Colegio de Postgraduados

Financial evaluation of small-scale pig farming in central Hidalgo

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ABSTRACT
Objective: To evaluate the financial performance of small-scale pig farming in central Hidalgo.
Design/methodology/approach: Economic data from 32 pig farms were analyzed through the Cost-Benefit Analysis (CBA) methodology. This method includes a set of criteria to evaluate economically and financially an agricultural production system; among the most relevant there are Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit-Cost Ratio (B/C R).
Results: The project is profitable in a horizon of 5 years, since the NPV was higher than 0 ($54,127.03), even when the initial capital investment is low ($141,008), the project financial yield (IRR=25.84%) indicates that pig fattening evaluated as an investment option exceeds 2.3 times the potential yield that can be obtained with the annual CETES rate (11.25%).
Limitations on study/implications: The size of the sample used suggests a challenge to generate the results, given the heterogeneity of the economic variables in the small-scale pig production systems.
Findings/conclusions: The financial yield evaluated through the IRR shows the highest return provided by pig fattening in comparison to the traditional investment instruments. In conclusion, this study supports the notion that small-scale pig farming constitutes a profitable and sustainable agribusiness, with the potential of significantly contributing to the economic progress of Mexican rural areas.

Keywords: Family livestock production, cost-benefit analysis, net present value, pig farming.

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INTRODUCTION

Pig meat is the one with highest consumption globally and it is expected for its demand to continue increasing to 129 million tons in 2029 (OCDE/FAO, 2022; Bartlett *et al.*, 2023). In Mexico it represents 30% of the total meat consumption and given its versatility to

prepare dishes and the existence of a wide network of sale points, it has been positioned as one of the favorite meats to satisfy the growing demand of the Mexican middle class (COMECARNE, 2023).

In this scenario, small-scale pig farming represents a relevant activity since it contributes significantly with food security and income generation in rural communities of the entire world (Das *et al.*, 2021). In Mexico, it plays a crucial role in rural economy through the generation of sources of employment (Martínez-Castañeda and Perea-Peña, 2012) and through its contribution (22%) to national production (Amo, 2018).

However, despite the economic and social importance that small-scale pig farmers have in Mexico, they face considerable challenges in terms of access to credit, technical training and scarcity of economic resources for investment in new technologies (SENASICA, 2021). With these conditions, it is important to develop scientific research that analyzes both the financial and the structural aspects, given their critical impact on the growth and sustainability of small-scale pig farming in Mexico.

While some studies in Mexico have addressed the analysis of profitability and production costs in pig production systems (Benítez-Meza *et al.*, 2015; Venegas *et al.*, 2017), there is a clear research opportunity in the agricultural economics literature to conduct financial analyses of these production systems, both at the national level and in the study region. This deficiency limits a comprehensive understanding of the true economic potential and sustainability of small-scale pig farming under local production conditions.

While many small-scale pig farmers may lack familiarity with formal economic tools, such analyses can provide valuable insights for improving operational efficiency and competitiveness, it is certain that when it is implemented they can get useful information to execute their operations in a more efficient, profitable way and can be more competitive in the demanding environment of the present market (Tsiouni *et al.*, 2023). Based on the foregoing, the objective of this study was to evaluate the financial viability of small-scale pig fattening systems in central Hidalgo, Mexico, using Cost-Benefit Analysis to assess Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit-Cost Ratio (B/C R).

MATERIALS AND METHODS

Study area

The study was conducted in 32 small-scale pig farms located in the municipality of Ixmiquilpan Hidalgo, Mexico, between coordinates 20° 29' 03" of latitude North and 99° 13' 08" of longitude West; the municipality has an altitude of 1,680 masl, semi-warm climate with rainfall of 300 to 500 mm and rains from June to September (INAFED, 2023).

Sampling

A non-probabilistic sampling design was used to obtain the information, following the guidelines proposed by Otzen and Manterola (2017). This approach eased the selection of the 32 production units that cooperated, which adequately represented the diversity of the pig production sector in the region of interest. To select the farms, criteria of inclusion were established, considering aspects such as the size of the production unit, the technological level, and the geographic location; meanwhile, the criterion of exclusion used was the

lack of interest of producers to participate in the study. This approach guaranteed the representativeness of the sample obtained.

Although selection bias is an inherent limitation of non-probability sampling, this approach was adopted due to the lack of a clearly defined target population, as there was no formal producer association in the region. The selection process was based on prior field observations and a pilot survey of 20 production units, which verified key characteristics such as farm size and technology. While lack of interest was used as an exclusion criterion, the survey results demonstrated that the selected farms were not biased toward more successful producers, as they exhibited homogeneous characteristics in terms of size and technology. This ensured the representativeness of the sample within the regional context. The sample size (n=32) was defined considering the specific operational context of the study, particularly the limited accessibility to dispersed rural areas and the availability of producers to participate. Although a formal statistical power analysis was not conducted, previous research in the agricultural sector has employed similar or even smaller sample sizes (Albarrán-Portillo *et al.*, 2015; García-Martínez *et al.*, 2017; Hernández *et al.*, 2025), demonstrating their adequacy for obtaining valid results in descriptive, social, and economic studies. Given the descriptive and exploratory nature of this study, the sample size was deemed adequate for the objectives set. However, it is acknowledged that future research could expand the sample size to enhance the robustness and generalizability of the findings.

