Appendix III: Environmental and Social Management Plan (ESMP)

Shiva Shakti Khadya Udhyog, Chitwan

Executive Summary:

This Environmental and Social Management Plan (ESMP) has been developed for proposed 15m^3 biogas sub-project within Shiva Shakti Khadya Udhyog in order to mitigate the likely environmental impacts predicted during environmental and social screening. This sub-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 sub-project are: health and safety issues of construction workers, possible ground 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. 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

For implementation of the biogas sub-project, this environmental and social management plan is prepared for Shiva Shakti Khadya Udhyog, Ratnanagar-4, Chitwan, Nepal. The industry is going to establish a 15m^3 large biogas plant in its own compound. The sub-project is supported by AEPC/SREP.

2. Description of Sub-project and Location

The sub-project lies in Ratnanagar-4, Chitwan district. Locally, the sub-project is proposed to be constructed within the industry. The proposed site of construction is in the proximity of toilet and cow farm. The distance to the nearest market, Sauraha Chowk, is approximately 1 km. Approximately 45 m^2 land will be required to construct proposed biogas plant. The constituents of the biogas plant will be inlet, digester, outlet and two compost pits.

The GPS location of the sub-project site is:

N	$28^0$16'41.68''
E	$083^0$56'58.83''
Altitude (m)	995

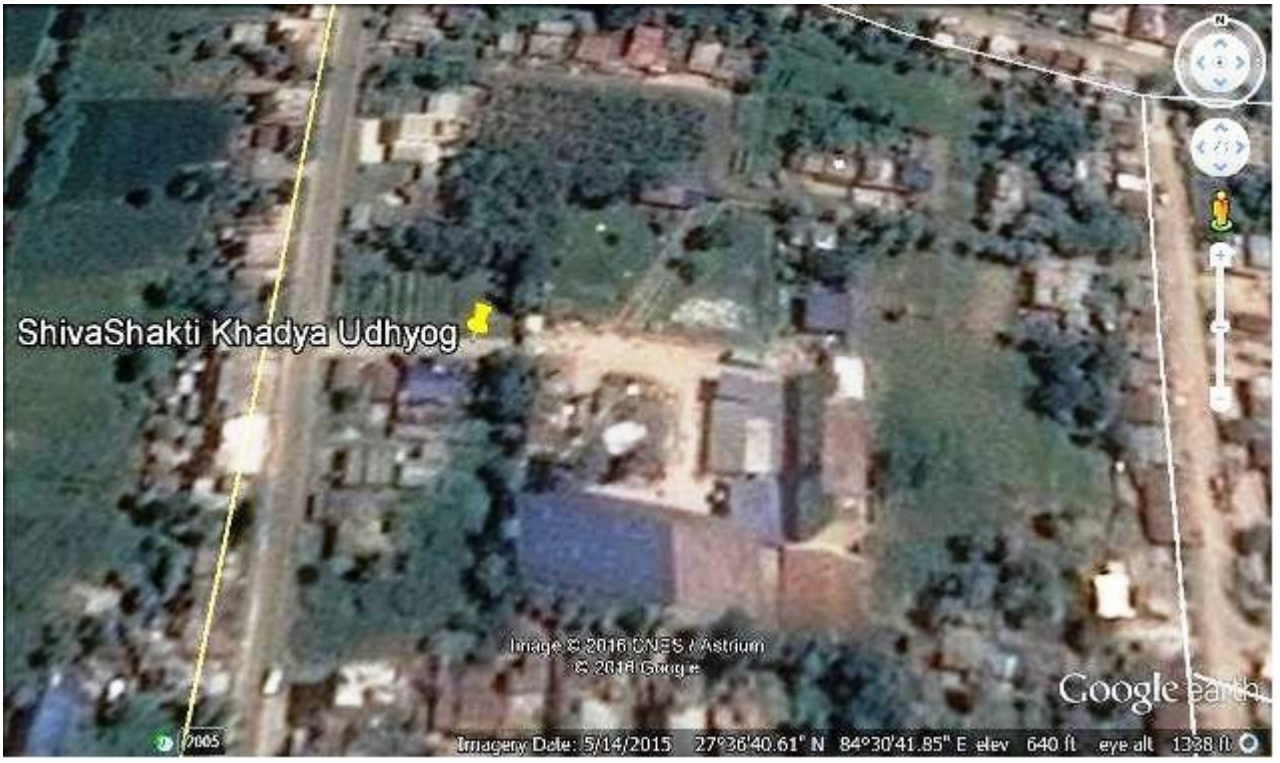

Figure: Location Map of proposed sub-project

A capacity of 15m^3 biogas plant is proposed to install in Shiva Shakti Khadya Udhyog. The gas produced by the plant will be 3.5m^3 per day. The plant will produce 181 kg of slurry per day which will be stored in compost pit to make dry and convert it into compost manure.

