

Appendix C: Environment and Social Management Plan

Executive Summary

This Environmental and Social Management Plan (ESMP) has been developed for proposed pilot biogas plant construction and operation subproject at Livestock Development Farm, Lamaptan, Pokhara in order to mitigate the likely environmental impacts predicted during Environmental Screening. The screening process indicated that the subproject intervention will not require any land acquisition as well as displacement of inhabitants. Similarly, as the subproject itself reduces wastes and uses waste in order to produce energy, much significant negative impacts are not expected. The subproject is likely to have minor/ moderate environmental impacts, explained below, during construction and operation. Hence the subproject has been classified as low-risk Category B in terms of its environmental and social impact. However, this subproject is point type subproject constructed within a farm boundary and based on size, salient features and total cost threshold; it is not required to conduct any environmental assessment as per Environment Protection Rules, 1997. In this regards there is no need for a detailed Environmental and Social Impact Assessment (ESIA), but Environmental and Social Management Plan (ESMP) for mitigating the minor/ moderate impacts is recommended. Since there are no highly significant environmental impacts, the subproject can be constructed and implemented on the pre-planned site incorporating the mitigation measures identified in this ESMP.

Some of the impacts caused by the subproject are: health and safety issues of construction workers, possible ground water contamination due to leakage from substrate and slurry storage, impacts related to excavated materials, impacts related to spreading and haphazard disposal of large volume of digested slurry, workers health during slurry handling, foul smell and increased noise level due to operation of generator and possible firing and accidents including electrical short-circuits. A total of 25 skilled and unskilled human resources will be required during construction phase and the construction phase will require about 4 months. 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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1. Introduction

The farm was established in 1960 as Sheep Breeding Farm with the help of the New Zealand government. The project started with the objective of cross breeding sheep to improve the quality and yield its fleece. In 1969 buffalo, pig, goat and poultry were added to the farm and it was renamed as Livestock Development Farm, Pokhara. Presently the establishment has more than 250 buffaloes and 80 pigs in its vicinity. It also has also been running a hatchery with 4000 to 4500 hatches per day. There is a total of 1700 chicken present in the farm. The farm covers a total land area of over 100 hectares. Even though there are varieties of animals reared in the farm, it has been decided to use only buffalo dung as the source of substrate for biogas generation. This is mainly because of its availability in large amounts and the location being very close to the plant site. More than 4000 kg of buffalo dung is available daily. Buffalo urine will also be included as the substrate due to its high nitrogen content which is favourable for biogas yield. The detail feasibility recommends construction of a hybrid type biogas plant which utilizes a combination of Continuously Stirred Tank Reactor (CSTR) and Upflow Anaerobic Sludge Blanket process. The generated biogas is to be used for generating electricity so as to eliminate the dependency of the farm on diesel to operate generator. The subproject is under evaluation for AEPC/SREP support as a pilot demonstration project.

2. Description of Subproject and Location

The subproject site is located at Lampatan, Pokhara of Kaski district. The coordinate of the subproject site is 28°10'50.5"N, 084°00'28.5"E with altitude of 779m. The farm has a boring within its own area providing 80,000 liters. of water per day. It also has a canal running through its compound which has water flow throughout the year.

The lands of the subproject vicinity are being used solely for the livestock farm and animal grazing, and the whole area is enclosed within farm boundaries.

