BUSINESS MODEL 5

Power from manure

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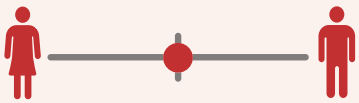
A. Key Characteristics

Model name	Power from manure
Waste stream	Livestock manure, agro-waste as additional input
Value-added waste product	Biogas, energy (electricity as well as thermal energy), carbon credit, slurry/liquid and solid bio-fertilizer
Geography	Rural regions with livestock farming and large livestock industry
Scale of production	Small, medium to large scale 16 kW up to 5 MW of electricity 22,000 to 700,000 ton CO_2-eq/year
Supporting cases in this book	Santa Rosillo, Peru; Concordia, Brazil; Culiacan, Mexico
Objective of entity	Cost-recovery [X]; For profit [X]; Social enterprise [X] Community development [X]
Waste removal capacity	Manure from small (less than 600 animals), medium (600 to 1,000 animals) and large (more than 1,000 animals) livestock farms
Investment cost range	500–5000 USD/kW for capacities ranging between 1 MW to 3 MW (based on International Renewable Energy Agency or IRENA)
Organization type	Private, public-private partnership (PPP), public and non-profit organization
Socio-economic impact	GHG emission reduction (up to 700,000 ton CO_2-eq/year), improve water quality and reduce air and soil pollution, access to electricity (50 households from 16 kW plant), improved livelihood of remote communities, improved working conditions of slaughterhouse and animal farms
Gender equity	Neutral 

B. Business value chain

This business model can be initiated either by livestock processing factories such as meat or dairy processing factories with the objective of ensuring that their products have been produced in an environmentally sustainable way or by small, medium and commercial-sized livestock farms in remote communities to utilize livestock waste to produce off-grid power for rural electrification with the support of regional government and NGOs. Depending on the size of the project, the business can also be registered as a Clean Development Mechanism (CDM) project to earn additional revenue from carbon credit sales.

While the power from manure model can be implemented in different scenarios, the following sections describe power from manure model for: a) carbon credit and sustainable value chain and b) rural electrification.

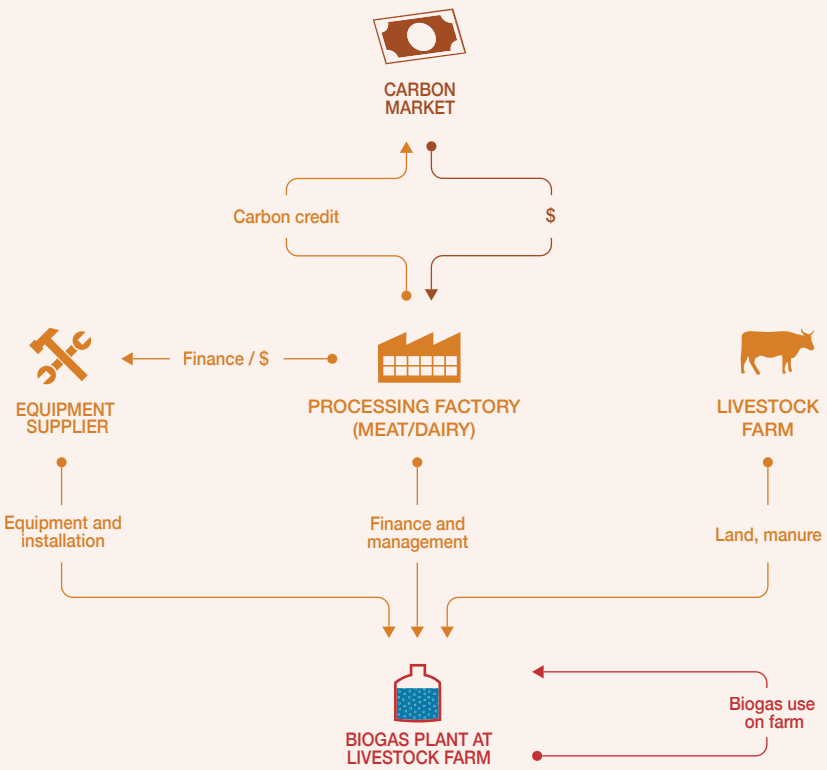
Power from manure for carbon credit and sustainable value chain

