

## Appendix C: Environmental and Social Management Plan of KK Livestock and Agriculture Research Centre

### Executive Summary

This Environmental and Social Management Plan (ESMP) has been developed for proposed large biogas construction and operation at K.K Livestock and Agriculture Research Center located at Dharan-26, Sunsari in order to mitigate the likely environmental impacts predicated during Environmental Screening. The screening process indicated that the sub-project intervention will not require any land acquisition as well as displacement of inhabitants. Similarly, as the sub-project itself reduces wastes and use of waste in order to produce energy, the significant negative impacts are not envisaged. However, the screening process indicated negligible impacts during construction and operation phase. The overall impact caused by the sub project intervention was classified as "Category C" with minimal environmental impact and hence there is no need of conduction of further environmental or social assessment. Nevertheless, in order to reduce or mitigate thus adverse impacts, "Environmental and Social Management Plan (ESMP)" was recommended to prepare prior to sub project implementation.

Some of the impacts caused by the sub-project are: health and safety issues of construction workers, possible ground water contamination due to leakage from substrate and slurry storage, 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.

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## **Introduction**

K.K livestock and Agriculture Research Center was established on the year of 2013 A.D. The farm is situated at Dharan Submetropolitan-26, Bishhnupaduka. The farm has altogether 100 cows, 60 pits and 106 goats. The total land area of the farm is 8 Bigha. From available 1771 kg of various substrates (cow dung and pig manure). The detailed feasibility study recommends construction of 200m<sup>3</sup> biogas plant. The proposed design technology is floating drum model biogas plant. Thus, generated biogas is proposed to be used in the form of electricity and cooking gas. The sub project is under evaluation for AEPC/SREP support.

## **Description of Subproject and Location**

The sub project is located at Dharan-26, Bishnupaduka of Sunsari district. The coordinate of the sub project site is 26°50'19.3"N & 087°14'34.3"E and at the elevation of 569m. Figure 1 illustrates the location and Figure 2 illustrates the Google Earth Map of sub project intervention.

The landuse of the sub-project vicinity is moderately dominated by agriculture land with sparse settlement



Figure 1: Sub project location map

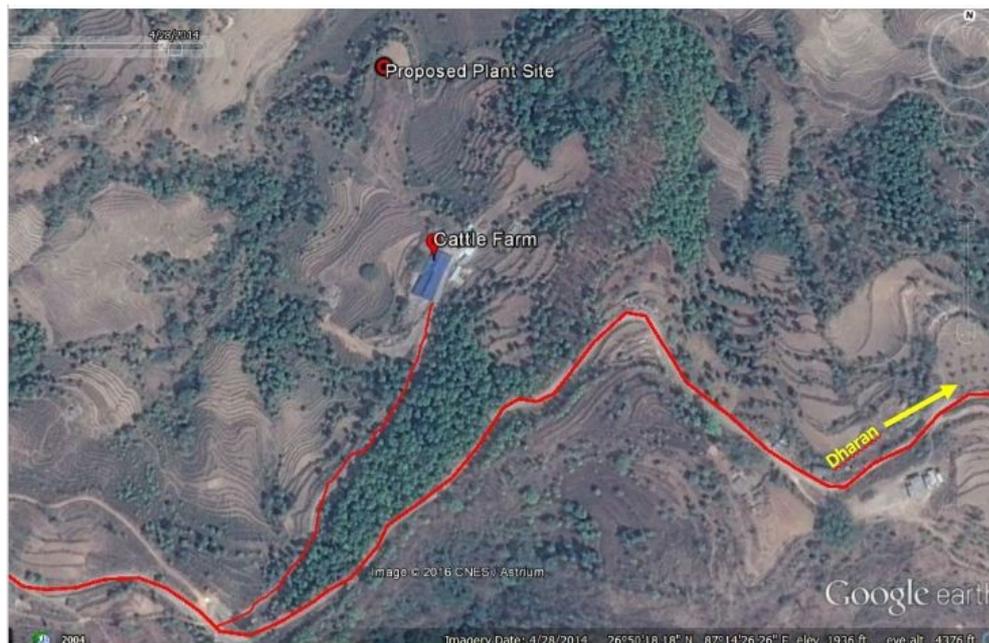


Figure 2 Google Earth Map: 26°50'19.3"N & 087°14'34.3"E

The proposed plant is 200 m<sup>3</sup> single unit floating dome digester (161 m<sup>3</sup> digester and 39m<sup>3</sup> gas storage) with 53.2 m<sup>3</sup> of biogas production per day. The generated biogas will be used primarily (95%) for electricity generation and remaining (5%) for cooking. 15 kVA biogas generator will generate maximum of 88 Kwh of electrical output each day. The 24 hour base load of the sub-project is 3.67 kW. 2.66 m<sup>3</sup> of biogas will be used for cooking in 14 worker's working within farm premises.

