

Management of Health Risk from Biogas Effluent at Small-Holder Pig Farms in Vietnam: A Transdisciplinary and Community Participatory Approach



A local inhabitant using biogas effluent for crop irrigation

Key messages

In Vietnam, the use of biogas in treatment of livestock waste is a common solution, especially among pig-farm holders. However, most pig-farm smallholders do not operate biogas facilities properly.

- Biogas effluent contains various chemical and biological hazards that can pollute the environment and adversely affect humans and animals' health.
- Effluent from biogas facilities is commonly used in agriculture in rural areas. Therefore, appropriate measures for processing biogas effluent before use are necessary.
- The burden of diarrhea associated with pathogens in biogas effluent was very high, which exceeded 10^{-6} DALYs (disability-adjusted life years) as recommended by the World Health Organization.
- Intervention solutions using Ecohealth approach aiming to change behaviours and practices of people in the operation of biogas facilities contribute to mitigating the burden of diseases and environmental pollution.

In recent years, livestock has been robustly developing, i.e. increasing in the number of herds in general and in herb size/number of households in particular. Small-scale household livestock accounted for 65%-70% of the total production. Waste in animal livestock amounted to 85 million tons per year as opposed to 37 million tons of wastewater per year (*Vietnam rural agriculture, 2014*). A large amount of these wastes is directly disposed to the environment, causing environmental pollution and exerting adverse impacts on human health.



To confront this situation, biogas is used as an effective measure for processing wastes from household-scale and/or farm-scale husbandary. The effectiveness of household biogas to economy, the environment, health and related factors in the context of Vietnam's agriculture needs to be specifically assessed. Therefore, the transdisciplinary and community participatory approach (called Ecohealth approach) has been applied in research to provide scientific evidences, contributing to the development of proper solutions to operate and manage household biogas facilities.



Smallholder pig farm (1) and effluent of household biogas (2)



Wastewater did not meet standards and contained high levels of pathogens.



The quality of household biogas effluent has not met the standards recommended by the WHO, having potential risk of environmental pollution.

In this study, samples of biogas effluent had an average *E. coli* concentration of 1.4×10^6 bacteria/100 ml of biogas effluents, which surpassed the health sector's standard (10^6 bacteria/100 ml) and QCVN 62-MT: 2016/BTNMT (Vietnamese standards on environment issued by the Ministry of Natural Resources and Environment in 2016) with regard to wastewater used in agricultural cultivation (5,000 bacteria/100 ml). The rates of biogas effluent samples containing pathogens such as *Giardia*, *Cryptosporidium* were 44% and 34.7%, correspondingly.

Effluent from biogas is commonly used in agricultural cultivation in rural areas.

Biogas effluents are not further processed and used directly for irrigation of trees and vegetables, or fish raising. About 27.9%, 24.4% and 26.4% of households used biogas effluents for irrigation of crops, fruit trees and vegetables.



Farmer cleaning cages to load waste for biogas

Use of household biogas poses potential threats to human health, especially diarrheal diseases.

It is estimated that the risk of diarrhea due to *E. coli* in biogas effluent ranged from 17.4% to 22.0%. In other words, 17-22 out of 100 people used biogas effluent for agricultural cultivation within a year

in surveyed communes suffered from diarrheal diseases related to this activities. Likewise, the annual risk of diarrhea among local people due to *Giardia* in biogas effluent varied between 0.7% and 2.3% compared to 0.2% - 0.5% due to *Cryptosporidium*. Also

indicated by the assessment results, the burden of diseases among local people due to diarrhea associated with the use of biogas effluent was many times in excess of 10^{-6} DALYS as recommended by the WHO (WHO, 2011). In particular, the burden of diarrhea caused by *E. coli* in biogas effluent ranged between 2,400 and $3,700 \times 10^{-6}$, compared to $180 - 750 \times 10^{-6}$ by *Giardia* and $45 - 130 \times 10^{-6}$ by *Cryptosporidium*. The study estimated 47% of people in the study site carried out activities related to biogas effluent. Therefore, it is of great importance to reduce the quantity of pathogens in biogas effluent before use in agricultural cultivation, and this is considered an public health issue.

