Assessment of the Environmental Status of Household's Pig Farming System, at An Nhon, Binh Dinh Province, Vietnam

M.T. DANG[1)], B.T TO[1)*]

[1)] Faculty of Environment and Labour Safety, Ton Duc Thang University, Ho Chi Minh City, Vietnam
*Corresponding author: dangmythanh@tdtu.edu.vn

http://doi.org/10.29227/IM-2022-02-16

Submission date: 26-08-2022 | Review date: 23-11-2022

The livestock industry has played an important role in Vietnam's economic development. In particular, pig farming is the bright spot of the industry, playing a role in ensuring food security across the country. Along with the rapid development of the livestock industry in general and pig farming in particular, environmental problems in livestock production are becoming more and more serious.

This study was carried out in Nhon Tan commune, An Nhon district, Binh Dinh province to initially assess the environmental status of pig production at household scale in the area. Nhon Tan commune is a mountainous commune, the terrain is mainly forest and low hills, is a purely agricultural commune, the labor structure is mainly agriculture, with little training, so the application of scientific and technological advances production technology has many limitations. In recent years, pig farming in the area has grown rapidly in both scale and value, contributing 51.97% of GDP, the commune's pig herd ranks first in An Nhon district and third in the world. Binh Dinh province (Economic office, Nhon Tan commune, 2020). The whole commune has 05 villages: Nam Tuong 1, Nam Tuong 2, Nam Tuong 3, Tho Tan Bac and Tho Tan Nam, pig raising is scatteredly distributed in all these 5 villages and most households still follow the form of individual husbandry so the scale is still small and scattered.

The investigation and data collection were done in the form of semi-structure interview directly. The survey sample was conducted to meet the data collection, including general information: (1) Number of households raising, number of pigs in the area; (2) livestock scale: less than 10 heads of pigs, from 10 to 50 heads of pigs, more than 50 heads of pigs; (3) time and experience in livestock production, (4) current state of the barn system, (5) livestock production and waste treatment; (6) technical information such as waste classification. By the end of December 2020, the total number of pig-raising households in the area remained 80 households (Economic Department, Nhon Tan commune, 2020), the research team had surveyed on a total of these 80 households. The results show that 59% of households have a number of pigs from 10 to 50 heads, mainly from 6 to 10 years of experience, accounting for 41%. The current status of the barns, 100% of the barn floor in the farms is cement, built 0.5-1m higher than the ground, the roof is 100% covered with corrugated iron, in some barns the roof has the phenomenon of falling down. The disease is clearly acute, rotten, affecting the hygiene of the barn and animal health, especially during the time when swine fever is still present and in the rainy season. In particular, in the process of raising, processing and storing animal feed, countless combinations of waste in solid, liquid and gaseous forms have been generated, 90% of farmers have not controlled and 51% of households have Waste treatment system (Biogas) has not been built to ensure environmental sanitation.

Keywords: *environmental status, household's pig farming, livestock industry, biogas, sustainable development*

Introduction

Vietnam in the last 5 years, pork production accounted for 76% of all meat production (Thu, 2019). Pork products are familiar and indispensable products for Vietnamese people, it has become the most popular food compared to other types of meat on the market such as beef, buffalo, chicken, shrimp, crabs. Along with the rapid development of the livestock industry in general and pig farming in particular, environmental problems are becoming more and more serious. The phenomenon of environmental pollution occurs not only in developed countries but also in developing countries including Vietnam.

An Nhon is a mountainous commune, in Binh Dinh province, Vietnam. The terrain is mainly forest and low hills. As a purely agricultural district, people are rarely trained in farming and livestock techniques, so the application of science and technology to improve production is still limited. In recent years, in An Nhon district, small-scale livestock production and pig farms have grown rapidly in both size and value, contributing approximately 52% of GDP (Binh Dinh, 2020). The pig herd of An Nhon district ranks third in Binh Dinh province. In An Nhon district, most pig raising models still follow the individual and traditional form. The development of livestock means that a lot of waste is released into the environment, which, if not properly managed and treated, will be a serious source of greenhouse gas emissions, with a great impact on climate change, threatening soil quality, surface water, groundwater and human health. Therefore, environmental problems in livestock production are becoming more and more serious. The current situation of livestock environment in Nhon Tan commune is a common feature of many villages in rural Vietnam, so it is necessary to quickly find management measures to make the most of waste resources and minimize waste environmental pollution. The study was carried out with two main objectives: (1) Assessment of the environmental status of household's pig farming system at An Nhon, Binh Dinh province. (2) Applying some available technology to improve the environmental status of household's pig farming in this area.

