

Executive Summary

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Introduction

As per the Ministry of Environment and Forests (MoEF), Government of India guidelines, Environmental Impact Assessment (EIA) is a prerequisite for any major development project. In compliance with this requirement, the Water Resource Department, Amravati, Maharashtra, retained the CSIR-National Environmental Engineering Research Institute (CSIR-NEERI), Nagpur to prepare the Environmental Impact Assessment (EIA) report for the proposed construction of earthen dam across the Bordi Nalla to fulfill the demand of water for irrigation and drinking purpose in the study area.

The EIA report presents the objectives and scope of the study, the environmental baseline status of the project area, identification of major environmental impacts, prediction of various impacts during and after the proposed developmental activities, evaluation of these impacts, followed by suggestions for effective environmental management plan to minimize the adverse impacts.

The objective of this project is to provide irrigation facilities in Amravati District. The Amravati District has meagre irrigation facilities and dependent on rain water. This project is expected to provide irrigation facilities to Chandur Bazar and Achalpur taluka of Amravati District. The project is proposed in the highest irrigation deficit area of the Amravati District and completion of this project will result in increase in crop production, provision of drinking water and will bring financial stability in the region.

The proposed project site is located at upstream of village Borgaon (Mohana) and in Chandur Bazar Tahsil. The dam site is located at a latitude of $20^{\circ}13'07''\text{N}$ and longitude of $77^{\circ}36'55''\text{E}$. The nearest airport is Nagpur and is approximately 180 km away from the project site.

Salient Features of the Project

The ICA (Irrigation Command Area) of the project is 4126 ha and falls in the medium category. It is proposed to irrigate 489 ha by lift irrigation system and 3637 ha by flow canal. The area under submergence would be 627.16 ha which constitutes 588.59 ha of private land, 12.72 ha of forest land and 25.85 ha of Govt. land.

It is proposed to divert the river Megha into the Bordi Nalla with the help of intake structure at village Pala, using a feeder canal upto the origin of Bordi Nalla. Bordi Nalla is proposed to carry 21.049 Mm^3 of flood water into the Bordi dam. An earthen dam of length

1620 m and height of 17.97 m is proposed across the Bordi Nalla. The dam will have side gated spillway of size 8m x 2m to pass the designed flood of 1325.76 cumec. It is proposed to lift the stored water in Bordi Dam into the balancing tank of 5.914 Mm³ store capacity. Farmers from the village Kondwardha and Inyatpur will lift the water from barrage to irrigate 489 ha area. In this scheme 2.631 Mm³ of water is reserved for the drinking water purpose. Submergence under the Bordi main Dam is 273.05 ha and it includes 12.72 ha of forest area.

The storage capacity of dam is as follows:

(a) Dead Storage	:	1.048 Mm ³
(b) Live Storage	:	17.446 Mm ³
(c) Gross Storage at F.R.L.	:	18.494 Mm ³

Baseline Environmental Status and Identification of Impacts

Air Environment

Four major air pollutants viz., suspended particulate matter (SPM), respirable particulate matter (RPM), sulphur dioxide (SO₂) and oxides of nitrogen (NO_x) representing the basic air pollutants in the region were identified for Ambient Air Quality Monitoring (AAQM).

The pollutant levels monitored at 15 sampling stations reflected the regional background levels. The mean levels of SPM were in the range of 87-107 µg/m³ whereas, RPM was in the range of 27-41 µg/m³ respectively. The 98th percentile values of SPM ranged between 101-131 µg/m³. The 98th percentile values of RPM were below the CPCB standard (100 µg/m³).

The average concentrations of SO₂ were in the range of 5-10 µg/m³; the 98th percentile value of SO₂ varied in the range of 8-16 µg/m³. The mean concentrations of NO_x were in the range of 10-18 µg/m³ and the 98th percentile values varied between 13-23 µg/m³, which is far below CPCB stipulated standard (80 µg/m³).

Noise Environment

The noise levels in the residential zone ranged between 46-60 dBA during daytime and 42-47 dBA during night time, and for commercial zone, the noise levels ranged between 59-68 dBA during daytime and 50-52 dBA at night time respectively.

Noise levels were also monitored in schools, hospitals and temples in the study area, i.e., the silence zone. The noise levels varied from 45-56 dBA during daytime and 40-46 dBA during night time.

