

Appendix 2: Environmental and Social Management Plan (ESMP)
Laxmi Krishi and Aayat Niryat

Executive Summary:

This Environmental and Social Management Plan (ESMP) has been developed for proposed 25m³ biogas project in Laxmi Krishi and Aayat Niryat for mitigating likely environmental impacts predicted during environmental and social screening. This project is classified as “Category C”, which means there is minimum environment impact and hence there is no need of conduction of further environmental or social assessment. Some of the impacts caused by the project are: health and safety issues of construction workers, construction related health risks, possible water sources contamination due to leakage of slurry liquid, workers health during slurry handling and foul smell. The possible mitigation measures have been proposed in this ESMP and shall be implemented by the Construction Company and developer. 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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1. Introduction

For implementation of the biogas project, this environmental and social management plan is prepared for Laxmi Krishi and Aayat Niryat, Sudal-6, Bhaktapur, Nepal. The organization is going to establish a 25m³ large biogas plant within its premise. The project is supported by AEPC/NRREP/SREP.

2. Description of Subproject and Location

The project lies in Sudal-6, Bhaktapur district. The coordinate of the sub-project is site 27° 41' 23.1" N, 85° 29' 05.1" E with altitude of 1503 m. The biogas plant is proposed to be constructed within the organization. The Google map of the proposed location is provided below:

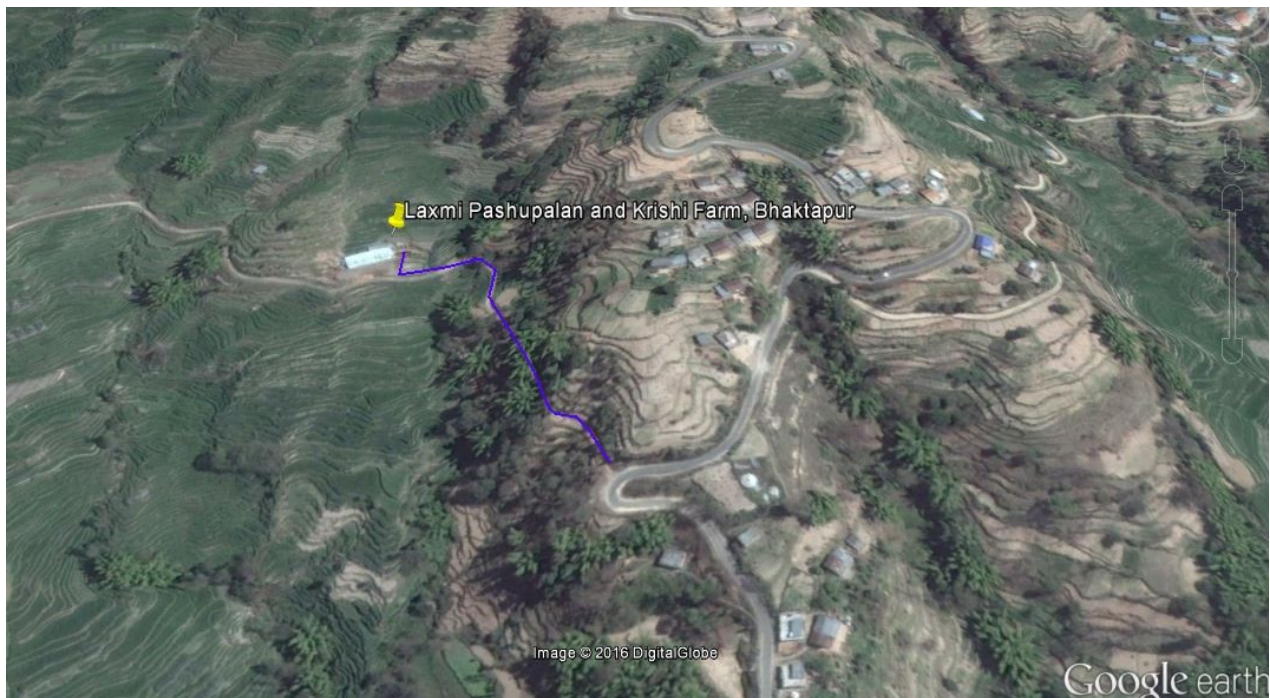


Figure: Location Map of proposed project

The biogas plant size is 25m³ from which 4.22m³ of biogas is produced per day which will be used for cooking food. The design adopted is native Modified GGC 2047 Model. The digester utilizes 105kg of waste per day for the operation of the plant and produces 234 kg of slurry per day which will be stored in compost pit to make dry and convert it into compost manure. The manure will be applied as fertilizer in their own agricultural land and the surplus fertilizer will be sold in the nearby markets.