Fig. 1. Study area in Binh Dinh province
Rys. 1. Lokalizacja badanych gospodartw w prowincji Binh Dinh

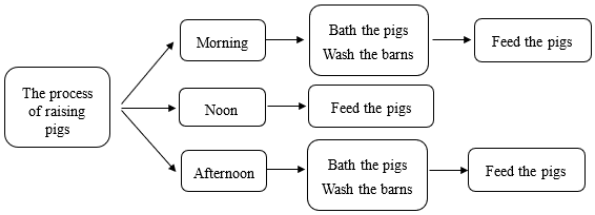
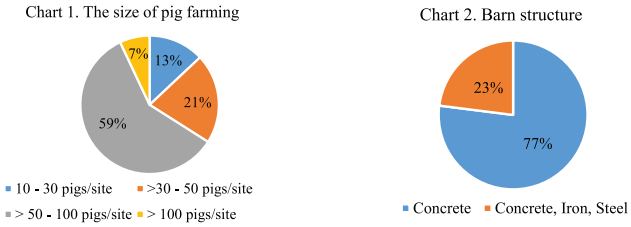


Fig. 2. The process of raising pigs
Rys. 2. Proces hodowli świń



Wykres 1. Wielkość farm świńskich
Wykres 2. Struktura obory

Materials and Methods

Study Area

In Vietnam, this study was conducted in Binh Dinh province, mainly focusing on An Nhon commune - the locality with the third largest pig raising scale in Binh Dinh province.

Sample Collection

The study applying the Slovin's method to determine the sample size in case the overall size is known.

With the lowercase n is the sample size, and the uppercase N is overall size, the total pig site in An Nhon district is 874 (Follow to Economic Department, Binh Dinh province, in first 6 months of 2020). So, we can calculate the sample size is 274 the pig sites.

$$\Rightarrow n = \frac{N}{1+N\times e^2} = \frac{874}{1+874\times 0.05^2} \approx 274\ (The\ pig\ sites)$$

With:
n: The sample size
N: Overall size (874 *The pig sites*)
e: Allowed error (choose e = 5%)

With this sample size, we investigated and collected data through using a semi-structured interview directly, it focuses on main groups question such as:

- The process of raising pigs
- The characteristics of pig farming in An Nhon
- Raw materials in livestock
- Application of mechanization in pig farming
- The waste and the status waste treatment from pig farm

Data Analysis

Statistical Package for the Social Sciences software (SPSS, version 18.0) was used for statistic and assessment. In this study, the results were selected and expressed as a percentage (%) or the chart depending on the in-tended use.

Results and Discussions

The process of raising pigs

Through the survey process, it shows that the pig raising process of the households in An Nhon district is similar. There is only variation in the time for pig shower, the barn washed and feed pigs. Most of the households bath their pigs

Fig. 3. Pig feed storage
Rys. 3. Magazyn paszy dla świń

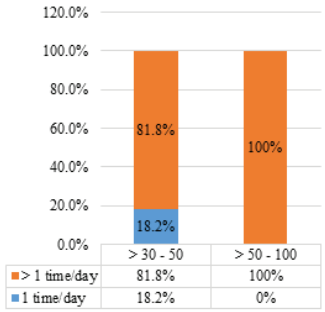


Chart 3. The ratio of washing barn
Wykres 3. Częstotliwość mycia stodoły

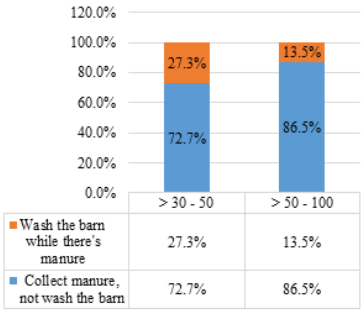


Chart 4. The ratio of manure removal
Wykres 4. Stopień odzysku gnojowicy

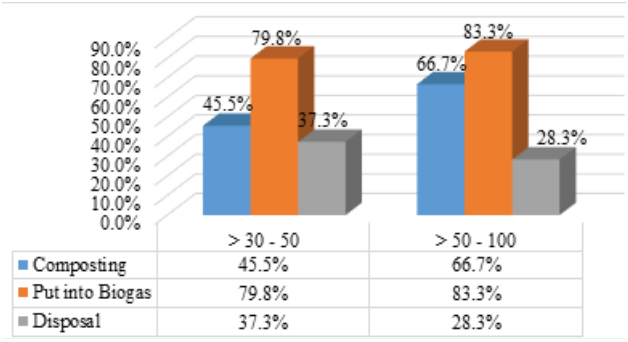


Chart 5. The method of pig manure treatment
Wykres 5. Metody postępowania z gnojowicą

twice per day (in the morning and in the afternoon), and they bath their pigs combine with washing the pens.