Water Environment

Total 14 samples were collected; out of which 1 was surface water and 13 were groundwater samples. The physico-chemical characteristics of surface water for winter season indicated a temperature of 29.5^oC; pH: 8.0; TDS: 258 mg/l and TSS: 4 mg/l. Alkalinity is 170 mg/l, whereas total hardness was found to be 177 mg/l as CaCO₃. The chloride and sulphate were observed to be 17 mg/l and 11 mg/l respectively, whereas sodium and potassium concentrations were found to be 17 and 2 mg/l respectively.

The organic load in terms of COD and BOD was found to be in the range of <5 mg/l and <3 mg/l respectively; nutrient parameters with respect to nitrates and phosphates were found to be 1-6 mg/l and 0.07 mg/l respectively. Heavy metals, except iron, were found to be within the permissible limits of drinking water.

The physico-chemical characteristics of groundwater indicate pH in the range of 7.8-8.7; temperature 26-30^oC; turbidity 4 NTU; TDS 300-967 mg/l. The total suspended solids (TSS) concentration was in the range of 1-6 mg/l.

The inorganic parameters viz., chloride, sulphate, sodium and potassium are in the range of 13-287 mg/l, 1-161 mg/l, 25-150 mg/l and 5-14 mg/l respectively.

Organic parameter COD, was found to be negligible whereas nitrates and phosphates were 2-11 mg/l and 0.01-0.05 mg/l respectively. Concentrations of heavy metals viz., copper and nickel, cadmium, chromium, lead, iron, manganese and zinc were found in the ranges of 0.07-1.60 mg/l, ND-01 mg/l, ND, ND-0.04 mg/l, ND-0.27 mg/l, ND-2.30 mg/l, ND-2.99 mg/l, 0.01-2.40 mg/l and Cobalt is ND respectively. (ND-Not detected)

The surface water was found to be faecally contaminated and hence need chlorination before consumption. Most of the groundwater samples were also found to be faecally contaminated and hence need chlorination before consumption.

The total count of phytoplankton was found to be 112-369 no./ml with the moderate diversity. The SWD index varied between 1.0 to 3.68 indicating a healthy water body.

Zooplanktons are absent in most of the groundwater samples, while in surface water samples, total counts were observed to be in the range of 300-6000 per m³ containing two groups of organisms namely *Rotifera* and *protozoa*.

Land Environment

Agriculture is the major activity in the villages; more than 72 % land is under cultivation. The irrigated agriculture land covers only 17 % crops. Jowar, Soyabean, Cotton and Tur are grown in the Kharif season. Unirrigated crops like Til and Chana are the prominent crops grown in the Rabbi season. Cotton is the major crop. In the Kharif season, Mung, Tur, Jawar and Soyabean are prominent crops of the study area.

The texture of the soil is clay. The bulk density of the soil is in the range of 1.32 to 1.40 g/cm³, whereas the porosity and water holding capacity are in the range of 47.80 to 56.59 % and 48.20-55.27% respectively. The pH of the soil in the study area is slightly to moderately alkaline which is in the range of 7.3-8.0. The electrical conductivity (EC) of the soil samples are in the range of 0.28-1.9 dS/m. The soluble salts content in all the soils are low (EC<1 dS/m), chemical analysis shows that the soils are normal. It was observed that calcium and magnesium are in the range of 1.22-4.28 meq/l and 0.36-2.22 meq/l respectively. Sodium and potassium in the soils vary from 0.18-0.88 meq/l and 0.04-0.18 meq/l respectively.

In general, the soil of the region has very high adsorption capacity as evident from the cation exchange capacity, which was found to be in the range of 38.61-45.98 c mol (P⁺) Kg⁻¹ soil. the exchangeable sodium percentage of soil is below 15. The soils of all the villages have very high adsorptive capacity and also have high productivity.

Organic carbon, available nitrogen, phosphorous and potassium are found to be in the range of 0.46 to 0.59 % and 215.20 to 390.27 kg/ha, 10.78 to 23.18 kg/ha and 140.40 to 296.40 kg/ha respectively. Soil samples have poor to medium level content in organic carbon. Data indicates that soil are medium fertile but the available potassium present in the soils shows high fertility level.

Remote Sensing/GIS studies revealed that the study area mainly comprises of 31.31 % agricultural land. The total area under fallow land is 21.03% and sparse vegetation is about 19.52% of total area. The terrain is almost flat with 3-5% slope. The groundwater potential of the region is fairly good along the river.