The major works that will be carried out during construction are excavation of earthwork for digester, cement aggregate works and installation of steel dome as gas storage. A generator will be installed in order to generate electricity from biogas. Once after the construction completion, 1327.5 kg of cow dung and pig manure along with 1600 litres of dilution water will be fed into the digester daily. A total of 3045 litres liquid slurry will be generated each day which will be dried to generate about 250 kg of dry manure in each day with the help of **dewatering unit**. The separated liquid slurry from dewatering unit is proposed to store in a enclosed pit and it will further use as a liquid fertilizer in the fodder plantation area within farm.

The schematic diagram and technology details of the biogas plant and dewatering unit are provided below:

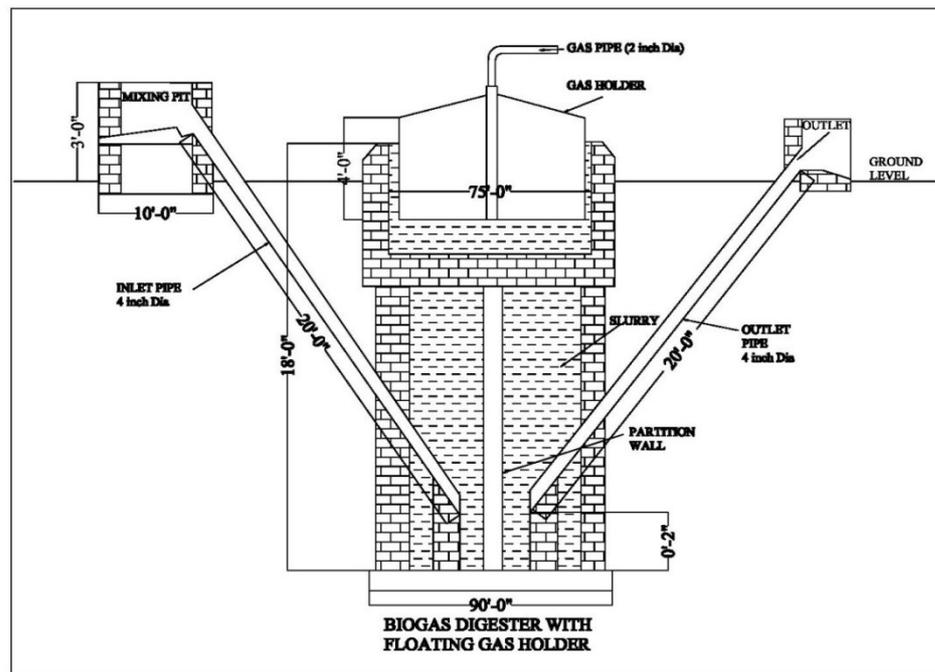


Figure 3: Schematic Design of the proposed biogas technology

The figure 3 shows the schematic diagram of floating drum biogas plant. Floating-drum plants consist of an underground digester (cylindrical or dome-shaped) and a moving gas-holder. The gas-holder floats directly on the water jacket. The gas is collected in the gas drum, which rises or moves down, according to the amount of gas stored. The gas drum is prevented from tilting by a guiding frame. When biogas is produced, the drum moves up and when it is consumed, the drum goes down.