The flow of water for pig shower depends on the number of pigs. Wastewater from the process of bathing pigs and washing the barns will be piped down to the Biogas tank for treatment or disposal on the fields, into the near canals. Therefore, we can summary the process of raising pigs including 3 times: in the morning, at noon and in the afternoon.

The characteristics of pig farming in An Nhon

Survey Data Analysis shows that the size of pig farming focus on from over 50 to under 100 pigs per site with 59% and 21% is from over 30 to under 50 pigs per site in Pie chart 1. To explain for this, An Nhon is a mountainous district, most of the pig farms are still follow the form of individual and traditional method. Therefore, it will be limited in quantity.

With the barn structure in Pie chart 2, The barn is mainly built of concrete with 77%, and some households also combine concrete with iron and steel barns to separate the sow and pregnant pigs for convenient to care and clean.

Raw materials in livestock

Feed for pigs is bran mainly. In addition, some households also add pellets, probiotics, beer wort or something like that, into the food of pigs. Most of the livestock households use automatic feeders, so the loss and loss of feed is also limited significantly. Food of pigs is stored in a separate warehouse.

There are some famer households have not an area to build a warehouse, it is stored indoors their house or indoor the barn area. So, the food is not well preserved.

Food of pigs is stored in a separate warehouse. There are some famer households have not an area to build a warehouse, it is stored indoors their house or indoor the barn area. So, the food is not well preserved. This is the cause of reducing the quality of the feed affecting the growth of the pig.

The famers separate the sow and pregnant pigs for convenient to care and clean.

The waste and the status waste treatment from pig farm

Wastes from pig farming include: (1) Pig manure, (2) Pig urine, (3) Water to clean the barn, (4) Dead pig carcass, (5) Veterinary specimens, (6) Odor.

Fig. 4. The situation of waste disposal in household's pig farming system at An Nhon
Rys. 4. Składowanie odpadów na farmie świń w An Nhon

Fig. 5. The situation of waste disposal in household's pig farming system at An Nhon
Rys. 5. Składowanie odpadów na farmie świń w An Nhon

Fig. 6. The methods of waste anaerobic treatment
Rys. 6. Metoda anerobowej przeróbki odpadów

Tab. 1. The wastewater characteristics from pig farms
Tab. 1. Charakterystyka ścieków z farmy świń

Parameter	*Unit*	*Value*
pH	-	7-8
TSS	mg/l	1000
BOD5	mg/l	2014
COD	mg/l	3082
Total Nitrogen	mg/l	212
Total Phosphorus	mg/l	8
Coliform	MPN/100ml	107

Tab. 2. The quota for biogas generation from livestock waste

Tab. 2. Ilość biogazu generowanego z odpadów zwierzęcych

Kind of waste	*Kg VSS generate/ animal/day*	*% VSS decomposing*	*CC Biogas/mg/ VSS generate*	*m^3 Biogas/ animal/day*
Waste from cows	4,0 kg	30%	800 cc/mg	1 m^3
Waste from pigs	2,7 kg	50%	1.100 cc/mg	1,6 m^3
Waste from poultry	5,9 kg	60%	600 cc/mg	2,2 m^3

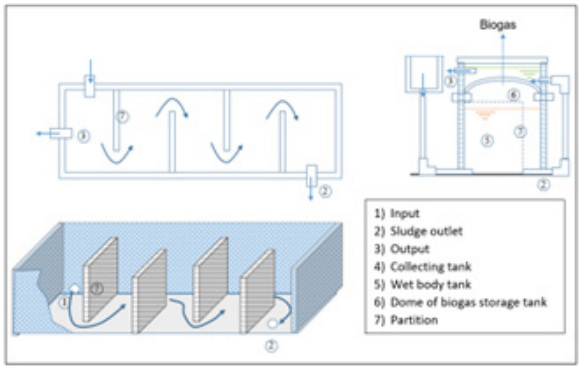


Fig. 7. The available technology

Rys. 7. Dostępna technologia W

In which, the most generated amount is pig manure, pig urine and water to clean the barn. Dead pig carcass and veterinary specimens only generate at the time when pigs are sick. For odor, with mountainous characteristics, the pig farming are sparse, so the odor doesn't have an effect significantly.

