

Doi: 10.21059/buletinpeternak.v45i4.68763

Profitability of the Three Types of Smallholder Pig Farming in Indonesia: An Adaptation of Enterprise Budgeting Method

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ABSTRACT

This study aims to analyze the production cost structure and to measure the profitability of three types of smallholder pig farming, namely farrow-to-finish, pig-finishing, and pig-nursery in Indonesia. This study employed the data from the Statistics Indonesia-Livestock Business Household Survey (ST2013-STU). The measurement of profitability was carried out by calculating the profitability of three types of pig farming business using the adapted enterprise budgeting method. Based on the production cost structure, the percentage of pig feed costs accounted for more than 70% of the total cash of the three types of pig farming. The percentage of unpaid labor costs is more than 50% of the total non-cash. Based on the measurement results of the profitability indicators, it can be shown that the pig-finishing type has the highest profitability among the three types of smallholder pig farming. Government policies are needed to increase pig farmers' access to financing and better pig farming technology.

Keywords: Farrow-to-finish, Household survey, Pig-finishing, Pig-nursery

Article history

Submitted: 30 August 2021

Accepted: 17 November 2021

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Introduction

Pork is high protein meat that its protein content is almost equivalent to beef but is more economical and nearly all parts of the animal can be consumed (Dietze, 2011; Nistor *et al.*, 2013). The consumption rate of pork in Indonesia is found to be higher in rural households, especially in communities with low-income levels in non-muslim majority province such as of East Nusa Tenggara and Papua. According to the Indonesia Food Materials Balance-NBMI data (BKP, 2019), the average national pork consumption in the 2014–2019 period reached 207,333 tons per year and the average consumption rate per capita was 0.81 kg/capita/year. The consumption according to BKP (2019) and OECD (2020) data tends to increase, although it is relatively slow at 1.13% and 1.74% per year, respectively. The consumption of pork in Indonesia is also triggered by the consumption of international tourists, especially those who come from pork consuming countries. BPS (2020) shows that the average growth of international tourist visits is always positive and has an increasing trend. This indicates that under normal circumstances (without the pandemic Covid-19), it can be estimated that the number of foreign tourists will increase as well as the need for pork in tourism

areas. Therefore, it is important to pay more attention to the potential of this commodity, especially the domestic pig livestock commodity. The commodities will play a significant role to support the development of tourism in Indonesia.

From the production side, pig livestock commodity is mostly cultivated by small farmers and is generally still subsistence and semi-commercial. The choice to cultivate this commodity is mostly based on its advantages. Pig farming provides cash and is generally used to meet the needs of families in rural areas, such as paying school fees, health costs, and agricultural inputs, as well as basic daily needs (Umeh *et al.*, 2015). This option is considered practical since pigs are classified as prolific animals which can give birth to more than two piglets in one birth, have high feed conversion efficiency, fast growth, relatively small space requirements, and are marketable within six months (Sihombing, 1997). However, pigs are classified as livestock that is susceptible to diseases and parasites. Pig farming also faces the challenge of applying environmentally friendly cultivation techniques (Liang *et al.*, 2017). Therefore, reducing the production cost of pig farming was the best long-term strategy to deal with price fluctuations and uncertainties (Lu *et al.*, 2020).

There are several types of pig production. They are classified based into the stage of the growth of the livestock, including: farrow-to-finish, pig-finishing, and pig-nursery. Pig production systems in the world are relatively complex, both in terms of production, as well as the economic and social environment that affects them (McGlone, 2013). Farmers need to vividly pay attention to the structure/formula of production costs in order to achieve the target profit. Then, with these three livestock business options, farmers who want to go to pig farming are encouraged to adopt any of the three enterprises depending on their capital requirements and risks associated with the enterprise (Mbaso and Kamwana, 2013).

