

**Appendix III: Environmental and Social Management Plan
(ESMP)**

**Khanal Poultry Farm
Ratnanagar, Chitwan**

Executive Summary: This Environmental and Social Management Plan (ESMP) has been developed for the proposed 520 m³ Continuously Stirred Tank Reactor (CSTR) biogas sub-project within Khanal Poultry Farm in order to mitigate the likely environmental impacts predicted during environmental and social screening. This sub-project is classified as “Category C”, and is predicted to pose minimum environmental/social impact and hence there is no need of conduction of further environmental or social assessment.

Some of the impacts caused by the sub-project are: health and safety issues of construction workers, increased dust level during construction phase, muck disposal, possible water sources contamination due to leakage from substrate and slurry storage, management of digested slurry, workers health during slurry handling, foul smell and increased noise level due to operation of generator. The possible mitigation measures have been proposed in this ESMP and shall be implemented by the contractor/Construction Company and developer. In addition, the monitoring as mentioned in this ESMP shall also be performed accordingly. The likely impacts not identified during screening as well as in this ESMP, if perceived during construction and/or operation phase shall also be avoided or mitigated by the Construction Company and/or developer.

1. Introduction

For implementation of the biogas sub-project, this environmental and social management plan is prepared for Khanal Poultry Farm, Ratnanagar, Chitwan. The poultry farm is going to establish a

520 m³ CSTR biogas plant within poultry farm premise. The sub-project is supported by AEPC/SREP.

2. Description of Subproject and Location

The sub-project lies in Ratnanagar, Chitwan district and is lies in Terai plain. The subproject is proposed to be constructed within the poultry farm. The distance to the nearest market, Ratnanagar, Tandi, is approximately 5.4 km from the sub-project site. The preferred biogas technology is Continuous Stirred Tank Reactor (CSTR) and the main constituents/facilities of the biogas plant will be inlet with grit removal system, digester with mixing and temperature control system, biogas storage balloon, H₂S and moisture removal, generator with control panel and digested slurry handling system using screw press.

The GPS location of the sub-project site is:

