Research article

Piggery Farm Wastewater: Alternative Solution for Agriculture and Soil Fertility

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Abstract The consequences of piggery farm are increasing public concern particularly, wastewater because of its high pollutant potential. Without the good wastewater treatment systems, it could lead to contaminate the natural water resources nearby. The number of the small and medium size of piggery farms could not afford the wastewater treatment cost. The wastewater management is needed. The objective of this study aims to evaluate the water quality characteristics from the piggery farm in Northeast of Thailand and feasibility study of using wastewater from piggery farm for agriculture purpose. The wastewater from influent, effluent from the system and wastewater before release to natural waterway were sampled and analyzed for water characteristics in term of pH, Temperature, Electrical Conductivity (EC), Total Kjeldahl Nitrogen (TKN), Total Total Phosphorus (TP), Total Solids (TS), Total Suspended Solids (TSS), Total Dissolved Solid (TDS), Fat OilandGrease (FOG), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD) and other heavy metal contaminants such as Zinc (Zn), Lead (Pb), Cadmium (Cd) and Cupper (Cu). The results found that the wastewater had high potential to pollute the natural waterway. However, some water quality characteristics such as N and P may be the source of good nutrients for agriculture production and increasing soil fertility. Therefore, using piggery farm wastewater for agriculture may be one of alternative solution for soil fertility and wastewater management.

Keywords piggery farm wastewater, agriculture, soil fertility

INTRODUCTION

There are 10 million Piggery farms in Thailand in 2007 and increase to 13 million farms in following year due to the high demand of pork product. Therefore, the waste from piggery farm has been increased followed the piggery farm. The consequences of piggery farm are increasing public concern particularly, wastewater because of its high pollutant potential. The wastes from piggery farm are difficult to manage compared with the waste produced in each day (Noophan, 2009; Department of Livestock, 2007). It could lead to contaminate the natural water resources nearby (Srilachai et al., 2007). Wastewater characteristics in form of BOD and COD were about 1,500-3,000 mg/L and 4,000-7,000 mg/L respectively. Piggery farm wastewater has high of NO_3-N and NH_4-N, through 60-70% of organic nitrogen and wastewater could replace chemical fertilizers as much as 80-100% of the application rate depending on type of growing crops (Panichsakpatana, 2006). In wastewater is widely used as fertilizer in many countries because of its high organic, nitrogen and phosphorus content (Deng et al., 2006).

The utilization of wastewater from biogas in piggery farm helped to increased height and seed yield of corn significantly, and increases the accumulation of P, K, and Mg in soil. Moreover, Cu and Zn in pig manure did not accumulate in soil (Aoungsawad, 1999). The effluent form biogas cloud substitute the irrigation water as much as 40,000 L/rai/week for the whole growing period (1 hectare = 6.25 rai). With the mentioned rate, there was no change in some chemical and physical properties of the soil (Panichsakpatana, 1995). However, the impact of wastewater reuse on land application in

Northeast of Thailand was less studied. The objective of this study aims to evaluate the water quality characteristics from the piggery farm in Northeast of Thailand and feasibility study of using wastewater from piggery farm for agriculture purpose and it may be one of alternative solution for soil fertility and wastewater management.

MATERIALS AND METHOD

Grab samples of piggery farm wastewater from large-scale piggery farm in Northeast of Thailand were studied. The study site of piggery farm is located in Khon Kaen province (Coordinate: 15°58'15"N 102°49'16"E). The number of pig was about 9,645 in this farm and wastewater treatment system was UASB anaerobic type. Sampling the wastewater from influent, effluent from the system and wastewater before release to natural waterway was monitored every month (Fig.1). Three samples per sampling sites were collected. The samplers were taken to the laboratory and analyzed water characteristics immediately. The characterization of physical chemical and biochemical properties of wastewater characteristics were analyzed following the method of APHA-AWWA-WEF and EEAT of Thailand (1998).

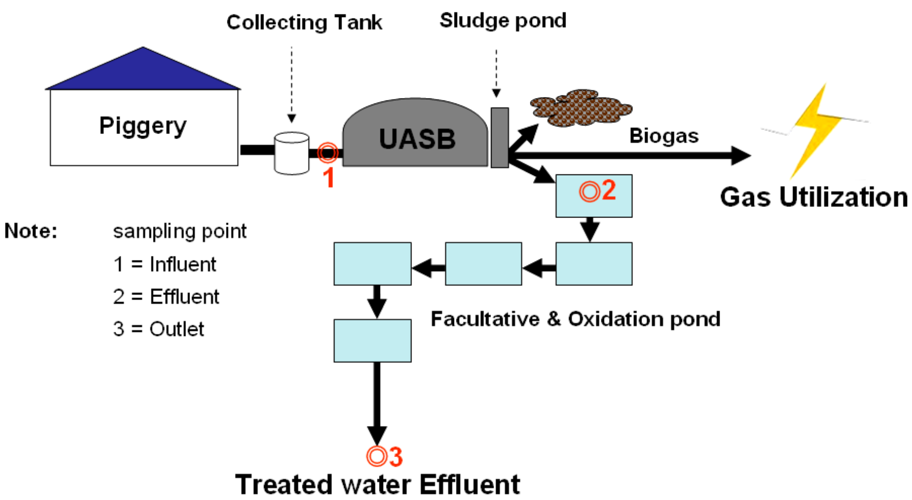

Fig.1 The study site and sampling points

RESULTS

Piggery farm wastewater from influent, effluent from the system and wastewater before release to natural waterway were showed in term of water characteristics in Table 1. The result showed that water quality in most of water parameters were better from the beginning and after the treatment process, except pH and CEC which have higher values before release to natural waterway. The reason for these may be because of the soil texture in this area has sand or loamy sand and high gradient erosion and salt (Land development department, 2008).