The major works that will be carried out during establishment are excavation of earthwork, stone lining, and reinforcement and cement aggregate works. Once after the construction

completion, the cow dung and night soil from toilet 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 detailed design. The gas produced from the sub-project shall be used for thermal process only.

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 the sub-project intervention. The negative impacts are not predicted since the sub-project itself reduces wastes and use of waste in order to produce energy. Similarly, the subproject is very small sized (15m^3). However, negligible impacts identified during screening process might prevail during construction and operation phase. This sub-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 sub-project site lies in the Terai region of Nepal. The meteorological data from 2008 to2010 indicated that the region (Chitwan) has mean annual maximum temperature is about 40.5°C and minimum temperature is about 4.5°C. The total annual rainfall received by the station in 2010 was 2210 mm with maximum 24hr rainfall as 165 mm. The subproject location has moderate settlement and lies aside of Sauraha road about 1.5km from Sauraha Chowk.

Kayar Khola, small tributary of Narayani River flows some 550m south east from the sub-project area and can be considered as safe distance for not affecting river. There is no any forest area within periphery of 3 km from sub-project; however, Chitwan National Park is situated in about 4 km south of the sub-project within a district.

The sub-project location is dominated by Brahman-hill, Chhetri and Tharu. The sub-project site is location within a moderate settlement and in western side of the subproject across Sauraha road, the landuse is dominated by agriculture. Most of this community depends in agriculture followed by business and service. An all weather asphalt road exists to reach the sub-project location from East West Highway via Sauraha road.

5. Environmental and Social Impacts

During feasibility study of Shiva Shakti Khadya Udhyog, considering environmental and social screening performed, it is not predicted to have significant negative environmental and social impacts. However, few impacts have been predicted due to implementation of subproject and is provided below.

5.1 Beneficial impact

Considering benefit to the community, there seems no any direct advantage whereas, from the owners view there seems to be some benefit creating job opportunities to some extent during construction phase. The sub-project will provide renewable energy to the farm. The gas produced will replace about 15 kg of firewood consumption per day.

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.

Construction Phase

Worker health from dust inhalation during excavation and construction work: During the construction phase, the excavation work shall be done for construction of inlet, digester, outlet and compost pit . In this case, there would be chance of dust inhalation to workers. There will be about 5 skilled and semi skilled man power. In this regard, the envisaged impact would be site specific, low in magnitude, short term in duration.

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 construction machineries, etc. could lead minor accidents. It is projected that some 5 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.

Operation Phase

Seepage and leakage from substrate storing area, digester and slurry storage yard into ground water resource: The seepage of water from feedstock storage, digester, outlet and compost pit may reach to groundwater increasing nitrogen level. This can affect not only workers but also people living nearby who rely on same source of water. Similarly, effluent from toilet waste separated from sludge thickening unit would have high BOD contain and fecal contamination and could reach to groundwater. However, because the plant is processing very small amount of slurry, the impact is expected to be low, but long term.

Foul smell due to slurry around surrounding community, during extreme temperature and windy day: The undigested bio slurry could result foul odors which can be nuisance to farm workers and biogas operator as well as local residents. The overfeeding is one of the most reasons of under digestion of feedstock within biogas digester. The magnitude is expected to be low because of biogas plant size but is expected for long term in duration and farm workers as the main receptor.

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.

Spreading of disease due to increased disease vectors, flies, and mosquitoes: About 181 kg of liquid slurry will be generated each day from the plant, however the volume is so tiny and manageable. If the slurry is left over near plant location could result formation ditch and wet area, this can favor several disease vectors including flies and mosquitoes. 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 and farm workers and community as receptors.

Operational Health and Safety during handling of slurry and compost: It is possible to present contaminants and disease causing pathogens in bio-slurry, especially in undigested bio-slurry. In this regard, during handling of slurry, it could have chance to impact worker who deals with such handling of slurry and compost. The impact is predicted as site specific, with low

magnitude and for long term duration and operator as receptors.

