

Optimizing environmentally friendly biogas production from livestock manure for the reduction of green house gas emissions – SUSANE-II

Editors: Vu Van and Sven G. Sommer

This year the first phase of the SUSANE project is being finalized and a second phase has been initiated. This phase II of the SUSANE project focuses on contributing to enhance the benefits for both farmers and society of using animal manure for biogas production. The overall objective is to convert animal manure from an environmentally detrimental waste to a valuable resource through the development of a sustainable Vietnamese manure-based biogas production. The intention is to ensure that biogas production contributes significantly to both energy production, reduction in greenhouse gas emissions and safe and efficient recycling of the biomass for plant production. We hypothesize that with the current rapid expansion of biogas schemes, not all of these benefits are achieved at the same time.

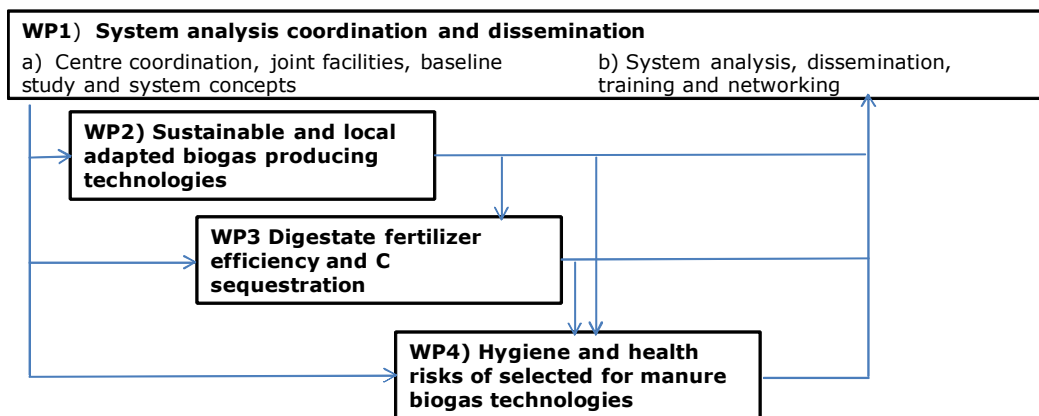


Figure 1. Diagram showing the activities in the project and the links between activities.

1) Activities

There are four closely linked activities in the project. Work-package 1 (WP1) comprises coordination and communication, joint research facilities and baseline studies as input for activities carried out in WP2-WP4. Laboratory and field scale research will be carried out in WP2-WP4 and in WP1 the output of the studies will be used for developing decision support at farm and higher levels. The results from the studies will be disseminated through the SUSANE knowledge centre (WP1) and through in-service and MSc training.

2) Research area and PhD studies

The core issue of the research is optimal and hygienic safe transformation of organic matter in slurry into energy and available nutrients with minimal environmental emissions. It has been identified that the amount of organic matter and ratio of the pool of easily digestible to slowly

digestible organic matter is a most important factor for biogas productivity, emission of the greenhouse gasses methane (CH₄) and nitrous oxide (N₂O) and for carbon addition to soils (C-sequestration).

Precise knowledge of digestibility and amount of excreted organic matter is therefore a crucial issue for R&D in biogas production, emission of GHG, supply of organic matter to the soil C and also pathogen content which is affected by transformation of manure organic matter.

The project has been initiated with a baseline study in northern Vietnam, carried out by the nine Ph.D. students, where manure management in selected provinces (Hanoi and Hue provinces) was monitored and described through an extensive questionnaire survey and sampling of material flows on selected biogas and non-biogas farms and analyses for nutrient budgets and pathogen indicator organism fate.

The SUSANE II studies will be carried out by PhD students enrolled in joined Vietnamese Danish PhD studies, called sandwich PhD studies, and in Vietnamese studies where the student is enrolled in Vietnamese institutions. Both PhD study programs have Vietnamese and Danish supervisors. The PhD studies are presented in Table 1 below. For more information, please see the web page [www. Susane.info/en/home](http://www.Susane.info/en/home)

Table 1. PhD studies in the project.

WPs	PhD studies	PhD students	Place of studies	Supervisors
2	Developing methods for assessing pools of easily and slowly digestible VS in manure for the development of biogas digester control	Ms. Cu Thi Thien Thu	University of Southern Denmark	Prof. S G Sommer Assoc. Prof. Nguyen Xuan Trach
2	Assessing biogas production potential of animal manure biomasses as affected by temperatures and on development of new Vietnamese adapted biogas digesters technology	Mr. Pham Hung Cuong	University of Southern Denmark	Prof. S G Sommer Assoc. Prof. Vu Chi Cuong
2	Study in the methane production and environment treatment efficiency by anaerobic	Ms. Le Thuy Hang	National Institute of Animal	Assoc. Prof. Vu Chi Cuong

