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# PRODUCTION OF SUGAR AND ASSESMENT OF ITS IMPACT ON THE ENVIRONMENT

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**Abstract**

EID Parry (I) Ltd. sugar and distillery industry located in Nellikuppam town of Cuddalore district has various production units such as sugar plant, sugar refinery plant, distillery plant, co-generation plant and dryer plant. The major products of the industry include sugar, alcohol, power and bio-fertilizer. In this work, the impact on environment during operation phase of the industry was assessed. Initially baseline data of the air, water, noise, land, soil, ecology and biological environments were collected. Then, anticipated impacts to the environment were listed to suggest mitigation measures. Matrix and checklist methodology was adapted in this study for Environmental Impact Assessment. Other than environmental impact of the industry, the social impact, cultural impact and economic impact of the Industry were also assessed. From the study conducted, it can be concluded that EIDP follows good environmental policy and have more positive impact on the environment.

**Keywords:** Environment, Sugar, Pollution, Industry, Impact

## Introduction:

The process of Environmental Impact Assessment serves to meet the primary goal of Parliament in enacting Environmental Protection Act (EPA), 1986 to establish a national policy in favor of protecting and restoring the environment. As per Environmental Impact Assessment (EIA) Notification SO 1533 dated 14th September 2006, environmental clearance prior to construction and during operation is mandatory. In this study Environmental Impact during operation of the existing EIDP sugar plant were discussed. Mitigation measures to be taken, Base line environmental status and Environment Management Plan (EMP) of EIDP were also reported.

## Scope of the study

The scope of work includes Environmental Impact Assessment of EIDP and a detailed characterization of the environment in an area of 10 km radius of the EIDP factory site for various environmental parameters like air, water, noise, land, biological and social-economic aspects. The present Final EIA report is prepared incorporating the TORs (Terms of Reference) accorded by the Hon'ble Ministry of Environment & Forests, New Delhi for sugar industry with distillery.

**Need and Justification for sugar factory**

India is predominately a country with an agro based economy. Sugarcane plays a very vital role in the agro based economy by providing sugar, the main sweetener used in India. With the growing demand for sugar, the emphasis has been on increasing sugar production. India is the second largest producer of sugar over the globe. With more than 45 millions of sugar cane growers in the country, the bulk of the rural population in India depends on this industry. One of the major agro-based industries in India is sugar industry. Sugar industry is the second largest agricultural industry followed after the textile industry. It will also ensure saving in foreign exchange. Employment benefit to local communities will grow exponentially as raw material base is agriculture.

**Raw material**

The major raw material for EIDP is sugar and water. EIDP purchases sugar from the farmlands around the Cuddalore region and indirectly promotes the livelihood of farmers. Source for water is ground water and the water content in sugar cane. EIDP have good water management plan to avoid over exploitation of the ground water table. Other raw materials required to process 210000 ton/month were

- Lime/$Ca(OH)_2$ (from Local market) : 315 ton/month
- Sulphur (from government) : 210 ton/month
- Caustic soda/NaOH : 4.2 ton/month

**Anticipated Impacts during Operational Phase and Mitigation Measures**

**Air pollution**

From co-generation power plant boiler and bio gas boiler smoke is released into the air at 0.03 $kg/cm^2$ pressure through a chimney. Before emission, the flue gas is pre-treated in 3-fields Electro Static Precipitator to arrest particulate matters. However, 44 PPM of carbon particles was observed in the stack monitor (which is a minimal quantity only). The sugar dust from the centrifuge is also a pollutant and it was removed by scrubber. From condenser vent of distillery and dryer plant, non condensable vapor is let into atmosphere. Other than these exhaust from biogas flare and RO-DM degasifier tower also pollutes the air. Ambient air quality and stack emission was regularly monitored and effective control exercised, so that the stack emission load limits were met at all the time.

**Water pollution**

From the year 2013, Zero Liquid Discharge (ZLD) has been implemented at EIDP. Though the BOD and COD levels of spent wash from distilleries are very high, biogas is produced from it and the BMSW was dehydrated to ensure ZLD. Cooling water is also recycled and put into closed circuit to minimize the evaporation losses. Thus water is not polluted by EIDP. Also it has been ensured that the treated effluent quality comply with norms of MINAS (Minimal National Standards)

**Noise pollution**

Operation of EIDP does not involve any heavy duty impact type of machinery operation hence there is no contribution to noise pollution in the environment. All the rotating type machineries were well lubricated and noise was reduced. Noise generated by various heavy machineries such as turbine was ensured that the noise is

within the limit by safety department once in a week. Personal Protective Equipments (PPE) like ear muffs and plugs are provided to employees working in turbine region. It has been ensured that generated noise are within the ambient noise levels standard set by CPCB.