Implementation

In 2014, a study was conducted at 451 households using biogas in processing husbandary wastes in three communes of Ha Nam province, namely Hoang Tay and Le Ho communes in Kim Bang rural district, and Chuyen Ngoai commune in Duy Tien district. It aimed to describe the situation of how biogas and their by-products were used in agricultural cultivation. Besides, 75 samples of wastewater from pressure tanks of biogas and 75 samples of sewage where wastewater from those pressure tanks flowed out were tested for microbial and chemical indicators.

The quantitative microbial risk assessment (QMRA) framework was used to assess the potential risk of acquiring diarrheal diseases due to pathogens in biogas effluents when local people carried out their production and agricultural cultivation activities.

This is one of the very first studies in Vietnam to assess the risks of community health related to the management and use of household-scale biogas facilities using an Ecohealth approach.



The research team collected samples of biogas wastewater for testing

From Ecohealth research to Policy

From research to the development and implementation of policies on management and processing of livestock wastes

The situation of the management and use of household biogas facilities is diverse and has a lot of constraints.

The proportion of people with correct knowledge of how to operate and maintain biogas facilities was low. Those who had correct knowledge of retention time of wastes accounted for 1.4%, daily substrate input quantity 1.1%, the “excreta: water ratio” before the input 6.1% and processing compost before the input to increase the efficiency of biogas operation 6.8%. Noticeably, very few surveyed households estimated the “excreta: water ratio” for average daily feedstock (6.8%). The practices of collecting excreta before cleaning pig sheds and selecting an appropriate time for cleaning sheds only accounted for low rates, 25.6% and 26.2%, respectively. These factors either directly or indirectly make the total quantity of waste input surpass the processing capacity of biogas plants. Regarding the average daily feedstock for biogas plants, 80% of households had their latrines connected with biogas systems. This may be a health risk if biogas facilities are not properly operated.

The situation of livestock waste management and impacts on environment and human health

Over the past two decades, Vietnam’s animal husbandary has been rapidly developing to meet the increasing social demand for meat, eggs and milk, leading to the rise in the quality of animal husbandary. Particularly, most households did not apply proper measures for managing wastes. As a consequence, the environment has been heavily polluted, and human health has been severely affected.

Policy recommendations and evidence-informed actions

- Further research is needed to specifically assess the impacts of pathogens possibly available in biogas effluent on the environment, community health, economy and society.
- It is necessary to raise the local governments' and people' awareness and enhance practice of properly using biogas facilities.
- The levels of pollution caused by pathogens and chemicals from biogas effluent need to be monitored and supervised by agencies in the health sector and other related sectors.
- Policy makers, experts and people should understand and practice proper management of biogas facility operation.
- Information, communication and education activities are necessary to change unsafe behaviors of people in operating and using biogas facilities.



People keep track on and clean pig sheds in accordance with the instructed procedure that was developed by researchers, farmers and other stakeholders

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Further Reading

- Luu Quoc Toan et al. 2016. Operation and characteristics of biogas effluents at households in Ha Nam province in 2014. Vietnam Journal of Public Health, Volume 13, issue 2(40).
- Lam S, Pham THG, Dinh XT, Adisasmito W, Pham-Duc P, Jing F, Kittayapong P, Nguyen-Viet H. 2016. Advancing Ecohealth in Southeast Asia and China: Lessons from the Field Building Leadership Initiative. Field Building Leadership Initiative, Hanoi, Vietnam.
- Thu LT, et al., 2016. Exposure to biogas effluents in Ha Nam province, Vietnam - Assessment of diarrhea risk (in revision). International Journal of Public Health.

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