The profitability analysis of pig farming in Indonesia is not new. There are several analyses that have been discussed on this topic (Ariana *et al.*, 2014; Kojo *et al.*, 2014; Warouw *et al.*, 2014; Santa and Wantasen, 2018; Purwadi and Ick, 2019; Sarajar *et al.*, 2019). The previous analysis used the following patterns: analysis of production costs per unit of output, Return Cost Ratio (BCR), Benefit Cost Ratio (BCR). Some other types are the investment analysis with several criteria including Net Present Value (NPV), Internal Rate of Return (IRR), Net Benefit-Cost Ratio, Profitability Ratio, and Pay Back Period. The weakness of these previous analyses is that there is no categorization of costs based on cash and non-cash. This categorization becomes very important for small-scale or household-scale farming. On the recent data, the research of Suranjaya *et al.* (2017) is the only research that distinguishes production costs into real and disguised costs.

Based on the description above, this study aims at measuring the profitability of three types of pig farming in Indonesia, namely farrow-to-finish, pig-finishing, and pig nursery. Previous studies on the profitability of pig farming were based on primary data and in the form of case studies in certain areas (Iyai *et al.*, 2013; Soewandi *et al.*, 2013; Sarajar *et al.*, 2019; Kaka *et al.*, 2020) and have not been observed the type is pig farming run by the farmers. There is only Kusumastuti and Irham's research (2001) discussing the three different types of pig farming but limited only on a small sample and particular region (Sleman). Meanwhile, this study was based on secondary cross-section data and the samples cover all provinces in Indonesia that were considered to have significant numbers of pig farming. Since the existing data was not specifically designed for analysis of farm profitability, it was necessary to adapt to the profitability formula. Adaptation was especially needed in terms of the classification of cash and non-cash. This research was expected to contribute not only to enriching information about the pig farming economy in Indonesia but also to the development of a financial analysis based on household surveys.

Materials and Methods

Source of data

The data used was part of the Agricultural Census in 2013 of Statistics Indonesia. The data in this research was Livestock Business Household Survey (ST2013.STU). This study covered pig farming in Indonesia using samples from 20 provinces. The total sample were 6,738 households pig farming: 3,542 farrow-to-finish, 3,139 pig-finishing, and 57 pig-nursery. The samples employed in this study were dominated by pig breeders from North Sumatra 28.01%; East Nusa Tenggara 27.86%; and Bali 21.42%. These three provinces had contributed more than 77 % of the total sample.

The ST2013-STU uses the following terms in the questionnaire, farrow-to-finish and pig-finishing, and pig-nursery to define the types of livestock farming business. The farrow-to-finish type is a business with the aim of multiplying pigs through breed pigs, raises them until they are ready to be slaughtered and then sells them for profit. The pig-finishing type is a business with the aim of increasing the weight of livestock by buying piglets and then selling them when they have reached a certain weight that is qualified for market. The pig-nursery type is a business with the aim of obtaining piglets, boar, and gilt who inherit superior traits by means of livestock breeding (selection) and then sells them to another business, which will raise them to market size.

The category of samples selected in this study was based on the methods of raising pigs. The households selected as samples raise their pigs using a pen. The selection of a sample based on the use of the pen which certainly allows a more accurate calculation of the relationship between the input and output of pig farming. In the pen system, there are also various variants of pig farming methods, especially in terms of the characteristics of pen and how much space pigs have to wander (Delsart *et al.*, 2020). The data used in this study also did not differentiate between the breed types (native or commercial) of pigs raised by the household. The choice of breed type and production system will certainly determine the productivity and performance of pig farming (Galanopoulos *et al.*, 2006; Silalahi *et al.*, 2016).

Data analysis

This research uses enterprise budgeting analysis method (Lloyd and Thilmany, 2008) to measure the profitability of pig farming with adaptation in its use. Adaptation to the analytical method is needed because the data from the Statistics Indonesia survey used in this study did not present various technical parameters, such as litter size, mortality, weight and age of slaughtered pigs. The use of this method in agricultural analysis generally assumes that all products produced by farmers are sold to the market and all inputs used are obtained from purchases and are

not produced internally within households. However, in Indonesia, there are some products that are intended for household consumption or social purposes. Moreover, the domestic or small-scale pig farms in Indonesia usually do not purchase all the input on this business. Some of them such as feed and labor usually come from their own land and family.