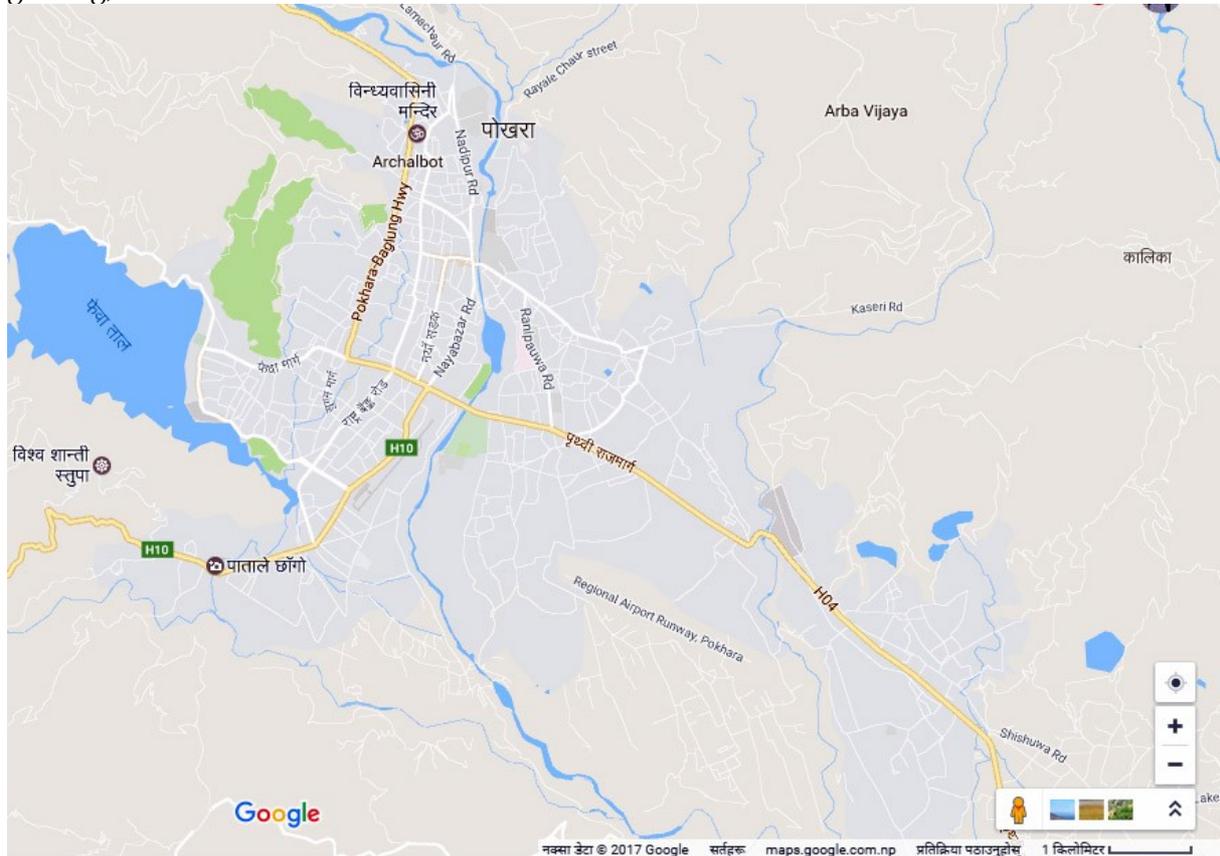


Figure 1: Location map of proposed pilot subproject



Figure 2: Google Earth showing various components of the Farm.

Prop

Nearest Settlement

103.4 m



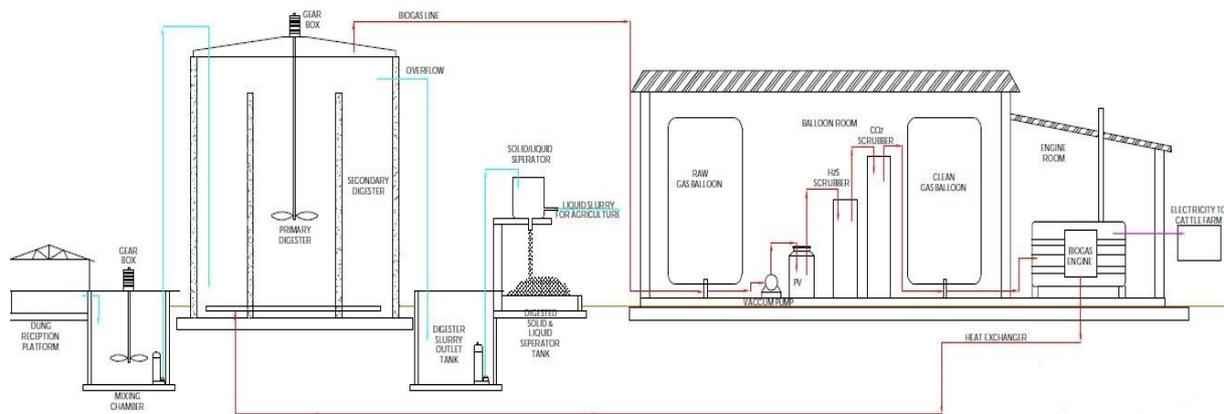
Figure3: Distance for the plant location from the nearest settlement (103m)

