



Received: 15-09-2025
Accepted: 25-10-2025

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Analysis of the Effects of Large Swine Farm Waste in Savannakhet Province, Laos

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DOI: <https://doi.org/10.62225/2583049X.2025.5.6.5198>

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Abstract

The effluent wastewater quality from the last ponds of three swine farms in the Lao PDR—TVX, MX, and BSV—was examined in this study. pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), temperature, and electrical conductivity (EC) were among the factors that were examined. 6.04 ± 0.07 , 6.10 ± 2.67 mg/L, 69.93 ± 32.50 mg/L, $30.08 \pm 1.05^\circ\text{C}$, and 677.33 ± 10.07 $\mu\text{S/cm}$ were the average values of these parameters in the TVX farm. 5.92 ± 0.04 ; 9.55 ± 3.57 mg/L; 50.93 ± 8.07 mg/L; $28.97 \pm 0.86^\circ\text{C}$; and 214.33 ± 51.48 $\mu\text{S/cm}$ were the

equivalent averages in the MX farm, whereas the BSV farm had the following: 6.68 ± 0.18 ; 11.35 ± 0.98 mg/L; 62.73 ± 8.40 mg/L; $35.82 \pm 1.11^\circ\text{C}$; and 236.17 ± 5.24 $\mu\text{S/cm}$. The findings showed that all three farms' measured parameters fell within the wastewater quality range set by the Lao PDR's Ministry of Natural Resources and Environment (MONRE, 2017) [6]. These results show that the swine farms under study have efficient wastewater treatment systems that guarantee the effluents released into the environment adhere to national environmental regulations.

Keywords: Swine Farm, Wastewater, Analysis, Last Pond

1. Introduction

The objective of commercial pig production is to produce and market pigs or pig meat by breeding, maintaining, and rearing pigs (*Sus scrofa*) in whole or in part (Office International des Epizooties [OIE], 2022) [5]. Pig farming is an important part of the culture and economy, and it serves as a primary source of income (Okello *et al.*, 2017) [8]. It also plays a significant role in farmers' traditional livelihood activities (Keonouchanh *et al.*, 2014) [3]. According to the Department of Livestock and Fisheries [DLF] of the Ministry of Agriculture and Forestry [MAF] in Lao PDR (2017), pig farming provides not only food and nutrition but also a vital means of sustenance. Cleaning, bathing, and manure make up the majority of swine farm wastewater. The fattening pig has the highest levels of the chemical oxygen demand (COD) at 7,000–10,000 mg/l and Biological Oxygen Demand, or BOD, at 1,500–3,000 mg/l (Naviphoum *et al.*, 2003) [7]. Although they also aid in maintaining the soil's fertility, total nitrogen and the entire phosphorus in manure are believed to be the main causes of environmental contamination (Briukhanov *et al.*, 2020) [1]. According to the results of the inventory, Laos removes 414.900 megagrams of carbon dioxide per year, making it a net carbon dioxide sequester. Agriculture accounts for 81% of the 312 gigagrams of methane gas released annually. According to Holt *et al.* (2019) [2], 40% of farmers applied garbage as fertilizer. 40.9% of farmers in Luang Prabang let the manure flow off into water sources, compared to 48.3% of farmers in Savannakhet who did nothing with it. Wastewater is released into the environment in some places as a result of swine producers' improper waste treatment. This research aims to assess the wastewater quality from large swine farms in Savannakhet Province, Laos.

2. Methodology

The wastewater was collected from the last ponds of three (3) large swine farms, such as Bouasavanh Swine Farm (BSV) in Nonphai village (NP), Songkone district; Thavyxay 2 Swine Farm (TVX) in Lak 35 village (L35), Champhone district, and Mixay Swine Farm (MX) in Kenglouang village (KL), Phalanxai district.

Sampling Site of the Study: Three (3) sampling sites in a pond, and two (2) samples per sampling site were collected (6 samples/pond/farm). A total of 18 samples from four swine farms were submitted to the Laboratory for analysis using a grab

The wastewater from swine farms in the last pond (before release to the natural environment) was collected and analyzed for water quality as pH, Temperature, Electrical Conductivity (EC), Biological Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) parameters.