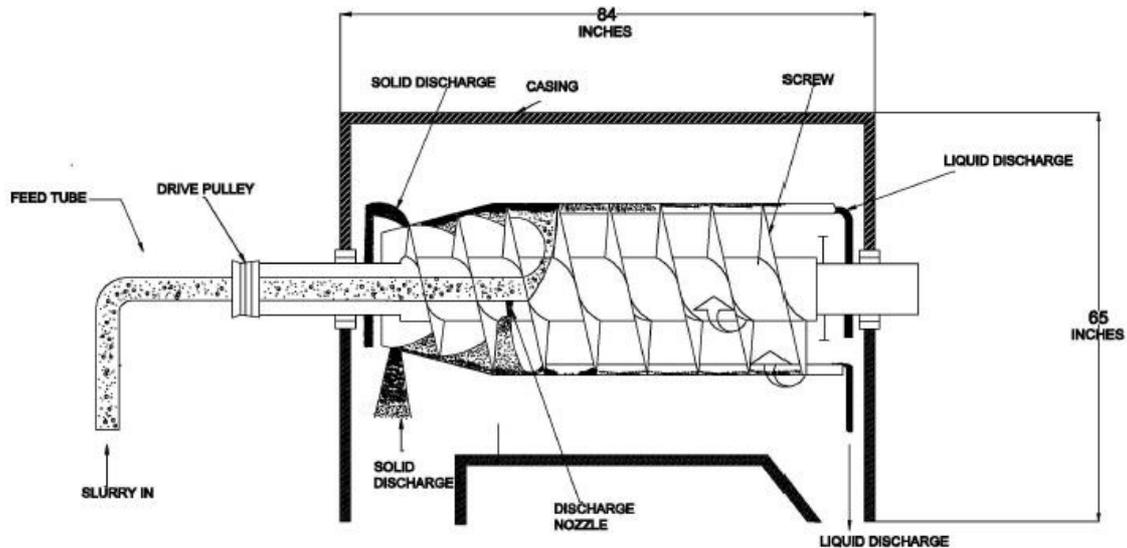


Figure 4: Schematic Diagram of Dewatering System

The figure 4 shows the schematic diagram of dewatering system. A screw based dewatering system will be installed to separate dry and wet slurry. The slurry which comes out from the Biogas tank is fed into the dewatering plant. It separates the slurry and water from the manure. The solid manure is discharged separately while the slurry water is dispensed from a different tube. The solid manure is highly efficient & natural nitrogen rich. It is odour less and since processed in a closed environment it retains the maximum organic values with composition of 30% of moisture. The solid manure will be directly loaded in sacks and store in the closed shed until it is sold as an organic fertilizer to the local market.

The slurry water still contains organic values. So, the water will be stored in an enclosed pit system. It will be further used as a fertilizer within the farm to grow high quality grass for cows. Alternatively, it can also be used to recharge the ground water through water recharge pits.

### 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**

The sub-project location is situated in the hilly region of Nepal. The topography is steep with altitude of about 569 m above sea level. There is no any governmentally declared protected areas or any forest area within the 3 km radius from the sub-project site however there are sparse vegetation under private belongings. Regarding the climatic condition, as it is situated in mid hill region, sub-tropical to temperate climate with hot summer and cold winter prevails in the sub-project area. The land use pattern of proposed sub project is fallow land within farm premise. In addition, most of the total land area owned by the developer is used for fodder plantation.

The developer owns 10,015.85 m<sup>2</sup> whereas the proposed plant will cover 677.26 m<sup>2</sup>. The plant is proposed nearly at the centre of the owned land. Neighbouring settlement is sparsely settled with 8-10 households and more than 250 meter away from the proposed site hence there is no significant negative affect to settlement. The sub-project location is dominated by, Braman, Chettri and Limbu community. Land is mostly used for production and cultivation of grass for livestock. The area is surrounded by sparsely vegetated area. An all weather gravel road exists exits from K.K farm to Dharan Bazaar which is around 11 km.

In addition, there is a small stream which flows from north to south direction and lies about 150 m east form the plant site. Another seasonal river named Kokaha Khola which meets Koshi flows some 200m north of the subproject location. There is a religious spot named Bishnupaduka which is situated some 3 km north east from the subproject location. Besides, there are no other water resources, public and private buildings that will be directly affected by the plant. Regarding water availability within farm, the ground water (well) is present within the farm premise.

## **5 Environmental and Social Impacts**

During feasibility study, considering environmental and social screening performed, it is not predicted to have significant negative environmental and social impacts. The beneficial impact in environment is management of waste within farm and conversion of organic waste into biogas energy and dry slurry. Socially the sub-project will demonstrate the renewable energy sub-project in the locality.

### **5.1 Beneficial Impacts**

Considering the benefit to the nearby community, there seems no any direct advantage to nearby population however; management of the organic waste within the farm obviously reduces the foul odour which is the nuisance to nearby locality. During construction phase, there would be few numbers of employment opportunities. Nevertheless, the project will be present itself as a show case waste to energy subproject.

### **5.2 GHG emission reduction from subproject implementation**

Cow manure is an organic waste and during storage of manure, significant quantity of methane is released to the atmosphere due to establishment of anaerobic condition within the dump. Methane is highly potent greenhouse gas than CO<sub>2</sub> with global warming

potential 28- 36 over 100 years time period. The installation of biogas plant will directly reduce the emissions of methane gas from cattle manure. In addition, the biogas will also replace fossil fuels such as LPG and diesel that is being consumed in the farm thereby further contributing in greenhouse gas reduction. 20.66 t CO<sub>2</sub> e from replacing diesel fuel to generate electricity and 1.93 t CO<sub>2</sub> e from replacing LPG giving at total of about 22.59 t CO<sub>2</sub> e of GHGs shall be reduced from the implementation of the sub-project annually.