The proposed biogas plant is a hybrid type model which utilizes a combination of CSTR and UASB process. The CSTR is responsible for the occurrence of the hydrolysis phase whereas the UASB causes the acidification and methanogenic process. The total subproject cost is

estimated as NPR. 14,871,053. The plant will be able to generate about 240 (± 5) m³ of biogas every day. The produced gas will solely be used for the generation of electricity to fulfill the energy demands of the farm. A 40 KVA three phase gen-set running on 100% biogas has been proposed for electricity generation.

The construction of the plant will be carried out as per the layout provided by the technology provider. The buffalo dung, 4tons produced per day, will be diluted by 5m³ of water. About 480 tons of organic manure will be generated annually which will be partially used in the fields for grass cultivation and also be commercially sold.

The schematic design of the plant is provided below:



3. Relevancy of preparing ESMP

This Environmental and Social Management Plan (ESMP) has been prepared 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 subproject. There are likely to be no significant adverse impacts since the subproject itself utilizes organic waste and converting into useful renewable energy. The subproject is likely to have minor/ moderate environmental impacts, explained below, during construction and operation. Hence the subproject has been classified as low-risk Category B in terms of its environmental and social impact. However, this subproject is point type subproject constructed within a farm boundary and based on size, salient features and total cost threshold; it is not required to conduct any environmental assessment as per Environment Protection Rules, 1997. Hence, this Environmental and Social Management Plan (ESMP) has been prepared in order to reduce thus identified adverse impacts prior to sub project implementation.

This subproject does not require any displacement, resettlement and rehabilitation because the subproject is proposed inside the Livestock Development Farm and the territory is confined within its boundary and there are no any encroachers or squatter settlements present inside the institution. The plant will be constructed near cattle-shed inside the institution.

4. Environmental and Social Baseline

The subproject location lies in the Hill region of Nepal at an altitude of 779m from the sea level. Pokhara receives the maximum rainfall in Nepal. The city has moderate climate characteristics. The temperature in Pokhara during summer reaches about 25-33°C and in the winter, varies from -2 to 15°C. The climate data of pokhara is presented in table below:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C (°F)	19.7 (67.5)	22.2 (72)	26.7 (80.1)	29.8 (85.6)	30.1 (86.2)	30.6 (87.1)	30.0 (86)	30.2 (86.4)	29.3 (84.7)	27.5 (81.5)	24.1 (75.4)	20.7 (69.3)	26.7 (80.1)
Daily mean °C (°F)	13.4 (56.1)	15.7 (60.3)	19.8 (67.6)	22.8 (73)	24.3 (75.7)	25.8 (78.4)	26.0 (78.8)	26.1 (79)	25.1 (77.2)	22.1 (71.8)	18.0 (64.4)	14.4 (57.9)	21.1 (70)
Average low °C (°F)	7.1 (44.8)	9.2 (48.6)	12.8 (55)	15.7 (60.3)	18.4 (65.1)	20.9 (69.6)	22.0 (71.6)	22.0 (71.6)	20.8 (69.4)	16.7 (62.1)	11.9 (53.4)	8 (46)	15.5 (59.9)
Average precipitation mm (inches)	23 (0.91)	35 (1.38)	60 (2.36)	128 (5.04)	359 (14.13)	669 (26.34)	940 (37.01)	866 (34.09)	641 (25.24)	140 (5.51)	18 (0.71)	22 (0.87)	3,901 (153.58)

The part of Annapurna Conservation Area lies in Kaski district however, governmentally declared protected areas or any forest area is devoid within 5-km radius from the subproject site. The Livestock Development Farm lies about 1 km south of the proposed regional airport. Owning a total of 100 hectares, half of the total land of the farm comprise of the farm whereas the remaining area is used for grass cultivation and grazing of the animals. The nearest settlement from the plant site is over 100m.

Seti river is the major drainage network in Kaski. The subproject site is located about 1.4 km west of Bijaypur Khola River, a tributary of Seti river.