Latitude	27°37'47.97"N
Longitude	84°32'53.30"E
Altitude	207 m

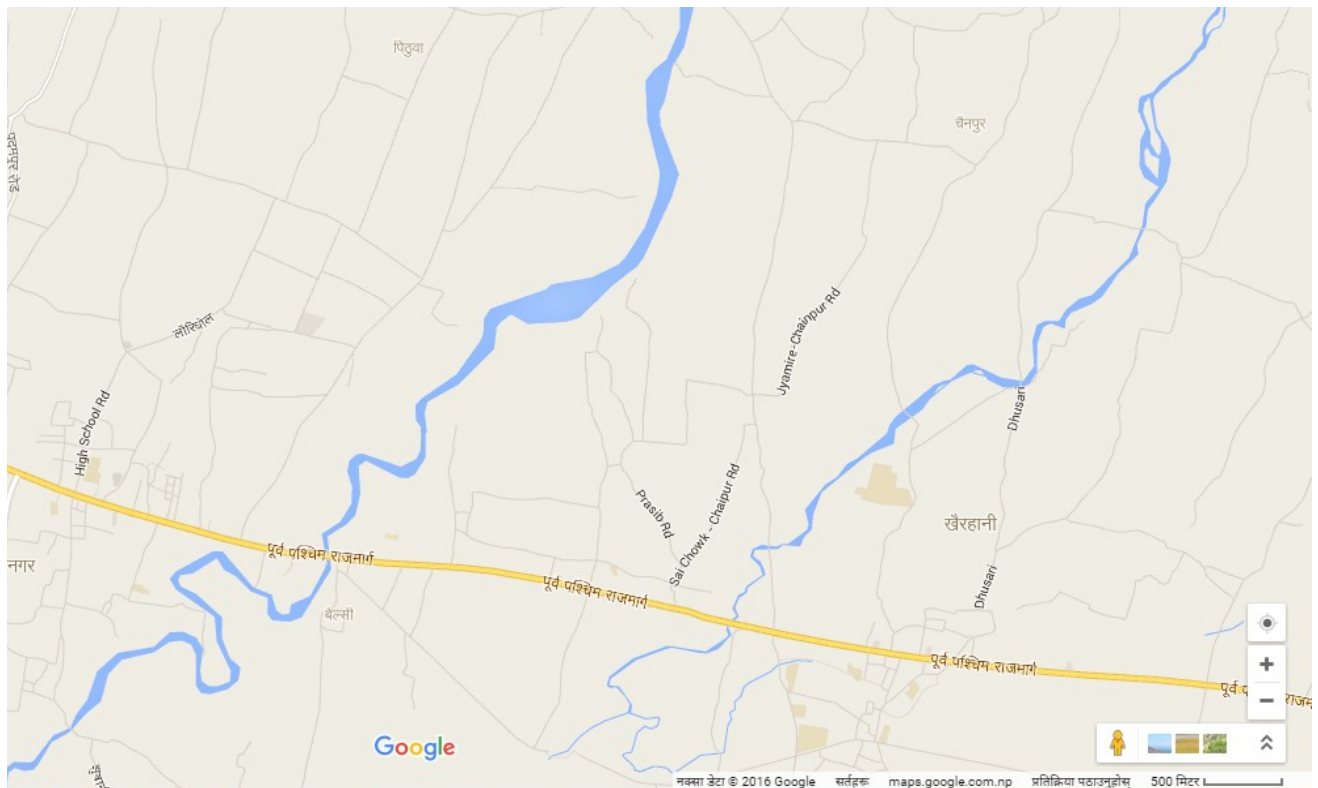


Figure: Location Map (Chitwan District)