This study distinguishes cash and non-cash in the cost structure of pig farming production. Total cash are the accumulation of cash variable costs and cash fixed costs. Cash variable costs are all costs to buy or rent inputs, such as labor fee (permanent and variable), feed, fuel, and medicines. Fixed cash are all costs to purchase or rent inputs such as repair and maintenance of facilities, transportation costs, taxes, and levies. Non-cash are the estimated value of production inputs that are not categorized as purchases by farmers. Total non-cash are the accumulation of non-cash variable costs and non-cash fixed costs. Non-cash variable costs are all estimated values for non-purchase-inputs such as unpaid labor, feed, fuel, and medicines. Non-cash fixed costs can be seen from depreciation and opportunity costs of using household resources themselves (without paying/renting) in production. The total cost of livestock business examined in this study is the accumulation of total cash and total non-cash.

The farming revenue is the multiplication between production and selling price (Soekartawi, 2006). The revenue from pig farming in ST2013-STU comes from the calculation of the production value of pigs, which consists of the added value of livestock and other production values (byproduct). The definition of added value of livestock in the ST2013-STU guidelines is the value of production as a result of weight gain/fattening of livestock for a year. The method of calculating the added value of livestock is presented in Table 1. Each component in the calculation of the added value of livestock is the multiplication of the number of livestock and the price of livestock (in Rupiah). The livestock value-added approach has also considered the cash receipts (selling and buying value) and non-cash. The value of non-cash receipts comes from slaughter, death, birth, deduction, and others. The main weakness of this livestock value-added approach is the separation of the cost of purchasing piglets from the total cost because the price of piglets is already included in the calculation of the added value of livestock. Apart from the added value of livestock, revenue also comes from the value of other by-products such as manure, biogas, and liquid fertilizer (animal urine). The calculation of the value of other by-products is the multiplication between the amount of production and the price (in Rupiah or IDR). The income from pig farming in this study is the accumulation of livestock added value and by-product production value.

The profitability indicators in this study were calculated based on cash and non-cash (Seger and Lins, 1986; Kay *et al.*, 1994). The

profitability indicators used include: financial profit, economic profit, gross margin index, and net margin index. The profit is a deviation between the revenue and the total cost of farming (Soekartawi, 2006). Due to the fact that costs are divided into cash and non-cash, profits are divided into financial and economic profits. The formulas used to analyze the profitability with an enterprise budgeting approach are as follows:

- 1) Gross Farm Revenue = Value-Added + Value of Byproducts of Farming
- 2) Cash Total Costs = Cash Variable Costs + Cash Fixed Costs
- 3) Non-Cash Total Costs = Non-cash Variable Costs + Non-cash Fixed Costs
- 4) Total Cost = Cash Total Cost + Non-cash Total Cost
- 5) Financial Profit = Gross Farm Revenue – Cash
- 6) Economic Profit = Financial Profit – Non-cash
- 7) Gross Margin Index = Financial Profit/Gross Farm Revenue
- 8) Net Margin Index = Economic Profit/Gross Farm Revenue.

This study applies a form of revenue and cost analysis by calculating the average of total revenue and the average of total cost and then dividing it by the average number of pigs that are farmed so that the revenue and cost per pig or per head are obtained. The data sourced from a survey by the Central Statistics Agency employed in this study used the head unit and not the animal unit in presenting the number of pigs cultivated. Revenues and costs were considered to be linear with the number of farmed pigs regardless of the age of the livestock. To ascertain whether or not there is a significant difference in costs, revenue, and profitability between the three types of pig farming, a statistical t test is carried out.

Results and Discussion

Cash structure

The formula of cash for the three types of pig farming in Indonesia per pig per period is presented in Table 2. From the data in Table 2, it is known that the total cash for the type of pig-finishing business are the highest among the three types of pig farming. The components of cash for the types of farrow-to-finish and pig-finishing businesses are relatively the same. Table 5 shows that there are no significant differences in cash among the three types of pig farming. In the farrow-to-finish type business, 72.28% of cash are used to buy feed, especially factory feed (28.01%) and factory waste (44.27%). In the pig-finishing type, 76.48% of cash are also used to buy feed, especially factory feed (36.79%) and factory waste (39.69%), while in the nursery type, 81.66% of cash are allocated to buy feed, especially factory feed (34.61%) and factory waste (22.13%) as well as to pay labors (24.92%). The average cost of feed in this study was relatively higher when compared to the case study results of Kueain *et al.* (2017) on a farm in Bali. Based on

observations of the data series for six years, they found that the cost of feed was 63.80% of the total cost.