### **5.3 Adverse Impacts**

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

### *Construction Phase*

- **Construction related accidents:** There are several processes which will be involved in the site during its construction. Excavation work, use of machineries, welding etc which could lead accidents, but would be exceptional. It is projected that some 15 skilled and unskilled human resources will be involved in construction process. *The impact is envisaged as site specific, low in magnitude, short term in duration, and construction workers as receptor.*
- **Respiratory problems due to dusty environment:** During construction phase, there will be regular vehicle movements for transportation of construction materials which can generate large volume of dust from gravel road. The dusty environment can directly affect the health of construction workers.. *However, the impact is envisaged to be a low in magnitude, short term duration and construction workers as receptor.*
- **Increased noise due to construction activity:** The noise will be created due to vehicular movement and construction activities such as loading and unloading of construction materials and activities such as drilling and welding at site. This will mainly affect construction workers. *The impact will remain for short duration i.e. construction period only and magnitude is projected to be low.*

### *Operation Phase*

- **Health and safety issue due to haphazard disposal and mismanagement of digested slurry:** 3,045 litres liquid slurry will be generated each day from the plant. If the slurry is not well managed, this can result vector borne diseases. This can affect farm workers as well as local resident living in near vicinity. *The impact can be area specific, with moderate magnitude and for long term duration. Farm workers and community as receptors.*
- **Foul odour from substrate storage area:** If not properly managed, the slurry can generate foul odours which can be nuisance to farm workers (14 workers) . As there is very sparse settlement and is far away from subproject location, this impact would not be affect community. *The magnitude is expected to be low, short term in duration and farm workers as the main receptor.*
- **Ground water pollution due to seepage and leakage from substrate storing area, digester and slurry storage yard:** The seepage of water from manure and slurry can pollute ground water decreasing its quality. *The magnitude can be moderate with long term impact and local residents as the main receptor.*
- **Occupational health and safety issues including accidents associated with firing and explosion:** The biogas is highly flammable. The open firing or electrical shorts can cause huge fire and explosion. Also, many mechanical and electrical devices such as generators, tractors, pumps will be in use during the operation which could lead to fire or accidents. As the subproject area is sparsely vegetaged, the accidental fire can spread over broad area. *The impact is envisaged as site specific, moderate in magnitude, occasional but the risk is long term in duration, farm workers as receptor.*

- **Noise from operation of generators:** Generators will be used for electricity generation. It can generate loud noise and can be nuisance to farm workers residing within farm. *The impact is envisaged as site specific, low in magnitude, long term in duration, farm workers as receptor.*

## 6 Mitigation Measures

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

Regarding alternatives, the developer has selected floating drum model from wide range of technologies like modified GGC 2047, floating drum type mode, up-flow sludge blanket, CSTR etc. which will have greater conversion efficiency than existing native technology with moderate cost. 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 dewatering unit is proposed for producing dry manure from liquid slurry. Regarding timing, this ESMP prescribed to precede construction work only on 9:00 am to 6:00pm.

*Environmental and Social Mitigation Plan*

S.N	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility
<b>1.0 Construction Phase</b>					
1.1	Construction related accidents	The construction premises shall be barricaded by rope or wire	During construction phase	-	Construction Company
		Provision of personal protective equipments (PPEs) like helmets, boots, gloves, etc for construction workers	During construction phase	-	Construction Company
		Provision of First Aid Kits at construction site	During construction phase	Minor	Construction Company/ Sub-project Developer
1.2	Respiratory problem due to dusty environment/vehicular emission in construction site	Spraying of water during excavation and vehicular use to reduce dust re-suspension	During construction phase	-	Construction Company/ Sub-project Developer
1.3	Increased noise due to construction activity	Work will be conducted from 9:00 AM- 6:00 PM. If additional times are needed, local residents will be informed prior to do so.	During construction phase	-	Construction Company/ Sub-project Developer
<b>2.0 Operation Phase</b>					
S.N	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility