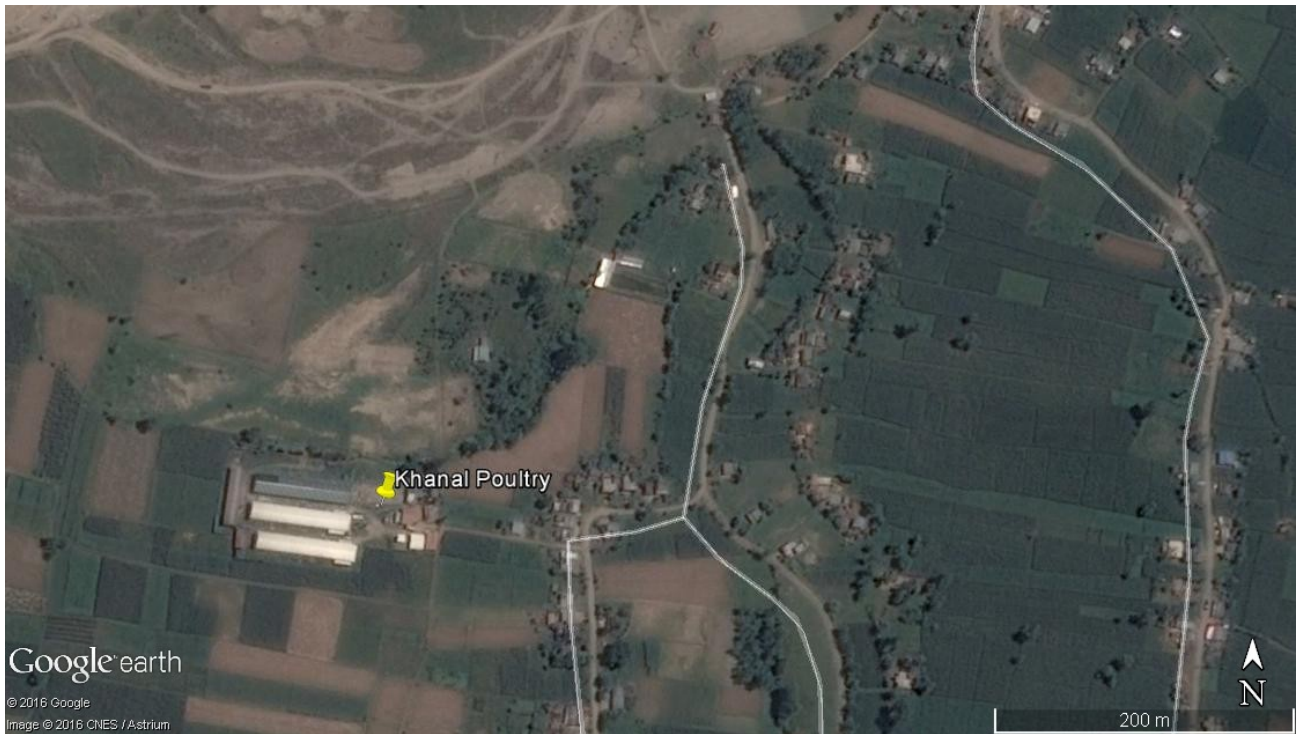
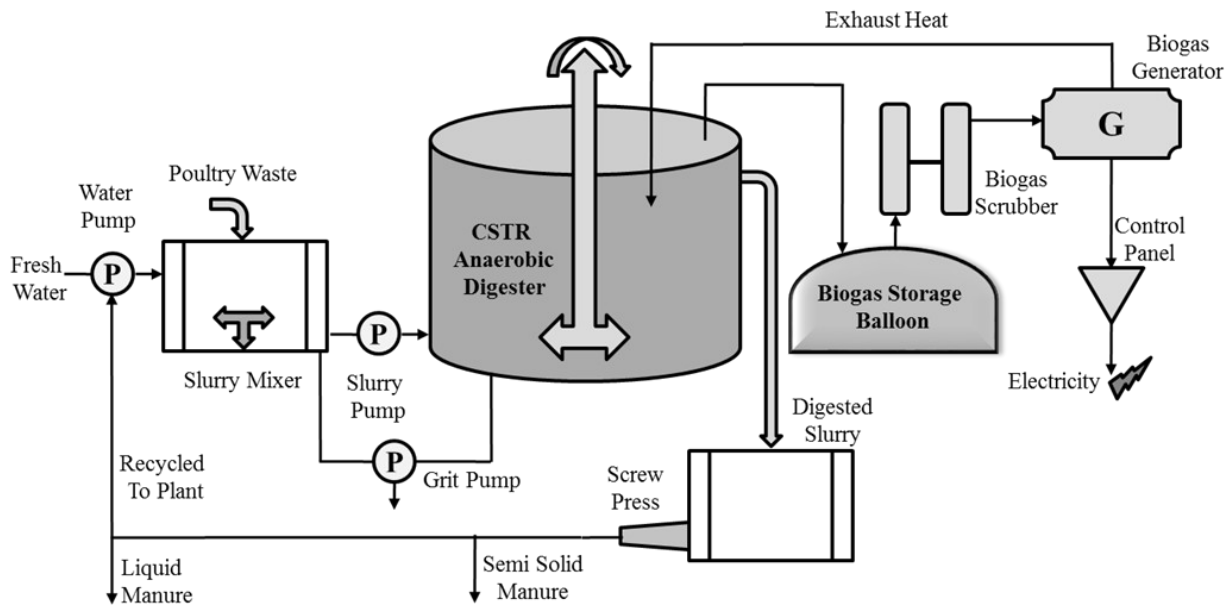


Figure: Google Map of proposed sub-project site

A capacity of 520 m³ biogas plant is proposed to install in Khanal Poultry Farm. The gas produced by the plant will be 197.8 m³ per day. The plant will produce 9455 kg of total digested slurry per day from which water content will be separated using screw press. This will produce a total of 936kg of dry manure (with 50% DS) and a total of 8.5 m³ of water with DS less than 3% per day.