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	fermentation of pig production waste supplemented with some plant materials		Sciences	Prof. S G Sommer Assoc. Prof. Bui Van chinh
2	Assessing N, P and organic matter in excreta from sows and their potential biogas production	Mr. Nguyen Van Chao	Hue University of Agriculture and Forestry	Assoc. Prof. Dam Van Tien Assoc. Prof. Hoang Trung Thong
3	Green-house gas emissions and soil C sequestration potential from manure biogas digestate	Mr. Vu Duong Quynh	University of Copenhagen	Prof. Lars Stoumann Jensen Assoc. Prof. Andreas de Neergaard Dr. Tran Duc Toan
3	Transformation of Manure in the Soil and Nutrient Efficiency in Degraded Alluvial Soil	Mr. Nguyen Duy Phuong	VAAS	Dr. Tran Duc Toan Dr. Didier Orange Prof. Lars Stoumann Jensen
3	Research methods of composting with agricultural wastes after Biogas wastewater as fertilizer to reduce pollution, reduce emissions causing greenhouse effect and return to soil organic sources	Mr. Le Xuan Anh	VAAS	Dr Bui Huy Hien Dr Tran Duc Toan
4	Hygiene and health risks associated with manure biogas systems and the management of manure from animal-biogas-application of agricultural land	Ms. Luu Quynh Huong	University of Copenhagen	Prof. Anders Dalsgaard Dr. Pham Thi Ngoc
4	Effects of fermentation in bio-digester on survival of pathogens in effluent	Mr. Le Xuan Anh	Hue University of Agriculture and Forestry	Assoc. Prof. Pham Hong Son Assoc. Prof. Dam Van Tien Prof. Anders Dalsgaard

WP2: Sustainable and locally adapted biogas producing technologies

Ms. *Cu Thi Thien Thu* from Hanoi Agricultural University. The major tasks of the Ph.D. study will be to i) Development of standard reproducible batch fermentation procedures, ii) Develop algorithm for characterization of easily and slowly digestible organic matter in animal slurry, and iii) Develop models for predicting degradability of VS in animal manure.



Mr. *Pham Hung Cuong* from National Institute of Animal Sciences. The major tasks of the Ph.D. study will be to i) Development of standard and reproducible batch fermentation procedures, ii) Develop algorithm for assessing biogas production at low temperatures, and iii) Develop new Vietnamese adapted biogas digester design.



Ms. *Le Thuy Hang* from National Institute of Animal Sciences.



The major tasks of the Ph.D. study will be indentified

Mr. *Nguyen Van Chao* from Hue University of Agriculture and Forestry. The major tasks of the Ph.D. study will be to i) Assessing nitrogen, phosphorus, organic matter in excreta from sows fed prevalent diets in Vietnam, ii) Assessing nitrogen, phosphorus, organic matter in excreta from sows fed prevalent diets in Vietnam with phytases supplementation, iii) Assessing nitrogen, phosphorus, organic matter in excreta from sows fed prevalent diets in Vietnam with some amino acids and iv) Assessing potentially biogas production from sows' manure in vitro conditions.



WP3: Green-house gas emissions, digestate fertilizer efficiency and C sequestration

Mr. *Vu Duong Quynh* from Institute for Agricultural Environment. The major tasks of the Ph.D. study will be to i) Quantify the reduction in GHG emission from storage and treatment of manures (with and without biogas treatment) as affected by introduction of biogas technology, ii) Quantify the GHG emission under field condition with different rate of manure application and iii) Develop methods and algorithms for effect assessment.



Mr. *Nguyen Duy Phuong* from Soils and Fertilizers Research Institute. The major tasks of the Ph.D. study will be to i) optimize utilization of the biogas fermented manure (biodigestate) to produce an organic fertilizer. ii) evaluate nutrient efficiency in agricultural production and in soil rehabilitation, iii) estimate C-sequestration in soil as affected by introduction of a new

organic fertilizer from biodigestate use, iv) pilot demonstrations in farmer fields in order to establish responses to rehabilitation under farmer conditions and socio-economic impact.



Mr. *Le Xuan Anh* from Soils and Fertilizers Research Institute. The major tasks of the Ph.D. study study will be to i) Identify the appropriate composting methods which used by-agricultural products and biogas wastewater for crop nutrition, and ii) Assess economic and environmental effects of using composts which made from by-agricultural products and biogas wastewater for some main crops (maize, rice and soybean) on degraded soil in Northern Vietnam



WP4: Hygiene and health risk assessment of selected manure biogas technologies

Ms. *Luu Quynh Huong* from National Institute of Veterinary Research. The major tasks of the PhD studies will be to i) Identify and assess hygienic aspects of existing and locally adapted biogas technologies ii) Establish quantitative risk models for assessment and reduction of hygiene related risks, incl use of treated manure to fertilize foods.



Mr. *Le Xuan Anh* from Hue University of Agriculture and Forestry. The major tasks of the PhD studies will be to i) Assessing the survival rate of *E.coli* in bio-digester fermentation process, ii) Assessing the survival rate of *Listeria monocytogenesis* in bio-digester fermentation, iii) Assessing the survival rate of *Ascaris suum* eggs during fermentation process in bio- digester and iv) Comparison of survival rate of *E. coli* in two types of bio-digester (polyethylene cylindrical shape and concrete spherical shape).



3) Post-doc research, dissemination and training

Post Doc. Vu Thi Khanh Van from NIAS will be research system responsible carrying out system analysis and contributing to LCA analysis. Post Doc, Tran Minh Tien from SFRI and Post doc. Dang Thi Thanh Son from NIVR will carry out research and be responsible for transfer of knowledge between the phase one and phase two of the project and for teaching in manure management. Furthermore, Post Docs will be responsible for dissemination and training activities , which are:

- Develop animal waste management network and major tasks of the network will be to i) updating, sharing and disseminating of information, ii) Building capacity for animal waste management group iii) Consulting on animal waste management, and iv) Collaboring research activities at national and international level.

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- Coordinate research activities between PhD students to fit the requirements of the project.
- Support the PhD students by giving them advices on setting up research treatments in field, collecting and analyzing samples, and writing papers.
- Develop training materials and course on manure management given to PhD and Msc students in coodination with CIRAD, IRD-IWMI and guest lectures from different institutions.
- Develop a life cycle assessment course which will be given to PhD and Msc students with lectures from Denmark and Vietnam.
- Organize the english and statistic courses for PhD and Msc students.