barrier to the movement of wildlife and there are no reports of wildlife crossing river Narmada. Thus, construction of the reservoir as a part of the project, is not likely to have any impact on wildlife movement in the area.

Impacts on migratory routes

The faunal species observed in the project area is not migratory in nature. The construction of the proposed Upper Narmada irrigation Project, will form a reservoir of area, and is not expected to have any impact on the migratory route. The river in the pre-project scenario, acts as a barrier to the movement of fauna, as a result of which no major migratory route has developed. Thus, no adverse impacts on migratory routes is anticipated as a result of the proposed project.

4.4 IMPACTS ON AQUATIC ECOLOGY

a) Construction Phase

Impacts due to increased human activities

The increase of human activities in the project area, results in enhancement in indiscriminate fishing including use of explosives. The use of explosive material to kill fish in a pool would result in complete loss of fish and other aquatic life making a river stretch completely barren. Indiscriminate fishing will reduce fish stock availability for commercial and sport fishermen. Thus, it is recommended that adequate surveillance measures are implemented during project construction phase to ameliorate such impacts.

Extraction of construction material

Extraction of gravel and sand causes considerable damage to fish stocks and other aquatic life by destabilizing the sub-stratum, increasing the turbidity of water, silting of the channel bottom and modifying the flow, which in turn may result in erosion of the river channel. These alterations upset the composition and balance of aquatic organisms. For the construction site at or near Narmada the effluent with high turbidity levels would outfall in river Narmada. Though riverine ecology is well developed in river Narmada, but the flow in river Narmada provides adequate dilution. Thus, no adverse impacts on this account are anticipated.

b) Operation Phase

Impacts on riverine ecology

The water for diversion for irrigation in Upper Narmada Irrigation project would lead to marginal reduction in flow. The quantum of diversion is within the stipulated use, hence, no adverse impacts on downstream users is anticipated.

Impacts on fisheries potential

The proposed project would increase the water availability in the command area. As a result, there will be increase in potential for tank and pond fisheries. Currently, within the command area, tank and pond fisheries are in vogue. Within the command area blocks there are 336 fish ponds and tanks in project area districts in which pisciculture is being practiced. The total area under these ponds is more than 274.794 ha. With the increased availability of water the tank and fisheries potential would improve. The average fish production from these tanks is about 0.5 tonnes/ha/yr. However, in the irrigation tanks and in intensively cultured ponds, the average fish yield is of the order of 1 to 2 tonnes/ha/yr. Thus, with introduction of extensive pisci-culture, fish production is expected to increase significantly.

4.5 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. It is a known fact that there is a reduction in noise level as the sound wave passes through a barrier. Thus, no increase in noise levels is anticipated as a result of various activities, during the project construction phase. 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.

4.6 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 1 µg/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.

4.7 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.

4.8 IMPACTS DUE TO COMMAND AREA DEVELOPMENT

The proposed envisages increase in cropping intensity by about 1.9 time, i.e. from 75% to 143%, alongwith increase in irrigation intensity as well. This will lead to increase in agriculture production as well as increase in increase in increase level as well.

Change in cropping pattern

During project operation phase, the cropped area in Kharif cropping season will increase from 9,455 ha to 15,080 ha. The increase in cropped area in Rabi cropping season shall be from 4,503 ha to 11,551 ha. At present, the area under agriculture in the command area is 13,958 with a cropping intensity of 75% (50.8% in Kharif season and 24.2% in Rabi season). With the introduction of irrigation, not only the irrigation intensity will improve, but the cropping intensity in Kharif and Rabi seasons will improve from 50.78% to 81.00% and 24.19% to 62.05% respectively.

The total agriculture production would increase from 9,534 tonnes/year at pre-project level to 114,202 tonnes/year in project operation phase. The increase in cost of

value of produce would increase from Rs.33.85 million to Rs.616.98 million. The net income would increase from Rs.16.62 million to Rs.506.98 million. Considering the cropping area, the income would increase from pre-project level of Rs.1,190 per ha to Rs.19,037 per ha.