To mitigate the social and environmental impacts associated with livestock production systems, the processing factory (e.g. meat processing factory) installs bio-digesters on the animal farms within its supply chain on a Build and Transfer (B&T) basis. The factory oversees the installation of the bio-digesters on the farms, provides finance for initial capital cost, registers the project as a CDM project and manages the carbon credit revenues. The animal farm operates and maintains the bio-digesters. The factory assists the farmer in loan repayment by trading the carbon credit on behalf of the farmer. After deducting a portion of the receipts for loan repayment, the amount obtained is shared with farmers according to their potential emission reduction. The factory owns all the equipment until such time that the farmer pays back in full. The energy produced from livestock waste is used within the farms resulting in reduced farm operational costs and improved animal waste management, and the bio-fertilizer can be used on farms' own land. This business model seeks to bring sustainability to the entire supply chain by improving animal waste management while providing additional revenue to livestock farmers. In addition to cost recovery from utilizing the energy at the farm, the business model results in additional revenue for the farmer from sales of carbon credits (Figure 63).

Power from manure model for rural electrification

The business model can be commissioned by regional government in villages where there is no access to the national electricity grid or where there is very limited access to gas or electricity and where the

FIGURE 63. VALUE CHAIN FOR POWER FROM MANURE FOR CARBON CREDIT AND SUSTAINABLE VALUE CHAIN



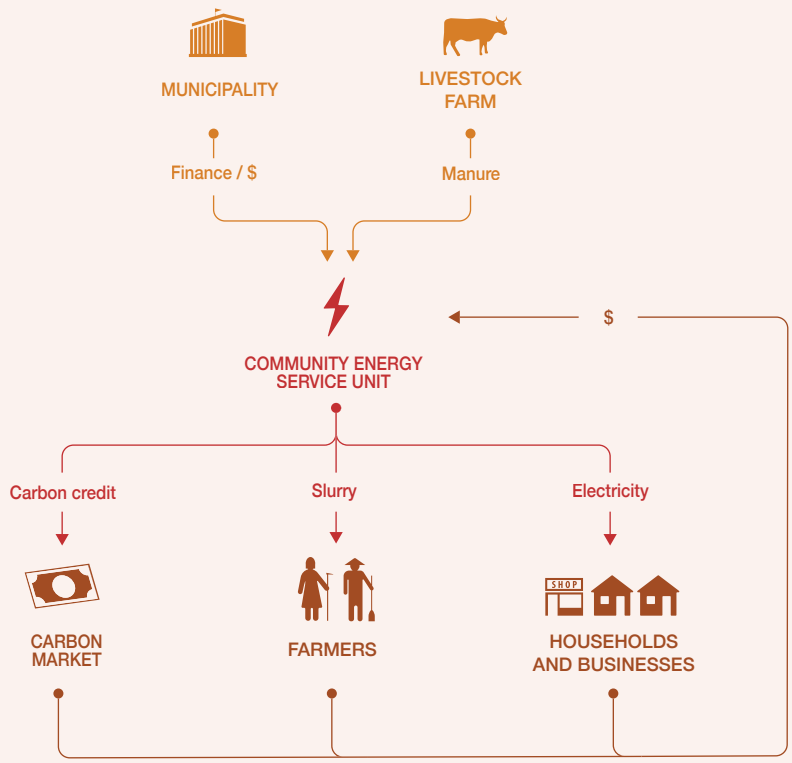
community's primary economic activity is livestock farming. This is done by installing bio-digesters, which are fed with all the livestock and other organic waste from the community to generate biogas, which in turn is fed into the electricity generator and channelled to each house through a newly-installed electricity grid. The by-product from the bio-digesters is used as fertilizer by individual farms within the community to improve the soil quality or can be sold to other local farmers. The project can be financed through a public-private partnership between the regional government and the community with the major part of the funding coming from the regional government. Although the business is financed primarily by government subsidy, the investment can be supplemented with market-based approaches. The project will sustain itself through income streams primarily from monthly electricity usage fees charged to families and secondarily from the sale of slurry. This business has also the potential to earn additional revenue from carbon credit revenues by registering the business as a CDM project (Figure 64).