Biological Environment

Total 16 sampling locations were selected for study of biological characteristics based on topography, land use and vegetation pattern. The study area mostly comprises of agricultural fields, rivers and nallahs. Out of total area studied, 112 plant species were recorded, comprising 28 trees, 19 shrubs, 47 herbs, 9 climber/linas, 8 grasses and one parasitic plant. The dominant plant in the study area was *Prosopis juliflora*, found commonly

near the river, nallahs and village wasteland. The *Parthenium* was a common weed growing in wasteland and in agricultural field. *Azardirachta* was a common tree near the villages and on the hedge of agricultural field.

All the species observed were common and no threatened or endangered plant species are known to exist in or near the study area. The commonly found wild animals in the study area are monkey, squirrel and lizards. They live in the agricultural field and near the river and nallah side. Some reptiles like cobra, water snakes, monitor lizards and common lizards were also observed near the village boundary.

A total of 45 birds species were observed in the study area of 16 sampling locations. The dominant birds in the study area are green bee eater, little brown dove, common myna, black drongo, little egret, pond heron, white breasted kingfisher, Grey shrike, Coppersmith, Spoonbill, white necked stork and grey heron.

Socio-economic Environment

The socio-economic profile of 15 villages falling in the area in the vicinity of the project has been covered in survey and it includes information on demography, infrastructural facilities, economy, health, literacy and cultural and aesthetic attributes. The quality of life (QOL) index for the villages shows a reasonably satisfactory level.

The area under submergence which is Amravati district is flat and plain. The most of the land under submergence is culturable. The villages in the command area welcome the project. In villages under submergence, people of villages Kondwardha and Inayatpur are willing to support the project provided compensation package is attractive to them.

There is no forest and commercial area coming under submergence. The project affected population would be rehabilitated and resettled as per the norms of the Government of Maharashtra. The water from the reservoir will be used for industrial, irrigation and drinking purposes.

Good economic conditions in terms of income, employment, food, clothing and shelter contribute towards higher QoL-value, while factors like inadequate medical, educational facilities, social-insecurity, water scarcity, insufficient irrigation facilities, and inadequate sanitation facilities bring the QoL-Value down.

The average QoL index values are estimated as:

QoL (S)	=	0.46
QoL (O)	=	0.48
QoL (C)	=	0.47

In general, the project appears to improve conditions for a large number of people. The main objective of Bordi Nalla dam project is to increase the productive capacity of the land in the command areas, since the people are dependent largely on rain fed farming.

Identification of Impacts

For the activities envisaged under the project, impacts have been identified for the pre-construction, during construction, post-construction and operational phases of the project using the network approach which involves an understanding of the cause condition effect relationship between an activity and environmental parameters. The networks indicate the primary, secondary and tertiary impacts due to the various activities.

The significant environmental issues due to the proposed Bordi nalla project are broadly identified as under:

Impact on river hydrology and sediment transport

Impact on water table and consequent water logging

Impact on the water quality

Impact on the terrestrial flora and fauna due to site clearance and construction activities in the project area including loss of forest cover in the submergence area.

Impact on the land use pattern and land availability

Impact on air quality and noise levels during the construction period

Direct and indirect impacts on the local community impact on wildlife, sensitive area, and archaeological sites

Prediction of Impacts

Air Environment

During construction phase of the project, the major activities are drilling, blasting, and quarrying transportation, construction of barrage and other components of project. All these activities lead to an increase in concentration of air pollutants, particularly SPM and NO_x which are further added due to increased vehicular traffic. However, the levels of SO₂ and NO_x were predicted well below the stipulated standards during the construction phase.

It is predicted from CL4 model that the maximum contribution to ground level concentrations of NO_x and SPM due to vehicular movement will be less than 5 µg/m³ beyond

500 m from the road. It is noteworthy that this activity is mainly located away from this proposed project site.

Noise Environment

The study area is affected by transportation due to State Highways i.e., SH-6, SH-200 and SH-194. The trucks, buses, cars, jeeps and two wheelers are running through this route. Considering natural growth and increase due to proposed project, appropriate traffic composition was considered on SH-6, SH-200 and SH-194.

The predicted cumulative noise level at 50m & 100m from the center of the road i.e. SH-6 ranges between 65-70 dBA. On SH-200 the cumulative noise level at 50 & 100 m varied between 62-65 dBA. The cumulative noise level on SH-194 is predicted to be in the range of 55-57 dBA at 50 & 100m from centre of the road.

