Mapping waste distribution in intensive pig production areas in Malaysia using GIS

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Introduction

It is estimated 28,000 tons of livestock manure consisting of 30% of pig manure are being excreted daily in West Malaysia. Majority of the pig manure is not being utilized and consequently serve as a source of environmental pollutant. The recent intensification of pig production to meet the increasing demand for pork in Malaysia will further worsen the environmental problem. In view of growing concern among the relevant authorities and pig producers to achieve a sustainable pig industry in Malaysia, it is felt that Geographical Information System (GIS) could serves as an information management tool for waste monitoring in the pig farming areas. Because of its capabilities in integrating spatial data from different sources with diverse formats, structures, projections or resolutions levels, GIS has been widely used to integrate watershed-level assessment of the economic and environmental implication of livestock production practices. The availability and management of numerical statistical information of GIS and its graphical representation is very important for improving the livestock, including pig waste management. The objectives of this project were (i) to develop thematic map for the visualization and interpretation of pig waste distribution and (ii) to develop a GIS database for monitoring and decision making relating to pig waste management.

Materials and Methods

This paper consists of 2 sub-studies, the first was to map out the extend of daily waste discharged based on Standing Pig Population (SPP) for the whole Peninsular Malaysia. While the second study focused on a sub-watershed area with intensive pig population, located at Kampung Selamat Chinese Residential area (CRA), Tasik Gelugor, Seberang Perai Utara. Approximately, the latter has 700 lots (1.5 – 2.0 acre per lot) out of which residence of about 100 lots are involved in pig rearing, while the remaining are orchard, light industry and poultry. The study area consists of about 100,000 SPP which discharging approximately $4.02 \times 10^3 \, m^3$ wastewater daily or produced about 580 tons of fresh manure per day. Majority of the pig farms adopted the conventional lagoon pond system to treat the wastewater before being discharged into the nearby channel. The waste treatment system varies in size and number of pond used accordingly to farm size. A GIS database relevant to pig waste management was constructed using digital basemap of peninsular Malaysia (scale 1:500000) and Tasik Gelugor (scale 1:5000) in PC ArcView GIS software. On-site study information from our previous study combined with the primary data such as farm inventory, farm location, yearly wastewater quality discharge etc. that collected from the local Municipal Council (Majlis Perbandaran Seberang Perai) and Department of Veterinary Services were stored into different themes in GIS. The attribute data could be manipulated and analysed to generate the needed output ant then displayed in the form of maps, tables and graphs. Generally, the data were analysed for mapping purpose by overlaying the different themes and/or classified on the attribute results.

Results and Discussion

The pig waste distribution could be mapped out based on Standing Pig Population (SPP), farm size or wastewater discharge in this study. The volume of pig manure generated daily in individual farm was calculated from multiplying SPP with daily pig excretion rate (5.8×10^{-3} ton/day), and was categorized into 5 classes with different symbols in the map based on farm size. The Peninsular Malaysia map illustrated that most of the pig production areas were concentrated along the west coast, with Penang, Perak, Selangor and Johor having the highest SPP and volume of daily manure generation rate. In the study of Kg. Selamat areas, the BOD effluent concentrations were grouped into 4 categories; namely, Category I (the unknown) and the remaining according to the 3-phase BOD effluent compliance levels (Category II: 1 to 50 mg/L BOD, Category III: 51 to 250 mg/L BOD and Category IV: 251 to 500 mg/L BOD) that enforced in Malaysia. Based on the results, there was only 1% meeting the 50 mg/L BOD effluent compliance level set for year 2001, 33% of unknown, 65% and 1% of category III and IV, respectively. It is clear that the majority of pig farmers in the study area could only comply with the 51-250 mg/L BOD, which is beyond the level set for year 2001. Since most of the farmers use lagoon system to treat the wastewater, it is implied that the next step would be to determine the efficacy of those lagoons. The efficacy of these systems is affected by the design and operation. Proper design and maintenance of lagoon systems are essential to maintain high efficacy of the systems.

Conclusions

As mentioned in the previous section, majority of pig farmers in the study area could not meet the 50 mg/L BOD level imposed by the local authority, and the efficacy of the lagoon systems is affected by the design and operation. Proper redesign

and/or improve maintenance of lagoon systems are essential to maintain high efficacy of the systems to meet the discharge requirement.

Benefits from the study

GIS serves as an information tool to enable spatial retrievals pig farm location, the attribute data or image which associated with the selected map themes. Thus it provides on screen information directly when feature in the map was selected. GIS offers a god potential for obtaining and structuring information to improve monitoring and evaluation of wastewater discharge or waste loading and related policy decision. It facilitates identification of those problems encountered spatially in pig production area and helps to make sound decisions speedily through information retrieving and graphical representation from this GIS constructed database.

Patent(s), if applicable:

Not applicable

Stage of Commercialization, if applicable:

Not applicable

Project Publications in Refereed Journals:

Nil

Project Publications in Conference Proceedings

1. Tee, T.P., J.B. Liang, E.S. Chew, Z.A. Jelan, T.C. Loh and P. Loganathan. 2002. Mapping waste distribution in intensive pig production areas using GIS. *Proceedings of 4th International Livestock Waste Management Symposium.* May 2002. Penang, pp. 85-90

Tee, T.P., J.B. Liang, Z.A. Jelan, E.S. Chew and P. Logananthan. 2000. Effectiveness of pig wastewater management in Kampung Selamat, Seberang Perai. *Proceedings MSAP Conference,* May 2000. Sabah p.