C. Business model

Business model – Power from manure for carbon credit and sustainable value chain

The processing factory installs bio-digesters at its livestock farmers within its value chain on a Build and Transfer basis in order to reduce GHG emissions from the livestock producers and to qualify the emission reductions as a CDM project. The processing factory could either obtain funds from banks or use own funds to finance the small and medium animal farmers to take part in the program.

FIGURE 64. VALUE CHAIN FOR POWER FROM MANURE FOR RURAL ELECTRIFICATION

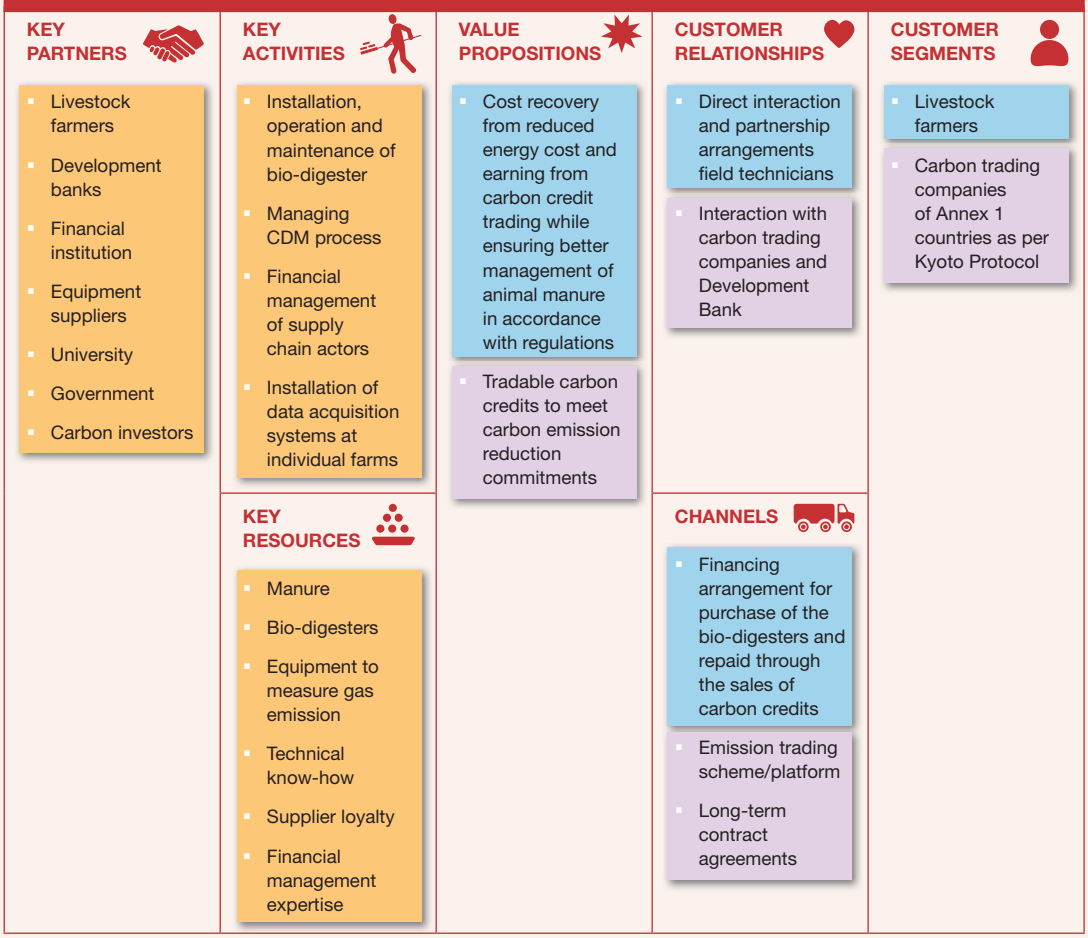


The program benefits both parties. The processing factory is able to increase supplier loyalty and secure supply in the light of environmental regulation and farmers benefit from improved management of animal manure. Moreover, in addition to creating revenues from carbon credit trading, farmers are able to benefit from cost recovery due to reduced operational costs from using energy produced from the bio-digester (Figure 65). The by-product from the fermentation process can also be used as crop fertilizer or as food for fish breeding. The processing factory owns all the equipment installed in the farmers' facilities and is responsible for managing the CDM benefits. The amount obtained from carbon trading is shared with farmers, according to each potential emission reduction and after deduction of the investment made in the bio-digesters including the program implementation and operation costs. The bio-digesters and related equipment will change ownership to the farmer ones the farmer completes payment for the investment cost on installment basis.

Business model – Power from manure for rural electrification

This business model has two key value propositions (Figure 66) – providing electricity service to houses and businesses and providing fertilizer to community farmers. The municipality, donor agency

FIGURE 65. BUSINESS MODEL CANVAS: POWER FROM MANURE FOR CARBON CREDIT AND SUSTAINABLE VALUE CHAIN



COST STRUCTURE

- Investment costs (engineering, construction, equipment, commissioning)
- Costs for training farmers
- Operational and data management costs (labor and maintenance cost) – covered by the farmers
- Maintenance costs – covered from carbon credit
- Savings from energy displacement, both electricity as well as diesel-benefit to farmers

REVENUE STREAMS

- Sales of carbon credit

SOCIAL & ENVIRONMENTAL COSTS

- Potential leakage of CH_4 from bio-digesters

SOCIAL & ENVIRONMENTAL BENEFITS

- Improved social and economic sustainability of livestock farms
- Improved animal waste management system and better working conditions