Compressor, feed pumps and generator etc., would be the main sources of noise during the construction phase of the dam. The noise levels expected would be in the range of 75-85 dBA during construction activity. This temporary increase in noise levels would not have any significant impact on the community.

Water Environment

Surface water quality was monitored to assess the impact of the proposed activity. The assessed parameters indicate that surface water is good physico-chemically. The water from river contains moderate dissolved solids. However there will be maximum dilution due to rain water runoff collected in the dam if river and Nallahs are discharged into the Dam. If the discharge will be properly managed, then there would not be any impact of these rivers and nallahs on the dam water collected during rainy season. The surface water is faecally contaminated and not useful for drinking purposes unless chlorinated.

The water requirement for crops has been calculated. The average rainfall for the period from 1942 to 2002 in nearby command area is considered for this computation. The water requirement is 27.949 Mm³ for 4126 ha. The entire irrigation is planned for conventional Irrigation system. The net yield available at dam site is 51.097 Mm³, out of which 27.949 Mm³ of water is planned to be utilized.

The total water available for this scheme is 27.949 Mm³. To provide irrigation benefit to the village Kondwardha and Inyatpur on balancing barrage is proposed at 5.0 km upstream of Bordi near village Kondwardha. It is proposed to lift the stored water in Bordi dam with the help of lift irrigation system. 8.03 Mm³ water will be available in balancing reservoir for irrigation. At this Kondwardha barrage, two head regulators are proposed on

either side to irrigate 2651 ha of land. Farmers from village Kondwardha and Inyatpur will lift the water from barrage to irrigate 489 ha area.

Land Environment

The construction of the earthen dam will cause rise of the water table in the upstream part of the dam. The soil here is clayey and topographically the area is saline (i.e. relatively flat). Hence water logging may occur in a large area.

Seepage from irrigation canals and excess irrigation of fields would lead to rise of water table, and increase in salinity of soils. Further assured water supply for irrigation may lead to use of HYV (High Yielding Variety) seeds. HYV seeds demand considerable use of fertilizers which could play a role in increasing the salinity of soils.

Existing Crop Pattern

The predominant crops prevailing in the area are Jowar, Cotton, hy. Jowar, groundnut, pulses, wheat and chilies. The command area comprises mostly of medium to light soils for irrigated cultivation.

Existing Crop Pattern

Sr. No.	Name of the Crops	% of the Crops
1.	Soyabean	-
2.	Cotton	41
3.	Hybrid Jowar	15
4.	Pulses	11
5.	Groundnut/soyabean	6
6.	Wheat	2
7.	Chana	1
8.	Vegetable	11
9.	Oranges	13
		100%

Proposed Cropping Pattern

The cropping pattern proposed is based mainly on the agroclimatic zoning of the region keeping in view of soil condition. The L.S. cotton, Hy. Jowar & Oil Seed also find place in view of the fact that these are high yield crops when adequate supply of water is assured. People can be encouraged to grow these profitable varieties in lieu of the conventional crops.

Biological Environment

Megha river is a seasonal river hence there is no prominent fishing activity and hence it may not be affected

The proposed earthen dam on Bordi Nalla river may be used for pisciculture (fish farming)

The area under submergence is mostly agricultural land with rain fed farming so there is very low floristic and faunal diversity

No endangered or endemic plants were recorded in the study area

Wild faunal diversity is only represented by monkey, squirrels etc., which may not be affected due to project activities.

Socio-economic Environment

The project mainly refers to providing irrigation facilities as major source of livelihood is agriculture. The project will create employment and business opportunities during construction phase at local as well as district level. Agriculture related employment will continue during operation phase of the project. Increased revenue to the government through taxes will be indirect benefit.

Improved infrastructural facilities like road, communication, market, health, services and other amenities will help in the development of the region. The project would setup a new township with improved infrastructural facilities. These facilities would be used by local people and would help in betterment and upliftment of the quality of life of local people. The formation of reservoir at Borgaon (Mohana) may promote tourism activities in the project area as well as a source of income for the local people.

Expected change in subjective quality of life (QoL) may increase up to 0.49 and cumulative quality of life may increase upto 0.50 in the project region, as the activity may bring development.

Environmental Impact Statement

Air Environment

The air pollutants relevant to the activities of project were identified as SPM, SO₂ and NO_x. Lower levels of SPM were contributed due to local atmospheric surroundings with flat plain area without industrial activities. The concentrations of RPM, SO₂ and NO_x were well within the established standards.