Moreover, Table 2 also shows that the variable cost component is higher in percentage than the fixed cost component. These results are in accordance with the research of Suranjaya *et al.* (2017) that notes that there are 94% variable costs and 6% fixed costs in the type of breeding business in Bali. The same result was also found in the pig farming business in Ekiti, Nigeria (Aminu and Akhigbe-Ahonkhai, 2017) where the percentage of variable costs reached 92% while fixed costs were only around 8%.

The high expenditure for factory waste is in line with its high use in the composition of pig feed. The price of factory waste such as tofu dregs is relatively cheap. The right use of this waste will have a positive impact on the economic benefits of livestock business (Ariana *et al.*, 2014). The high budget allocation for factory feed justifies the fact that the price of factory feed is very expensive. The results of this study can be an indication that an improve feed technology is needed in accordance with the various limitations faced by small-scale pig farming. Feed technology is needed whose raw materials are available and can be accessed cheaply by farmers, but still with feed quality that can increase productivity.

Furthermore, the percentage of labor costs for pig-nursery type business is the highest compared to the other two types of pig farming. This is because the laborers are required to have adequate skills, especially in terms of the selection and recovery of livestock. The selection

of livestock is carried out based on the sorting of piglets, production results, and livestock pedigrees.

The energy cost component is most likely used for transportation costs in livestock accommodation, both for selling the product and for purchasing the new breeds. The low percentage of health care costs as presented in Table 2 is thought to be influenced by: a) livestock are rarely affected by disease because local pigs are known to be more resistant to disease, b) farmers' awareness to prevent disease is low, c) farmers use traditional medicines. In addition, the construction of the pen also affects the cost of water. According to (Huong *et al.*, 2020), the design of the pigpen can reduce water use to clean the pen.

Noncash structure

The formulation of the non-cash of three types of pig farming in Indonesia per pig per period is presented in Table 3. Table 5 shows that the total non-cash of farrow-to-finish and pig-finishing businesses were not different statistically. However, the non-cash in these two types of pig farming are significantly different from the pig-nursery type. Significant differences in non-cash expenditures mainly occurred for the procurement of labor and feed. Unpaid workers are assumed to be workers from family members/relatives.

The percentage of unpaid labor costs reaches more than 50% of the total non-cash. This result is in line with the high involvement of family workers in the composition of workers in household-scale pig farming. This result is also in

Table 1. A value-added method in calculating revenue of pig farming in one period (1 year)

Description	Quantity (head)	Value (IDR)
a. Quantity of pigs at the end of a period		
b. Sales		
c. Slaughter		
d. Dead		
e. Other reduction		
f. Total (a+b+c+d+e)		
g. Purchase		
h. Birth		
i. Other addition		
j. Quantity and value of big at the beginning of period (f-g-h-i)		
k. Total (g+i+j)		
l. Value-added or revenue of pig farm (f-k) in one period		

Source: Questionnaire of Livestock Business Household Survey.

Table 2. The structure of average cash of three types of pig farming in indonesia per pig head per period

Description	Farrow-to-finish		Pig-finishing		Pig-nursery	
	IDR	%	IDR	%	IDR	%
A1. Variable cost	520.33		597.65		475.85	
Paid labor	13.55	2.48	10.68	1.70	122.90	24.92
Feed	453.60		546.29		315.78	
Green leaves	11.51	2.11	9.75	1.56	4.74	0.96
Factory feed	152.82	28.01	230.54	36.79	170.70	34.61
Household waste	21.72	3.98	6.39	1.02	0.18	0.04
Agriculture waste	4.66	0.85	9.28	1.48	19.60	3.97
Industrial waste	241.52	44.27	248.74	39.69	109.14	22.13
Other feed	21.36	3.92	41.59	6.64	11.42	2.31
Energy and water	40.23	7.37	29.15	4.65	28.61	5.80
Health maintenance	12.95	2.37	11.54	1.84	8.55	1.73
A2. Fixed cost*	25.27	4.6	29.06	4.64	17.33	3.51
A3. Total cash (A1+A2)	545.60	100	626.71	100	493.18	100

IDR in '000'; *With the following details: capital goods improvements; land lease; rent on stables, buildings, machinery, and tools; tax and levies; interest on loans; other expenses.