- Reduced GHG emission (CH_4) and climate change mitigation
- Better local environmental condition by improving quality of water and reducing soil pollution and foul doors
- Dissemination of environmental education among swine producers and the surrounding community
- Displacement of fossil fuel consumption for electricity as well as thermal energy
- Sale of bio-fertilizers to surrounding farmers

and local organization play key roles in mobilizing the community and securing financial resource to establish electricity service provision. Since the project results in carbon offset, there is potential for generating revenue from sales of carbon.

Alternative business model – Centralized biogas systems for carbon credit and sustainable value chain

An alternative business model is setting up centralized biogas systems owned and operated by farm cooperatives, the members being the participating manure suppliers (Figure 67). Thus, instead of installing bio-digesters at individual farms, manure from several farms within a region is supplied to a central bio-digester. Apart from the manure, the plant can receive various sorts of organic waste to increase energy yield of the system. This centralized system can be implemented by the processing factory on a Build, Operate and Transfer (BOT) model. Centralized system would benefit farmers that cannot individually construct and operate a bio-digester on their own due to capital expense or just don't have the required land, other infrastructures, sufficient number of animals and skilled labor to operate a bio-digester successfully or cost effectively.

The centralized system results in improved economic and organizational framework. It has an economy of scale advantages, and the fact that the centralized system results in a significant supply of energy is an advantage in negotiating contracts for sale of electricity to the state utility. Furthermore, the electricity produced can be supplied to the processing factory and partly used at the farms supplying

FIGURE 66. BUSINESS MODEL CANVAS: POWER FROM MANURE FOR RURAL ELECTRIFICATION

KEY PARTNERS

- Municipality
- Non-profit organization
- Community

KEY ACTIVITIES

- Agreement with relevant partners
- Community mobilization
- Organic waste collection
- O&M of the biogas unit
- Sale of electricity and fertilizer

KEY RESOURCES

- Land
- Capital
- Labor
- Manure and other organic waste

VALUE PROPOSITIONS

- Providing low-cost electricity service to houses and businesses in the community
- High quality solid/liquid organic fertilizer for self-use and sale to farmers

CUSTOMER RELATIONSHIPS

- Interaction with community through local subsidiary that manages the operation of the unit