The construction work starts with excavation of earthwork followed by stone lining, and reinforcement and cement aggregate works. Once after the construction completion, the dung and kitchen waste will be fed into the digester. The gas produced from the subproject shall be used for thermal process only. AEPC will provide subsidy only after successful testing and commissioning of plant against guaranteed performance requirement as mentioned in detailed design report.

3. Relevancy of preparing ESMP

This Environmental and Social Management Plan (ESMP) has been done for the proposed 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 the sub project intervention. The significant negative impacts are not envisaged, however, negligible impacts identified during screening process might prevail during construction and operation phase. This project is classified as “Category C”, which means there is minimum environment impact and hence there is no need of conduction of further environmental or social assessment. The 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 project site lies in Hill. From environmental aspect there are no public water sources from the project vicinity. The meteorological data indicates that the region has warm summer days with cold winter temperature. The land-use pattern of the project area indicates agricultural land as major land-use.

Developer owns 19 ropanis of land in form of hilly terrain. The biogas plant will be located in flat land prepared by flattening the terrain and cover around 6 aanas. Almost all land is being used for agricultural purpose and grass production for cows. The nearest settlement from the plant site is more than 200 meter away. Hence, there will not be any significant negative effect to neighboring settlement. The spring water is 150 m upstream from the project site and a seasonal river is 100 m adjacent to the project site. The project does not affect the water source as it is upstream from the site.

The sub-project location is dominated by Chhetri and Brahman. The settlement pattern is sparse. An all weather gravel road exists to reach the sub-project location at distance of 250 m from pitch road.

5. Environmental and Social Impacts

During feasibility study of Laxmi Krishi and Aayat Niryat, 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 compost and gas. Socially, the positive impact is control of foul smell in the surrounding areas as well as management of solid wastes. This may encourage the developer to install large biogas plant utilizing all the farm waste and produce large quantity of fertilizer sufficient for farms in the community.

5.1 Beneficial impacts

Considering benefit to the community, the waste management from the project can reduce the pollution on the surrounding. The fertilizer from the project can be sold to farmer community at low cost helping them to produce more agricultural products. The farm is also buying grass from farmers giving them opportunity to earn money. The project can also provide job to local skilled workers during the construction phase. The project will provide renewable energy to the farm. Cow manure is rich in organic substances so significant quantity of methane is released to the atmosphere during manure storage with anaerobic condition inside the dump. Methane is highly

potent greenhouse gas than CO₂ 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 firewood and LPG that is being consumed in the farm thereby further contributing in greenhouse gas reduction.

5.2 Adverse impact

There will be no any major adverse impact to the surrounding community and environment. During construction phase, some minor impacts may be seen such as dust pollution, increased noise level and occupational health and safety of construction workers.

5.2.1 Adverse impact (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. could lead accidents, but would be exceptional. It is projected that some 12 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 as well as local people of surrounding vicinity. *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 and partly to resident living close to the construction site. *The impact will remain for short duration i.e. construction period only and magnitude is projected to be low.*

5.2.2 Adverse Impact (Operation Phase)

- **Health and safety issue due to haphazard disposal and mismanagement of digested slurry:** 234 kg of 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 odor from substrate storage area:** If not properly managed, the slurry can generate foul odors which can be nuisance to farm workers (some 4 workers) as well as local residents. However, the compost pit constructed to manage slurry will reduce the smell. *The magnitude is expected to be low, long term in duration and farm workers as the main receptor.*
- **Over use of spring water for meeting water requirement (mixing dung, drinking water for livestock, flushing and cleaning):** The plant will be require 128 liters of water on daily basis only to feed into the plant. In addition water will be required for drinking and other farm activities. Spring water will be the main supply source. *The magnitude will be low, site specific 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 downstream water sources decreasing its quality. This can affect not only workers but also people living nearby who rely on same source of water. *Since the water source is upstream the magnitude can be moderate with long term impact and farm workers and local resident 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, the gas stoves in use during the operation could lead to fire or accidents. *The impact is envisaged as site specific, low in magnitude, occasional but the risk is long term in duration, farm workers as receptor.*

