DETERMINANTION OF ECO-EFFICIENCY FOR SMALL PIG FARMS IN THE SOUTHERN OF THAILAND

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Abstract- The objective of this study was to determine the eco-efficiency value of small pig farms in the Southern of Thailand. The data of five small pig farms including the economic and environment performances during 2011 – 2013 were collected. Net sale was performed as the economic performance of these farms. The environmental performance of small pig farms consisted of feed consumption, water consumption, electric consumption, drug consumption, and waste production. Then, the eco-efficiency value of small pig farms was determined by World Business Council for Sustainable Development method. The results presented that the averaged net sale of small pig farms was 1,559,140 Baht per year. Feed and electric consumptions were the height and lowest eco-efficiency values of small pig farms, respectively. This result mentioned that small pig farms in the Sothern of Thailand should be developed the reduction approach of feed consumption for decreasing the operation cost and supporting sustainable development.

Keywords- Eco-efficiency, Pig Farm, Sustainable Development, Indicators.

I. INTRODUCTION

The pig farm is the importance of economy in Thailand. Currently, the pig farms are developed for the composition and respond of commercial demands, which affect to the increasing productivity, the development of management systems and the reduction costs. Office of Agricultural Economics, 2013 reported that the quantity of pig production in 2013 was higher 1.87 percent than 2012. However, the environmental pollution was produced by the operation of pig farm because the wastewater of pig farm was highly contaminated by the pig feces with process of cleaning corral and was discharged to the natural river. Hence, The Pollution Control Department recommended the environmental management guidelines of pig farms for protecting and fixing this occurrence. In addition, various studies and measurements were developed for finding the pollution prevention approach of pig farm activity. The environmental problem was non-reduced and the highly strong effect, although the measurement development with many campaigns of conservation was created. Presently, many related organizations interest with the approach and standard development and focus the development of balance between economic, environmental and human-caused condition, which was sustainability. Sustainable development is the development for the needs of people inthe present without affect to the next generation. Eco-efficiency is the interesting concept for sustainable development and is the integration of environmental and economic dimension for developing the highest production and achieving sustainable development. In addition, eco-efficiency can be defined the role for bringing the result of the operation based on the eco-efficiency and assessed the situation of industry in the past period. Development of agriculture in the national economic and social development plan No. 11 (2012 - 2016) is to promote and enhance the development of the agricultural sector, create green product, strengthen agricultural production and promote and develop the research, science innovation. Moreover, the enhancement of agricultural section with production demand, the effective of basic structure for agricultural section, the agricultural restoration of suitable agricultural production toward sustainability was presented in this plan. Besides, the basic principle of increase production for agricultural production was presented by the reduction of resource and production cost. This technique is a guide to find the suitable approach of the pig farm operation and the guidelines for operating business in the future.

Therefore, this research was to apply the eco-efficiency tool to assess the performance of pig farm as the value and trend of eco-efficiency for reflecting the sustainable development.

II. MATHODS

A. Inventory data collection

The data used this study including primary and secondary data. The primary data obtained from pig farms surveying in Phatthalung province, Southern Thailand and operators interview. This data was validated by comparing with secondary data or literature reviewed about pig farm process and eco-efficiency principle. These data was used to set

the indicators described in the next section. B. Development eco-efficiency indicators and questionnaire The framework of developing the pig farm eco-efficiency indicators was adapted efficiency assessment method that by has been developed by National Round Table.

This questionnaire was approved by the ethics committee of Mahidol University Institutional Review Board.

C. Data collection

The primary data obtained from five small pig farms was collected by interview. The data related with the economic and environmental performance during the years 2011 – 2013 of each farm was collected in order to assess the current state of the eco-efficiency of farm operations.

Firstly, the socio-demographic of farm owner about organization and finance, number and species of pig farming, production situation were studied. Secondly, environmental performance of each pig farming process was investigated.

Finally, the economic performance of data was also collected. However, the data obtained in all step were compared to literature review for identifying inconsistent values.