**Solid waste management**

The solid wastes generated in EIDP were baggase from mill, ash from co-generation plant, dried BMSW, and press mud. Baggase is used as boiler fuel and the ash generated is sold to farmers. Press mud enriched with in organic content was also sold to farmers at subsidized price. Dried BMSW enriched with potassium content was sold as K-Boost Bio-fertilizer.

Bio-fertilizers are known to play a number of vital roles in soil fertility, crop productivity and production in agriculture as they are eco-friendly. The Main advantages of bio-fertilizer are as follows.

- Increase crop yield by 20-30%
- Replace chemical Nitrogen and Phosphorous by 25%
- Stimulate plant growth
- Activate soil biologically
- Restore natural fertility
- Provide protection against drought and some soil borne diseases.

The press mud is also enriched with various nutrients, which are as follows

- Cellulose -11.4 %
- Hemi cellulose - 10.0%
- Lignin - 9.3%
- Protein - 15.5%
- Wax - 8.4%
- Sugar - 5.7%
- Sodium - 0.22%
- Remaining is mud

**Biodiversity**

As EIDP opted ZLD, no effect is expected on existing biodiversity of region. Also there is no endangered flora and fauna or rare species of plant and animals existing in the plant area.

**Socio-Economic Environment**

EIDP actively contributed to improve the socio-economic conditions of the area and also actively participated in various socio economic activities like: educational campaigns, health check-ups, training programs, awareness campaigns etc (as per the need) which laid stress on the overall development of the industry.

**Mitigation Measures**

**Air Pollution:** Adequate measures for control of fugitive dust emissions in ware house should be taken. Road surface should be provided with black toping to avoid dust emission due to transportation and all the roads

should be asphalted. Green belt should be further developed which will help in attenuating the pollutants/dust emitted by the plant.

**Water Pollution:** The present processing methods of effluent at EIDP were eco-friendly. But, the retentate from ETP and RO-DM plant is high in mineral content, thus it can be evaporated and the inorganic salt deposits can be sold as fertilizer. Sewage water generated from sanitary blocks shall be treated and used for watering the green belt.

**Noise Pollution:** Frequency of noise level inspection can be increased / automated. Turbine house can be insulated with acoustic materials. Proper maintenance, oiling and service of the plant equipments should be ensured. If green belt is further developed, plantation of dense trees across the boundary will help in reducing noise levels in the plant as a result of

**Land Pollution:** For the value addition of ash produced from the boilers, a fly ash brick unit can be started. Dried BMSW can also be used as feed for boilers.

**Green Belt Development**

Though there are some plantations around EIDP, it should be further increased. Development of green belt in and around EIDP complex should be done in 8 acres of plot to curtail the dispersion of pollutants in the surrounding areas. Height, width, foliage, surface area, density of the leaf, etc are the degree of pollution attenuation by a green belt. Various common plant species like Banyan Mango, Neem, etc. are should be planted in the green belt. On the boundary side, species like Safeda [*Eucalyptus hybrid*], Subabhul [*Leucaenea leucocephala*], Poplar [*Poplus alba*], Shatut [*Morus alba*] should be planted. Fruit trees like Mango, Jamun, Amrud, Ber, Neebu, Banana, and Papita should be in the inner sector. Also herbs and shrubs like Munj, Behaya, Bhang, Dub, and Kanas are suggested for plantation.

The main objectives of the green belt development in and around the EIDP factory will be to

- Provide a barrier to absorb sound waves and avoid noise pollution
- Act as windbreakers.
- Mitigate impact due to fugitive emissions.
- Create an aesthetic environment.
- Create a complex bio-diverse ecology.
- Restore the water balance
- Prevent soil erosion & surface run off.

**Rain Water harvesting**

The various plants of EIDP provide a large scope of rainwater collection from roof as the plant building is usually constructed with sheets and not with concrete. A large area is available unpaved at EIDP for water percolation within ground in raining season. But, EIDP is suggested to construct storm water drains in such a way so as to have rain water harvesting pits constructed in the path of storm water. This drain leads to an underground collection tank were excess storm water will be collected.
Overflow of storm water drain shall be connected to fire water tank. Excess storm water shall be filtered of dust and other foreign particulates and used for non process application.

**Odor Control**

The following measures will help in minimizing the odor.

- The spent wash storage should be restricted to 3 days capacity.
- Spent wash treatment should take place in extremely closed condition.
- Greenbelt development around the plant will help in controlling odor.

