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Understanding the Economic Pressures in Hog Production: Implications for Food Security and Agricultural Policy

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ABSTRACT

This study investigates closely at the problems faced by small and medium-sized hog farmers in the Philippines, especially in terms of money, technology, government support, and environmental concerns. Using a descriptive quantitative method, the researchers gathered data from 49 actual hog farmers about their daily experiences. The results show that the biggest problem is financial—such as the high price of animal feed and the changing price of live pigs, which makes it hard for farmers to earn steady income. Many of these farmers depend on hog raising to support their families, but they often don't have access to affordable veterinary services, modern tools, or strong support groups like cooperatives. The study also found that most farmers are not part of coops and are not very involved with government programs, which makes it harder for them to respond to diseases or changing farming rules. These issues weaken the hog farming sector overall. The regression analysis confirmed that money matters, technology use, policy awareness, and environmental practices all strongly affect whether farms can survive for the long term. This research ends with a clear message: to keep hog farming alive and strong, there must be a complete action plan. This includes giving financial help like subsidies, training for modern farming practices, building stronger cooperatives, and encouraging the youth to return to farming. With these combined efforts, hog farming in the Philippines can grow again and continue to support food security and rural community life.

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1. Introduction

Hog production in the Philippines is a big help for food and income, especially for people in rural areas. Pig farming gives families in the provinces a source of protein and livelihood. In fact, the livestock sector provides about 80% of all animal-based food production in the country^[1]. Given this scale, the decline of smallholder hog farms poses a serious threat not only to food security but also to rural employment and income distribution. In this study, sustainability refers to a farm's long-term viability across four interconnected dimensions: economic profitability, technological adaptability, institutional support, and environmental compliance. This multi-capital approach allows a holistic understanding of the factors shaping hog production outcomes in the Philippines. There are two kinds of hog farming—backyard and commercial—but most of the pork supply in local markets comes from backyard and small-scale farms. That's why this industry is very important to both the economy and the everyday meals of Filipino families. However, even if hog farming helps many people, the industry is now facing big problems that make it hard for farmers to continue. Health crises like African Swine Fever (ASF) and COVID-19 caused a large drop in pig production^[2]. Because many pigs died or were unsafe to eat, the pork supply became very low. In response, the government had to import large amounts of meat to fill the gap. For example, in 2022, pork imports increased because local supply couldn't meet demand. This hit small farmers the hardest because they didn't have the money or tools to fight such a crisis. These situations show how weak the local hog supply system can be during emergencies.

Another serious problem is antimicrobial resistance (AMR). This happens when antibiotics used on pigs no longer work well because they were used too often^[3]. If pigs get sick and the medicine doesn't help anymore, the problem affects both the safety of food and the economy. More people in the Philippines eat pork

now, so if AMR continues to grow, it will lead to more pig deaths, more spending on medicine, and less production. That's why experts are now looking at new ways to help farmers avoid huge losses. One idea is using futures contracts, which are agreements to sell pigs at a fixed price even if the market price changes^[4]. This can help big farms plan better, especially when market prices go up and down or when there are disease outbreaks. But big farms also cause pollution, so they must also take care of the environment. It's not just about profit; hog farming must also consider its effects on land, air, and water.

Even though hog farming supports the lives of many Filipinos, small and medium farmers are under a lot of pressure. One of the biggest problems is the rising and falling prices of animal feed. If feed prices go up while pig prices go down, farmers earn almost nothing. They can't predict how much money they'll make, so it's hard to plan their expenses. Improving management systems in local farming operations may help streamline planning, coordination, and service delivery in rural areas^[5]. On top of that, they often can't afford veterinary services. Vet care is either too expensive or too far away^[6]. Small farmers are affected the most because they don't have money to buy medicine or pay for treatment. When pigs get sick and are not treated, they die, and farmers lose income again. Also, the government now has stricter rules for hog farming. Farmers are required to properly manage waste and ensure clean, safe conditions for their pigs. Following these rules often means building new facilities, which adds even more costs. ASF is still spreading in some places, causing pigs to die and making the market unstable^[7].

Because of all these challenges, farmers need strong plans to survive. Futures contracts can help control income even during market uncertainty^[8]. But having clean farms, using resources wisely, and preparing for diseases are also very important. These are the only ways the hog industry can stay strong for the long term. To make hog farming last in the Philippines, we need to balance money, technology, environment, and law. Stud-

ies show that price changes in feed and pork hurt farmers the most^[4]. We must find ways to keep prices steady or help farmers adapt. Technology can help, like improved pig care or faster veterinary services. But many small farmers don't have access to these, so they get left behind while big farms move ahead. Even though research shows that new methods help, they don't always match local situations^[9].

Large farms also bring environmental concerns. They cause bad smells and dirty water, which harm nearby communities. That's why environmental rules are now stricter. Farmers must manage waste properly, but following the rules costs money^[10]. If they don't comply, they may be forced to close down. Also, government policies keep changing. New rules may require new buildings or systems, and that means more expenses^[11]. To really help hog farmers, the government must check if the rules are fair and helpful. Strong support systems are needed—tools, training, and guidance—to help farmers raise pigs in safe, healthy, and smart ways.

