Potential global warming of manure management for household pig producers with and without biogas digester in Vietnam

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Introduction

Anaerobic digestion of the manure holds a number of advantages and widely applies in Asia as a technology for manure treatment and biogas production. The biogas can be used in the household for cooking, heating and lightening to replace the use of coal, propane and wood for cooking. In addition, using biogas could reduce odour and flies on livestock farms. However, the solid manure which would normally be left in the animal house and later brought to a field; garden or fish pond is washed into the bio-digester. Because of the high dilution with washing water, transportation is a barrier to recycling the digestate [1]. This means that the nutrients are not recycled, but are typically discharged to the environment. Another disadvantage is that biogas may be lost from the system, which is a problem because the methane contained in it is a strong green house gas. Biogas production increases above the amount needed in the household and the excess gas is in many cases released to environment.

The objective of the study was to assess the global warming associated with biogas digesters in Vietnam and compare them with traditional manure management.

Material and method

Life Cycle Assessment is employed to assess the environmental impact manure management systems with and without biogas digesters throughout its entire life cycle of the manure from storage to field application. The functional unit applied in this study was the treatment of 100 kg of pig solid and 1000 kg of liquid manure collected from animal houses. Beside literature reviews, data were analysed using unpublished data sources from different surveys in the north and south of Vietnam.

Two manure management systems are considered on basis of current farm practices of small and medium-scale farms with and without biogas digester. The fixed dome digester design is mainly used in Vietnam and so it is used for this current study. The manure management systems with and without biogas in northern Vietnam were modelled as found in the study of 12 farms without biogas production and 12 farms with biogas production [2]. Emissions from animal house were not included because emissions were considered to be similar in the two manure management systems. Mineral fertilizer production, and/or energy replacement was included in these models as saved fertilizer and traditional fuels. It is assumed that firewood used for cooking is deadwood or branches broken from live trees which is normally collected and carried home by farmers. Therefore, environmental impacts were negligible to firewood production and transportation.

Results and discussion

The handling of one functional unit of manure resulted in an impact of 4.8 CO_2 equivalents when traditional methods were used. The largest part of the impacts resulted from emissions of methane during solid storage and emissions of nitrous oxide after field application. Some emissions were saved due to avoided fertilizer production, but not enough to compensate for the emissions during storage and after field application.

The handling of a functional unit of manure resulted in an impact of 19.4 CO_2 equivalents when biogas digesters were applied. It is evident that there are large impacts associated with different losses of biogas, which contain methane results in less advantage of biogas technology. The large savings in impacts is caused by the avoided production and combustions of liquid petroleum gas.

The results clearly show that losses of biogas, mainly from intentional release of biogas when production exceeds consumption compromise the environmental benefits of biogas technology. It is therefore important that losses of biogas are prevented by providing options for the utilization or safe disposal of excess biogas such as biogas storage, biogas network sharing and biogas convert to electricity.

References

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Keywords

Environment, life cycle assessment, methane