

**ANNEX VI: Environmental and Social Management Plan (ESMP)
of Hope House Company (15m³), Jagatpur, Chitwan**

Executive Summary:

This Environmental and Social Management Plan (ESMP) has been prepared for proposed 15 m³ biogas sub-project within Hope House Company 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, increased dust level during construction phase, possible water sources contamination due to leakage of slurry liquid and haphazard disposal of digested slurry, 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

Hope house is a non-profit making non-governmental organization which intends to utilize toilet waste and available kitchen waste to generate biogas and use of thus produced biogas to prepare (cook) food for student and staff. The total land area owned by the company is 81268 sq. m. (12 bigha) and is resident of 110 permanently living orphan student and staff. In addition, there are currently 5 small sized buffalos ranches for meeting daily demand of milk. From available dung, toilet waste and kitchen waste the detail design recommends construction of 15m³ biogas plant. The proposed design technology is Modified GGC 2047 model biogas plant. Thus generated biogas is proposed to be used for cooking purpose. The sub-project is under evaluation for AEPC/SREP support.

2. Description of Sub-project and Location

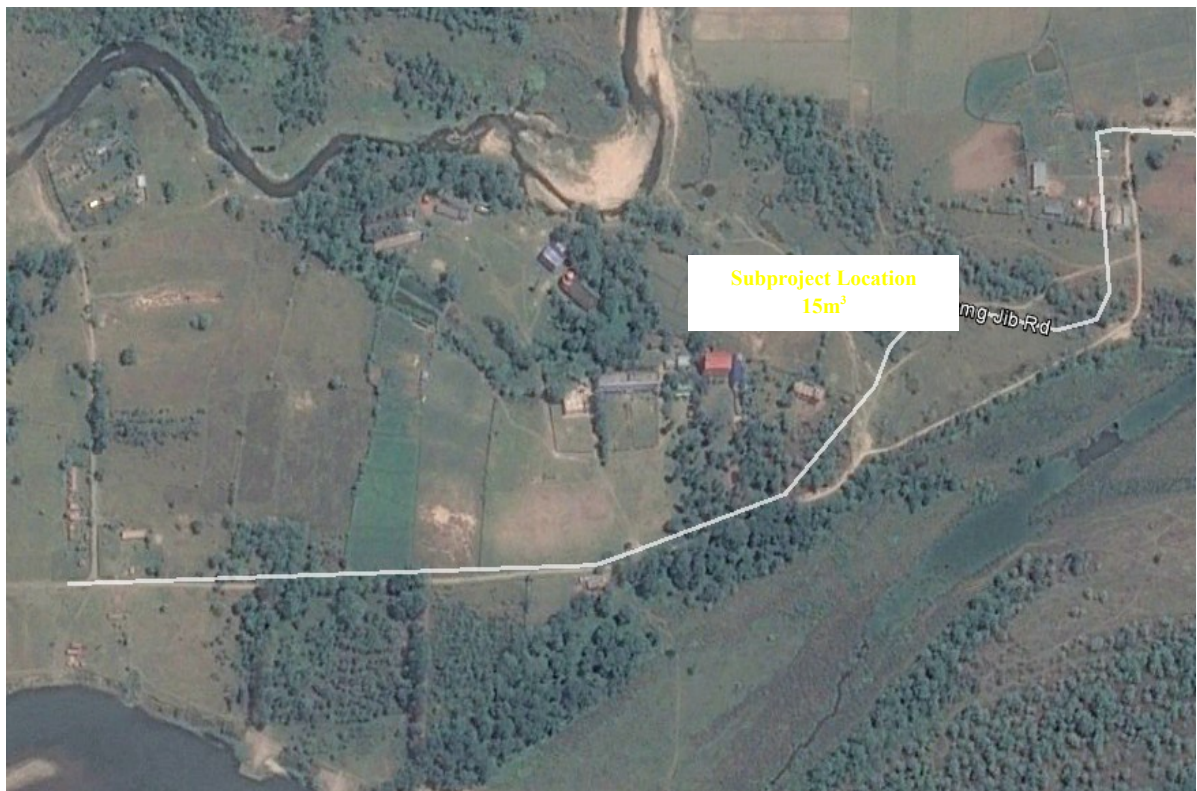
The sub-project is located at Narayani Municipality-10, Jagatpur, Chitwan. The coordinate of the sub-project site is 27°33'58.81"N, 84°17'58.72"E and with altitude of 170 m.