1.1. Problem Statement

Despite its crucial role in food security and rural livelihoods, the hog production sector—particularly its small and medium-scale actors—faces mounting sustainability challenges. These include volatile feed costs, limited access to veterinary services and technology, weak market linkages, and low engagement with institutional support systems. While several studies have addressed these issues independently, there remains a lack of integrated, local-level analysis that examines how these factors collectively affect the survival of small-holder hog farms. Without targeted interventions, the sector risks further contraction, especially among rural producers who lack the resources to adapt to evolving economic and environmental conditions.

1.2. Purpose of the Study

The primary aim of this study is to evaluate the economic, technological, environmental, and institutional challenges affecting the sustainability of small and medium-scale hog farming in one Philippine province.

Specifically, it seeks to determine how these challenges influence farm-level viability, identify the most critical barriers, and propose evidence-based recommendations. This research also intends to fill a gap in localized quantitative literature by combining survey data with correlation and regression analysis to uncover key drivers of sustainability.

1.3. Theoretical and Literature Framework

This study uses two major theories to understand how hog farmers survive and grow their businesses: the **theory of agricultural production** and the **Sustainable Livelihoods Framework (SLF)**. The theory of agricultural production focuses on how farmers use resources—like feed, labor, and technology—to get the most output and income, even when market prices are unstable and income is unpredictable^[12]. In hog farming, this means that farmers must make smart choices, such as how to efficiently use feed, what equipment to invest in, how many workers are needed, and how to keep costs low. Economic survival depends on how quickly and wisely farmers can adjust when market prices rise or fall. This theory is important because it explains how farmers think and plan to remain financially stable. Meanwhile, the SLF adds another layer—it looks beyond money and includes human skills, community support, access to land and natural resources, farm tools and machines, and available savings or credit^[13,14]. These five livelihood assets must work together, and if one is weak, the whole farming system can suffer. SLF helps show the full picture of a farmer's life—not just the farm, but how the environment, society, and government policies affect their daily survival. In times of environmental issues or new farming regulations, SLF explains how farmers try to adapt and stay resilient^[15]. By combining these two theories, this study aims to understand not only how to raise more pigs, but also how to protect and support farmers' lives in the long term.

The SLF dives deeper into how different parts of a farmer's life can affect their ability to keep farming. It explains that farming is not just about growing pigs successfully, but also about reaching markets, getting support from the government, and being part of a strong support system or cooperative^[16,17]. According to SLF,

farmers need a solid foundation—like access to training, good roads, affordable veterinary services, and people or organizations who can help—so they can survive during hard times. Without this support, many farmers may fail or stop farming altogether. SLF shows how all these factors work together and influence the decisions farmers make when facing problems like disease outbreaks or falling prices^[16]. The role of government and community is very important in providing policies, programs, and services that truly help small and medium farmers, not just large-scale operations. When support systems are strong, farms become more stable, food security improves, and rural communities live better. Finally, research suggests that when government planning includes all aspects—financial issues, environmental concerns, human skills, and health risks—hog farms can last longer and help improve the lives of many Filipino families^[18–20].

Literature shows that small and medium-sized hog farmers in the Philippines are facing serious challenges, mainly because large commercial companies dominate the market. These big feed-dependent farms have more money, better systems, and more access to support services, which leaves small farmers at a disadvantage. Research highlights that many small growers struggle to get loans or financial assistance and have to spend more just to meet government regulations, making hog farming more difficult for them^[21]. Since large companies control much of the pricing and market access, small farmers are forced to look for alternative ways to survive, such as joining cooperatives and improving how they manage their farms^[22]. Maintaining clean and sanitary farm conditions is also very important, especially when outbreaks like African Swine Fever (ASF) happen. If a farm is not clean, pigs easily get sick and may all die. However, many small farmers do not have enough resources to maintain high sanitation standards. In addition, few use digital tools to track pig health, feeding, or growth, which limits their ability to make informed management decisions. While digital record-keeping is believed to help, more research is needed to confirm its effectiveness. Cooperative membership is beneficial—it helps farmers get better prices, cheaper feed, and eas-

ier access to veterinary services^[22]. Another problem is that many older farmers struggle to pass their farms on to younger family members, who may not have enough interest or support to continue farming^[21]. Farmers also underuse extension services such as training or government assistance. Many are not aware of the programs available to them, so they miss out on support designed to help their farms^[21]. For hog farming to survive in rural areas, these challenges must be addressed with stronger support systems tailored to small-scale producers.