The wastewater from every study sites had high value of organic and N as well as BOD, COD, N and P which caused water pollution in areas with intensive animal farming, phosphorus from livestock waste contributes to the eutrophication of surface water (Daumer et al., 2007). However, another point of views, the beneficial of wastewater form piggery farm could be used for agriculture and plant production. In particular, when look at the high value of N about 284.20-481.04 mg/L and P 24.50-79.98 mg/L from influent and wastewater before release to natural waterway could be used as N and P fertilizer source. The results from this study shows that the wastewater from this piggery farm could substitute Nitrogen and Phosphorus fertilizer by producing nitrogen 29-50 kg/day and phosphorus 3-8 kg/day. Therefore, the utilization of piggery farm wastewater for agriculture may be one of alternative solution for soil fertility.

Table 1 Water quality of piggery farm

Parameters	Result[1]		
	Influent	Effluent	Outlet
pH	7.4±0.05	7.8±0.05	8.0±0.05
Temperature (^{o}C)	29±0.00	37±0.00	30±0.00
EC (dS/m)	6.9±0.05	7.7±0.01	8.0±0.05
TKN (mg/L)	481.04±2.02	458.92±0.10	284.20±0.20
TP (mg/L)	79.98±0.10	44.34±0.98	24.50±0.50
TS (mg/L)	5,100±6.58	2,250±10.00	190±5.00
TSS (mg/L)	2,317±5.10	1,200±624	24±2.45
TDS (mg/L)	2,783±10.39	1,050±7.00	165±4.58
FOG (mg/L)	130±1.73	85±5.00	30±5.00
COD (mg/L)	4,889±6.58	698±2.65	254±5.52
BOD (mg/L)	3,555±5.00	67±4.00	59±2.65
Zn (mg/L)	-	-	0.0930±0.001
Pb (mg/L)	-	-	0.0022±0.000
Cd (mg/L)	-	-	0.0360±0.000
Cu (mg/L)	-	-	<0.0002±0.000

[1] values are means (n = 3)

There was an example study of applying only wastewater in sugar cane production compared with chemical fertilizer and the result found that there were no significantly effects on sugar cane production. The diameter of stem and sweetness of sugar cane were similar to the one applied with chemical fertilizer (Techaviriyataveesin, 2004). Not only waste water could increase soil fertility and wastewater could be used as an alterative source of water for plant growth. It could substitute the irrigation water as 40,000 L/rai/week or 280,000 L/rai for the whole growing period (1 hectare = 6.25 rai) (Panichsakpatana, 1995) .

CONCLUSION

The results found that the wastewater from piggery farm has high potential to pollute the natural waterway. However, some water quality characteristics such as N and P may be the source of good nutrients for agriculture production and increasing soil fertility and could substitute the irrigation. The results of these study showed that the amount of wastewater per day was 103,350 L and nitrogen and phosphorus in wastewater were 29-50 kg/day and 3-8 kg/day, respectively. Therefore, using piggery farm wastewater for agriculture may be one of alternative solution for soil fertility and wastewater management.

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REFERENCES

Aoungsawad, K. (1999) The study on the usage of wastewater from pig farm for agriculture. Faculty of agriculture, Chiang Mai University, Chiang Mai, Thailand.

Daumer, M.L., Béline, F., Guiziou, F. and Sperandio, M. (2007) Influence of pH and biological metabolism on dissolved phosphorus during biological treatment of piggery wastewater. Biosystems Engineering J., 96, 379-386.

Deng, L.W., Zheng, P. and Chen, Z.A. (2006) Anaerobic digestion and post-treatment of swine wastewater using IC-SBR process with bypass of raw wastewater. Process Biochemistry J., 41, 965-969.

Department of Livestock (2007) Piggery farm database in Thailand. http://www.dld.go.th/ict/yearly/yearly49/stat/annex05.xls.

Land Development Department (2008) Soil series characteristics and management. http://www.ldd.go.th/web_study_center/khoahinson/kazadsub/ka_soil.asp.

Noophan, P. (2009) The piggery waste problem and sustainable approach management. Thai environmental engineering magazine, 5, 19-25.

Pollution Control Department. (2008) Sampling technique for good laboratory. Ministry of Natural Resources and Environment, Bangkok, Thailand.

Panichsakpatana, S. (2006) Recycling of wastewater from pig farms in urban and peri-urban agriculture. http://agent.org/activities/sw/2006/729863362/paper-556441822.pdf.

Panichsakpatana, S. (1995) Utillization of effluent from biogas production as nitrogen source for Pak-choy (*Brassica camperstris* var *chenensis*) grow on Kamphaeng Saen soil. Kasetstart J., 29(2), 445-453.

Srilachai, S., Wongpan, P. and Kuna-ek, V. (2007) Application of the appropriate wastewater treatment for small-sized pig farm. Environment Research and Training Center, Ministry of Natural Resources and Environment, Bangkok, Thailand.

Techaviriyataveesin, S. (2004) Utilization efficiency of wastewater from pig farm as fertilizer for sugar cane var. K 88-92 grown on sandy loam soil. M.S. Thesis, Kasetsart University, Thailand.