The figure provided below illustrates the sub-project location as well as environmental setting near the sub-project site.



The proposed plant is 20 m³ modified GGC 2047 model fixed dome digester with 3.6 m³ of biogas production per day. The generated biogas will be used for cooking.

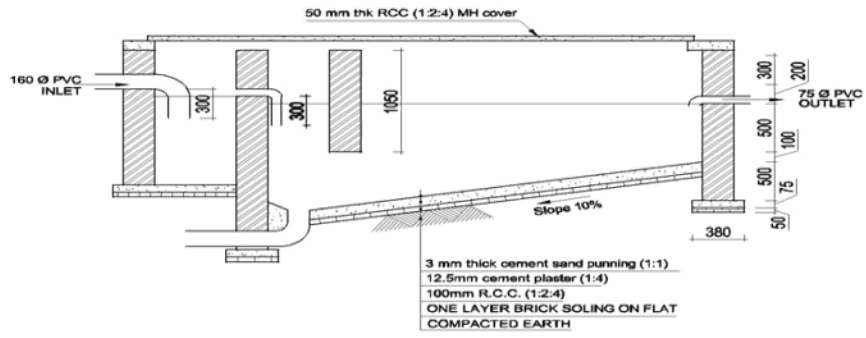
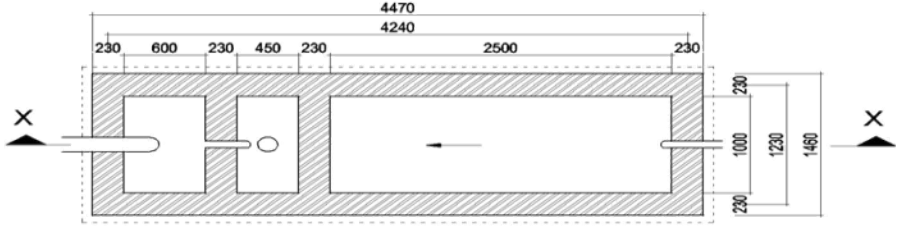
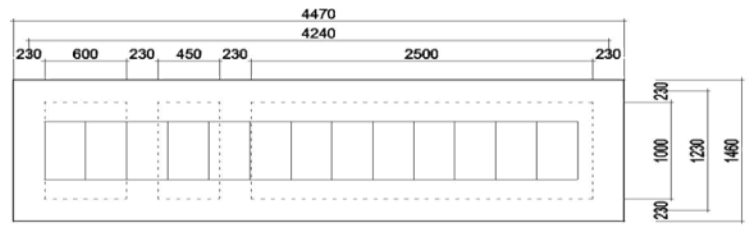
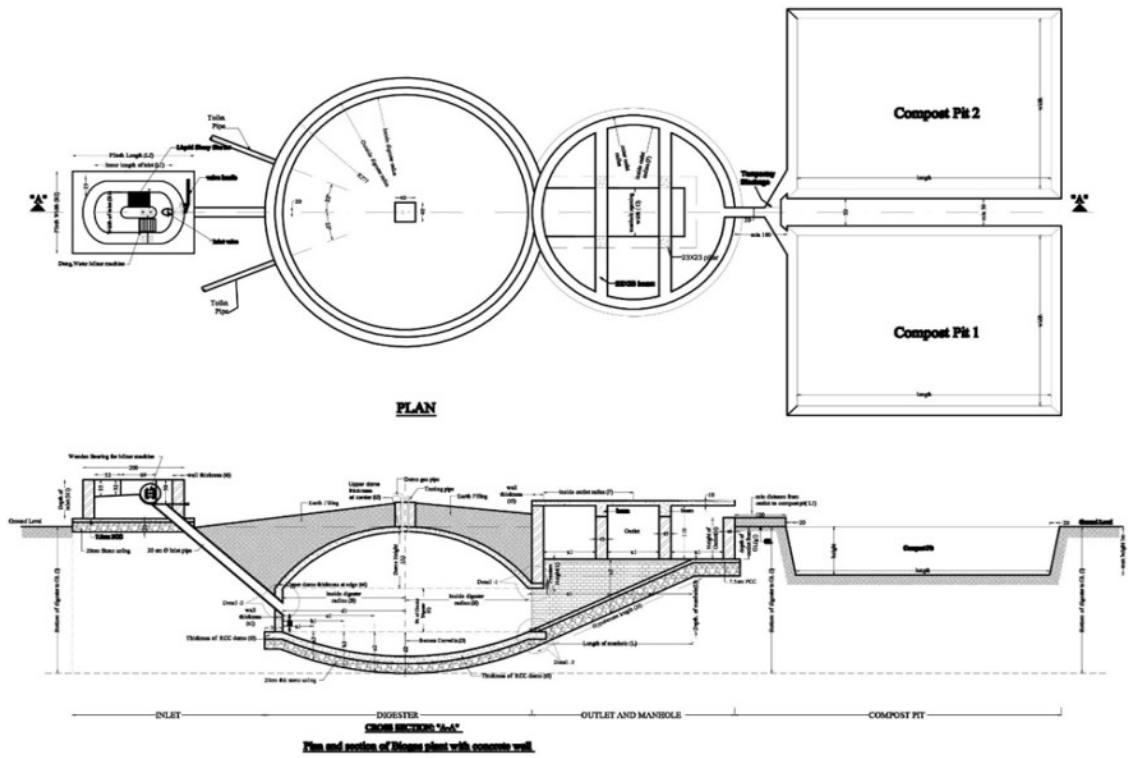
The following figure shows the location of biogas construction.