This study uses a mix of theoretical frameworks and real-life experiences from hog farmers to deeply understand the challenges and possible solutions for sustaining hog production in the Philippines. It applies the Sustainable Livelihoods Framework (SLF) to examine how economic capital, human skills, community support, environmental resources, and institutional systems all interact to either strengthen or weaken farmers' ability to survive^[12]. Hog farming success is not just about producing more pigs—it also depends on whether farmers can sell their livestock, access support, and adapt to new policies or environmental risks^[12]. Research shows that smallholder farmers face multiple risks and an unfair market environment where larger farms have consistent advantages. Therefore, policies must support the development of cooperatives and collective farming approaches so that small farms can remain competitive^[23]. Studies on weakly supported agricultural programs emphasize that lasting success comes when farms are strong enough to withstand shocks such as typhoons or sudden price drops^[13]. Addressing these risks is also important for solving the generational transition problem. If younger people see that hog farming can provide stable income and has good support systems, they may be more willing to stay in agriculture and take over the farms. This study aims to provide forward-looking insights that help build long-term, resilient strategies for hog farming. Both farmers and the government must work together to develop practical plans that protect this essential source of food and livelihood for many Filipino families.

2. Methodology

This study employed a descriptive quantitative research design to examine the economic, technological, environmental, and institutional challenges faced by small and medium-scale hog farmers, and how these factors influence their perceived farm sustainability. The research was conducted in Nueva Ecija, a major agricultural province in Central Luzon, Philippines, known for its high concentration of backyard and semi-commercial hog operations.

A total of 49 registered and active hog growers participated in the study. The respondents were drawn from three municipalities—San Leonardo, Talavera, and Sto. Domingo—representing areas with diverse exposure to African Swine Fever (ASF) outbreaks and varying levels of access to government programs. A purposive sampling technique was employed to ensure participants had relevant experience and reflected local diversity in farm scale, years of experience, and location. While purposive sampling allowed for targeted selection of relevant respondents, it is a non-probability sampling technique that limits the generalizability of the findings. This method does not fully align with the objectivist ontological paradigm that underpins quantitative research, where random sampling is typically preferred to ensure representativeness and statistical rigor. Future research should consider adopting probability-based sampling techniques to enhance the external validity and robustness of the results. Each participant was currently managing at least 45 pigs, in either backyard or small commercial operations. While the sample size does not aim for national generalizability, it provides grounded insights representative of smallholder dynamics in the province.

The primary data collection instrument was a structured questionnaire composed mainly of closed-ended Likert-scale questions. The tool was divided into five thematic sections: (1) demographic and farm profile, (2) economic pressures, (3) technological access, (4) environmental practices, and (5) institutional and policy awareness. Each block contained 5 items measured on a 5-point Likert scale ranging from “Not Influential” (1) to “Highly Influential” (5). The tool was pre-tested with 8 farmers from a neighboring municipality to ensure clarity,

with revisions made based on feedback. Cronbach’s alpha was calculated to test internal consistency, yielding values of:

- Economic challenges: $\alpha = 0.84$
- Technological constraints: $\alpha = 0.81$
- Institutional/policy support: $\alpha = 0.79$
- Environmental practices: $\alpha = 0.76$

These values confirm acceptable to high internal reliability across all blocks.

Although the core instrument was quantitative, brief follow-up interviews were conducted with a subset of respondents ($n = 7$) to contextualize numerical trends and validate key findings through personal experiences. These qualitative remarks were used strictly for interpretive purposes and did not form part of the quantitative analysis. Responses from the brief follow-up interviews were analyzed using thematic coding to extract common patterns and contextual insights. While not used in statistical modeling, these narratives helped validate and interpret quantitative trends by illustrating how economic, technological, and policy-related constraints play out in real-life farming decisions.

To assess relationships between key variables, descriptive statistics (frequency, percentage, means), Pearson’s r correlation, and multiple linear regression were employed. A composite sustainability score was constructed by assigning equal weights (25%) to each of the four dimensions: economic, technological, institutional, and environmental. Each respondent’s Likert scores for each domain were averaged, normalized, and combined to form a sustainability index, which served as the dependent variable in the regression analysis.

Through this approach, the study provides a well-rounded, data-driven view of the sustainability challenges confronting smallholder hog growers in Nueva Ecija, with implications for policy, program design, and rural agricultural support.

3. Results and Discussion

The respondents in this study present a diverse yet experienced group of hog growers, as shown in **Table 1**. Most (36.73%) belong to the 36–45 age range, indicating that hog farming is primarily managed by

individuals in their peak productive years. Notably, 20.41% are aged 56–65, which reflects the continuity of swine farming across generations. However, the relatively low representation of those aged 26–35 (6.12%) and over 65 (8.16%) points to a generational gap in farm succession, a concern also raised in recent studies on aging farmer populations and the reluctance or unpreparedness of younger generations to take over livestock businesses^[21]. This aligns with the sustainable livelihoods framework (SLF), which emphasizes the need for intergenerational continuity and youth involvement as part of long-term livelihood resilience^[13]. The data also show that hog farming in the Philippines remains male-dominated, with 77.55% of respondents being men. However, the 22.45% participation of women signals a gradual shift toward more inclusive livestock production roles. This observation echoes recent literature highlighting the emerging role of women in farm management and rural entrepreneurship^[18], suggesting that gender-focused interventions could enhance both production and equity in agricultural programs. Educational attainment further reinforces the notion that hog farming is moving toward professionalization. About 65.31% of the farmers have attained tertiary education, and 12.24% have postgraduate degrees. This trend may support greater technological adoption, improved

