Financial Aspects of Pig Production in Brazil: Case Study in a Farm using Sustainable Management

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Abstract. The Brazilian pig production generates substantial effluent that may be used for the generation of bioenergy. Bioenergy is an opportunity to reduce costs production and environment impact, as well as to offer better prices to consumers and obtain a better profit unit. Thus, the present study aims to show the importance of spending in pig production as a precondition for a proper sustainable business management. The study shows the scenario of pig production in Brazil, and the Direct-Costing concepts as a decision support tool for the production optimization based on the demand of slaughter plants. A case study was conducted on a farm located in the Southeast of Brazil. For financial measurements, the Direct-Costing method was used. The survey was conducted with the use of financial and accounting information by the composition of farm costs from the production process to the turnover in the slaughter of the pigs. The results showed that the usage of alternative energy based on waste of pigs activity provided a profit increase of 52.73% per unit to famer. Thus, we conclude that biodigester applied in pigs farms is profitable.

Keywords: Break-even point, Bioenergy, Production costs, Profitability, Swine.

1 Introduction

Brazilian pig production is significant activity in the country' economy with nearly 40 million heads [1]. The predominant commercial breeds are hybrids from Landrace and Large White breeds. Nowadays the pig supply chain in Brazil involves 60 thousand pigs farmers, and 660 thousand employees (230 in the farm; 150 in inputs industry; 120 in the processing plants; and 160 in the sales) [2]. Brazil is a continental size country and the pig production in intesive systems is concentrated in three main regions as: 50% in South of the country (the Rio Grande do Sul, Santa Catarina, and Paraná states), 18% in Southeast region (Minas Gerais and São Paulo states), and 13% in Midwestern region (Goiás, Mato Grosso and Mato Grosso do Sul states) [3]. Pig production actual output of wastes might apply to sustainable actions such as the biogas generation and fertilizer. Using pigs waste to produce energy is an alternative to reduce production costs and contribute to the environment [4].

There are two different systems of pig production in Brazil: 1) integrated systems, and 2) independent systems. In the first system, the production costs are shared between farmers and slaughter plants, while, in the independent systems, the pig farmers are entirely responsible for production costs [5]. Thus, generally the farmer in independent systems are interesting in all methods of production that contribute to reduce costs and risks of business.

Independent pigs' farmers have a high-risk business due to the variation in pork market. Independent farmers assume all the market risks and they compete in the pork market with integrated farmers. Usually, the integrated sector obtain lesser costs production that allow offer pork by less price and become market competitive. The sustainable practices applied to reduce costs of production are an opportunity to independent farmers become more competitive in the market by offering a better price to the customers.

It is economically feasible using the digester breeding of pigs for slaughter?

The present study shows the composition of costs and accounting aspects in the production of pigs, considering a sustainable alternative such as the bioenergy produced from pigs waste. This is a case study in a Brazilian farm, in Southeast of the country, through visits and monitoring of production slaughter of animals. The data collected show preliminary financial results, which have a financial evaluation of production.

2 Literature Review

All activities involve a capital consumption which is subject to certain risks accompanying the return. The positive return is directly proportional with the risk degree, as the higher is the return expected, the greater is the assumed risk and vice versa [6][7].
The research used a controlling technique spread with the name of Direct-Costing, also called Variable Costing. This technique is the inventory costing which applies only variable production cost to product, under this method fixed factory overhead is not assigned to product [8].
The method allows the knowledge of costs for a decision, which is the Contribution Margin. The contribution margin shows the difference between the selling price and variable costs. In other words, is how much the sales price contributes to the payment of fixed costs and still generate profit for the company [8].
The break-even point is characterized by the return or the level of activity that the company must reach to cover the total of costs (either fixed or variable) so that it does not release any benefit or loss [6]. To calculate the break-even point, Eq. 1 has been used.

$$\text{Break-even point} = \text{Fixed expenses} / \text{Contribution Margin}. \quad (1)$$

The margin of safety is how much output or sales level can fall before a business reaches its break-even point [9]. Eq. 2 was used to calculate the margin of safety.

$$\text{Margin of safety} = \text{Actual sales} - \text{Break-even sales}. \quad (2)$$

3 Methodology

The research method using a case study on a farm located in Espírito Santo state, Brazil (20°50'58'' S, 41°6'48''W). The farmer has seventeen facilities for animal housing, with a herd of 8,400 pigs. The farm has twenty staff members and has feed mill. The farmer is the responsible for the logistics operations and owns a truck to perform pigs' transportation (Figure 1).