The Microsoft Excel program 2020 was used for data encoding and generating tables. The Statistical Package for the Social Sciences (IBM SPSS Software version 25) was used for descriptive statistics such as mean/average, sum, and standard deviation (SD) of sample sites in different ponds from three farms.

3. Results and Discussion

3.1 Wastewater of the TVX Swine Farm

The wastewater quality of the TVX swine farm from the last pond. The results show the pH values increasing in the following order for sampling sites 1, 2, and 3: 5.98 ± 0.04 mg/L, 6.03 ± 0.01 mg/L, and 6.12 ± 0.03 mg/L, respectively. The BOD values are highest at sampling site 2, followed by sampling site 3, and lowest at sampling site 1, with values of 9.30 ± 0.85 mg/L, 4.65 ± 0.64 mg/L, and 4.35 ± 1.91 mg/L, respectively. Similarly, the COD values are highest at sampling site 3, followed by sampling site 2, and lowest at sampling site 1, with values of 98.55 ± 52.96 mg/L, 57.45 ± 1.77 mg/L, and 53.5 ± 1.70 mg/L, respectively. The average values of pH, BOD, COD, temperature, and EC were 6.04 ± 0.07 , 6.10 ± 2.67 , 69.93 ± 32.50 , 30.08 ± 1.05 , and 677.33 ± 10.07 , respectively.

This study found that all five parameters of wastewater quality in the TVX swine farms are under the standard of MONRE (2017) [6] in the Lao PDR. It means that the wastewater management in the TVX swine farm is adequately treated. The reason may be that the swine farm has only nursery pigs, and their wastewater management processes in the farm are that manure and waste are cleaned into the anaerobic pond, then wastewater is connected to the biogas plant production, the liquid fractions from biogas are dumped into 5 five ponds for wastewater treatment. On the other hand, nursery pigs consume less drinking water and feed, and without water bathing their pig when compared to fattening and breeder pigs. Similarly, the report by Catelo *et al.* (2019) [9] revealed that commercial farms can reduce their BOD levels by up to 16 mg/L, rendering the incoming water suitable for recreational and bathing activities. Emissions from swine production are highest in feed production at 60% followed by manure storage/processing at about 27% and the remaining is a combination of post-farm processing at 13% (MacLeod *et al.*, 2013) [10].

3.2 Wastewater of the MX Swine Farm

Wastewater from the MX swine farm from the last pond. The pH levels at sampling sites 1, 2, and 3 were recorded as 5.93 ± 0.03 mg/L, 5.88 ± 0.03 mg/L, and 5.94 ± 0.04 mg/L, respectively, with the highest pH level at site 3. The BOD values were highest at site 1 (10.35 ± 5.73 mg/L), followed by site 3 (9.90 ± 2.97 mg/L), and lowest at site 2 (8.4 ± 4.24 mg/L). In terms of COD values, the highest was observed at site 3 (55.05 ± 12.09 mg/L), followed by site 1 (52.55 ± 5.16 mg/L), and the lowest at site 2 (45.2 ± 6.93 mg/L). The average values of pH, BOD, COD, temperature, and EC were 5.92 ± 0.04 , 9.55 ± 3.57 , 50.93 ± 8.07 , 28.97 ± 0.86 , and 214.33 ± 51.48 , respectively.

This study shows that all five parameters of wastewater quality in the MX swine farm are under the standard of

MONRE (2017) [6] in Lao PDR. The reason may be that the swine farm collected manure in the pen before cleaning waste into the pond, and their farm has four ponds for wastewater treatment. The pond size is about 10,000 m² (50 x 200 m in width and length). On the other hand, they are planting water spinach in the last pond for treating wastewater, and this pond allows people near the farm to access the pond to harvest water spinach using small boats. These findings are similar reasons of the report of Trang *et al.* (2015) that water spinach effectively absorbed nutrients, including nitrogen and phosphorus, from the wastewater, with higher removal rates observed in systems with longer retention times.