Improvement in livestock

During project operation phase project food grain production will increase from 9,534 tonnes per year to 114,202 tonnes per year. The increase in agriculture by product would be of the order of 104,668 tonnes per year. Assuming even 50% of agriculture by product is usable as fodder, hence, about 52,334 tonnes of additional fodder would be available. This would satisfy the fodder requirements of about 5,700 cattles per year. This will reduce the pressure on the existing forests or vegetation of the area, which is a significant positive impact.

Employment generation

With the increase in the irrigation intensity, manpower requirement in the agriculture sector would increase from 1.40 million mandays per year to 5.33 million mandays per year, i.e. an increase of 3.93 million mandays per year.

5. RESETTLEMENT AND REHABILITATION PLAN

The total private land to be acquired for the project is about 2952.15 ha, located in 27 villages. The details of project affected families are given as below:

- | | |
|--|------|
| • No. of families whose only houses are affected | 172 |
| • No. of families whose land and houses are affected | 746 |
| • No. of families whose only land is affected | 464 |
| • Total No. of affected families | 1382 |

The cost required for implementation of Resettlement and Rehabilitation Plan is Rs. 365 million. The details are given in Tables-5 to 7.

TABLE-5
Abstract of cost required for implementation of R&R plan

Sl. No.	Item	Amount (Rs. in lakhs)
1.	Provision for compensation of land and property coming under submergence. (refer Table-6)	1937.99
2.	Provision for rehabilitation of families affected due to construction of dam (Refer Table-7)	1297.15
3.	(A) Solatium charges @ 30% of cost of land.	295.16
	(B) Interest charges @12% on ½ of compensation for 2 years.	116.28
	Total	3646.58 or Rs. 364.658 million say Rs. 365 million

TABLE-6
Cost required for acquisition of property and land

Sl. No.	Item	Qty.	Unit	Rate	Amount (Rs. lakhs)
1.	Compensation for land coming under submergence.				
	(A) Culturable Area				
	(i) Dindori District				
	(a) Type I				
	(b) Type II	680	Ha.	41000/-	278.80
	(c) Type III	340	Ha.	39000/-	132.60
	(ii) Shahdol District	113	Ha.	36000/-	40.68
	(a) Type I				
	(b) Type II	677	Ha.	41000/-	277.57
	(c) Type III	338	Ha.	39000/-	131.82
		113	Ha.	36000/-	40.68
	(B) Compensation to be paid for field bunds.				
		30		36000/-	10.80
	(i) Dindori District	20	Ha.	36000/-	7.20
	(ii) Shahdol District		Ha.		
	(C) Culturable area (Fellow land)				
				36000/-	33.84
	(i) Dindori	94	Ha.	36000/-	29.88
	(ii) Shahdol	83	Ha.		
	(D) Compulsory acquisition Charges @ 30% of item				295.16

Sl. No.	Item	Qty.	Unit	Rate	Amount (Rs. lakhs)
	1 (a) + 1 (C)				
	(E) Land under forest (with revenue dept.)	-	-	-	-
	(F) Forest land (up-to F.R.L.)	-	-	-	-
2.	Compensation of Trees and Forest Land				
	(a) Compensation to be paid for fruit bearing trees.	1994	Each	900/-	17.95
	(b) Other trees	11163	Each	500/-	55.82
3.	Compensation for Private Property				
	(A) House – Compensation to be paid for houses				
	Dindori District –	99709	Sqft.	62/-	61.82
	(a) Kachcha	97318	Sqft.	195/-	189.77
	(b) Pakka	263977	Sqft.	62/-	163.67
	Shahdol District –	3429	Sqft.	195/-	6.69
	(a) Kachcha				
	(b) Pakka				
	(B) Other Property – Compensation to be paid for well & handpump				
	Dindori District –				
	(a) Kachcha	15 Nos.	Each	11000/-	1.65
	(b) Pakka	5 Nos.	Each	22000/-	1.10
	Shahdol District –				
	(a) Kachcha	71 Nos.	Each	11000/-	7.81
	(b) Pakka	15 Nos.	Each	22000/-	3.30
4.	Compensation for Govt. Property (Other than forest)				
	(a) Compensation for Govt. wells	4	Each	50000/-	2.00
	(b) Govt. Buildings	1279	Ft ²	195/-	2.49
	(c) Temples	9 Nos.	Each	25000/-	2.25
5.	Colony/road etc. Compensation to be paid for land acquired for colony/road etc.	130	Ha.	36000/-	46.80