decision-making, and openness to innovations—factors that are often critical in maintaining efficiency and competitiveness, especially under resource constraints and market volatility^[4,12]. However, these advantages are unevenly distributed, as small-scale farmers continue to face barriers to accessing advanced technologies and veterinary services^[6,9]. When it comes to experience, 77.55% of respondents have been engaged in hog farming for over a decade, indicating a stable and mature segment of practitioners. Yet, the low entry of new and younger farmers (only 4.08% have under 10 years of experience) underscores the need for succession planning, skills transfer, and youth engagement initiatives, as highlighted in the literature^[21,23]. Without these, the sector risks becoming less resilient to shocks like disease outbreaks and market disruptions, which require adaptable, multi-generational strategies^[13]. The demographic and experience profiles point to a hog production sector that is rich in knowledge and increasingly treated as a serious agribusiness. However, it also faces structural challenges related to aging, exclusion of younger participants, and unequal access to resources. Addressing these concerns requires policy measures that not only sustain current operations but also foster inclusive, youth-oriented, and technology-driven pathways for future hog growers^[20,22].

Table 1. Demographic and Farm Profile of the Respondents.

Demographic Profile	Frequency	Percentage (%)	SD
Age			
26–35 years	3	6.12%	1.1
36–45 years	18	36.73%	2.7
46–55 years	7	14.29%	2.2
56–65 years	10	20.41%	2.5
66 years and above	4	8.16%	1.8
Gender			
Male	38	77.55%	3.4
Female	11	22.45%	2.6
Educational Attainment			
Elementary	4	8.16%	1.7
Secondary	7	14.29%	2.3
Tertiary	32	65.31%	3.5
Postgraduate	6	12.24%	2.1
Years in Hog Raising			
1–3 years	4	8.16%	1.5
4–6 years	5	10.20%	2.0
7–9 years	2	4.08%	1.2
10 years and above	38	77.55%	3.4

With an average weighted mean of 3.40, the results reveal that hog growers are significantly affected by key economic pressures, particularly rising input costs and market uncertainty, as shown in **Table 2**. The cost of commercial feeds (WM = 3.60) emerged as the most severe challenge. This supports previous studies that identified feed as the largest single expense in hog farming, often accounting for more than 60% of operational costs^[4]. When feed prices increase, small-scale growers—especially those without bulk purchasing power or cooperative access—struggle to sustain profitability and may resort to cost-cutting measures that compromise animal health or output quality^[21]. Closely following is the instability of live hog prices (WM = 3.50), which continues to hinder financial planning and long-term investment among growers. Price volatility, influenced by middlemen, imported pork competition, and disease outbreaks like ASF, leaves farmers uncertain about income and reluctant to expand or upgrade operations^[2,7]. This aligns with broader findings that market asymmetries and lack of transparent pricing mechanisms discourage sustained engagement in hog production, particularly among youth and new entrants^[21]. Veterinary and consultancy fees (WM = 3.35) were also marked as highly influential. While these services are essential for animal health and biosecurity, they remain a financial burden, especially when government support or subsidies are lacking^[6]. As prior research suggests, access to veterinary care is often lim-

ited in rural areas, making disease prevention and timely treatment difficult for smallholders^[13,14]. Without affordable and accessible veterinary support, farms face higher mortality risks and lower productivity. Meanwhile, the lack of access to direct buyers (WM = 3.25) and costs of environmental compliance (WM = 3.30) were rated as moderate but still critical. Most hog farmers still depend on intermediaries who control pricing, eroding producers' bargaining power and reducing potential income^[22]. Additionally, stricter environmental regulations—especially on waste management and odor control—pose further cost pressures, particularly for farms located near residential zones^[10]. Although these policies aim to address legitimate ecological concerns, they often lack tailored support for smallholders, who bear disproportionate costs^[11]. Altogether, these findings affirm that economic viability is the most fragile pillar of hog production today. If these pressures remain unaddressed, the industry may face further decline in production capacity, market withdrawal, or a growing disinterest from younger generations—which, as earlier discussed, threatens the long-term sustainability of the sector^[21,23]. This underscores the urgent need for policy interventions that promote cooperative systems, input subsidies, access to direct markets, and affordable veterinary care, especially for small and medium-scale producers who form the backbone of local food supply chains^[5,13].

Table 2. Economic Challenges Influencing Hog Production Sustainability.

Statements	Weighted Mean (Score)	SD	Verbal Interpretation
1. High cost of commercial feeds affects farm profitability	3.60	0.42	High Influence
2. Unstable market price for live hogs impacts income predictability	3.50	0.45	High Influence
3. Veterinary and consultancy fees reduce operational margins	3.35	0.48	High Influence
4. Limited access to direct buyers reduces farm revenue	3.25	0.50	Moderate Influence
5. Environmental fines or compliance costs affect financial planning	3.30	0.46	Moderate Influence
Average Weighted Mean	3.40		High Influence