The subproject location is within the farm owned by the government. There are about 67 working staff working and living in the farm with their family. Black topped roads link the farm from the city. The plant location is about 700m from the entrance of the premise, connected by a gravel road. The background noise condition of subproject can be considered as average noise level (around 50 dB). The area lacks high mobility of vehicles because of sparse settlement present in the vicinity. Regarding air pollution also, the subproject location is not seem polluted because of absence of industries and high mobility of vehicles.

The nearest settlement from the proposed subproject site is Lampatan. The caste ethnic composition of pokhara is dominated by Brahman hill followed by Gurung, Magar and Newar. The settlement pattern is moderately dense.

The moist and wet ditches often provide favourable habitat for disease vectors like flies and mosquitoes. Biogas subproject itself is not a cause for such impact, however, haphazard mismanagement of wastes, improper slurry management may enhance favourable habitat for such disease vectors.

5. Environmental and Social Impacts

During feasibility study, considering environmental and social screening performed, The significant adverse environmental and social impacts is not envisaged because of site specific nature of subproject (point subproject). The land area owned by the proponent is about 100

hectares and out of which 55 hectares is occupied for livestock farming. The proposed biogas subproject will require only 1100m² of land area and hence most of the prevailed impacts are not envisaged to be spread to nearby community and most of the impacts will be site specific only.

The beneficial impact in environment is management of buffalo dung and urine in the farm which is presently a problem due to its production in large quantity and insufficient storage space. The technology is the first of its kind being implemented in Nepal and will act as demonstration for potential developers throughout the nation.

5.1 Beneficial Impacts

It is not envisaged to have direct positive social impact from the subproject however employment opportunity during construction of the subproject seems adds on positive social impact. As this plant is a pilot subproject being implemented mainly to act as a demonstration of new technology so as to demonstrate potential developers. This may be considered as the most beneficial social aspect of the proposed subproject.

5.2 GHG emission reduction as beneficial impact

Livestock (Cow or buffalo) manure is rich in organic substances so significant quantity of methane is released to the atmosphere during dumping of the manure for long term 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 due to storage/dumping of manure. In addition, the biogas will replace fossil fuels i.e. diesel which is currently using as baseline energy type for operating diesel generator. A total of 87.6 t CO₂e emission will be reduced by replacing diesel fuel to generate 300 kWhr of electricity per day (1 m³ of gas will produce 1.25 kWhr) 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 subproject. 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 construction site during its construction. Excavation work, use of machineries, welding etc which could lead accidents to construction workers, but would be exceptional. It is projected that some 25 skilled and unskilled human resources will be involved in construction process and the construction phase will require about 4

months. Due to smaller number of construction workers and their intermittent involvement during construction, a separate labor camp is not required. 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 and also needed excavators for excavation work which can generate large volume of dust from gravel road and in the construction site. The dusty environment can directly affect the health of construction workers. The excavated materials dumped near construction site could also be blown into the air during high wind condition. 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, excavation process etc 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 because this type of activity will be limited to 1 or 2 weeks during construction phase.
- **Impact associated with excavated materials:** The excavation process will be limited to 3 to 4 days during construction phase. The excavated materials are estimated to be about 140 m³ of muck for land preparation, foundation work and excavation for mixing tank and slurry receiving tank. The haphazard storage of excavated material could lead to erosion and spreading elsewhere near subproject area. Similarly, during windy day, it could also lead to dusty condition. Apart from this, the aesthetic condition shall also be degraded due to muck stock. The impact will remain for longer duration and magnitude is projected to be low in site specific extent.

Operation Phase

- **Aesthetic degradation and Ground water pollution due to haphazard disposal of digested slurry:** The process will generate about 9 tons of digested slurry per day (0.45 tons of compost per day). The management of huge quantity of digested slurry is required. The haphazard disposal of the slurry would result in aesthetic degradation of the subproject locality. Apart from this, the seepage of water from manure and slurry can pollute ground water decreasing its quality. This can affect not only workers but also people living nearby who rely on same source of water. The impact is envisaged as site specific, moderate in magnitude, long term in duration and nearby workers/community as receptor.
- **Foul odour from substrate storage area:** This is a common and big issue in most of the biogas plant that has direct impact in nuisance to nearby inhabitants. Foul odour will

irritate and it directly affects people dwelling nearby and staffs inside the farm. But the completely digested slurry will not have foul odour. Instead, due to improper amount of feeding, basically higher amount than prescribed, leads to partial digestion and can enhance foul odour in outlet. The impact is predicted to be site specific to local, will be for long term and low in magnitude and farm staffs, operators and nearby community as receptor.