Obtaining the information

The data analyzed were obtained using the procedure proposed by Herrera *et al.* (2019), which involves collecting information through face to face surveys with producers. The survey included open ended, closed ended, and categorical questions, addressing technical, economic, and social aspects of the production process. Following the initial survey, the data were processed in an Excel spreadsheet, and the results were validated through a second visit to the producers. This feedback process allowed the questions to be refined and ensured that they accurately reflected the realities of the production system under study.

Economic and financial analysis

The methodology used to evaluate the financial behavior of pig fattening was the CBA. This technique is easy to use and explain, and it adjusts to new data and to possible extrapolation of results to other agricultural systems (Márquez and Castro, 2015). CBA includes a set of criteria to economically and financially evaluate a production system; among the most relevant there are the NPV, IRR and B/C R.

The NPV is an indicator that represents the sum of the net effects on the economic life of a project, reduced or discounted at present time (Cetkovic *et al.*, 2022). The equation to calculate it is the following:

$$NPV = -Io + \left(\frac{FNE_1}{(1+TREMA)^1}\right) + \left(\frac{FNE_2}{1+TREMA^2}\right) + \ldots + \left(\frac{FNE_n + VS}{(1+TREMA)^n}\right)$$

where: $-Io$ is the initial capital investment; *FNE* is the net flow in cash in the year *n*; *TREMA* is the discount rate, and *VS* is the salvage value of fixed assets. If the *NPV* is 0 or positive, it indicates that a project must be accepted, given that the financial return generated pays for the opportunity cost of the capital invested.

The IFF is the updating rate that seeks to equalize the NPV of a project to 0. This rate reflects the efficiency of the project and the eligibility criterion, and under this indicator the IRR should be higher than the discount rate (Kim *et al.*, 2021). The B/C R shows how much net benefit can be achieved by unit of cost and it is calculated as the updated value of the benefit divided by the updated cost value (Márquez and Castro, 2015).

The financial analysis for this study was built according to the following assumptions: 1) the evaluation was carried out in Mexican pesos, 2) the financial analysis used real prices (market prices in the purchase of inputs and the product), 3) the initial year of analysis was 2023, 4) the planning period of the project was five years, 5) the production cost and sale price per pig for the five years of project planning were adjusted with the foreseen inflation data for the 2023-2027 period extracted from Statista (2023), 6) The discount rate (TREMA) used to update future cash flows was 13.65%. This rate was derived by adding a 10% risk premium, , to the average inflation rate observed over the 5-year project planning period (2023-2027) (Statista, 2023), in accordance with the methodology proposed by Dorantes-Coronado *et al.* (2025), and 7) the benefits derived from the project were analyzed in relation with the poverty lines defined by the National Council for Evaluation of the Social Development Policy (Consejo Nacional de Evaluación de la Política de Desarrollo Social, CONEVAL), as a measure to evaluate its financial capacity in terms of family upkeep.

RESULTS AND DISCUSSION

The results from the study show that in a horizon of 5 years, the project is profitable (Table 1), and this is because the NPV was higher than 0 ($54,127.03), which indicates that the benefits exceed the costs of investment, positioning the small-scale pig fattening project as a financially attractive option (Santiago-Santiago *et al.*, 2020). The Benefit-Cost Ratio (B/C R=1.31) confirms the profitability of the evaluated system, indicating a net return of 0.31 monetary units for every unit invested. This value is higher than that reported by Martínez-Castañeda *et al.* (2024) for pig fattening systems in central Mexico (B/C R=0.98), suggesting greater economic efficiency under the conditions assessed in this study. This behavior highlights that the project is economically sustainable and offers a solid financial yield during its useful life (Bonazzi *et al.*, 2021; Ivanović *et al.*, 2015), since the initial investment is recovered and benefits are obtained in each year of the project (Ivanović *et al.*, 2015).

On the other hand, the IRR value of 25.84% exceeds a TREMA of 13.65%, indicating a robust margin for the investment made by the evaluated farms. Previous studies on pig finishing systems in Mexico and Brazil reported lower IRRs of 11.06 and 10.08%,

respectively (Martínez-Castañeda *et al.*, 2024; Krüger *et al.*, 2024). These findings position the evaluated model as a more economically attractive alternative within the context of pig production in the study region.