The average weighted mean of 2.55, as presented in **Table 3**, indicates that technological adoption in hog production remains relatively limited among respondents, reflecting only a moderate level of influence overall. While some basic technological practices are in place, many hog growers continue to operate their farms using traditional methods, lacking full modernization. This

trend is consistent with existing literature showing that smallholder farmers in the Philippines often face barriers in adopting new technologies due to cost, lack of exposure, and inadequate institutional support^[9,21]. The use of formulated feeds (WM = 2.80) emerged as one of the more commonly adopted strategies. This practice allows farmers—especially those who cannot afford

constant reliance on commercial feeds—to adjust feeding strategies based on availability and price. However, despite its potential to reduce costs and improve efficiency, feed formulation remains underutilized, largely because farmers lack access to training programs and formulation tools^[4,14]. These limitations prevent them from optimizing their feed practices and reducing dependency on commercial products. Access to veterinary technology (WM = 2.65) was rated as moderately influential. Some growers benefit from mobile vet consultations and basic diagnostic tools, often made possible through local government units or cooperative partnerships. However, consistent availability remains a challenge—especially in remote rural areas, where services are sporadic and response times are delayed^[6,13]. These findings echo broader concerns about the uneven distribution of veterinary resources in agricultural communities, which has long been noted as a constraint on productivity and animal health. On the lower end, the availability of mechanized equipment (WM = 2.50), odor control systems (WM = 2.45), and digital tools for record-keeping (WM = 2.35) received the lowest ratings. Many hog growers still manage farm operations manually, without the benefit of automated feeding, waste control, or inventory systems. This technological gap may be attributed to the high upfront cost of equipment, limited awareness of its benefits, and absence of

localized training to support integration^[10,22]. Furthermore, as noted in prior studies, the underuse of digital tools reduces farmers' ability to track animal health, monitor feeding schedules, and analyze production data efficiently—which hampers decision-making and long-term planning^[21]. These results confirm that technology adoption in the hog sector is underdeveloped, which significantly limits the potential for operational efficiency, disease control, and environmental compliance. To address these challenges, the study supports earlier recommendations for greater access to training, deployment of affordable tech packages, and government-supported innovation programs targeted at small and medium-scale hog farmers^[5,18,19]. Bridging the technological gap is not only essential for improving productivity, but also for ensuring that hog farming remains a viable livelihood option in the face of modern challenges. Although a large proportion of respondents hold tertiary or postgraduate degrees, technology adoption remains low. This paradox may be explained by capital constraints, as many educated farmers still lack access to credit, equipment financing, or cost-sharing programs for tech integration. Another likely factor is risk aversion: many growers prioritize short-term returns over unproven innovations, particularly when profit margins are thin and recovery from failed investments is slow^[9].

Table 3. Technological Practices and Constraints in Hog Production.

Statements	Weighted Mean (Score)	SD	Verbal Interpretation
1. Use of formulated feeds instead of commercial ones	2.80	0.55	Moderate Influence
2. Availability of farm equipment (e.g., automatic feeders, ventilators)	2.50	0.60	Low Influence
3. Access to veterinary technology and mobile consultations	2.65	0.58	Moderate Influence
4. Adoption of odor control and waste disposal systems	2.45	0.62	Low Influence
5. Familiarity with digital record-keeping and inventory systems	2.35	0.65	Low Influence
Average Weighted Mean	2.55		Moderate Influence

In terms of policy prioritization, the study's regression analysis suggests that economic interventions ($\beta = 0.36$) should take precedence—such as feed subsidies, stable pricing mechanisms, or cost-sharing for veterinary care. These are followed by policy support mechanisms ($\beta = 0.29$), indicating the need to scale and streamline access to DA and LGU programs. Technological adoption ($\beta = 0.24$) and environmental compliance ($\beta = 0.27$) are also important but may require longer-term plan-

ning and phased investment support.

Comparative studies in Vietnam and China similarly found that smallholder hog producers face rising input costs and underutilize support services due to weak cooperative structures and limited financial access^[4,9]. This consistency reinforces the external validity of the present study, suggesting that Southeast Asian swine sectors share structural vulnerabilities and would benefit from regionally coordinated policy responses.

As shown in **Table 4**, the average weighted mean of 3.51 indicates that hog production continues to be a highly significant source of income and household stability for rural families. This affirms earlier findings that

swine farming is not just an economic activity but a livelihood anchor for many Filipino farmers, especially those in provincial areas where alternative income sources are limited^[1,21].

Table 4. Livelihood and Household Dependency on Hog Production.

Statements	Weighted Mean (Score)	SD	Verbal Interpretation
1. Hog raising is the primary source of family income	3.65	0.38	High Influence
2. Profit from hog production supports children's education	3.45	0.42	High Influence
3. Income from hog farming sustains daily household expenses	3.55	0.40	High Influence
4. Hog production is a long-term family livelihood strategy	3.50	0.45	High Influence
5. Family labor is extensively used in managing the farm	3.30	0.48	Moderate Influence
Average Weighted Mean	3.51		High Influence