Sl. No.	Item	Qty.	Unit	Rate	Amount (Rs. lakhs)
6.	Stationary required for preparation of land acquisition proposals tracing blue prints duplication etc.	27 vill.	Each	2000/-	0.54
7.	Cost of boundary stones purchase of maps demarcation of property acquired @ 1% of cost of land.			L.S.	2.00
8.	POL & repairing charges of inspection vehicle for verification of work during land acquisition.	3000 per vehicle	--	L.S.	1.50
9.	Legal expenses required during acquisition	--	--	L.S.	14.5
10.	Compensation for electric line coming under submergence.	--	--	L.S.	10.00
11.	Publicity required for evacuation of villages during monsoon together with safety demarcation.	25000/- For 3 years	Per year	L.S.	0.75
12.	Construction of new temple.	1	-	L.S.	2.00
13.	Establishment of land acquisition and other expenses 6.25% of 418.82 Item No. 1 (a)+(c)+(f)	-	--	--	61.49
	Total				1937.99

TABLE-7
Estimate for rehabilitation work for the oustees

S. No.	Description of Item	Qty.	Unit	Rate	Amount (Rs. lakh)
1.	Resettlement grant (for all) families to be rehabilitated.	1382	Each family	18700/-	258.43
2.	Grant in aid (compensation Rs. 2000/- per ha.)	863	Ha.	2000/-	17.26
3.	Acquisition of land for resettlement of families affected @ 0.0502 ha. for one family	68.87	Ha.	36000/-	24.79
4.	CIVIL AMENITIES –				
	(a) Primary School @ 100 family	14	No.	273000/-	38.22
	(b) One Community Hall Panchayat Bhavan	3	No.	174000/-	5.22

S. No.	Description of Item	Qty.	Unit	Rate	Amount (Rs. lakh)
	(c) One dispensary for every 500 families.	3	No.	371000/-	11.13
	(d) One seed store for 500 families.	3	No.	125000/-	3.75
	(e) Drinking water well through for every 100 families.	14	No.	77000/-	10.78
	(f) One pond for 500 families.	3	No.	220000/-	6.60
	(g) One tree platform every 27 Km.	18	No.	34000/-	6.12
	(h) One religious Place of worship	3 No.	Each	200000/-	6.00
	(i) Construction of approach road and link roads for new abadi.	27 Km.	Km.	179000/-	48.33
	(j) Electrical distribution lines and street light 2 km./100 families.	21	Km.	25000/-	5.25
	i) 11 KVDp structure on 400 Kg. 8 m. long PCC pole.	18	No.	15780/-	2.84
	ii) 3 face, 5 wire L.T. 17 line on 140 km., 8 m. long PCC poles with 4 rabbit + 1 squirrel.	28	Km.	126260/-	35.35
	(k) Children's park for 664 families.	3	No.	100000/-	3.00
	(l) Goshala (cattle yard) one per 100 family 664/100=7				
5.	Distribution of culturable land of oustees.	1618	Ha.	41000/-	663.38
6.	Adding 1% preliminary survey and investigation of item 4 & 5 (Rs. 845.97 lakhs)				8.45

S. No.	Description of Item	Qty.	Unit	Rate	Amount (Rs. lakh)
7.	Planning of one model village with consultation of experts.	One/village	L.S.		1.00
10.	Transportation aid for shifting of rehabilitated families.	1382	Families	5000/-	69.10
	Total				1235.38
	Add 5% for work charged and contingencies				(+) 61.77
	Grand Total				1297.15 lakh

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 oxidation ditch.