3.3 Wastewater of the BSV Swine Farm

The results of wastewater analysis in the last pond of the BSV swine farm. The pH value is highest at sampling site 3 (6.83 ± 0.04 mg/L), followed by sampling site 2 (6.75 ± 0.01 mg/L), and lowest at sampling site 1 (6.46 ± 0.02 mg/L). The BOD value is highest at sampling site 1 (11.85 ± 1.48 mg/L), followed by sampling site 3 (11.40 ± 0.85 mg/L), and lowest at sampling site 2 (10.8 ± 0.85 mg/L). The COD value is highest at sampling site 1 (66.65 ± 11.24 mg/L), followed by sampling site 2 (62.35 ± 10.39 mg/L), and lowest at sampling site 3 (59.2 ± 7.92 mg/L). The average values of pH, BOD, COD, temperature, and EC were 6.68 ± 0.18 , 11.35 ± 0.98 , 62.73 ± 8.40 , 35.82 ± 1.11 , and 236.17 ± 5.24 , respectively.

Table 1: Results of water quality analysis of the selected large commercial swine farms

Parameters ¹	TVX	MX	BSV
pH	6.04 ± 0.07	5.92 ± 0.04	6.68 ± 0.18
Temp (°C)	30.08 ± 1.05	28.97 ± 0.86	35.82 ± 1.11
EC (µS/cm)	677.33 ± 10.07	214.33 ± 51.48	236.17 ± 5.24
BOD (mg/L)	6.10 ± 2.67	9.55 ± 3.57	11.35 ± 0.98
COD (mg/L)	69.93 ± 32.50	50.93 ± 8.07	62.73 ± 8.40

¹Values are mean (n=6)

This study shows that all five parameters of wastewater quality in the BSV swine farm are under the standard of MONRE, (2017) [6] in Lao PDR. The reason may be because the swine farm collected manure in the pen before cleaning wastes into the pond, and their farm has five ponds for wastewater treatment. The first three ponds are about 2,000 m² (20x100 m in width and length), and the remaining two large ponds are about 20,000 m² (100x200 m in width and length). On the other hand, in the third pond, they always pumped wastewater to their forage (Napier, Mulato, and Guinea grasses).

Similarly, with the report of Smiderle *et al.*, (2016) [11] the reuse of wastewater for agriculture found that the highest concentration of both micro and macronutrients in wastewater can promote healthier plant growth. Wastewater enhances the chemical, biological, and physical properties of the soil because it supplies nutrients for the crops with high productivity while lowering costs.

The wastewater analysis of three swine farms under study has found that the MX, TVX, and BSV swine farms do not meet the wastewater quality standard set by MONRE (2017) [6]. This is due to these swine farms being operational for over 9 years, then wastewater was stored in the last pond for treatment, and the wastewater from the last pond was collected for analysis of wastewater quality, as detailed in the previous objective in the wastewater management

section. These findings are like those of Cheng *et al.* (2004) also found that the piggery farm raises pigs from farrowing to weaning, with about 4,000 sows, has high-strength wastewater (18,000 mg/L of COD; 1,600 mg/L of TKN; 360 mg/L of total phosphorus).

This objective finding is that the wastewater quality analysis of three large swine farms (TVX, MX, and BSV) in Savannakhet Province, Lao PDR, revealed significant variations across the farms. The TVX, MX, and BSV swine farms had wastewater parameters within acceptable limits, likely due to their longer operational histories and more established wastewater treatment practices. TVX is within standards, likely due to effective wastewater management, such as lower pig water consumption and reduced bathing in the pig pen, as this farm focuses on nursery piglets. MX within standards, with additional treatment from water spinach cultivation in the last pond, and BSV within standards, with wastewater used for irrigating forage crops.