Chart 3 shows the ratio of washing barn with the scale from over 30 to under 50 and over 50 to under 50 for one time/day or more than 1 time/day. This figure explains the flow of water discharged in each pig bath, it also depends on the number of pigs. Chart 4, this chart illustrates the figures about the ratio of manure removal in 2 cases: the first, wash the barn while there's manure and the second, collect manure, not wash the barn. The method of pig manure treatment including: composting, put into Biogas and disposal. Each household's pig farming can apply more than one method, it showed at Chart 5. Besides that, the household's pig farming dispose the waste from pig farming around their land, into canals near their house or make wet fertilizer to plant the trees.

Another way, the household's make composting from pig manure.

Two popular ways of composting in An Nhon district are: Biogas bag and Biogas tank. Because the missing in transferring Biogas technology, the household's pig farming can't know how to calculate the scale of Biogas tank correctly. Therefore, the waste treatment from pig farms aren't effective. Besides that, they're only use Biogas tank to treat the waste. It's a an unoptimized design when lack of clarifier tank before and after the main Biogas tank.

This is the wastewater characteristics from pig farms, we can see the parameter TSS, BOD, COD. Among that, TSS, it's over 150 milligrams per liter. So, if move this flow into main Biogas tank, it's can't treatment completely.

Applying some available technology

From The quota for biogas generation from livestock waste, following The New Age International Publisher. We can see that waste from pig has 2,7 kg Volatile Solid (VSS) generate/animal/day. Accordingly, having 1100 CC biogas/mg/VSS generate. So, we can calculate the scale of Biogas tank correctly.

The design of clarifier tank before and after the Biogas tank. We can see the symbol number 1, this's input waste water, symbol 7 is partition, we have 4 partitions in here. Wastewater moves to the last partitions, under the last partitions, symbol 2 is the sludge outlet, behind the last partitions, here output wastewater treated….5 is wet body tank and 6 is dome of biogas storage tank.

Conclusions

Before the situation of African swine fever is still raging, the owners of pig raising households in Nhon Tan commune are very concerned about the increase in herd. Most households import piglets from reputable farms, having bought before in a small quantity, with the desire to continue with the profession and maintain the family economy. Before that, a cholera epidemic caused many livestock farms to close. Currently, the total number of pigs in the area is about 814, down 90.3% compared to the same period last year.

The source of feed for pigs is taken from eateries and restaurants and mixed with industrial bran. Therefore, the quality of diets for pigs cannot be guaranteed. Sanitary wastewater from the barn is discharged into the biogas tank and then to the receiving source without any other treatment. Therefore, the quality of wastewater discharged after biogas does not meet the required standards.

In general, pig raising in Nhon Tan commune applies outdated breeding technology, there is no investment in supporting models to help people both save water use, save effort, and save money. solve environmental problems. At the same time, the management of the government is not effective. Therefore, in order to limit environmental pollution caused by livestock production, it is necessary to perform well from planning the breeding area to building or renovating a reasonable system of stables, taking into account the increased demand for livestock. herd later. Attention should

Fig. 8. The Biogas technology
Rys. 8. Techologia produkcji biogazu

be paid to taking advantage of waste sources to use for other agricultural models, creating more economic for the family. Combining both the interests of the breeder and the problem of environmental protection.

Strengthening the management and state supervision of animal husbandry safety and environment for the purpose of synchronizing the environmental pollution control system.

Acknowledgement

The authors would like to express our thanks the Department of Economic and Department of Environment of Nhon Tan Commune, An Nhon District, Binh Dinh Province for human and the technical support for this study.

Literatura – References

1.]. Department of Economic of Nhon Tan Commune, An Nhon District, Binh Dinh Province. (2020). Report on socio-economic development of Nhon Tan commune. Nhon Tan Commune.
2. ICRAF Vietnam. (2018). CSA Practice No. 04 - A collection of replicable Climate Smart Agriculture (CSA) models.
3. Cong, H. V. et al. (2019). Initial study to calculate CH4 emissions from pig production waste at different scales in Van Giang district. Hung Yen province.
4. Huong, V.T.T and associates. (2013). Research on the current situation and environmental management solutions in household and small-farm livestock production in some northern provinces. Journal of Irrigation Science and Technology No. 18.
5. America, V. T. (2017). Study to evaluate the effectiveness of organic matter treatment in livestock wastewater by upstream filtration biotechnology. Vietnam Science and Technology Magazine No. 32.
6. Tung, N. T. (2015). The impact of the Trans-Pacific Partnership (TPP) on the Vietnamese livestock industry: an approach from a partial equilibrium model. Vietnam Science and Technology Magazine No. 11.
7. Thang, N. T. (2015). Enhancing the competitiveness of smallholder livestock production outcomes and interventions from the LIFSAP project. LIFSAP Vietnam.
8. Trung, D. Q. (2019). Research on the anaerobic decomposition of pig waste and organic waste in rural activities to produce methane and organic fertilizers. Vietnam Science and Technology Magazine No. 28.
9. Vien, T. D. (2016). Study on the effectiveness of application of bio-buffer technology in pig farming at households. Vietnam Science and Technology Magazine No. 17.
10. Celia De La Mora –Orozco and partners. (2018). Removing organic matter and nutrients from pig farm wastewater with a constructed wetland system. J. Envirion Public.
11. Natsima Tokhun. (2010). Piggery farm wastewater: Alternative solution for agriculture and solid fertility, IJERD Public.