The major works that will be carried out during construction are excavation of earthwork for sump and grit chamber, brick lining, and reinforcement, cement aggregate works and installation of digester as well as other facilities. Once after the construction completion, the poultry waste of about 2.8 tons/day will be fed into the digester. Once after gas production starts, AEPC will perform testing and commissioning and verify the amount of gas production as specified in DFS. The gas produced from the subproject shall be used for electrification purpose only. A total of 326.4 kWhr electricity will be generated and a 100% biogas generator with capacity 31.25 (~32) kVa (25 kW) will be used for generation of electricity.

The flow diagram of the proposed sub-project is provided below:



Process Flow Diagram of Biogas Power Plant

3. Relevancy of preparing ESMP

This Environmental and Social Management Plan (ESMP) has been done for the proposed sub-project in order to mitigate the likely environmental impacts predicted during environmental and social screening. Any land acquisition or displacement of inhabitations will not be involved in this sub-project. The significant negative impacts are not predicted since the sub-project itself reduces wastes and converts into useful renewable energy. However, negligible impacts identified and might prevail during construction and operation phase. This sub-project is classified as **“Category C”**, with minimum environmental/social impacts and hence there is no need of conduction of further environmental or social assessment. This Environmental and Social Management Plan has been prepared in order to reduce thus identified adverse impacts prior to sub project implementation.

4. Environmental and Social Baseline

Topographically, the sub-project site lies in the Terai region of Nepal. The meteorological data from 2008 to 2010 indicated that the region (Chitwan) has a mean annual temperature is about 25°C. The total annual rainfall received by the station in 2010 was 2210 mm with maximum 24hr rainfall as 165 mm. The land-use pattern of the project area indicates of more agricultural land and less settlement.

Kayar Khola, small tributary of Narayani River flows some 480m west from the sub-project area. There is no any forest area within periphery of 3 km from sub-project; however, Chitwan National Park is situated in about 10 km south of the sub-project within a district. In the northern part of the subproject location, there exists sparse vegetation with scattered trees in flood plain of Kayar Khola.

The sub-project location is dominated by Brahman-hill, Chhetri and Tharu. There are about 25 households within 100m east of the subproject location and is dominated by Brahman and Chhetri. Most of this community depends in agriculture followed by business and service. In general, the settlement pattern is sparse and concentrated within road alignment. However, the landuse pattern of the subproject vicinity can be characterized as agricultural land. An all weather gravel road exists to reach the sub-project location from East West Highway at Jyamire.

5. Environmental and Social Impacts

During feasibility study of Khanal Poultry Farm, considering environmental and social screening performed, it is not predicted to have significant negative environmental and social impacts.

The beneficial impact in environment is conversion of waste into biogas energy and dry slurry. Socially the sub-project will demonstrate the renewable energy project in the locality.

5.1 Beneficial impact

Considering benefit to the community, there seems no any direct advantage however, management of the waste obviously reduce nuisance to nearby locality. Whereas, from the owner's view, the sub-project will manage poultry waste and provide renewable energy to the poultry farm. The dumping of poultry including all biodegradable substances releases methane due to lack of air circulation, while, the biogas technology utilizes biogas (methane) as energy source and reduces green house gas emission (GHG). The technology is environment friendly and reduces consumption of diesel for electricity generation during load shedding time.

5.2 Adverse impact

There will be no any significant adverse impact to the surrounding community and environment. However, during construction and operation phase, minor impacts have been predicted and provided as below:

Construction phase

- **Worker health from dust inhalation during excavation and construction work:** The excavation work for construction of sump/conical mixing tank and grit chamber, dilution water storage tank and digester slurry discharge pit shall be done and as a result, there would be chance of dust inhalation to workers. There will be about 20 skilled and semi skilled man power. In this regard, the envisaged impact would be site specific, low in magnitude and short term in duration.