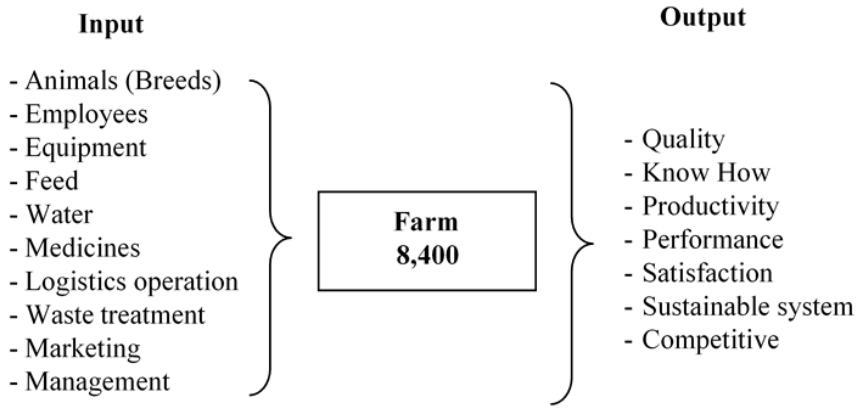

Figure 1: The flow of the system input, process, and output in a pigs' farm.

The research was conducted in the 2014/2015 period, the prediction based on Farmer technical coefficients (Table 1). From the collection of data production levels, revenues, costs and expenses, fixed and variable, we made the management analysis of production costs.

Table 1: Pig farm technical coefficients.

Parameter	N	Parameter	N
Sows (heads)	960	Weight of piglet (kg)	25
Finishing pigs (heads)	7,440	Weaning age (days)	21
Age of finishing pigs (days)	156	Finishing farm density (m²/pigs)	1,2
Weight of finishing pigs (kg)	120	Area of finishing farm (m²)	960
Age of piglet (days)	66	Quantity of finishing farm	9

N = number.

The present study considers the financial impact of weight loss that is occurring between the time of departure and time of slaughter of pigs. The method combined the case study with the use of strategic management techniques costs, particularly with indicators generated from the direct costing. Amongst those indicators, the break-even point from the contribution margin with the separation of fixed expenses in variable costs was applied.

The case study approach, defined by [10] as a research strategy that seeks to examine, in deep, a phenomenon within its context, to identify the business needs to be related to the costing process. There is a concern about the farmer costs due to a lack control system. We noted the use of costing methods, which was combined, as the direct costing and activity-based costing. According to [11] the farmer should use a dedicated information system based on cloud computing to improve the system management.

4 Results and Discussion

The farm in the case study has 92% of sales concentrated to a single slaughterhouse. However, is free to sell their produce to market. The current condition allows the producer under vulnerable from oscillations in variable costs, subject to inflation, both in the feed as the growing increase in the prices of fuels [12]. Managerially does not use the concept of marking rate, which is an index applied to the cost of a good or service for the formation of the selling price [13].

Regarding production strategies, the farmer shows a pull system, due to all the stock, was sold after the pigs reached the ideal weight and the pigs were produced based on consumers' specification. Also, an important aspect of taxation on the sale is tax deferral for producers, focusing solely on the productive activity. The deferral of tax on sales made by the farmer means it will not be taxed at the time of slaughter [14]. Therefore, it will be due in the next stages of the production chain.

The International Accounting Standard (IAS) 41, which deals with agriculture in dealing with the recognition and measurement of biological assets explains that animals should be measured on initial recognition and at the end of each reporting period at its fair value fewer costs to sell [15].

The income statement was based on parameter of the weight of finishing pigs with 120 kg, however the farmer is paid by weight of pigs delivered at slaughterhouse. Thus, the income farmer is based on average finishing pigs with 118 kg and the difference between weight of pigs in the departure and arrival are 2 kg that represent an average loss of 1.67% of the revenue, Table 2. The percentage of loss is association with average of the losses occur during transportation.

Table 2: Income Statement in the farm.