Even most of the farm data and the literature data were in accordance, values far outside the regional average were double checked by means of further investigations directly on the farms.

D. Eco-efficiency assessment

The method of eco-efficiency assessment used in this study was adapted from the method of evaluating eco-efficiency of WBCSD (2000). The ratio of income value obtained from products or services and the sum of impacts on environment, resource and emissions was used to calculate eco-efficiency value. It could be expressed as equation (1)

$$EE_n = \frac{EI_n}{\sum E_{nm}} \quad (1)$$

where, EIn and ENnm are the economic and environmental indicators, respectively, unit expressed in Bath. The environmental indicator is environmental impacts of growing-fishing pig farm.

The snapshot graph proposed by the Anite System in Netherland was adopted for eco-efficiency assessment in this study. The percent variations of the economic and environmental indicators were analyzed following in equation (2)

$$\%VE = \frac{(\Sigma EV_y - \Sigma EV_b) \times 100}{\Sigma EV_b} \quad (2)$$

where % VE = Percent variation of economic or environmental indicators, ΣE_y = Summation of economic or environmental indicators of growing-fishing pig farm, and ΣE_b = Summation of economic or environmental indicators of growing-fishing pig farm. The percent variation analysis of economic and environmental indicators of growing-fishing pig farm were subsequently plotted in one graph, where the Y-axis and X-axis are the variation of the percent variation of the economic indicator and environmental indicator of growing-fishing pig farms, respectively. The interpretation of the eco-efficiency level is made by the X–Y plan.

III. RESULTS AND DISCUSSION

A. Delineation of operation small pig farms

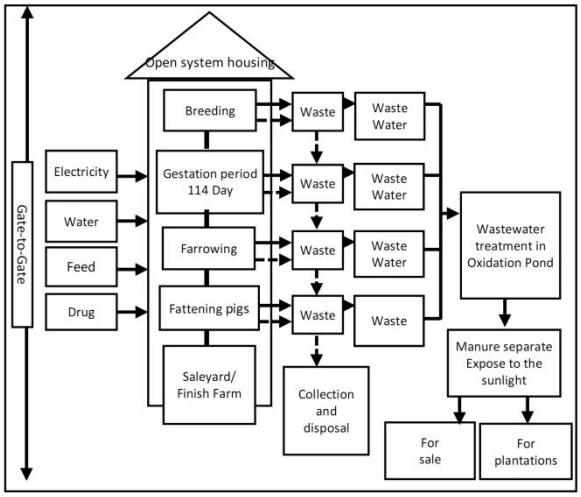


Fig.1 Delineation of Small pig farm.

The process flow diagram of small pig farms was shown in Fig.1. The small farm means a farm which has number of pig from 50 bodies to 500 bodies. Material flow analysis of small pig farm was generated by the literature review and benchmarked of the pig farming. During process pig farm the farmers there to feed animals, drug or vaccination, water consume, Electricity consume cleaning up housing and cleanliness of pig. The main output of this was the wastewater because the water was used for all activities, but pig manure was by- products with separate expose to the sunlight for sale or for plantations.

B. Eco-efficiency indicators of pig farm operation

Table 1 shows the eco-efficiency indicators for pig farming operation that was developed in this study. These indicators were developed and verified by material flow analysis. The economic indicator of pig farm operation is net sale.

The environmental indicators of operation pig farming are feed consumption, drug consumption, energy consumption, water consumption, waste production (total amount of waste), and greenhouse gas emissions from pig farming. These indicators was validated by experts and operators.