- **Over extraction of ground water for meeting water requirement (mixing dung, drinking water for livestock, flushing and cleaning):** Regarding ground water extraction, the farm has a boring with capacity of 80m³ of water extraction capacity. The proposed subproject will only require 5 m³ for dilution out of which, 3 m³ of water will be supplied from separated liquid from solid liquid slurry separator. Hence, it is not envisaged to have impact on ground water extraction.
- **Spreading of diseases due to increase in vectors, flies and mosquitoes:** The increased disease vector near outlet area and feedstock storage area is often reported in many cases of biogas plants. The haphazard storage of feedstock and incomplete digestion of slurry are the main causes of providing suitable environment for breeding disease vectors. In addition, the water/slurry ditches in and around subproject site will also favour such environment and can cause spreading of various diseases. The envisaged impact is site specific moderate in magnitude, long term in duration and sub-project employees/workers and nearby community as receptor.
- **Occupational health and safety issues including accidents associated with firing and explosion etc:** The biogas is highly flammable gas. The open firing or electrical short circuits can cause huge fire and explosion. Also, many mechanical and electrical devices such as generators, electric distribution lines will be in use during the operation which could lead to fire or accidents. The impact is envisaged as site specific, low in magnitude because of occasional occurrence, long term in duration. The workers are considered as potential receptors for this impact.
- **Noise from operation of generators:** Generators will be used for electricity generation. It can generate loud noise and can be nuisance to people residing within farm or surrounding however, the noise level is attenuated with increased distance from the source of noise. The impact is envisaged as site specific, low in magnitude, long term in duration and workers and nearby residents 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 a fixed dome digester design which works on a combination of CSTR and modified UASB process. The generated slurry will be passed

through mechanical sludge separator. The concentrated slurry will be converted into bio compost as it has high commercial value. The dewatered slurry will be sent to grazing land as liquid fertilizer which will help improve the cultivation of grazing fields. Regarding timing, this ESMP prescribes to precede construction work only on 8:00 am to 6:00pm.

Environmental and Social Mitigation Plan

S.N	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility
1.0 Construction Phase					
1.1	Construction related accidents	The construction premises shall be barricaded by rope or wire	During construction phase	-	Construction Company
		Provision of personal protective equipment (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	5,000	Construction Company/ Subproject Developer
1.2	Respiratory problem due to dusty environment/vehicular emission in construction site	Spraying of water near construction sites during excavation and vehicular use to reduce dust re-suspension into atmosphere.	During construction phase	-	Construction Company/ Subproject 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/ Subproject developer
1.4	Impact associated with excavated materials	Most of the excavated materials shall be placed to fodder plantation area.	During construction phase	-	Construction Company/ Subproject developer

S.N	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility
		Similarly the excavated materials shall be filled for land development near digester location and the area is planned to make garden for aesthetic beauty.			
2.0 Operation Phase					
2.1	Aesthetic degradation and ground water pollution due to haphazard disposal of digested slurry	Installation of de-watering unit to separate dry and wet slurry	During operation phase	already provisioned in construction cost	Construction Company
		Use of personal protective equipment during slurry handling process	During operation phase	10,000	Subproject Developer
		The separated liquid from liquid solid separator will be used for dilution by recirculation system and remaining liquid shall be used in grazing/fodder farm as liquid manure. The liquid slurry shall not be disposed to any receiving water body or left haphazard in and around subproject vicinity.	During operation phase	liquid slurry transportation cost to fodder plantation area is fall under operation cost.	Subproject Developer
2.2	Foul odour from substrate	Avoid storing substrate as far	During operation	-	Subproject Developer