**Environmental Impact Assessment**

Legislations implemented in India related to environment conservation brought awareness to people as well as the administrators. It created the logical first step in this process of environmental impact assessment. It is the critical, represents the opportunity for the authorities concerned to consider, in their decision making, the effects of actions that are not accounted for in the normal market exchange of goods and services. Adherence to pure economic exchange theory and practice for decision making has possible adverse consequences for the proposed site at which the project is going to be implementing / implemented. The environmental impact assessment is the documentation of environmental analysis, which includes identifications, interpretations, prediction and mitigation by proposed action on project. A properly studied assessment should enable the planner to conclude whether the proposal should or should not be regarded as major action, or whether the environmental impact is or is not significant and if the action could not be environmentally controversial. Whenever it is concluded as significant environmental impact will result from a proposed action, or it may become environmental controversial, when others learn of the action a draft EIA must be prepared. The process of environmental impact analysis serves to meet the primary goal of Parliament in enacting Environmental Policy Act 1986 to establish national policy in favor of protecting and restoring the environmental. The primary purpose for preparing environmental impact assessment is to disclose the environmental consequences of a proposed action, there by alerting the agency, decision maker and the public to the environmental risk involved an important and intended consequences of this disclosure is to build in to the agency's decision making process, a continuous consciousness of environmental consideration. The spirit of the law is founded on the premises, that to utilize resources in an environmentally compatible way and to protect and enhance the environment. It is necessary to know how activities of the proposed project will affect the environment and to consider these effects early enough so that changes in plan can be made if the potential impacts warrant them.

Environmental impact assessment provides a vehicle to record impacts of activities so that knowledge of what adverse changes may occur can be collected and maintained. The purpose of inventory is to ensure discloser of the impacts on the proposed projects so that concern institutions or individuals will be aware of possible repercussions of the subject activities. Another valuable use for the inventory of impact to identify the potential cumulative effects of a group or series of activity in an area. Any single activity might not be likely to caused serious changes in the environmental but when its effects are added to those of other projects, the impacts of the environment might be severe. The potential for cumulative impacts must be identified and in some cases, this may be possible only at the intra agency level. Thus to account for cumulative impacts at a program which covers many projects or activities. A preliminary assessment will indicate the possible impact areas on which detailed data has to be collected for presenting the results of the preliminary assessment will attempt to answer the impacts on physical or health hazard, economic interest of the existing communities, impact on infrastructure, and future growth pattern in the region for next 20 years.

**Matrix method**

The major use of matrices is to indicate cause and effect by listing activities along horizontal axis and environmental parameters along the vertical axis. In this way the impacts of both individual components of projects as well as major alternatives can be compared. The simplest matrices use a single mark to show whether an impact is predicted or not. However, it is easy to increase the information level by changing the size of the mark to indicate scale. The greatest drawback of matrices is that they can only effectively illustrate primary impact.

A matrix having rows as environmental attributes or impact areas and columns having project activities is constructed. Each action having an impact on environmental attributes is given a weight or Parameter Importance Unit (PIU) viewed by experts. Weights given are on following conception ("-" sign indicates negative impact and "+" sign indicates positive impact).

**Weight 1** is given for insignificant low impact, which is not injurious to environment in case of its adverse nature.

**Weight 3** is given in case of measurable impact, which is not injurious to environment with proper planning and building in case of its adverse nature.

**Weight 7** is given in case of high impact on environment, which can be curbed by taking precautionary measures in case of its adverse nature.

**Weight 10** is given in case of very high impact on environment.

The predicted environmental impact rated on a scale of environmental scores multiplied by the corresponding weight then gives the weighted impact. All weighted impacts added together give the overall weighted impact of proposed project on environment. Negative sign in impact matrix indicates that the impact is of adverse nature. The environmental matrix is shown in the following table.

**Table 1: Environmental Impact Assessment Matrix**

| S.No | Environmental Attribute | Sugar & Refinery | Co-gen | Distillery | ETP | Dryer Plant | RO-DM Plant |
|---|---|---|---|---|---|---|---|
| 1 | Air Pollution | -3(dust) | -7 (Stack Emission) | -1 (Condenser Vent) | -3 (Biogas Flare) | -1 (Condenser Vent) | -1 (Degasser Tower) |
| 2 | Water Pollution | +7 | -- | +7 | -3 (Retentate) | +3 | -3 (Retentate) |
| 3 | Land Pollution | -- | -3(Ash) | -- | -- | +7 | -- |
| 4 | Noise Pollution | -1 | -3 (Turbine) | -1 | -1 | -1 | -- |

**Check List method**

The detailed impact analysis and form the curse of the environmental impact assessment one has to use a standard checklist format for identifying the possible impact after completion of the plant. This comprehensive and user friendly checklist is invaluable aid for several activities of EIA, particularly scoping and defining baseline studies. The check list has been prepared for non-specialist and enables much time consuming work to be carried out in advance of expert input.