Account	Vertical analysis %
Revenue	100.00
Cost of Sales	(81.54)
Gross Profit	18.46
Other Expenses	(21.50)
Profit unit	16.31

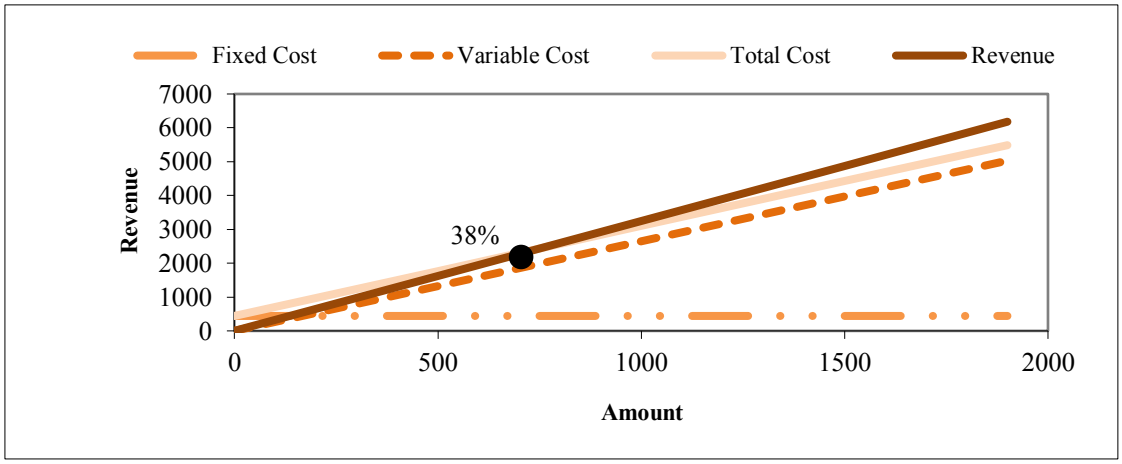

Figure 2: Break-even point using electricity from swine waste.

The break-even point is nothing more than the level of sales resulting in a zero net income for the project [7]. The estimate of break-even point to the farm shows 37.50% of revenue using electricity from swine waste. The contribution margin is the difference between revenue and all variable costs (the costs that would be incurred if not this client is refused) associated with a unit of the product [16]. Therefore, it is the profit that can be obtained from the balance, contributing to fixed costs and profits of the company. In our case, we found a margin of 18.46% contributions due farm using electricity from swine waste.
An estimative was found considering the same costs are adding electricity costs from a commercial supplier (Table 3), and the break-even point was 83.33%, Figure 3 in leverage effect.

Table 3: Estimate Income Statement in farm adding costs electricity.

Account	Vertical analysis %
Revenue	100.00
Cost of Sales	(81.54)
Gross Profit	18.46
Other Expenses	(10.75)
Profit unit	7.71

The difference between the break-even point in Figures 2 and 3 shows the marked decrease in activity profit margin. Using the bio-digester it has a profit margin of 16.31% and a safety margin of 62.50%. The present results shows a good return compared to a Brazilian government bond yield of approximately 14.25%.

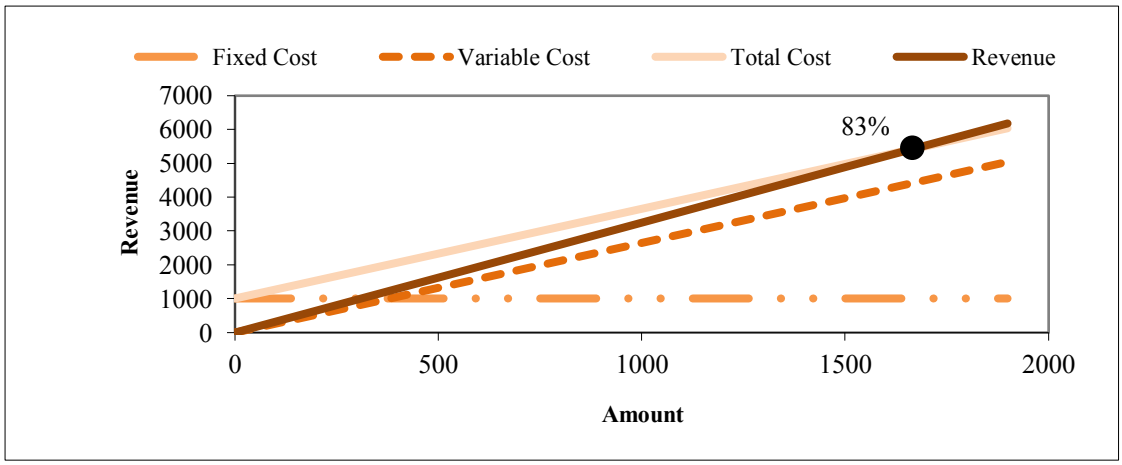

Figure 3: Break-even point using electricity from a commercial supplier.