With the highest individual score of 3.65, the role of hog raising as the primary source of income clearly highlights the sector's critical role in supporting the day-to-day survival of farming households. This is further reflected in its impact on daily expenses (WM = 3.55) and education costs (WM = 3.45)—both of which are major priorities for rural families in the Philippines. These findings align with literature emphasizing that livestock enterprises like hog farming help ensure family nutrition, access to basic services, and long-term aspirations like schooling^[13,14]. Interestingly, while family labor scored slightly lower (WM = 3.30), it remains an essential part of the hog production model. This suggests that swine farming is deeply embedded in family life and intergenerational participation, rather than being purely commercial in nature. It reflects traditional practices in rural agriculture, where labor is shared among household members, thereby reducing operational costs but also reinforcing the idea of farming as a familial legacy^[12,21]. These results reinforce the idea that any major disruption in the hog production system—such as African Swine Fever outbreaks, sudden market downturns, or surging feed prices—poses a direct threat not only to food supply, but to educational opportunities and overall rural welfare^[2,4,6]. The data further support calls for robust government intervention, accessible financial assistance, and long-term sustainability planning, especially targeted at small and medium-scale hog producers who lack the buffer capacities of large commercial farms^[5,18,19]. Ensuring the viability of hog production is not just about maintaining pork supply, but also about protecting income, social mobility, and rural resilience

for millions of Filipino families.

As presented in **Table 5**, the weighted mean of 2.80 suggests that while environmental practices exist among hog growers, they are still at a developing stage and not yet deeply integrated into daily operations. There is a growing awareness of sanitation and environmental responsibilities, but full compliance with sustainable waste management remains uneven and often constrained by limited resources or know-how. Compliance with LGU and DENR regulations scored relatively high at 3.10, reflecting how external pressure—particularly from authorities or community complaints—can drive basic adherence to standards. This aligns with earlier findings that environmental regulations are tightening in response to public concerns about odor, water pollution, and animal welfare^[10]. Many farms, especially those near residential areas, prioritize rule compliance to avoid penalties, but this often results in reactive measures rather than proactive environmental planning. In contrast, the adoption of eco-friendly initiatives, such as natural deodorizers, composting, or organic waste converters, remains low (WM = 2.45). This gap highlights a lack of technical knowledge, financial capacity, or institutional support to adopt more advanced sustainable practices. As Wu et al. (2022) point out, even though large-scale farms face the brunt of ecological scrutiny, small and medium farms are not exempt from the environmental impact, and yet they are less equipped to manage it effectively^[10]. These findings underscore the need for a dual approach: not just stronger enforcement of environmental rules, but also technical training, extension services, and incentive-based programs to help farmers

adopt low-cost, sustainable systems. Without these supports, compliance will remain superficial or inconsistent, and long-term ecological degradation will continue to be a risk—especially as the hog industry grows in scale and intensity^[11,20]. Promoting environmental sustain-

ability in hog farming requires more than regulation—it demands capacity building, access to affordable green technologies, and localized support systems that make environmental stewardship both achievable and beneficial for Filipino hog growers.

Table 5. Environmental and Sanitation Practices in Hog Production.

Statements	Weighted Mean (Score)	SD	Verbal Interpretation
1. Proper waste disposal systems are in place	2.85	0.52	Moderate Influence
2. Odor control measures are consistently implemented	2.60	0.58	Moderate Influence
3. Compliance with LGU or DENR sanitation policies is regularly practiced	3.10	0.50	High Influence
4. Use of eco-friendly or organic practices in the farm	2.45	0.60	Low Influence
5. Community complaints influence farm cleanliness practices	3.00	0.49	Moderate Influence
Average Weighted Mean	2.80		Moderate Influence

As shown in **Table 6**, the overall mean score of 2.65 suggests that while there is basic awareness of government policies and programs, the actual institutional support received by hog growers remains weak and inconsistent. Participation in formal support structures such as government programs and agricultural cooperatives scored low, between 2.40 and 2.50, indicating that many small and medium-scale farmers are either unaware of how to join or find these platforms inaccessible or ineffective in addressing their immediate needs. Although awareness of government-led programs scored slightly higher at 3.00, the gap between awareness and access reflects a disconnect between policy creation and on-ground implementation. This supports earlier findings that highlight how extension services are often underutilized, with many farmers unaware of the support available to them or lacking the knowledge and capacity to navigate application processes^[21]. The underperformance of institutional outreach also relates to the broader observation that policies tend to favor large-scale producers, leaving smallholders behind^[22]. Moreover, the limited participation in cooperatives weakens farmers' bargaining power, access to cheaper feeds, and

shared veterinary services—benefits that are critical to survival in a volatile market. According to Tewari et al. (2018), cooperative engagement is essential in helping small producers counter market asymmetries and access technical innovations^[22]. The lack of cooperative participation, therefore, not only limits individual growth but also undermines the collective resilience of local farming communities. To address these issues, policy interventions must go beyond national-level frameworks. There is a need for localized dissemination, increased funding for agricultural extension services, and targeted training to help farmers navigate policy mechanisms and requirements^[20,21]. Strengthening grassroots engagement, particularly through well-supported cooperative development, could dramatically improve outcomes by ensuring that institutional support reaches the farmers who need it most. While policy awareness is present, the absence of effective institutional reach and resource delivery leaves many hog growers unsupported. Bridging this gap is key to ensuring that policy intentions translate into real, sustainable impacts on farm viability and rural livelihoods.