Table 3. The structure of average non-cash of three types of pig farming in Indonesia per head per period

Description	Farrow-to-finish		Pig-finishing		Pig-nursery	
	IDR	%	IDR	%	IDR	%
B1. Variable cost	568.89		568.91		221.10	
Family labor	340.28	55.55	322.85	53.67	150.50	61.30
Feed	187.81		217.95		65.46	
Green leaves	87.22	14.24	93.13	15.48	32.39	13.19
Factory feed	0.71	0.12	4.81	0.80	0.00	0.00
Household waste	33.68	5.50	51.16	8.51	10.80	4.40
Agriculture waste	16.34	2.67	14.98	2.49	5.38	2.19
Industrial waste	20.47	3.34	22.19	3.69	9.27	3.78
Other feed	29.39	4.80	31.68	5.27	7.61	3.10
Energy and water	39.98	6.53	27.38	4.55	4.82	1.96
Health maintenance	0.82	0.13	0.73	0.12	0.32	0.13
B2. Fixed cost*	43.62	7.12	32.60	5.42	24.42	9.95
B3. Non-cash total cost (B1+B2)	612.52	100	601.51	100	245.52	100

IDR in '000'; *With the following details: base on valuation for own repairing and depreciation of capital goods (building, tools, and machinery); own land lease; and other expenses.

accordance with the findings of Suranjaya *et al.* (2017) that note that there are hidden costs of breeding pigs in Bali, came from 13% of land rent costs and 87% of labor costs.

The percentage of forage costs is the highest among the other types of feed in the non-cash formula. This result is in accordance with the composition of animal feed where forage is the second highest type of feed used by farmers. Forage is obtained from agricultural land. These results confirm the findings of Iyai *et al.* (2013) on pig farming in West Papua that there are 64% of farmers getting their feed from agricultural land. In the component of feed costs also found the cost of factory feed with a very small portion. It is because this type of feed only appears in the business when there is a promotion from feed mills or in a form of a grant from other breeders.

Profitability

The profit of a business is basically the difference between the total revenue and the total cost. The total cost is determined by the performance of the input and output relationship and the prices of the inputs. However, as stated in the previous section, the data used do not provide detailed information on the physical quantities of output and input. So that in this study the direct analysis of financial measures is used.

These three types of pig farming businesses have different selling orientations. In the farrow-to-finish type of business, farmers tend to sell piglets and adult pigs that fit for slaughter. In the pig-finishing type, farmers only sell adult pigs fit for slaughter. In the pig-nursery type, farmers only sell piglets. The profitability value (in

thousand Rupiah) per head per period in three types of household-scale pig business in Indonesia is presented in Table 4. Revenue is calculated based on the added value of livestock per head per period plus revenue from the value of by-products. Revenue from this pig-finishing type is the highest among the three types of pig farming. The same thing happened to the value of the profitability, where the pig-finishing business had the highest profit/financial advantage, economic profit/profit, gross margin index, and net margin index among the three types of pig farming business. This result is in line with the study of Suranjaya *et al.* (2017) and Göncü and Koluman (2019) which state that pig-finishing type is a profitable type of livestock business. Profits can be increased if the market weight (ready to be slaughtered) can be achieved with a shorter maintenance period. The results of research by Kusumastuti and Irlham (2001) reveal that this type of business has financially profitable because it provides high income.

Although the economic benefits in the pig-finishing type of pig farming are much higher than the farrow-to-finish type, the gross margin index of the two is not much different. This is because the cash cost of this type of farrow-to-finish is lower. If all the resources used in the pig farming business are taken into account, the farrow-to-finish type will have the lowest efficiency among the other two. This can be seen in the lowest net margin index of 0.19 in the farrow-to-finish type of business. Each unit of income (Rp000) is only able to generate a profit of Rp. 0.19. Although the net margin index for the farrow-to-finish type is the lowest, the market risk is also the lowest, because

Table 4. Profitability of three types of pig farming in Indonesia per head per period