Table 1: Eco-efficiency indicators of operation pig farming

	Indicators	Unit
The economic indicator	Net sales	Bath
The environmental indicators	Feed consumption	Ton
	Drug consumption	Tube
	Electric consumption	kW-hr
	Water consumption	m^3
	Total amount of waste	Ton
	Greenhouse gas emissions from pig farming	Ton CO_2-eq

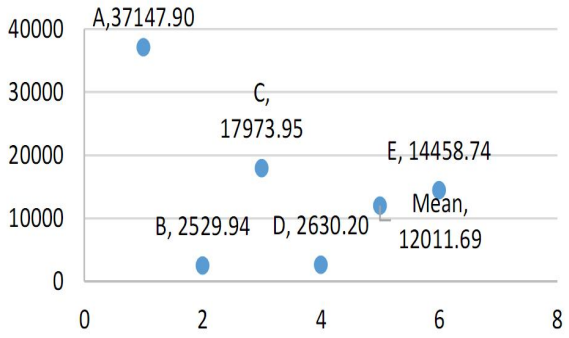
C. Eco-efficiency Degree of pig farm operation

The five pig farms that were used as the case studies were assigned as farm A, B, C, D and E. The Fig 2 illustrated the eco-efficiency level of each indicator among sample group compared with the mean value. It was found that Farm A and C had better eco-efficiency level in all indicators that other farms. Therefore the best practice of these farm should be investigated and transferred to other farms in order to enhance the eco-efficiency of this livestock operation in the southern Thailand. The water consumption should be prioritized and finding the water use reduction strategies because of its eco-efficiency values of most pig farm still lower that internal bench mark value.

Fig.3 presented that the eco-efficiency trends of all environmental indicators in 2012 and 2103 located in Haft-Eco-Efficiency. The explanation of this result identified that the stable trend of eco-efficiency affected by the increasing of pig price in 2012 and 2013, which was directly promoted to the highly increasing of resource use was found in 2013 for the acceleration of pig farm production.

CONCLUSIONS

The eco-efficieny evaluation of pig farm operation revealed that the eco-efficiency trend of these farms operation were in half eco-efficiency. Therefore, the production yield of these farms process can be enhanced. The pollution prevention techniques should be investigated and implemented in Farm B, D and E to improve all indicators. The water use is an urgent issue required to be improved in all farms.