The major works that will be carried out during construction are excavation of earthwork for digester, cement aggregate works and civil construction of inlet, fixed dome digester and outlet. About 45kg of buffalo dung and toilet waste from 110 people and kitchen waste of

17.6 kg will be used as substrate for biogas production. A total of 182 kg of digested slurry will be produced each day.

As the subproject's primary substrate is toilet waste with low total solids (TS) content, the sludge thickening unit shall be installed in order to maintain the feedstock TS to 9%. The schematic design drawing of biogas plant and sludge thickening unit are provided below:



3. Relevancy of preparing ESMP

This Environmental and Social Management Plan (ESMP) has been prepared for the construction and implementation of 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 utilizes available wastes as feedstock for producing biogas. 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 Terai region of Nepal. The topography is flat land with altitude of about 170 m above sea level. Regarding climatic condition, as it is situated in Terai region, sub-tropical climate with hotter summer and mild winter prevails in the sub-project area. The land use pattern of proposed sub-project is fallow land but present scattered trees within institution premise.

Rapti River, a major river flows south of the subproject. The same river demarcates the boundary of Chitwan National Park. A small tributary of Rapti River, named Kerunga Khola flows about 130m north from the subproject area.

The institution is spread over 81268 sq. m. (12 Bigha) of land with potential for land expansion. The ground conditions are favorable to build a biogas plant. The subproject location is situated completely in rural setting with nearest settlement of Dhruwa more than 1.5 km from the subproject location; hence it is not envisaged to impact nearby settlements from any impacts caused by the subproject. The subproject site can be reached via Gitanagar Jagatpur road. Regarding caste and ethnicity of the locality, the subproject location vicinity is residents of mixed community of Brahman Hill, Tamang, Chetri and Dalits with minority of Tharus.