CHANNELS

- Through appropriate agreement and self-interaction
- Direct

CUSTOMER SEGMENTS

- Household and businesses
- Farmers

COST STRUCTURE

- Investment costs (land, building and machines)
- Operational costs (raw material, labor, maintenance costs, marketing costs and R&D)

REVENUE STREAMS

- Sales of electricity
- Sales of organic fertilizer

SOCIAL & ENVIRONMENTAL COSTS

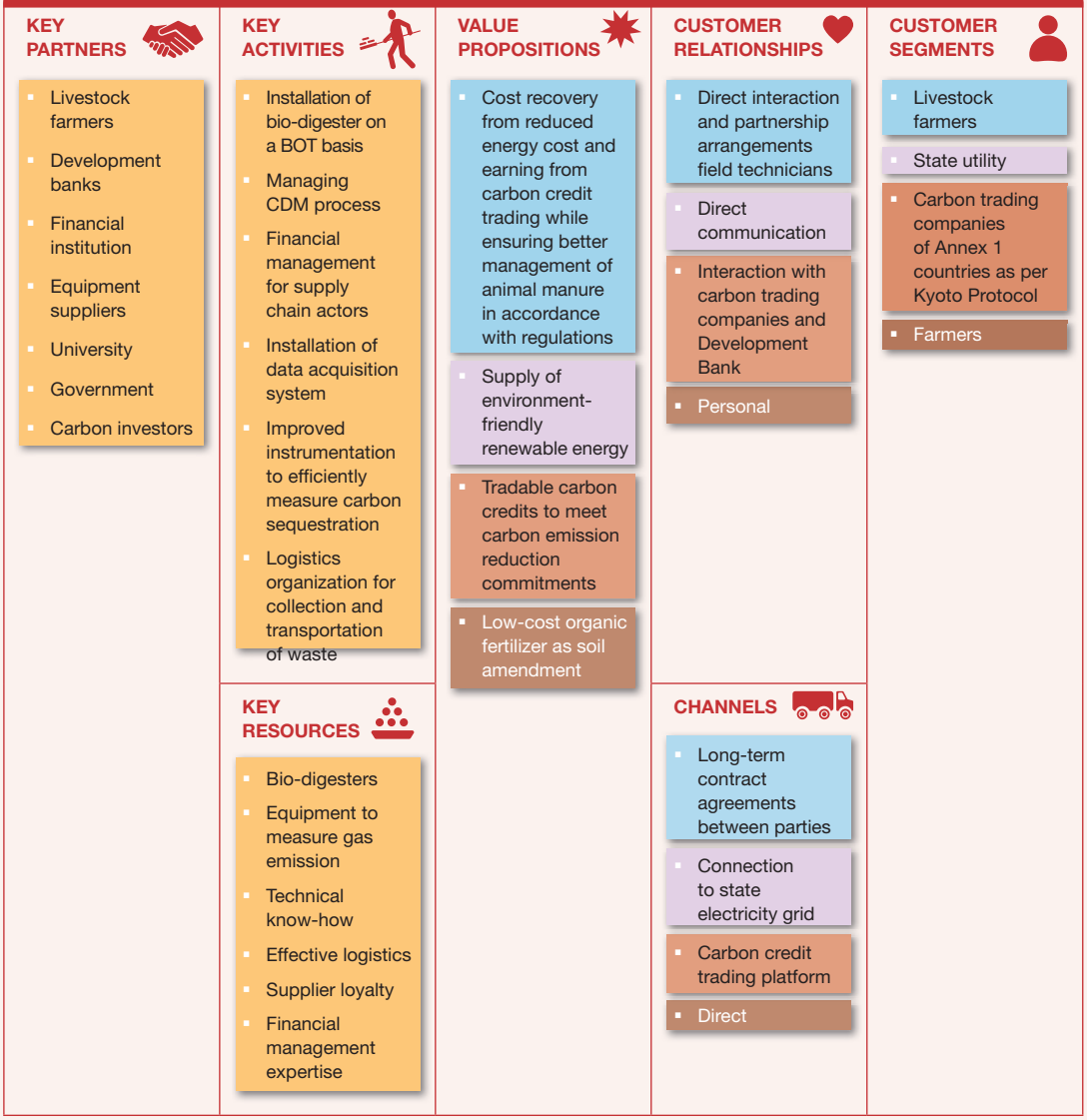
- Potential leakage of methane (CH_4) from bio-digesters