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 authority in association with the State Government should make necessary arrangements for supply of kerosene/LPG. The fuel would be supplied at sub-sidised rates to the local/contract labour for which provision should 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, 30 number of masonry storage vats, each of 2 m³ capacity should be constructed at appropriate locations in various labour camps. These vats should be emptied at regular intervals and the collected waste can then be transported to landfill sites. Two covered trucks to collect the solid waste from common collection point and transfer it to the disposal site should be put to service. A suitable landfill site should 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. Hence, separate provisions for the same have not been included in cost estimate for implementation of Environmental Management Plan.

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 if the proposed project area. The staffing details are given in Table-8.

TABLE-8
Details of Para-medical staff for the dispensary

Para medical staff	Numbers
Auxiliary Nurse	8
Male Multipurpose Health worker	4
Attendant	4
Driver	4
Total	20

The dispensary building shall have the following facilities:

- waiting hall where 20-30 people can sit.
- rooms for doctors
- one room for staff
- two rooms for stores
- one general ward to accommodate 10 beds
- one minor operation theater/dressing room
- one garage with space for vehicle

A first aid post shall be provided at the major construction site. 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 Upper Narmda Irrigation Project will increase the water availability in the project command area. The important management measures can be as below:

- slope and sides of dykes should be provided with grass turfing to reduce erosion
- ponds should be properly prepared
- manuring of ponds should be done before stocking and at regular intervals after stocking
- to avoid oxygen depletion, the manure should be put in heaps in ponds;
- on fouling of water or development of thick algal bloom, manuring & feeding should be stopped for some time;
- supplement natural food with artificial feed;
- sampling of fish stock every month to observe their growth rate & health.

6.5 CANAL BANK AND ROAD SIDE PLANTATION

The proposed project envisages construction of main canal of length 152 km. It is proposed to develop plantation on both side of distributaries, which would improve the overall aesthetics of the area.

6.6 INFRASTRUCTURE FOR AGRICULTURAL DEVELOPMENT

Financial and credit facilities

The credit agencies through their various rural development schemes can play a very important role. An optimal combination of short term, intermediate term and long term credits may be formulated to provide maximum benefits to the command area population.

Marketing facilities and institutions: Improved marketing facilities and procedures contribute to the objectives of agricultural development directly through providing greater use of a given level of production and indirectly by fostering increased production. Inefficiencies in processing, storing and transporting agricultural produce can cause actual loss of product

Efforts shall also be made to develop the transportation and storage facilities. The co-operatives can play a very important role in the marketing of agricultural commodities and supply of inputs to the farmers. The cooperatives through interaction with government agencies, research institutes can popularise new farm inputs, marketing facilities etc. These structures can be built as a part of various rural development schemes of the state and central government.

6.7 CONTROL OF WATERLOGGING AND SOIL SALINIZATION

There are few pockets in the command area, where ground water levels are high. It is proposed that these pockets be excluded from the command area and ground water wells should be developed in these pockets for the irrigation purpose. The cost of commissioning of these wells shall be borne by the project proponent. The operation cost for meeting the energy requirements shall be borne by the project proponents.

The project proponent shall develop a Water User Group comprising farmers to be served by these wells. The Water User Group shall elect a Group Leader which in all probability be the farmer in whose land the well is constructed. The Group Leader shall decide the water charges to be levied from the water users in consultation with the other members of the water user group. The Group Leader will ensure the equitable distribution of water among the water users.

6.8 CONTROL OF AQUATIC WEEDS

Aquatic weeds are those unwanted and undesirable vegetation, which reproduce and grow in water and if unchecked, may choke the water body posing a serious menace to canal management. Various control measures can be implemented for control of aquatic weeds. These include introduction of fish species that feed on aquatic weeds. In addition weeds in small or medium sized sheets can be controlled by manual or mechanical methods as well.