4. Conclusions and Recommendations

The pH, BOD, COD, temperature, and EC values of the effluent from the final ponds of the three swine farms (TVX, MX, and BSV) were all found to be within the permissible ranges established by MONRE (2017) [6]. The MX farm had the lowest EC levels among the farms, while the BSV farm had the highest BOD and COD values. The TVX farm's multi-pond treatment method and biogas generating system probably contributed to its successful wastewater treatment demonstration. By using a four-pond system and growing water spinach, which further absorbed nutrients like phosphate and nitrogen, the MX farm was able to maintain high effluent quality. Despite having somewhat greater amounts of organic load, the BSV farm likewise demonstrated good treatment performance. All things considered, the findings show that the swine farms in this research have put in place appropriate wastewater management systems that reduce pollution and comply with national environmental standards.

The recommendations include: Frequent Monitoring: to guarantee adherence to MONRE regulations, continuously check the quality of wastewater. Nutrient Reuse: to absorb nutrients and help the community, employ aquatic plants like water spinach. Enhance Biogas Systems increases the amount of biogas collected and uses it on farms as a renewable energy source. Training Programs: Teach farm laborers how to maintain ponds and handle garbage, and Model for Other Farms: Use these efficient techniques for managing wastewater in other pig farms in the Lao PDR.

5. Acknowledgement

The corresponding author is deeply thankful to the PAFO, DAFO, and Commercial swine farms of Savannakhet province for allowing him to conduct data gathering for his research. He would *also* like to thank his co-authors and his teammates.

6. References

1. Briukhanov A, Dorokhov A, Shalavina E, Trifanov A, Vorobyeva E, Vasilev E. Digital methods for agro-monitoring and nutrient load management in the Russian part of the Baltic Sea catchment area. IOP Conf. Ser. Earth Environ. 2020; 578:12011. [CrossRef]
2. Holt HR, Inthavong P, Blaszk K, Keokamphe K, Phongmany A, Blacksell, SD, *et al.* Production diseases in smallholder pig systems in rural Lao PDR. Prev. Vet. Med. 2019; (162):110-116.
3. Keonouchanh S, Phengsavanh P, Somchanh K. Complied for study and research on Lao local livestock breeds. NAFRI Rep, 2014, 30-43.
4. Ministry of natural resources and environment (MONRE). Lao National Environment Standard Department of Pollution Control, Laos, 2017, p32.
5. Office International des Epizooties (OIE). Animal welfare and pig production systems, 2022. Retrieved on July, 19 2023 from: https://www.woah.org/fileadmin/Home/eng/Health_standards/tahc/current/chapitre_aw_pigs.pdf
6. Ministry of Natural Resources and Environment (MONRE). Lao National Environment Standard Department of Pollution Control, Laos, 2017, p32.
7. Naviphoum KN, Songpakob S, Bounrath P, Aiemsamer K, Sounithsakoun S, Simachon V, *et al.* Handbook for treating wastewater of swine farms as a standard of the Department of Livestock in Thailand. Pollution Control Department. Ministry of Natural Resources and Environment, 2003, 1-2.
8. Okello AL, Tiemann TT, Inthavong P, Khamlome B, phengvilaysouk A, Keonouchanh S, *et al.* Integrating market chain assessments with zoonoses risk analysis in two cross-border pig value chains in Lao PDR. Asian Austral. J. Anim. 2017; 30:1651-1659.
9. Catelo MAO, Dorado MA, Agbisit E. Jr. Backyard and Commercial Piggeries in the Philippines: Environmental Consequences and Pollution Control Options. EEPSEA Research Report No. 2001-RR6. Ottawa, Canada: International Development Research Centre, 2019. Retrieved on December, 4 2022 from: <http://www.p2pays.org/ref/13/12938.pdf>
10. Macleod M, Gerber P, Mottet A, Tempio G, Falcucci A, Opio C, *et al.* Greenhouse gas emissions from pig and chicken supply chains. A global life cycle assessment. Food and Agriculture Organization of the United Nations (FAO), Rome, 2013. E-ISBN 978-92-5-107944-7
11. Smiderle OJ, Souza AG, Chagas EA, Souza MA, Fagundes PRO. Growth and nutritional status and quality of Khaya senegalensis seedlings, 2016. Revista Ciências Agrárias, (59):47-53.