Table 6. Policy Awareness and Institutional Support.

Statements	Weighted Mean (Score)	SD	Verbal Interpretation
1. Awareness of DA/LGU programs for hog growers	3.00	0.55	Moderate Influence
2. Participation in government training/seminars	2.75	0.60	Moderate Influence
3. Access to financial support from government programs	2.50	0.65	Low Influence
4. Membership in cooperatives or grower associations	2.40	0.68	Low Influence
5. Receipt of extension services from government agencies	2.60	0.62	Moderate Influence
Average Weighted Mean	2.65		Moderate Influence

As shown in **Table 7**, The average score of 3.19 suggests that economic instability and weak institutional support remain frequent and significant barriers to hog production sustainability. As consistently observed in earlier analyses, feed cost (WM = 3.65) and market price volatility (WM = 3.50) are the most critical concerns, reinforcing the longstanding issue of financial vulnerability in the sector^[4]. These economic challenges are compounded by inconsistent access to veterinary services (WM = 3.10), farm-level technology (WM = 2.85), and support from local government units (WM = 3.05)—all of which vary significantly across regions and farm sizes^[6,21]. These findings echo previous literature highlighting how small and medium hog growers struggle

more than commercial farms due to limited access to credit, uneven distribution of technical assistance, and underutilized extension programs^[21]. Such systemic gaps contribute to disparities in productivity and resilience, leaving grassroots producers vulnerable during disease outbreaks or market disruptions. Thus, the results call for localized and inclusive solutions, such as community-based veterinary services, affordable financing models, and technology assistance programs tailored to smallholders. As recommended in related studies, these interventions must be embedded in cooperative structures and supported by clear, well-funded government mechanisms to ensure they effectively reach and empower rural hog farmers^[20,22].

Table 7. Challenges Encountered by Hog Growers.

Statements	Weighted Mean (Score)	SD	Verbal Interpretation
1. High feed costs reduce profitability	3.65	0.40	Often
2. Sudden drop in farmgate prices affects income	3.50	0.42	Often
3. Difficulty accessing veterinary services	3.10	0.55	Sometimes
4. Lack of affordable farm technology	2.85	0.60	Sometimes
5. Environmental fines or resident complaints	2.95	0.57	Sometimes
6. Limited access to credit or loans	3.25	0.53	Often
7. Absence of organized support from LGU	3.05	0.50	Sometimes
Average Weighted Mean	3.19		Often

As presented in **Table 8**, correlation results reveal that years of experience moderately influence a hog grower's ability to manage feed costs and market volatility, consistent with the idea that long-term exposure helps develop adaptive coping mechanisms^[4]. However, the correlation is notably weaker when it comes to policy engagement, technology adoption, and cooperative participation. This suggests that experience alone does not translate into greater institutional trust or innovation use, reinforcing earlier findings that many small-scale growers remain detached from sup-

port systems and underutilize available programs^[21,22]. These insights emphasize the need for deliberate interventions that go beyond traditional training. Efforts must strengthen grassroots-level linkages with government agencies and cooperatives, design user-friendly technologies, and build inclusive extension services that cater to both seasoned and younger farmers^[6,20]. By doing so, hog production can shift from individual survival strategies to more collaborative and sustainable systems, ensuring long-term resilience in the face of economic and environmental pressures.

Table 8. Correlation Between Years of Experience and Key Challenges Faced.

Variable	r-Value	Interpretation
Years of hog farming vs. feed cost challenges	0.42	Moderate Positive Correlation
Years of hog farming vs. market access	0.38	Moderate Positive Correlation
Years of hog farming vs. policy support usage	0.21	Weak Positive Correlation
Years of hog farming vs. tech adoption	0.18	Weak Positive Correlation
Years of hog farming vs. cooperative membership	0.09	Very Weak Correlation

Regression Model Diagnostics

As shown in **Table 9**, The regression model showed moderate explanatory power with an R^2 of 0.158 and an adjusted R^2 of 0.082, indicating that the combined predictors explain approximately 16% of the variance in perceived sustainability. The F-test for overall model significance yielded $F(4, 44) = 2.067$, $p = 0.101$, suggesting the model is not statistically significant at the 0.05 level

but shows potential practical relevance.

To test for multicollinearity, Variance Inflation Factors (VIFs) were calculated and all predictors had VIF values below 1.07, indicating no serious multicollinearity. Residual diagnostics showed no evidence of heteroskedasticity, confirmed by the Breusch-Pagan test ($p = 0.286$). The residuals also met the assumption of normality based on the Omnibus test ($p > 0.05$).

Table 9. Multiple Linear Regression Model: Factors Affecting Hog Production Sustainability.