The current status of respiratory diseases of the community is not documented however, in rural areas of Nepal, the respiratory diseases are caused mainly because of burning of traditional energy sources especially firewood and cow dung cake. The major diseases that the community are commonly suffered are diarrhea, dysentery, flues and in some cases cholera too and are mostly transmitted because of unhygienic condition and through disease vectors like flies and mosquitoes.

5. Environmental and Social Impacts

The environmental and social screening task accomplished during feasibility study did not envisage any significant environmental and social impacts posed by the subproject intervention reasoning sparse settlement and the nearest settlement is more than 1 km far, the institution owns sufficient land area and the subproject intervention will require only 93m² and the size of the biogas plant to be constructed is also very small (15m³). However, some

environmental and/or social impacts have been predicted mostly arisen from construction and operation of the subproject but will be limited to site-specific impacts.

5.1 Beneficial Impacts

The prime benefits of this subproject are the utilization of wastes as resource for energy generation. The subproject will also manage the toilet waste produced inside the company; however, the subproject will not significantly provide benefit to nearby society except providing nominal number of employment during construction phase.

5.2 GHG emission reduction as beneficial impact

The installation of biogas plant will directly reduce consumption of fossil fuels such as LPG that is being consumed in the institution for cooking purpose and will replace this fossil fuel and thereby reduces GHG emission however, this impact is very nominal.

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, and civil construction works could lead accidents, but the occurrence would be exceptional. It is projected that some 18 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, construction workers and residents as receptor.
- **Respiratory problems due to dusty environment:** During construction phase, there will be intermittent movements for transport vehicles for transporting construction materials and can lead to generate dusts. Similarly, during excavation of digester and outlets, such impact could be visible. As the community settlement is significantly far from the subproject location, i.e. more than 250m, the impact will not be significant for community. However the impact is envisaged to be a low in magnitude, short term duration and construction workers and students as receptor.
- **Increased noise due to construction activity:** The increased noise may be experienced due to vehicular movement and construction activities such as loading and unloading of construction materials and other construction activities. This will mainly affect construction workers (18 workers) and school students. 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:** 182 kg of digester slurry will be generated each day from the plant. If the slurry is not well managed and disposed haphazardly in and around subproject site, this could establish favorable breeding environment for disease vectors. In addition, the aesthetics of the site would also be decreased due to such unmanaged disposal.

This can affect staffs and residents of total about 200 persons. The impact will be area specific, with moderate magnitude and for long term duration

- **Foul odour from digester and outlet of plant:** If not properly managed, the slurry can generate foul odors which can be nuisance to staffs and residents/orphans. The fact about the foul odour from biogas plant is that such foul odour would be prevalent only if the slurry is not properly digested. However, the designated compost pits will be installed in order to collect all slurries passed from outlet. The magnitude is expected to be low, long term in duration and farm workers as the main receptor.
- **Impact associated with liquid effluent separated from sludge thickening unit:** The sludge thickening unit shall be installed for biogas plants which use toilet waste as major substrate to maintain total solids in substrate. The liquid separated from the sludge thickening unit would have high BOD and contaminated fecal sludge and hence would have health risk if disposed haphazardly. The magnitude is expected to be moderate, long term in duration and residents as the main receptor
- **Ground water intrusion due to seepage and leakage from substrate digester, sludge thickening unit and slurry storage yard:** The seepage of slurry (contaminated with fecal coliform and other pathogens) can pollute ground water decreasing its quality. This can affect workers and residents who rely on contaminated source of water. So the magnitude can be moderate to high with long term impact and farm workers and local resident as the main receptor.
- **Intrusion of digested slurry into nearby river due to haphazard disposal of 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 130m, during rainy season, the left out digested slurry could even reach to river and can cause increased BOD affecting deterioration of river water quality. In this regard, this impact is characterized as site specific, low in magnitude and long term in duration.
- **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. The impact is envisaged as site specific, low in magnitude, occasional but the risk is long term in duration, kitchen staffs 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 modified GGC 2047 from wide range of technologies like floating drum type model, up-flow sludge blanket, CSTR etc. and the selected technology is the native design of the country. 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 composting technology is proposed for converting digested slurry into compost manure. The implementation of below mentioned mitigation measures shall be strictly done during specified time.