It includes extensive data collection sheets. The collected data can then be used to answer a series of questions to identify major impacts and identify shortage of data. The result sheet from the checklist is reproduces in the following table.

**Table 2: EIA - Assessed Checklist Result**

| S.No | Parameter | Positive Impact very | Positive Impact | No Impact | Negative Impact | Negative Impact very | No Judgment/ Comments |
|---|---|---|---|---|---|---|---|
| 1 | Alteration of Ground Water Hydrology | No | No | Yes | No | No | -- |
| 2 | Irrigation | No | No | Yes | No | No | -- |
| 3 | Noise and Vibration | No | No | Yes | No | No | -- |
| 4 | Urbanization | Yes | -- | -- | -- | -- | -- |
| 5 | Highways | No | No | Yes | No | No | -- |
| 6 | Dams | No | No | Yes | No | No | -- |
| 7 | Surface Excavation | No | No | Yes | No | No | -- |
| 8 | Well drilling | -- | -- | Yes | -- | -- | -- |
| 9 | Farming | Yes | -- | -- | -- | -- | -- |
| 10 | Pairing | Yes | -- | -- | -- | -- | -- |
| 11 | Energy Generation | -- | Yes | -- | Yes | -- | -- |
| 12 | Erosion Control | -- | Yes | -- | -- | -- | -- |
| 13 | Ground Water Recharge | No | No | Yes | No | No | -- |
| 14 | Water Recycling | Yes | -- | -- | -- | -- | -- |
| 15 | Fertilizer Application | Yes | -- | -- | -- | -- | -- |
| 16 | Trucking | -- | -- | -- | Yes | -- | -- |
| 17 | Communication | Yes | -- | -- | -- | -- | -- |
| 18 | Landfill | No | Yes | No | No | No | -- |
| 19 | Cooling Water Discharge | Yes | -- | -- | -- | -- | -- |
| 20 | Liquid Effluent Discharge | No | Yes | No | No | No | -- |
| 21 | Stack and Exhaust Emission | No | No | No | Yes | No | -- |
| 22 | Weed Control | No | No | Yes | No | No | -- |
| 23 | Insect Control | No | No | Yes | No | No | -- |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 24 | Explosion | -- | -- | -- | Yes | -- | -- |
| 25 | Operational Failure | -- | -- | -- | Yes | -- | -- |

**Expert advice**

Expert advice should be sought for predictions, which are inherently non-numeric and is particularly suitable for estimating social and cultural impacts. It shall be preferably taken in the form of a consensus of expert opinion for example, it is necessary to find out whether there is impact on wetland or not. The reduction in the wetland productivity may result in to the fall of grain yield. As a consequence the quantity of grain required for producing alcohol shall be severally affected. In order to mitigate these problems it is very much necessary to continuously monitor the production of grain. It is also necessary to make available the other type of biomass for producing power with the use of boiler.

**Social impact assessment**

EIDP has more positive social impacts. They are listed below

**Table 3: Social Impact Assesment - Assessed Checklist Result**

| S.No | Parameter | Positive Impact very | Positive Impact | No Impact | Negative Impact | Negative Impact very | No Judgment/ Comments |
|---|---|---|---|---|---|---|---|
| 1 | Industrial Development | Yes | No | No | No | No | -- |
| 2 | Promoting livelihood of local community | Yes | No | No | No | No | -- |
| 3 | Job opportunity | Yes | No | No | No | No | -- |
| 4 | Free Medical camps | Yes | No | No | No | No | -- |
| 5 | Education | Yes | No | No | No | No | Free Tuition to school students |
| 6 | Community Infrastructure Development | Yes | No | No | No | No | Public bus shelter renovation |
| 7 | Farming Advice | Yes | No | No | No | No | Free guidance |
| 8 | Vehicular Pollution | No | No | No | Yes | No | 90% Bullock cart used for raw |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | material transport and heavy vehicles were only used for product shipping |
| 9 | Traffic | No | No | No | Yes | No | Logistics |
| 10 | Landscaping | No | No | No | Yes | No | Aesthetic Damage |
| 11 | Dust | No | No | No | Yes | No | -- |

**Cultural Impact Analysis**

As the topography of Nellikuppam does not constitute any mountain nearby, the factory does not have any impact on tribes. Moreover EIDP respects the culture of the local community and also supports its labor union to organize traditional and cultural events like “Pongal”.