- **Haphazard disposal of excavated material and associated impact of sedimentation in nearby agricultural land and river (Kayar Khola):** There would be about 40m³ of spoil from excavation work for sump, mixing and dilution water storage tank and slurry discharge pit. If the excavated earth material is left over haphazardly, it would cause sedimentation in nearby agricultural field. The sedimentation of excavated material in the river could cause turbidity and thereby impact aquatic lives. However, the impact is assessed as site specific, low in magnitude and short term in duration..
- **Increased noise due to construction activity:** During construction work, there will be use of various machineries, excavators and operation of generators. In this regard, the construction workers might be exposed to high noise level (>70 DB). The envisaged impact is site specific because, the noise generation source is concentrated in construction site and decreases with distance, low in magnitude, short term in duration and will be ended up once after construction completes.
- **Construction related accidents (health and safety issue):** There are several processes which will be involved in the site during its construction. Excavation work, use of machineries, excavators etc which could lead accidents and even fatality in extreme case. However, this impact shall be considered as exceptional, if the construction work flow follows safety precautions. The main receptor for this kind of impact are construction workers and the envisaged impact is assessed as site specific, low in magnitude and short term in duration

Operation Phase

- **Ground water pollution due to leakage of slurry liquid:** The substrate as well as post digestate slurry would largely have higher BOD, and may also contain pathogens. In this regard, if the feed mixture tank, digester itself and slurry discharge tank are not properly constructed, the slurry can be leached and can reach to ground water. The envisaged impact is assessed site specific and long term in duration. The biogas operators, workers within farm and nearby community who depend on ground water are the main receptors for this kind of impact. The community are residing about 100m distance from subproject site and hence can be considered as low in magnitude.
- **Infection of pathogens during slurry handling:** There exists variety of pathogens including *Salmonella* in poultry manure but the anaerobic condition inside digester, retention time and temperature would reduce such pathogens. However, complete eradication is not expected. In this regard, while handling slurry without using proper protective measures like gloves and masks, it could lead to infection to workers or operators. In this regard, this impact is considered as site specific, low in magnitude, long term in duration.

The avian influenza or bird flu is first noted in Nepal in 2009 and is reported intermittently. The outbreak of avian influenza can significantly affect the workers as well as can spread to the communities as well. Poultry wastes also contain such viruses during outbreaks and can lead to serious impact to workforce handling slurry as well as wastes. However such outbreak is uncommon.

- **Foul smell due to slurry around surrounding community:** Decomposition of biodegradable substances in storage area or in open area cause foul smell. The anaerobic digestion can be taken as one of means to reduce foul odour. However, the undigested slurry could cause foul odour and might be nuisance to workers as well as nearby community. Considering anaerobic digestion of waste inside closed digester and the distance between the

subproject location and nearby community, the impact is considered as site specific, low in magnitude, long term in duration.