6.9 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.

6.10 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.

6.11 TRAINING AND EXTENSION COURSES FOR FARMERS

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.

6.12 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 hrs/day and 5 days/week
90	8
95	4
100	2
105	1
110	1/2
115	1/4
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.

6.13 LIVESTOCK DEVELOPMENT

The following measures are specifically recommended for improvement of livestock in the command area:

- Measures to improve availability and quality of feed
- Improvement in standard of nutrition by increasing the availability and quality of feed. The proposed project would go a long way in improving the availability of fodder.
- Improvement in marketing system to facilitate the movement of livestock and livestock products.
- Development of facilities to ensure easy availability to purchase inputs like drugs, draught oxen, tools, etc.
- Improvement in extension services by regular organization of field demonstration and improvement in visual-aid facilities.
- Establishing grass-legumes in pasture areas.

- Sourcing the soil conservation areas with improved forage species and prevention of grazing over these areas. The grass can be cut and transported to the point of consumption.
- Planting of trees such as *Leucaena* and *Sesbania* at a very close spacing along contours within arable areas.

6.14 ESTABLISHMENT OF ENVIRONMENTAL LABORATORY

An independent laboratory with facilities for chemical analysis should be set up in due course. A separate dust-proof room will have to be provided for installing analytical instruments.

6.15 ENVIRONMENTAL MANAGEMENT CELL

NVDA can develop an Environment Management Cell (EMC) at the project office. The task of the Group is to coordinate specific studies to carry out environmental monitoring and to evaluate implementation of environmental mitigatory measures. One Environment Officer can also be posted at the project site who would report to the Project Incharge. The Environment Officer will report to the appropriate authority having adequate powers to implement the required measures. The other responsibilities include liaising with relevant departments at the State Government level for effective implementation of the Environmental Management Plan (EMP) and the Environmental Monitoring Programme.

7. CATCHMENT AREA TREATMENT (CAT) 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 project, there is no area under very high erosion category. Hence, CAT plan has been suggested for area under 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 30,998 ha, which is about 28.1% of the catchment area considered for treatment. The cost required for Catchment Area Treatment is Rs.151.64 million.

8. DAM BREAK ANALYSIS AND DISASTER MANAGEMENT PLAN

The Dam Break Analysis study for the Halon irrigation project has been done by the Central Water Commission using HECRAS model. A separate report for the same has been prepared. The profile of the wave in the event of dam break is given in Table-10.

TABLE-10
Water depth and spread downstream of dam in the event of dam break

Distance d/s of dam (km)	River bed level (m)	Max. elevation above MSL (m)	Water depth (m)
1	733.54	739.20	5.66
3	723.48	735.75	12.27
5	725.11	734.26	9.15
10	716.21	733.86	17.65
15	711.90	719.90	8.00
20	701.00	710.83	9.83
25	694.31	705.99	11.68
30	688.76	699.92	11.16
35	683.52	693.03	9.51
40	672.67	683.95	11.28
45	664.83	676.18	11.35
50	657.00	669.79	12.79

A Disaster Management Plan has been prepared for implementation in case of a dam break. This comprises of:

- Surveillance
- Emergency Action Plan (EAP)
- Administration and Procedural Aspects
- Preventive Action
- Communication System
- Evacuation Plans
- Public awareness for disaster management
- Management after receding of flood water

9. ENVIRONMENTAL MONITORING PROGRAMME

An Environmental Monitoring Programme should be undertaken during construction and operation phase of the project. The details of environmental monitoring programme are given in Tables - 11 and 12 respectively.

TABLE-11
Summary of Environmental Monitoring Programme during Project Construction Phase

S. No.	Item	Parameters	Frequency	Location
1.	Effluent from STPs	pH, BOD, TSS, TDS	Once every month	Before and after treatment from each STPs

S. No.	Item	Parameters	Frequency	Location
2.	Water-related diseases	Identification of water related diseases, adequacy of local vector control and curative measure, etc.	Three times a year	Labour camps and colonies
3.	Air quality	SPM, RPM, SO ₂ and NO _x	Three times a year	At major construction sites
4.	Noise	Equivalent noise level	Once every three months	At major construction sites.