**Economic Impact Analysis**

A matrix of economic evaluation technique based on the major impacts of EIDP were listed below:
**Table 4: Economic Impact Assessment Matrix**

| S.No | Environmental Factors | I | II | III | IV | V | VI | VII |
|---|---|---|---|---|---|---|---|---|
| 1 | Health and Safety | No | Yes | Yes | No | No | Yes | No |
| 2 | Ecology | No | No | No | Yes | No | Yes | Yes |
| 3 | Environmental Resources | Yes | No | Yes | Yes | No | No | Yes |
| 4 | Recreational Values | No | No | No | No | Yes | No | No |

Where, I-COP (change in productivity), II-LE (loss of earnings), III-PE (preventive expenditure and cost-effectiveness analysis), IV-RC (Replacement and relocation cost), V-TC (travel cost), VI-LVC (land value change), VII-CVM (contingent valuation methods)

**Environment Management Plan (EMP)**

EIDP has drawn an Environment Management Plan (EMP) to conserve the resources, minimize the waste generation, treatment of waste, recovery of by products and recycling of material. The post project quality monitoring to ensure preservation of environmental quality is integral part of EIDP’s EMP.

The following aspects have been covered under EMP of EIDP

- Air Pollution Control- Provision of three fields ESP in co-generation power plant boilers
- Water Pollution Control- ETP to ensure zero liquid discharge

- Water conservation- Recycling of condensate water from distillation, cogeneration and in other process.
- Noise Pollution Control- Provision of vibration isolators, acoustic enclosures.
- Environment Monitoring and Management- Planned monitoring of air, water, noise and soil parameters
- Occupational Health- Regular health check-up of the workers
- Green Belt- Tree Plantation
- Safety management- Safety measures like ear muffs, gloves, helmet, shoes, goggles, aprons to all the workers.

**Benefits of EIDP**

- Baseline environmental status, anticipated environmental impacts and mitigation measures have been prepared and included in the report to ensure that there is no damage caused by EIDP to the environment.
- EIDP promotes urbanization and improves the economic status of Cuddalore district.
- EIDP follows zero discharge policy. Thus there will not be any wastewater discharge polluting the environment.
- Recycling of water in the plant reduce the demand of fresh water.
- All the by-products produced from sugar manufacturing process were used as the raw material for production in the other plants of EIDP (Molasses in distillery process for manufacturing of Rectified spirit, Alcohol and Ethanol; Baggase for generation of Electrical Power; Distillery spent wash for Biogas; Biogas for boilers; BMSW for bio-fertilizer).
- EIDP also procures molasses from the neighboring sugar mills and processes it to alcohol thus promoting value addition.
- The go-generation power in excess of own requirement was exported to state grid, thus reducing energy crisis.
- Being agro based industry EIDP offers ready market for local sugar cane growers.
- Apart from selling their sugar to factory, farmers will get back bio compost (Dried BMSW, Press mud, Ash) from factory at subsidized cost to enhance nutrient level of their farms.
- Farmers producing other variety of grains will also find a ready and cheap market for bio-fertilizer.
- EIDP delivers its obligations under corporate social responsibility (CSR). Under CSR policy it ensures development of the surrounding village area and quality of life of local people improved.
- EIDP prefers local population for employment as well as in awarding works/contract to ensure small scale industries promotion in that area
- EIDP also helps in the improvement of local infrastructural facilities

## Conclusion

The entire process of the industry was described and its impacts on the environment were also assessed. From the study carried out at EIDP, it can be concluded that EIDP follows good environmental policy and have more positive impact on the environment. For the mitigation of the anticipated negative impact, the following measures were suggested.

- Adequate measures for control of fugitive dust emissions in ware house should be taken.
- Roads shall be asphalted to control dust emission.
- Retentate from RO-DM plants shall be evaporated for inorganic content rich bio-compost recovery.
- Sanitary block sewage water shall be treated at ETP and reused for green belt watering.
- Turbine house shall be insulated with acoustic materials.
- Machineries maintenance, service and rotating part lubrication should not be under gone only during noisy days. The frequency has to be increased.
- Physical noise level inspections shall be automated
- A fly ash brick unit shall be established for the value addition of ash produced from the boiler.
- During lack of baggase, BMSW shall also be used as boiler feed after briquetting instead of coal which leads to $So_x$ and $No_x$ emission
- Green belt and rain water harvesting systems shall be further considered for expanding.
- Spent wash treatment shall take place in extremely closed condition to control odor emission.

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