- **Accidents associated with firing and explosion:** Biogas or methane is combustible gas and a naked flame can easily catch and fire if there is gas leakage. Such fire event or accident can cause loss of life and property. The envisaged impact is characterized as site specific, moderate in magnitude considering nature of impact and, long term in duration.
- **Spreading of disease due to increased disease vectors, flies, mosquitoes etc:** The storage and processing of waste can promote growth of disease vectors such as flies, mosquitoes, rodents etc. The result could be spreading of disease to workers and in some case, communities too. The impact is assessed as site specific, low in magnitude and long term in duration
- **Aesthetic degradation and river water pollution due to haphazard disposal and mismanagement of digested slurry:** The haphazard disposal of digested slurry in nearby area of subproject location would be unpleasant. The moist dampen surrounding not only degrade the aesthetic beauty but also can promote disease vectors. In addition, as the subproject site is located nearby to river within distance of 480m, during rainy season, the left out digested slurry could even reach to river and can cause increased BOD affecting aquatic lives. In this regard, this impact is characterized as site specific, low in magnitude and long term in duration.
- **Waste from the grit pump outlet:** Especially in poultry based biogas plants, the grit or stone found in poultry manure can deposit inside digester. It depends on how much grit supplement provided to the poultry. To prevent this, in CSTR model as proposed in this subproject, it is allowed to settle such calcium compound or grit separate grit chamber. The periodic removal of such grit shall be discarded in designated place. However the impact such disposal is only limited to deposition of grit where it is disposed. Hence, the impact caused is characterized as site specific, low in magnitude and long term in duration.
- **Noise from operation of generator:** The operation of generator can increase surround noise level greater than 70dB and can even reach above 100 dB if there is no any enclose or silencer system as found in new generators. Hearing loss and stress as a result of occupational exposure of noise is one of the most common work related illnesses. However the health impact directly related to the noise level as well as duration of exposure. The impact associated with noise from operation of generator is assessed as site specific, low in magnitude and long term in duration.

6. Mitigation Measures

The environmental mitigation measures with their time of action and responsibility are illustrated in the following matrix:

Regarding alternatives, there are different ways of management of digested slurry like composting, screw press for producing dry manure instantly, disposal of post digested without using it as manure etc. In this sub-project, a screw press technology is proposed for producing dry manure instantly. Regarding timing, this ESMP prescribed to precede construction work only on 8:00 am to 6:00pm. While talking about technology itself, the developer has selected Continuously Stirred Tank Reactor (CSTR) with heating from wide range of technologies like modified GGC 2047, floating drum type mode, up-flow sludge blanket etc., for assuring efficiency of conversion of biogas from bio-waste.

ENVIROMENTAL & SOCIAL MITIGATION MEASURES

Environmental Impact	Mitigating Measure	Cost of Mitigation (If Substantial)	Responsibility	Time of Action
Construction Phase				
Worker health from dust inhalation	Workers will be required to wear filter masks and eye protection	Minor	Construction contractor	Water Sump, Grit chamber, Outlet and manhole construction activities begin
	Dusty areas (construction site) will be sprayed with water, particularly during hot, windy weather	Minor		
Haphazard disposal of excavated material and associated impact of sedimentation in nearby area (agricultural land)	The waste material will be used for filling up a nearby pit or low land, the useful stone will be used in construction purpose the waste will be disposed safely.	-	Construction contractor	After excavation
Increased Noise	Work will be conducted from 8:00 AM-6:00 PM. If additional times are needed, local residents will be informed at least one week in advance and will be done in consultation with locals	-	Construction contractor	Construction Phase
Construction related accidents (Health and safety issue)	Arrangement of First Aid kit in the work site.	Minor	Construction Contractor	Construction Phase
Operation Phase				
Ground water pollution due to leakage of slurry liquid	Digester, Sump, dry and liquid slurry chamber will be water tight and sealed	Already included in construction cost	Contractor	construction phase
possibility of contamination of drinking water pipes due to the surface				

Environmental Impact	Mitigating Measure	Cost of Mitigation (If Substantial)	Responsibility	Time of Action
and subsurface flow of slurry liquid				
Impact on health during Slurry handling (pathogenic)	Workers will be required to provide personal protective equipments (PPEs) like appropriate clothes, gloves and masks	Minor	Developer	During operation phase
	Regarding avian influenza or bird flu, measures shall be taken for prevention, control and quarantine procedure to mitigate threat in accordance with the Nepal Government' standard procedure.	Operational cost of farm	Developer	During operation phase
Foul smell due to slurry around surrounding community, during extreme temperature and windy day.	Covering of substrate/waste if required to be stored.	Minor	Developer	During operation phase
	Appropriate feeding practice with prescribed quantity	-	Developer	During operation phase
	Maintain greenery around sub-project vicinity as windbreak.	Minor		Before operation phase
Accident associated with firing and explosion	As methane is combustible gas, naked flames shall be avoided strictly near digester area. Care shall be taken during use of biogas.	Minor	Developer	During operation phase
	Provision of fire extinguishers	Minor	Developer	Before operation phase
Disease vectors, flies and mosquito breeding, due to slurry	Avoiding waste water trench/ditch s near sub-project area	Minor	Developer	During operation phase
Aesthetic degradation and river water pollution due to haphazard	Provision of screw press facility for drying slurry and separate liquid slurry (dry slurry will be sold out)	Already included in construction cost	Developer	During construction phase