S.N	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility
	Health and safety issue due to haphazard disposal and mismanagement of digested slurry	Installation of dewatering system to separate dry and wet slurry	During operation phase	Provisioned in construction cost	Construction Company
2.1		Use of separate pit with cover for slurry storage and composting in closed yard	During operation phase	=	Sub-project Developer
		Use of personal protective equipments during slurry handling process	During operation phase	10,000	Sub-project Developer
		Self use of 20% composting slurry for fertilizer	During operation phase	-	Sub-project Developer
2.2	Foul Odour from substrate storage area	Avoid storing substrate as far as possible	During Operation phase	-	Sub-project Developer
		Covering of substrate by a polythene sheet, in case of storage of substrate required	During Operation phase	10,000	Sub-project Developer
		Storage of dry manure/compost and wet slurry in designated area	During Operation phase	-	Sub-project Developer
2.3	Ground water pollution due to seepage and leakage from substrate storing area, digester facility for producing dry manure	Proper sealing of base of storage area as well as digester and outlet/dewatering unit/manure storage area with sealing material or concrete casting	During construction phase	Included in construction cost	Construction Company/Sub-project Developer
2.4	Spreading of diseases due to increased disease vectors, flies,	Avoid storing substrate as far as possible	During Operation phase	-	Sub-project Developer

S.N	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility
	mosquitoes etc	Covering of substrate by a polythene sheet, in case of storage of substrate required	During Operation phase	-	Sub-project Developer
		Storage of compost and wet slurry pit in closed yard/structure	During Operation phase	-	Sub-project Developer
2.5	Occupational health and safety issues including accidents associated with firing and explosion	Strictly avoid naked flames near digester	During operation phase	-	Sub-project Developer
		Awareness building of workers on safety practices	During operation phase	-	Sub-project Developer
		Installation of fire extinguisher close to digester	During Construction Phase	12000	Sub-project Developer
2.6	Noise from operation of generators	Use of enclosure shed for generator	During operation phase	-	Sub-project Developer

## Monitoring

It is also necessary to monitor to ascertain implementation of mitigation measures mentioned as well as to perform impact monitoring to figure out the impacts of the project. The monitoring plan is provided in the table below.

### *Environmental and Social Monitoring Plan*

S.N.	Indicators	Methods	Frequency/Time	Place	Monitoring Authority	Monitoring Cost (NRs.)
<i>1.1 Construction Phase</i>						
1.1.1	The construction premises shall be barricaded by rope or wire	Direct Observation	During construction	Project Site	Sub-project Developer	-
1.1.2	Provision of personal protective equipments (PPEs) like helmets, boots, gloves, etc for construction workers	Direct Observation	During construction	Project Site	Sub-project Developer	-
1.1.3	Provision of First Aid Kits at construction site	Direct Observation	Once prior to start of construction	Project Site	Sub-project Developer	-
1.1.4	Spraying of water reduce dust re-suspension	Records/Photo graphs	During construction	Project Site	Sub-project Developer	-
1.1.5	Compliance of construction activities performed only in designated time (9:00 AM to 6:00 PM)	Interview with locals	During construction	Project Site	Sub-project Developer	-

<i>1.2 Operation Phase</i>						
1.2.1	Provision of dewatering system	Direct Observation/P hotographs/re cords	During construction			
1.2.2	Provision of personal protective equipments (PPEs) during operation	Direct Observation/p hotographs	Once prior to operation	Project Site	Sub-project Developer	-
1.2.3	Avoid storing substrate as far as possible	Direct observation	Bi-weekly	Project Site	Sub-project Developer	-
1.2.4	Cover substrate by a polythene sheet, in case of storage of substrate	Direct observation	Bi-weekly	Project Site	Sub-project Developer	-
1.2.5	Proper sealing of base of storage area as well as digester and outlet/dewatering unit/ manure storage area with sealing material or concrete casting	Record of specification of constructed plant	During construction	Project Site	Sub-project Developer	-
1.2.6	Storage of compost and wet slurry in designated area	Direct observation	Bi-weekly	Project Site	Sub-project Developer/Site manager	
1.2.7	Avoid naked flames near digester	Direct observation	Daily	Project Site	Sub-project Developer/Site manager	-
1.2.8	Build awareness of workers on safety practices	Direct observation/ verification of	Once prior to operation	Project Site	Sub-project Developer	-

		training conducted by technology provider and/or construction company				
1.2.9	Install fire extinguisher close to digester	Direct observation	Once prior to operation	Project Site	Sub-project Developer	-
1.2.10	Use personal protective equipments during operation	Direct observation	Daily	Project Site	Sub-project Developer/Site manager	-
1.2.11	Provision of generator enclose shed	Direct observation	Once prior to operation	Project Site	Sub-project Developer	-

Most of the mitigation costs are covered within total construction cost and others required minor costs. The monitoring part is assigned to developer and will require one human resource which will be assigned to existing subproject staff and other costs are minor.

### **Conclusion and recommendation**

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 likely impacts not identified in this ESMP, if perceived during construction and/or operation phase shall also be avoided or mitigated by the Construction Company and/or developer.