6 Mitigation Measures

The environmental mitigation with their time of action, mitigation cost and responsibility are illustrated in the following table:

ENVIROMENTAL AND SOCIAL MITIGATION MEASURES

S.N .	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility
1.0 Construction Phase					
1.1	Construction related accidents	The construction premises shall be barricaded by rope or wire	During construction phase	-	Construction Company

S.N .	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility
		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, wearing mask by construction workers	During construction phase	-	Construction Company/ Sub-project Developer
1.3	Increased noise due to construction activity	Work will be conducted from 8:00 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
1.4	Mismanagement of construction debris	Sands, Dusts to be used as filling ditches. Recycling metals and rods. Crushing bricks as aggregate for new concrete	During Construction phase		Construction Company
2.0 Operation Phase					
2.1	Health and safety issue due to haphazard disposal and mismanagement of digested slurry	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	5,000	Sub-project Developer
		20% slurry will be self-consumed as compost 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 closed yard/structure	During operation Phase	-	

S.N .	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility
2.3	Overuse of spring water for meeting water requirement (mixing dung, drinking water for livestock, flushing and cleaning)	Use of water from its own well	During operation Phase	-	Sub-project Developer
		Storage of dry manure/compost and wet slurry in closed yard/structure	Awareness to operators about conservation of water and instruct not to waste water		
2.4	Ground water pollution due to seepage and leakage from substrate storing area , digester and dewatering 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	Already included in construction cost	Construction Company/Sub-project Developer
2.5	Spreading of diseases due to increased disease vectors, flies, mosquitoes etc	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	-	Sub-project Developer
2.6	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

7. 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	Frequenc y/Time	Place	Monitoring Authority	Monitori ng 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/Photographs	During construction	Project Site	Sub-project Developer	-
1.1.5	Compliance of construction activities performed only in designated time (8:00 to 6:00)	Interview with locals	During construction	Project Site	Sub-project Developer	-
1.1.6	Management of construction debris	Direct Observation	During construction	Project site	Sub-project Developer	-
<i>1.2 Operation Phase</i>						
1.2.1	Provision of composting pit	Direct observation/ Photographs/records	During construction	Project Site	Sub-project Developer	-
1.2.2	Provision of personal protective equipments (PPEs) during operation	Direct observation/ Photographs	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 manure storage area with sealing material or	Record of specification of constructed plant	During construction	Project Site	Sub-project Developer	-

S.N.	Indicators	Methods	Frequenc y/Time	Place	Monitoring Authority	Monitori ng Cost (NRs.)
	concrete casting					
1.2. 6	Storage of compost and wet slurry in designated area	Direct observation	Bi-weekly	Projec t Site	Sub-project Developer/Si te manager	-
1.2. 7	Avoid naked flames near digester	Direct observation	Daily	Projec t Site	Sub-project Developer/Si te manager	-
	Monitoring metha ne concentration inside the building and near the plant to avoid the risk of explosion.	Measurement from a device	Intervals of 3 months	Projec t Site		
1.2. 8	Build awareness of workers on safety practices	Direct observation/ verification of training conducted by technology provider and/or construction company	Once prior to operation	Projec t Site	Sub-project Developer	-
1.2. 9	Install fire extinguisher close to digester	Direct observation	Once prior to operation	Projec t Site	Sub-project Developer	-
1.2. 10	Use personal protective equipments during operation	Direct observation	Daily	Projec t Site	Sub-project Developer/Si te manager	-
1.2.1 1	Provision of generator enclose shed	Direct observation	Once prior to operation	Projec t 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.

8. 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 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.