6. Mitigation Measures

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

ENVIROMENTAL & SOCIAL MITIGATION MEASURES

Phase	Issue	Mitigating Measure	Cost of Mitigation (If Substantial)	Responsibility*	Start Date	End Date
Construction	Worker health from dust inhalation	• Workers will be required to wear filter masks and eye protection • Dusty areas (construction site) will be sprayed with water, particularly during hot, windy weather	• Minor • Minor	Construction contractor	Digester pit, outlet pit and, manhole construction activities begin	Digester, outlet and compost pit construction is complete
Construction	Construction related accidents (Health and safety issue)	• Precautions need to be followed in every steps. • Presence of First Aid kit in the work site.	• Minor	Construction Contractor	Construction of pit begins	Construction of pit begins
Operation	Seepage and leakage from substrate storing area, digester and slurry storage yard into ground water resource:	• Compost pit will be constructed as per the design • Proper sealing of base of storage area as well as digester and outlet manure storage area with sealing material or concrete casting	• Cost of compost pit already included in BoQ and construction cost.	Contractor Client	Construction of pit begins	Till the sub-project runs.

operation	Pathogens harm during Slurry handling to clear compost pit and making dry compost	• Workers will be required to provide with appropriate clothes, gloves and masks.	Minor	Client	Periodic, during clearing up slurry and making dry compost	Till the compost is transported to the market.
Operation	Foul smell due to slurry around surrounding community, during extreme temperature and windy day.	• Avoid storing substrate as far as possible and daily feeding with recommended amount shall be performed	Minor	client	Till the sub-project runs	Till the sub-project runs
Operation	Accident associated with firing and	• As methane is combustible gas, naked flames shall be avoided strictly near digester area. Care shall be taken during use of biogas	Minor	Client	Till the sub-project runs	Till the sub-project runs
Operation	Flies and mosquito breeding, due to slurry	• Avoid storing substrate as far as possible. • Prevent haphazard disposal of bio-slurry and prevent	Minor	Client	Till the sub-project runs	Till the sub-project runs
Operation	Operational health and safety during	• provision of personal protective safety measures like boots, gloves and masks to worker	Minor	Client	Till the sub-project runs	Till the sub-project runs

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 sub-project. The monitoring plan is provided in the table below: Regarding alternatives, the technology selected for this subproject is modified GGC 2047 model from wide range of anaerobic digestion technologies. The compost pit has been proposed as cost effective measures to process digested slurry. The construction work shall be permitted in day time only.

ENVIROMENTAL & SOCIAL MONITORING PLAN

Phase	**What** *parameter is to be monitored?*	**Where** *is the parameter to be monitored?*	**How** *is the parameter to be monitored/ type of monitoring equipment?*	**When** *is the parameter to be monitored -frequency of measurement or continuous?*	**Monitoring Cost** *What is the cost of equipment or contractor charges to perform monitoring*	**Responsibility**	**Start Date**	**End Date**
Construction	Worker health Dust levels	At construction site	Visual: Worker wearing equipment Dust visible	Weekly: random times Weekly, more frequently during dry, windy weather	Minor Minor	Construction Contractor Construction Contractor	Construction activities begin	Till construction work ends.
Operation	Proper management of slurry waste and waste water via composting.	At subproject site	Visual: Periodic monitoring and testing	Monthly	Minor	Contractor Clients	Construction begins.	Till the sub-project runs.

Operation	Ground water pollution due to leakage of slurry liquid; possibility of contamination of drinking water pipes due to the surface and subsurface flow of slurry liquid	In the periphery of 100m of sub-project site	Slurry properly managed. No leakage and overflow in outlet and compost pit.	Monthly	Minor	Client	Entire operation phase	Entire operational phase
Operation	Pathogens harm during Slurry handling to clear compost pit and making dry compost	For workers	Monitoring of use of personal protective measures during slurry handling.	Once in two month	Minor	Client	Start of Compost pit clearing	End of compost pit clearing
Operation	Foul smell due to slurry around surrounding community, during extreme temperature and windy day	Farm area and surrounding community	Comment from community, and workers in farm	Monthly	Minor	Client	Sub-project operation phase	End of sub-project operation phase.

Operatio	Flies and mosquito breeding, due to slurry	Nearby farm area	Physically seen	Weekly	Minor	Client	Sub-project operation phase	End of sub-project operation phase

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.