Environmental Impact	Mitigating Measure	Cost of Mitigation (If Substantial)	Responsibility	Time of Action
disposal and mismanagement of digested slurry	Liquid slurry shall be reused for dilution requirement (remaining liquid slurry will be sold out)	-	Developer	During operation phase
Waste from the grit pump outlet	Disposal of grit waste in designated place	Minor	Developer	Operation phase
Noise from operation of generator	Provision of generator shed for dampening noise	Already included in construction cost	Developer	Prior to operation phase

ENVIRONMENTAL AND SOCIAL MONITORING PLAN

S.N.	Indicators	Methods	Frequency/ Time	Location	Responsibility	Monitoring Cost (NRs.)
1.0 Construction Phase						
1.1	Provision of personal protective measures to workers	Direct Observation/ Records	Once before construction starts	Construction site	Developer	-
1.2	Spraying of water in possible dusty areas within construction areas	Direct Observation/ Records	During construction period	Construction site	Developer	-
1.3	Excavated waste/muck used for filling nearby lowlands/ disposed in designated place	Direct Observation/ Records	During construction period	Designated area for disposal	Developer	-
1.4	Compliance of construction activities performed only in designated time (8:00 to 6:00)	Direct Observation/ Records/ interview with nearby community	During construction period	Construction site	Developer	-
1.5	Provision of First Aid Kits to construction workers	Direct Observation/ Records	Once before construction starts	Construction site	Developer	-
2.0 Operation Phase						
1.1	Proper sealing and water tight while constructing digester sump dry and liquid slurry chamber	Construction details; records	Once after construction phase	Construction Site	Developer	-
1.2	Provision of personal protective equipments to workers and operators	Direct observation; records	During Operation phase	Project site	Developer	-
1.3	Covering of substrate/waste if required while storing	Direct observation	During Operation phase	Project site	Developer	-

S.N.	Indicators	Methods	Frequency/ Time	Location	Responsibility	Monitoring Cost (NRs.)
	Appropriate feeding practice Greenery maintained	Interview with operator Visual observation	During Operation phase During Operation phase	Project site Project site	Developer Developer	- -
1.4	Provision of screw press facility for drying slurry	Construction record/visual observation	Before operation stage	Project site	Developer	-
	Reuse of liquid slurry for dilution	visual observation/ interview with operator	During operation phase	Project site	Developer	-
1.5	Disposal of grit waste in designated place	visual observation	During operation phase	Project site	Developer	-
1.6	Provision of generator shed for dampening noise	visual observation	Once before operating phase	Project site; generator location	Developer	-

Mitigation and Monitoring Cost: Most of the mitigation measures are part of the overall project facility and hence included in the construction cost. In case of monitoring, the responsibility is assigned to developer/Developer, and will incur minor cost.

7. Conclusion

The above mentioned mitigation measures shall strictly be implemented by the responsible individuals as mentioned in this ESMP. In addition, the monitoring as mentioned in this ESMP shall also be performed accordingly. The mitigation costs marked as “already included in construction cost” in mitigation matrix shall be reflected in construction bid document. The likely impacts not identified during screening as well as in this ESMP, if perceived during construction and/or operation phase shall also be avoided or mitigated by the Construction Company and/or developer.