The results demonstrates the importance of knowing the structure of costs and expenses for the adequate pig pricing. The farm had not the biodigester their unit profit falls 52.73%. Without the utilization of a biodigester, there will be a decrease in the profit margin of 7.71% and the margin of safety for only 16.67% of the current production and sales structure. Thus, the pig production activity proves not feasible to be comparable to other forms of investments.
The variable costs of the farm are high since only feed for pigs is 72.6%. The farm fixed costs are low, due they practice pigs' waste management and appropriate the technology from biodigester and transform biogas in electricity.
A previous study showed the development of the dynamic chain pig model system based on historical data; the system tracks the past data to predict possible fluctuations herds conditions in future herds. This technique allows the manager an anticipation of adverse conditions [17]. Also [18] presents an application to predict the average weekly weight and size distribution of finishing swine in a commercial pork production industry. A study that developed a heuristic algorithm to determine a pig acquisition plan that includes variations in pig size. According to the research, the model applies to industrial scale that can generate up to 10% less costly to traditional methods used were implanted [19].

4.1 Livestock waste management

The wastes are results from the process of production or operation in each phase of the supply chain, such as rural production (agricultural and livestock wastes), industry (transformation wastes), retailers (distribution wastes) and consumers (family wastes). The generation of waste mainly in food supply chain is a significant challenge for several fields, due the complexity process involves in food production that required food safety, quality, traceability, and origin. The sustainable productive processes have come to be relevant to governmental, corporate, academic and scientific areas. Also, the sustainable process is considerable as a result of attempts at reducing production costs and atmospheric pollution, such as control of gas and waste emissions [20].
Nowadays, the pig farm produces 80% of the KWh from pigs waste, and 20% comes from the commercial supplier of electricity. The sustainable management performance of the wastes using by the farmer is present in Table 4.

Table 4: Estimated value of biogas production of pigs wastes, energy consumption by farm and the costs per day.

Pigs (heads)	Waste production (ton^{-1}day)	Biogas production (m^3 day)	Energy production (KWh^{-1} day)	Energy consumption (KWh^{-1} day)	Energy costs ($US\$^{-1}$ day)*
8,400	96	1,080	805.97	1,007.46	98.59

* US$ 1 = R$ 3,1491996 [21].

The bioenergy generated is used to the whole farm and it is responsible for reducing 80% of electricity costs, that represent US$ 2,366.31-1 month, US$ 28,395.74-1 year. Using bioenergy farm also reduce the environment impact of 2,880 ton-1 month and 34,560 ton-1 year. Hence, takes virtually all amount of waste, contributing to the environment and business. Brazilian small and medium producers have no accounting controls of the income and expenses. The farmers are subjected to the acceptance or rejection of batches delivered to slaughterhouses.
The application of manure management system in livestock contribute not only do economic aspect, but to social and environmental concerns. The results show that the use of bio-digestion allows an increase in the profits. There is also a reduction in the waste emissions as the farmer adopted pigs manure management and applied a correct destination of solid wastes.
The pigs manure shows a power of biogas production estimated between 0.12 and 0.24 m^3/pig per day, considering a pig with 90 kg [22]. The solid waste from livestock activity have become an ecological problem and despite the technical and scientific areas show many alternatives to correct destination or the generate bioenergy, these initiatives are timid, due to the lack of knowledge by farmers to install biodigesters and investments. According to [23] and [24], the biogas produced from animal waste, like pigs' manure, is widely used as a renewable biofuel source, as well as an efficient method to generate renewable energy, biogas is playing an important role in environ-mental protection.

Potential benefits of solid waste expand beyond the cash or direct economic benefits [Mathew]. A policy concern in Iowa state, for example, is increase the use of alternative energy resources from 2% of Iowa's total energy consumption to 5% by the year 2005 and 10% by 2015.
The waste offers an alternative for dealing with a number of social and economic issues, apart those related to emerging agricultural concerns. This report showed that the use of waste is economically viable as well as in other studies [4] [25-26].

5 Conclusion

Research has shown that it is economically feasible to use digester for the production of pigs for slaughter. The usage of alternative energy provided a profit increase of 52.73% per unit. We detected a low break-even point 37.50%, a profit margin of 16.31% and a safety margin of 62.50% in production and sales structure. Thus, considering the actual scenario of farm case study, we conclude that despite the farm facing a fluctuation on the market their financial results will not compromised.
On the other hands, we reinforces the importance of using alternative energy sources to reduction environmental impact. The present study estimated a reduction in waste production of 34,560 ton^{-1} year.

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