TABLE-12

**Summary of Environmental Monitoring Programme during
Project Operation Phase**

S. No.	Items	Parameters	Frequency	Location
1.	Water quality	pH, Temperature, EC, Turbidity, Total Dissolved Solids, Calcium, Magnesium, Total Hardness, Chlorides, Sulphates, Nitrates, DO, COD, BOD, Manganese, Free Ammonia, Total Kjeldahl Nitrogen, Boron, Percent sodium, phosphates, Total coliforms, Faecal coliforms	Thrice a year	<ul style="list-style-type: none"> • Reservoir • Main canal and distributaries
2.	Soil	pH, EC, texture, organic matter	Once in a year	Command area
3.	Ecology	Status of afforestation programmes along canal, Pasture development	Once every year	-
4.	Water-related diseases	Identification of water-related diseases, sites, adequacy of local	Three times a year	<ul style="list-style-type: none"> • Villages adjacent to project sites

S. No.	Items	Parameters	Frequency	Location
		vector control measures, etc.		
5.	Weeds	Density, problem areas effectiveness of weed control measures	Once a year	<ul style="list-style-type: none"> Command area Water bodies
6.	Socio-economics	Changes in population growth, income level, infrastructure development	Once in a year	<ul style="list-style-type: none"> Command area
7.	Landuse	Landuse pattern using satellite data	Once in a year	<ul style="list-style-type: none"> Command area

10. COST ESTIMATES

10.1 COST FOR IMPLEMENTING ENVIRONMENTAL MANAGEMENT PLAN

The total amount to be spent for implementation of Environmental Management Plan (EMP) is Rs. 774 million (Refer Table-13). This cost is exclusive of the compensation required to be given in lieu of acquisition of land and other properties. Likewise, the cost required for implementation of measures to control water logging too has not been included.

TABLE-13

Cost for implementing Environmental Management Plan

S. No.	Item	Cost (Rs. million)
1.	Sanitation facilities in labour camp	25.88
2.	Free fuel to labour population	88.95
3.	Solid waste collection and disposal system	23.1
4.	Effluent treatment facilities in project colony	2.50
5.	Health Delivery System	54.98
6.	Fisheries development in reservoir area	25.82
7.	Canal bank side plantation	21.02
8.	Control of waterlogging	2.00
9.	Control of aquatic weeds	5.00
10.	Resettlement and Rehabilitation Plan	365.00
11.	Settling up of Environmental Laboratory	1.00
12.	Catchment Area Treatment Plan	151.64

S. No.	Item	Cost (Rs. million)
13.	Cost for Environmental Monitoring Programme during construction Phase (Refer Table-14)	6.79
14.	Cost of Noise Meter	0.05
	Total	773.73 Say Rs.774 million

10.2 COST FOR IMPLEMENTING ENVIRONMENTAL MONITORING PROGRAMME

The cost required for implementation of Environmental Monitoring Programme during project construction phase is Rs.6.79 million. The details are given in Table-14.

TABLE-14
Cost Required for Implementing Environmental Monitoring Programme during Construction Phase

S. No.	Item	Cost (Rs. million)
1.	Water Quality	2.24
2.	Public Health	3.08
3.	Air Quality	1.47
	Total	6.79

The cost required for implementation of the Environmental Monitoring Programme is of the order of Rs.1.96 million/year. A 10% annual price increase may be considered for every year. The details are given in Table-15.

TABLE-15
Cost for implementing Environmental Monitoring Programme during Operation Phase

S. No.	Item	Cost (Rs. million/year)
1.	Water quality	0.96
2.	Soil quality	0.30
3.	Ecology	0.20
4.	Public health	0.50
	Total	1.96