SOCIAL & ENVIRONMENTAL BENEFITS

- Jobs creation
- Environmental benefit through reduced CO_2 emissions by generating electricity from renewable source
- Improved animal waste management system and better working conditions with savings in cost of handling waste
- Better local environmental condition by improving quality of water and reducing soil pollution and foul doors
- Reduced GHG emission (CH_4) and climate change mitigation

the manure. Thus, the entire supply chain, starting from the farm to processing factory becomes energy self-sufficient. The project can be registered as a CDM project and thus earning additional revenue from carbon credit sales. Other industries or supply chains that are willing to pay premium prices for energy produced in a sustainable way can also be targeted. The bio-fertilizer produced can be used by all the participating farms as bedding for their animals or the excess sold as fertilizer and soil amendments to other farms. The drawback of centralized plants is the costly process of transporting livestock manure, and hence, a well-structured logistics is critical for the success of the business.

FIGURE 67. BUSINESS MODEL CANVAS: CENTRALIZED BIOGAS SYSTEMS FOR CARBON CREDIT AND SUSTAINABLE VALUE CHAIN



COST STRUCTURE

- Investment costs (Engineering, construction, equipment, commissioning)
- Costs for training farmers
- Transport costs
- Operational and data management costs (labor and maintenance cost) – covered by the farmers
- Maintenance costs – covered from carbon credit
- Savings from energy displacement, both electricity as well as diesel-benefit to farmers

REVENUE STREAMS

- Sales of electricity
- Sales of carbon credit
- Sales of organic fertilizer

SOCIAL & ENVIRONMENTAL COSTS

- Potential leakage of methane (CH_4) from bio-digesters

SOCIAL & ENVIRONMENTAL BENEFITS

- Improved social and economic sustainability of livestock farms
- Improved animal waste management system and better working conditions
- Reduced GHG emission (CH_4) and climate change mitigation
- Better local environmental condition by improving quality of water and reducing soil pollution and foul doors
- Dissemination of environmental education among producers and the surrounding community
- Displacement of fossil fuel consumption for electricity as well as thermal energy

D. Potential risks and mitigation

This section describes the potential risks and mitigation options for power from manure for carbon credit and sustainable value chain.

Market risks: The outputs from this business model are carbon credits sold in the international market, energy used by livestock farms and surrounding communities and bio-fertilizer used on farmers' own land. Market risks exist for the carbon credits as the carbon credit market is volatile which puts the sustainability of the whole reuse business under risk. Thus, the business has to diversify its revenue streams to sale of power, thermal energy and bio-fertilizers to mitigate market risks. For instance, instead of putting bio-digesters in every farm, the farmers can form a cooperative and build a centralized biogas system (alternative scenario), which collects all the manure from member farmers, processes the manure, produces and sells electricity to the national grid. The energy produced can also be supplied to the processing factories and distributed to member farmers. This ensures market for the electricity produced and also the entire supply chain, starting from the farm to processing factory becomes energy self-sufficient. Moreover, it will allow safety monitoring as well as quality control to be centralized if and where required.

Competition risks: In implementing this business model, the processing factory is incorporating environmental sustainability into its revenue design. The risk associated with output market is low. The carbon credits are sold in the international market. In the scenario where centralized biogas systems produce electricity at a large scale, competition risk can be reduced by entering into a long-term power purchase agreement with the state utility, hence ensuring a ready buyer. The electricity can also have a ready buyer when it is supplied to the processing factory and used within the farms. Moreover, other industries or supply chains that are willing to pay premium prices for energy produced in a sustainable way can be targeted.