The potential air pollution sources are due to vehicular traffic. Presently the traffic density is concentrated on SH-6, SH-200 and SH-194. The vehicular density will be expected to rise after the construction of proposed dam is completed. The impact of vehicular activity on air quality adjacent to vehicular movement on SH-6, SH-200 and SH-194 is predicted using CALANE 4 model developed by USEPA. It is predicted that the maximum contribution to ground level concentrations of NO_x and SPM due to vehicular movement will be less than 5 µg/m³ beyond 500 m from the road.

Noise Environment

On the basis of expected noise levels estimated through standard attenuation model, it is observed that general noise levels on the dam site and in the surrounding villages will be within the prescribed standard limits.

Water Environment

The data collected during winter season indicate that river water is physico-chemically fit for drinking purpose. However maximum provision has been made to use this dam water for irrigation purpose. If used for drinking purpose it should be chlorinated first. Due to maximum collection of rain water into the dam, the dilution effect may reduce the mineral content and there will not be much impact on the productivity of soil and crops, if used for irrigation.

The groundwater of nearby villages is moderately mineralized in terms of dissolved solids, hardness, chloride and sulphate. It was also found to be faecally contaminated at certain locations so proper precaution should be taken to avoid any further contamination of the ground water.

Land Environment

Soil and water resources do not possess any significant problems. The crops grown under rainfed (wells and river lifts) were cotton, tur, soyabean, pulses, brinjal, onion, wheat, sunflower, jowar and the crop productivity is satisfactory. Crop water requirement is estimated and suitable cropping pattern is suggested along with strategy of irrigation schedule.

The proposed project envisages construction of earthen dam across the Bordi nalla upstream of village Bargaon-Mohana in Chandur Bazar taluka as to harness water for irrigation. The irrigation benefits will be provided to Kondwardha and Inyatpur for that one balancing barrage is proposed at 5 km upstream of Bordi near village Kondwardha. It is proposed to lift the stored water in Bordi nalla dam with the help of Lift Irrigation System

(LIS) and then to be stored into the balancing barrage of 8.03 Mm³ storage capacity. At this Kondwardha barrage two head regulators are proposed on either side to irrigate 2651 ha of land.

Biological Environment

The associated activities of the proposed project may have adverse impact on the natural vegetation and animal life. However, with the implementation of mitigation measures like tree plantation and greenbelt development, afforestation and irrigation activities, the ecosystem balance in the region will be restored to a great extent.

Socio-economic Environment

It is envisaged that implementation of welfare measures including provision of basic facilities/amenities would result into increase in subjective QoL Index (QOL_(s)) from 0.49 to 0.50. However, objective QoL index needs to be ascertained after implementation of EMP. Overall, there would be positive impact on socio-economic environment due to upliftment of living standard of the people as a result of implementation of suggestions given in EMP.

Environmental Management Plan

The project activities during the preconstruction, construction and operational phases will have impacts, both positive and negative on various environmental components. An environmental management plan has been suggested for mitigation of adverse impacts and to maximize the beneficial impacts.

The catchment area of 323.89 sq.km has been divided into different watersheds based on the tributaries or nallahs, which are non perennial. Under this CATP issues addressed are (i) forestry (ii) wood plantation (iii) soil conservation and irrigation proposals.

For effective implementation of recommended environmental monitoring plan, it will be necessary to establish and develop adequate facilities for sampling and analysis. It will be desirable to set up an environmental monitoring cell at Bhatkuli and Water Resources Department, Maharashtra with competent trained staff and adequate instrumentation support.

The implementation of the mitigation plan should be regularly reviewed by a high level committee consisting of members drawn from Bordi Nalla project, Water Resources Department, Maharashtra, Pollution Control Boards, Central Water Commission and Forest Department so as to ensure compliance with the recommendations.

Approach to Disaster Management Plan is proposed. It is derived from the report that some of the settlements downstream of the proposed dam are going to be affected. As a preventive measure, it is suggested to constitute an Emergency Response Organization, which will take charge of overall planning, execution and coordination of all the activities of the Disaster Management Plan. Some of the vital activities of the organization may include demarcating emergency zones, carrying out emergency actions like extending relief, first-aid, human assistance, carrying out evacuation, if necessary and organization of rehabilitation centres. Similarly the Catchment Area Treatment Plan, Afforestation Plan, Biodiversity and Conservation Plan, Health Management Plan and details about the Rehabilitation and Resettlement Plan are presented in the report.