Environment 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	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 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
2.0 Operation Phase					
2.1	Health and safety issue due to haphazard disposal and mismanagement of digested slurry	Storage of digested slurry in designated compost pit to prevent haphazard disposal	During operation phase	-	Sub-project Developer
		Use of personal protective equipments during slurry handling process	During operation phase	5,000	Sub-project Developer
2.2	Foul odour from digester and outlet of plant	Appropriate amount of daily feeding shall be done for	During operation Phase	-	Sub-project Developer

S.N.	Environmental/Social Impacts	Mitigation Measures	Time of Action	Estimated Mitigation Cost (NRs.)	Responsibility
		complete digestion of slurry.			
		Storage of dry manure/compost and wet slurry in closed yard/structure	During operation Phase	-	Sub-project Developer
2.3	Impact associated with liquid effluent separated from sludge thickening unit	Proper sealing of base of sludge thickening unit with sealing material or concrete casting	During Construction Phase	Already included in construction cost	Construction Company/Sub-project Developer
		Prevent haphazard discharge of effluent and collection of separated liquid effluent in existing safety tank	During Construction Phase	Already included in construction cost	Construction Company/Sub-project Developer
2.4	Ground water intrusion due to seepage and leakage from substrate digester, sludge thickening unit and slurry storage yard:	Proper sealing of base of sludge thickening unit with sealing material or concrete casting	During Construction Phase	Already included in construction cost	Construction Company/Sub-project Developer
2.5	Intrusion of digested slurry into nearby river due to haphazard disposal of slurry	Prevent haphazard disposal of digested slurry and collection of digested slurry in designated compost pit only	During Operation phase	-	Sub-project Developer
2.6	Spreading of diseases due to increased disease vectors, flies, mosquitoes etc	Avoid formation of ditches and haphazard slurry disposal; storage of digested slurry in designated compost pits	During Operation phase	-	Sub-project Developer
2.7	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	-	Construction company

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.

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	Direct Observation	During construction	Sub-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	Sub-project Site	Sub-project Developer	-
1.1.3	Provision of First Aid Kits at construction site	Direct Observation	Once prior to start of construction	Sub-project site	Sub-project Developer	-
1.1.4	Spraying of water to reduce dust re-suspension	Records/Photographs	During construction	Sub-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	Sub-project site	Sub-project Developer	-
<i>1.2 Operation Phase</i>						
1.2.1	Provision of composting pit	Direct observation/ Photographs/records	During construction	Sub-project site	Sub-project Developer	-
1.2.2	Provision of personal protective equipments (PPEs) during operation	Direct observation/ Photographs	Once prior to operation	Sub-project site	Sub-project Developer	-
1.2.3	Avoid discharge of digested slurry and effluent from sludge thickening unit into nearby area	Direct Observation	monthly	Sub-project site	Sub-project Developer	-
1.2.4	Proper sealing of base of storage area as well as digester and outlet manure	Record of specification of constructed plant	During construction	Sub-project site	Sub-project Developer	-

S.N.	Indicators	Methods	Frequency/Time	Place	Monitoring Authority	Monitoring Cost (NRs.)
	storage area with sealing material or concrete casting					
1.2.5	Storage of compost and wet slurry in designated area	Direct observation	Bi-weekly	Sub-project site	Sub-project Developer/Site manager	-
1.2.6	Avoid naked flames near digester	Direct observation	Daily	Sub-project site	Sub-project Developer/Site manager	-
1.2.7	Build awareness of workers on safety practices	Direct observation/ verification of training conducted by technology provider and/or construction company	Once prior to operation	Sub-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 sub-project staff and other costs are minor.

8. 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.