Technology performance risks: The technologies applied for processing livestock waste are well-established and mature technologies. However, the technologies require skilled manpower to operate and maintain them. Maintaining the performance of the technologies at the standard level is very critical for the economic and environmental viability of the business as the business heavily depends on earnings from carbon credit sales. Farmer's lack of technical know-how to operate bio-digesters may result in leakages of CH_4 which will significantly reduce the carbon credit earnings. The centralized large scale plant will be easier to operate and maintain by skilled labor, which may be difficult at individual farms.

Political and regulatory risks: With the projected electricity demand set to grow, governments are encouraging green power initiatives by putting in place various incentive mechanisms such as concessional loans, feed-in tariff mechanisms and through long-term power purchase agreements. However, it is not advisable to entirely depend on government incentive mechanisms to ensure sustainability of the business. In order to ensure economic viability, the business should diversify its customer base. This can be done by supplying part of the electricity produced to the processing factory and other industries that are willing to pay premium prices for energy produced in a sustainable manner. However, this will also depend on the electricity regulation of the region where the business is operating.

Social-equity-related risks: The beneficiary of the model may change depending on the end use of the energy generated from manure. In the case of rural electrification, underserved communities are the beneficiary while in the case of livestock industry, power is generated for own use. The model offers employment opportunities which could be provided to informal laborer to mitigate any social equity risks the business model may create.

Safety, environmental and health risks: The environmental risks associated with the bio-digesters include possible leakage of CH_4. The safety and health risks to human arise when processing livestock waste.

Proper protection measures should be put in place to protect laborers (Table 21).

TABLE 21 POTENTIAL HEALTH AND ENVIRONMENTAL RISK AND SUGGESTED MITIGATION MEASURES FOR BUSINESS MODEL 5.

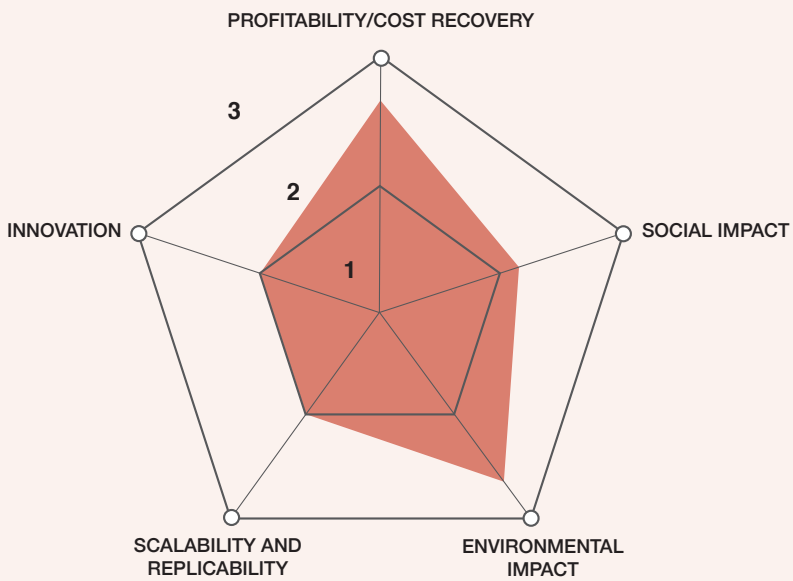
RISK GROUP	EXPOSURE					REMARKS
	DIRECT CONTACT	AIR	INSECTS	WATER/ SOIL	FOOD	
Worker						Direct contact risk relates to pathogens in livestock manure.
Farmer/user						
Community						
Consumer						
Mitigation Measures						

Key: NOT APPLICABLE; LOW RISK; MEDIUM RISK; HIGH RISK

E. Business performance

This business model is rated as high on profitability followed by environmental benefit (Figure 68). The business model is expected to result in a significant reduction of GHG emissions, which consequently is translated into carbon credit sales. Moreover, it is expected to result in promoting sustainable livestock production, generating environmental and social benefits.

FIGURE 68. RANKING RESULTS FOR POWER FROM MANURE MODEL



The business model has a potential to be implemented in regions where there are intensive livestock farms and where there is government support for CDM projects. Designing of innovative financing mechanisms and having access to finance are essential for the successful implementation of and ensuring sustainability of this business model.