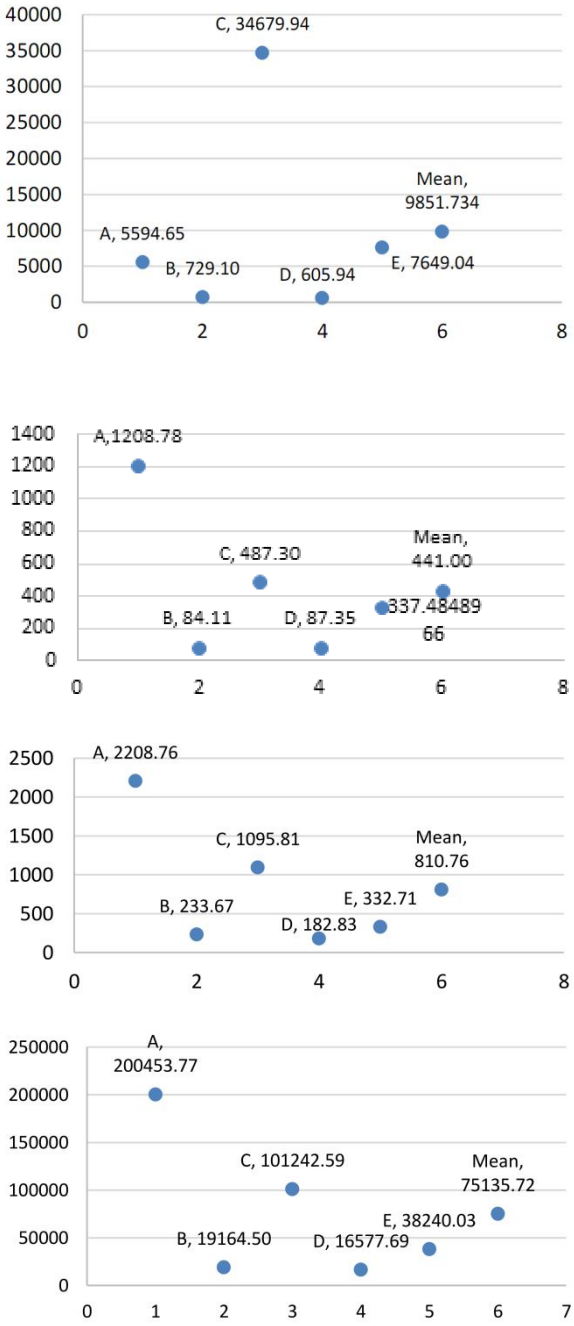


Fig.2. The eco-efficiency levels of each indicators in all farms investigated, from top to bottom respectively; feed, water use, electricity, drug consumption, GHGs emission and waste indicators.

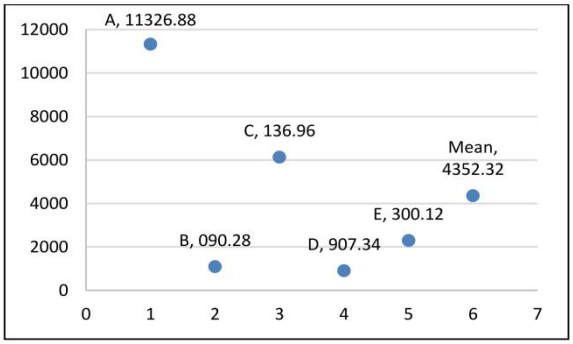


Fig.2. (continued)

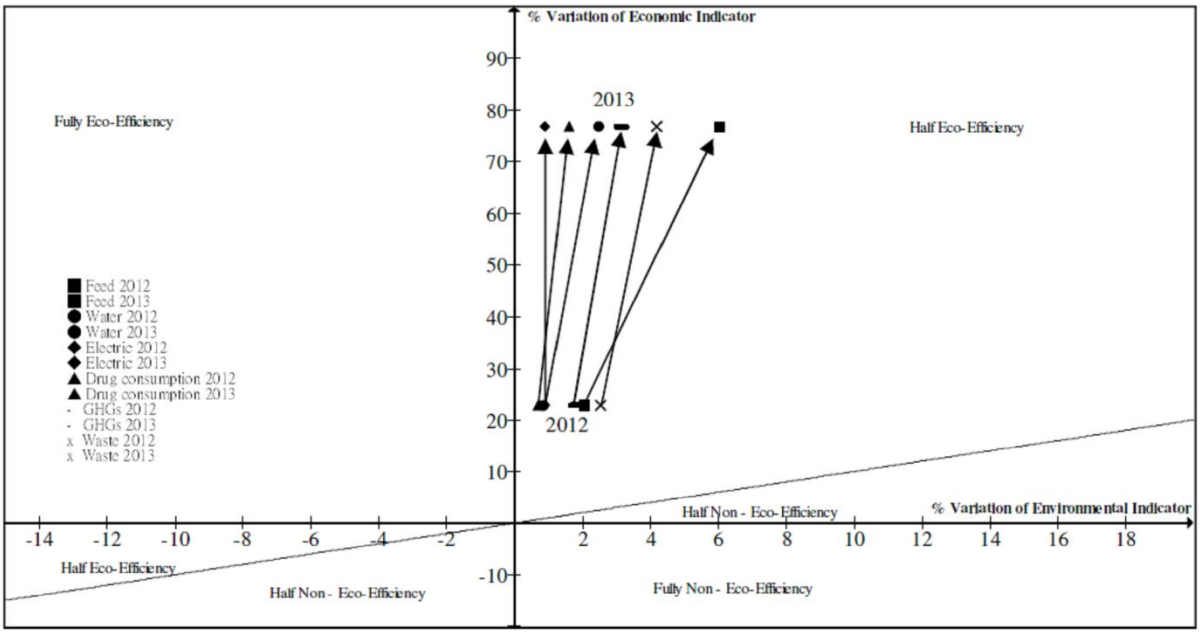


Fig.3. The snap shot graph

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