However, it is important to highlight that under the conditions observed on the farms analyzed, although producers have between 2 and 5 hectares available for food cultivation and an average of four family members (spouse, children, and elderly adults) providing labor, expanding production capacity presents significant challenges. These include technological limitations, lack of technical training, inadequate infrastructure, limited access to credit (SENASICA, 2021), and difficulties in product marketing. Despite these limitations, the farms evaluated represent a source of monetary income and constitute an effective model for leveraging human capital and generating economic value in the family business.

Considering the initial capital investment ($141,008), the results from the study show that the financial yield (IRR=25.84%) in the pig farm evaluated as an option of investment exceeds 2.3 times the potential yield that can be obtained with the annual CETES rate (11.25%; CONDUSEF, 2023), which indicates that small-scale pig farming is a good option since it can be a profitable business that can be promoted and undertaken (Obayelu *et al.*, 2017) with low investment.

It has been proven that small-scale pig farming in Mexico is an efficient business option that allows peasant families to have an alternative to complement their income (Martínez-Castañeda and Perea-Peña, 2012). This result can be confirmed with the values obtained in the project's annual net cash flows, which has the capacity to cover the annual food basket expenses of approximately 1.10 people, according to the rural poverty line defined by CONEVAL (2023). This organization established a monthly cost of $3,102.31 per person for that year, which when multiplied by 12 months is equivalent to an annual expense of $37,227.72. By dividing the project's average annual net cash flow ($41,127.72) by this value, it is estimated that the income generated can cover the basic food needs of 1.10 people per year. These results support the economic viability of the project and suggest that if small-scale pig production is reproduced in the Mexican rural communities, this business could be an efficient instrument to help eradicate poverty among peasant families; thus contributing to the fulfillment of two of the 17 sustainable development goals of the 2030 United Nations agenda (FAO, 2019).

Although the research results allow for an analysis of the financial performance of the studied farms, factors such as feed costs and pork prices are subject to variability, influenced by fluctuating input prices and the dynamics of the local market and regional demand. A sensitivity analysis of these factors would allow for an assessment of their impact on profitability, particularly in volatile economic contexts. However, despite this being a limitation in the present study, the cost and revenue projections are based on the macroeconomic trends expected for Mexico during the period 2023-2027. Therefore, the projected results, although dependent on external factors, are in line with the trends observed in recent years and can be considered realistic within the Mexican market.

Table 1. Determination of the net cash flow and financial indicators in small-scale pig farming in Ixmiquilpan, Hidalgo.

Concept	Years of project planning					
	2022†	2023	2024	2025	2026	2027
Production of heads of pigs		45.00	45.00	45.00	45.00	45.00
Average weight per pig at sale (kg)		110.00	110.00	110.00	110.00	110.00
Sale price per pig ($/kg)		41.07	42.67	44.07	45.43	46.81
Income from pig sale ($/kg)		203,296.50	211,204.73	218,132.25	224,872.54	231,686.17
Total income per year ($)		203,296.50	211,204.73	218,132.25	224,872.54	231,686.17
Average cost per pig ($/kg)		3,776.85	3,923.77	4,052.47	4,177.69	4,304.27
Total costs per year ($)		169,958.16	176,569.54	182,361.02	187,995.97	193,692.25
Depreciation of fixed assets ($)		6,737.32	6,737.32	6,737.32	6,737.32	6,737.32
Amortization of differed assets ($)		1,052.07	1,052.07	1,052.07	1,052.07	1,052.07
Gross return ($)		33,338.34	34,635.20	35,771.23	36,876.56	37,993.92
Financial costs ($)		0.00	0.00	0.00	0.00	0.00
Return before taxes ($)		33,338.34	34,635.20	35,771.23	36,876.56	37,993.92
Taxes (0%)		0.00	0.00	0.00	0.00	0.00
Net return ($)		33,338.34	34,635.20	35,771.23	36,876.56	37,993.92
¶Depreciation and amortizations ($)		7,789.38	7,789.38	7,789.38	7,789.38	7,789.38
Net cash flow ($)		41,127.72	42,424.58	43,560.61	44,665.95	45,783.30
Fixed asset investment	96,008					
Working capital	45,000					
Initial investment	141,008					
Rescue value (residuals)						86,282.59
TREMA						13.65%
NPV						54,127.03
IRR						25.84%
B/C R						1.31

† Year zero or base.

¶ The method used in this study to calculate fixed asset depreciation was the straight-line method, as it is one of the methods recognized in Mexico for tax purposes.

CONCLUSIONS

The results of the financial indicators such as NVP and the B/C R confirm the viability of the project by showing that the benefits exceed the costs in each year of planning. The financial yield of the project (IRR=25.84%) indicates that pig fattening evaluated as an investment option exceeds 2.3 times the potential yield that can be obtained with the annual CETES rate (11.25%). These results support the perspective that pig production constitutes a promising alternative for small-scale producers, offering an additional source of income as a means to strengthen food security in rural communities.

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