Ocena stanu środowiska w zakładzie hodowli świni w gospodarstwie w Nhon, prowincja Binh Dinh, Wietnam

Przemysł hodowlany odegrał ważną rolę w rozwoju gospodarczym Wietnamu. W szczególności hodowla trzody chlewnej jest jasnym punktem branży, odgrywając rolę w zapewnieniu bezpieczeństwa żywnościowego w całym kraju. Wraz z szybkim rozwojem przemysłu hodowlanego, a w szczególności hodowli trzody chlewnej, problemy środowiskowe w produkcji zwierzęcej stają się coraz poważniejsze. Badanie to przeprowadzono w gminie Nhon Tan w dystrykcie An Nhon w prowincji Binh Dinh w celu wstępnej oceny stanu środowiskowego produkcji trzody chlewnej na skalę gospodarstw domowych na tym obszarze. Gmina Nhon Tan to gmina górzysta, teren to głównie lasy i niskie wzgórza, jest gminą czysto rolniczą, struktura pracy to głównie rolnictwo, poziom wykształcenia pracowników niewysoki, więc zastosowanie technologii produkcji postępu naukowego i technologicznego ma wiele ograniczeń. W ostatnich latach hodowla trzody chlewnej na tym obszarze gwałtownie wzrosła, zarówno pod względem skali, jak i wartości, generując 51,97% PKB, a pogłowie trzody chlewnej gminy zajmuje pierwsze miejsce w dystrykcie An Nhon i trzecie na świecie. Prowincja Binh Dinh (urząd gospodarczy, gmina Nhon Tan, 2020). Cała gmina ma 5 wiosek: Nam Tuong 1, Nam Tuong 2, Nam Tuong 3, Tho Tan Bac i Tho Tan Nam, hodowla trzody chlewnej jest rozproszona we wszystkich pięciu wioskach, a większość gospodarstw domowych nadal prowadzi indywidualną hodowlę, więc skala hodowli jest wciąż mała i rozproszona. Badanie i zbieranie danych przeprowadzono bezpośrednio w formie wywiadu częściowo ustrukturyzowanego. Próba badawcza w celu zebrania danychzostała wytypowana w celu uzyskania ogólnych informacji: (1) liczba gospodarstw hodujących, liczba trzody chlewnej na danym terenie; (2) liczba zwierząt gospodarskich: poniżej 10 sztuk, od 10 do 50 sztuk, powyżej 50 sztuk; (3) czas i doświadczenie w produkcji zwierzęcej, (4) aktualny stan systemu obory, (5) produkcja zwierzęca i utylizacja odpadów; (6) informacje techniczne, takie jak klasyfikacja odpadów. Do końca grudnia 2020 r. łączna liczba gospodarstw domowych zajmujących się hodowlą trzody chlewnej na tym obszarze wynosiła 80 (Departament Ekonomiczny, gmina Nhon Tan, 2020), zespół badawczy przeprowadził ankietę w sumie w tych 80 domach. Wyniki pokazują, że 59% gospodarstw posiada liczbę trzody chlewnej od 10 do 50 sztuk, głównie od 6 do 10 lat doświadczenia, co stanowi 41%. Stan obecny stodół, w 100%gospodarstw posadzka obory jest cementowa, zabudowana 0,5-1m wyżej od gruntu, dach w 100% pokryty blachą falistą, w niektórych oborach występuje zjawisko zapadania się dachu. Odory występujące mają charakter wyraźnie ostry, zgniły, wpływający na higienę obory i zdrowie zwierząt, szczególnie w okresie występowania pomoru świń oraz w porze deszczowej. W szczególności w procesie hodowli, przetwarzania i przechowywania paszy dla zwierząt powstały niezliczone kombinacje odpadów w postaci stałej, płynnej i gazowej, 90% rolników nie kontroluje, a 51% gospodarstw domowych posiada system przetwarzania odpadów (biogaz).

Słowa kluczowe: *stan środowiska, chów trzody chlewnej, przemysł hodowlany, biogaz, zrównoważony rozwój*