Description	Farrow-to-finish	Pig-finishing	Pig-nursery
	IDR	IDR	IDR
Total revenue	1 433.73	1 777.98	940.40
Value added	1 425.83	1 768.69	935.98
Value of byproducts of farming (manure, biogas)	7.91	9.28	4.42
Total cost	1 158.12	1 228.22	738.70
Cash	545.60	626.71	493.18
Non-cash	612.52	601.51	245.52
Accounting profit	888.13	1151.27	447.24
Economic profit	275.61	549.76	201.71
Gross margin index	0.62	0.65	0.48
Net margin index	0.19	0.31	0.21

IDR in '000'

Table 5. Summary results of statistical t-test for the revenue, cost, and profitability variables of the three types of pig farming in Indonesia per head per period

Variable	Pair of comparison		
	(Farrow-to-finish) - (Pig-finishing)	(Farrow-to-finish) - (Pig-nursery)	(Pig-finishing) - (Pig-nursery)
Total revenue	-343.5557**	494.2962 ^{ns}	837.8519 ^{ns}
Total cost	-69.52875 ^{ns}	420.2042 ^{ns}	489.733 ^{ns}
A. Cash	-80.83973 ^{ns}	52.82736 ^{ns}	133.6671 ^{ns}
A.1 Variable cost	-77.06575 ^{ns}	44.86612 ^{ns}	121.9319 ^{ns}
A.1.1 Labor	2.879895 ^{ns}	-109.321***	-112.2009***
A.1.2 Feed	-92.46665 ^{ns}	138.1313 ^{ns}	230.598 ^{ns}
A.2 Fixed cost	-3.773976 ^{ns}	7.961252 ^{ns}	11.73523 ^{ns}
B. Non-cash	11.31098 ^{ns}	367.3769***	356.0659***
B.1 Variable cost	0.2634592 ^{ns}	348.1481***	347.8846***
B.1.1 Labor	17.6044 ^{ns}	189.9945**	172.3901***
B.1.2 Feed	-30.05713**	122.4667**	152.5238*
B.2 Fixed cost	11.04752***	19.2288 ^{ns}	8.181319 ^{ns}
Profitability			
A. Accounting profit	-262.716***	441.4688 ^{ns}	704.1848 ^{ns}
B. Economic profit	-274.027***	74.09193 ^{ns}	348.1189 ^{ns}

*** p<0.01; ** p<0.05; * p<0.1; ^{ns} p>0.1.

the main cost component is non-cash. Low market risk is thought to be the main factor that makes this type of business the most attractive for domestic pig farmers in Indonesia. In addition, in this type of farrow-to-finish business, farmers can sell piglets (pig seeds) and adult pigs fit for slaughter. According to Suranjaya *et al.* (2017), the sale of piglets in this type of business can reduce operational costs, especially the cost of feed whose prices tend to fluctuate. In addition, Taylor and Field (2014) confirmed that economically or socially, the farrow-to-finish businesses are superior and have the best development prospects compared to other types of businesses.

The average revenue and profitability of the pig-nursery type of pig farming are the lowest among the other two types of business. However, based on the t-test presented in Table 5, the difference is not statistically significant. This result is supported by Santa and Wantasen (2018) that confirm that with the same average number of broodstock, the average profit for the pig-nursery business is lower than for the combined type (farrow-to-finish). Kusumastuti and Irham (2001) added that a pig-nursery type of business is easily affected by fluctuating pig prices and an increase in environmental costs

Conclusions

The percentage of pig feed costs accounted for more than 70% of the total cash of the three types of pig farming. The percentage of unpaid labor costs is more than 50% of the total non-cash. The revenue and the profitability indicators of the pig-finishing type were the highest among the three types of pig farming. The profitability of the pig-finishing type was statistically higher than that of the farrow-to-finish type, but the difference was not significant compared to that of the pig-nursery type. Basically, pig farming in Indonesia has not been able to fully exploit its potential benefits and financial performance. Therefore, public policies are needed to gain access for better production technology and access to financial sources.

Acknowledgment

We would like to express our gratitude to the Department of Agribusiness for providing facilities to access Livestock Business Household Survey data. High appreciations are also conveyed to faculty members who provide suggestions for improving the paper. However, all errors and shortcomings that exist are the responsibility of the authors.

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