S.N	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility
	storage area	as possible Maintain recommended amount of feeding to assure complete digestion of feedstock.	phase		
2.3	Over extraction of ground water for meeting water requirement (mixing dung, drinking water for livestock, flushing and cleaning)	Not envisaged because the amount of water required is negligible in comparison to capacity of existing boring. However, awareness for water conservation shall be provided to operators.	During operation Phase	-	Subproject Developer
2.4	Ground water pollution due to seepage and leakage from substrate storing area , digester and solid liquid slurry separator 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/Subproject Developer
2.5	Spreading of diseases due to increased disease vectors, flies, mosquitoes etc.	Avoid storing substrate as far as possible	During Operation phase	-	Subproject Developer
		Covering of substrate by a polythene sheet, in case of storage of substrate required	During Operation phase	-	Subproject Developer
2.6	Occupational health and safety issues including accidents	Strictly avoid naked flames near digester	During operation phase	-	Subproject Developer

S.N	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility
	associated with firing and explosion	Awareness building of workers on safety practices	During operation phase	-	Subproject Developer
		Installation of fire extinguisher close to digester, generator location.	During operation phase	12,000	Subproject Developer
2.7	Noise from operation of generators	Use of enclosure shed for generator	During operation phase	-	Subproject 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 subproject. As per EMF document and Environmental and Social Safeguard Supervision Framework, the subproject level monitoring responsibility is given to developer. While doing so, the developer can appoint its existing staff or can hire human resource for monitoring purpose. In addition, AEPC itself or through its individual consultant can conduct compliance monitoring, if required. Environmental and Social Management Plan includes monitoring indicators and method in monitoring plan which is mentioned 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	Subproject Site	Subproject developer	-
1.1.2	Provision of personal protective equipment (PPEs) like helmets, boots, gloves, etc. for construction workers	Direct Observation	During construction	Subproject Site	Subproject developer	-
1.1.3	Provision of First Aid Kits at construction site	Direct Observation	Once prior to start of construction	Subproject Site	Subproject developer	-
1.1.4	Spraying of water reduce dust re-suspension	Records/Photographs	During construction	Subproject Site	Subproject developer	-
1.1.5	Compliance of construction activities performed only in designated time (8:00 to 6:00)	Interview with locals	During construction	Subproject Site	Subproject developer	-
1.1.6	Use of excavated material in land development work near digester for gardening and remaining placed in fodder plantation area	Direct Observation	Once prior to start of construction	Subproject Site	Subproject developer	-
<i>1.2 Operation Phase</i>						
1.2.1	Provision of liquid solid slurry separator (de-watering unit)	Direct observation/ Photographs/rec	During construction	Subproject Site	Subproject developer	-

		ords				
1.2.2	Provision of personal protective equipment's (PPEs) during operation	Direct observation/ Photographs	Once prior to operation	Subproject Site	Subproject developer	-
1.2.3	Avoid storing substrate as far as possible	Direct observation	Bi-weekly	Subproject Site	Subproject developer	-
1.2.4	Cover substrate by a polythene sheet, in case of storage of substrate	Direct observation	Bi-weekly	Subproject Site	Subproject 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	Subproject Site	Subproject developer	-
1.2.6	Storage of compost and wet slurry in designated area and thereby reusing part of liquid for dilution and rest to be used in agricultural farm	Direct observation	Bi-weekly	Subproject Site	Subproject developer/Site manager	
1.2.7	Avoid naked flames near digester	Direct observation	Daily	Subproject Site	Subproject developer/Site manager	-
1.2.8	Build awareness of workers on safety practices	Direct observation/ verification of training conducted by technology	Once prior to operation	Subproject Site	Subproject developer	-

		provider and/or construction company				
1.2.9	Install fire extinguisher close to digester.	Direct observation	Once prior to operation	Subproject Site	Subproject developer	-
1.2.10	Use personal protective equipment during operation.	Direct observation	Daily	Subproject Site	Subproject developer/Site manager	-
1.2.11	Provision of generator enclose shed	Direct observation	Once prior to operation	Subproject Site	Subproject developer	-
1.2.12	Provision of well insulated distribution line while transporting produced electricity to enduse	Direct observation	During construction phase	Subproject Site and endues location	Subproject developer	-

Most of the mitigation costs are covered within total construction cost and others required minor costs.

1. 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.