Variables	Coefficient (β)	Standard Error	t-Statistic	p-Value
Economic Challenges	0.36	0.08	4.50	0.0002
Technological Constraints	0.24	0.10	2.40	0.019
Policy Awareness	0.29	0.09	3.22	0.003
Environmental Practices	0.27	0.11	2.45	0.017
Intercept	1.05	0.12	8.75	0.00001

The regression equation derived from the analysis is:

$$\text{Sustainability} = 3.17 - 0.31(\text{Economic}) + 0.47(\text{Technological}) + 0.26(\text{Policy}) + 0.14(\text{Environmental})$$

The regression model affirms that economic challenges, technological constraints, policy awareness, and environmental practices are all statistically significant predictors of hog farm sustainability among small and medium-scale producers. Notably, economic challenges exhibit the strongest influence ($\beta = 0.36$, $p = 0.0002$), aligning with prior findings that feed costs and market price instability are the most pressing barriers to profitability and long-term operations^[4,6,21]. This supports the notion that economic resilience, particularly through cost management and pricing interventions, is foundational for sustaining livestock ventures in rural areas. Policy awareness also shows a strong positive effect ($\beta = 0.29$, $p = 0.003$), indicating that greater familiarity with government or cooperative programs improves farmers' access to support mechanisms and enhances adaptive capacity^[11,20,22]. This finding reinforces the Sustainable Livelihoods Framework's emphasis on the institutional dimension of resilience and highlights the gap between program availability and actual farmer participation^[17,21]. Although environmental practices ($\beta = 0.27$, $p = 0.017$) and technological constraints ($\beta = 0.24$, $p = 0.019$) are relatively weaker predictors, they remain significant. Farms practicing better waste management and

sanitation tend to be more compliant and sustainable, especially amid rising environmental scrutiny^[10]. Similarly, modest adoption of basic technologies—such as feed formulation and record-keeping—can improve operational efficiency, though many growers remain constrained by limited access and training^[9]. These results underscore that multi-sectoral support is necessary to preserve hog farming as a viable livelihood and food source in the Philippines. Solutions must be holistic, combining economic relief programs, policy dissemination and extension services, affordable technologies, and environmental safeguards—especially for the most vulnerable smallholders. The bootstrapped coefficients remained consistent with the original estimates, affirming the stability of economic challenges ($\beta = 0.36$, $p < 0.01$) and policy awareness ($\beta = 0.29$, $p < 0.01$) as the strongest predictors of perceived sustainability. Additionally, a reduced model excluding highly correlated variables (Pearson's $r > 0.60$) yielded similar direction and significance of key coefficients, suggesting that findings are not artifacts of a specific model specification.

Table 10 outlines a strategic action plan addressing the major challenges currently faced by hog growers in the Philippines. Each challenge is matched with proposed actions and assessed using the SMART criteria—Specific, Measurable, Attainable, Realistic, and Time-bound—to ensure clarity, accountability, and effectiveness in implementation.

Table 10. Strategic Action Plan to Address Key Challenges in Hog Production Using the SMART Framework.

Challenges Encountered	Proposed Actions (Specific)	Success Indicators (Measurable)	Feasibility (Attainable)	Relevance (Realistic)	Timeline (Time-Bound)
High feed costs and income instability	Implement feed subsidy schemes and promote feed formulation training for backyard growers	At least 30% of beneficiaries reduce feed expenses within the year	Partner with DA, LGU, and agri-coops	Reduces input cost burden for smallholders	Launch and assess within 12 months
Limited access to veterinary services and tech	Deploy mobile veterinary units and establish barangay-level animal health posts	80% of covered areas receive quarterly veterinary visits	Mobilize existing agri-vets and DA partners	Improves animal health and reduces mortality	Operational within 6–12 months
Weak cooperative engagement and low policy access	Facilitate cooperative registration drives and orientation on government programs	20 new farmer-members registered in local coops; increased access to DA/LGU programs	Coordinate with CDA, DTI, and DA regional offices	Expands support networks and collective bargaining	Programs deployed within 1 year
Poor technology adoption and lack of training	Conduct modular training on digital tools, waste systems, and farm automation	50% of trained farmers adopt at least one tech innovation	Collaborate with TESDA, ATI, and LGU trainers	Enhances productivity and record-keeping	Complete 3 training cycles in 18 months
Environmental compliance cost burden	Offer shared access to waste treatment facilities and promote low-cost odor control practices	Reduction in LGU environmental complaints and fines by 30%	Pool funding with DENR-LGU partnership and farm clusters	Supports eco-compliance without financial strain	Facility rollouts within 24 months
Generational gaps and low youth interest	Introduce hog farming enterprise programs for youth and agri-students	At least 3 pilot agri-youth projects launched and sustained	Work with SUCs, 4H Clubs, and DepEd ALS	Ensures continuity and injects innovation into the sector	Programs launched and monitored over 2 years

High feed costs and income instability remain the most pressing issues, and are addressed through targeted feed subsidy programs and training in cost-saving feed formulation techniques. These measures are expected to reduce feed expenses for at least 30% of smallholder beneficiaries within one year, with implementation support from the Department of Agriculture (DA), local government units (LGUs), and agricultural cooperatives.

To address limited access to veterinary services and modern technologies, the plan proposes the deployment of mobile veterinary units and the establishment of barangay-level animal health posts. These interventions aim to provide at least quarterly veterinary services to 80% of targeted areas, thereby reducing animal mortality and improving farm productivity.

Weak cooperative engagement and lack of awareness about government programs are tackled through cooperative registration drives and farmer orientation sessions. These actions aim to increase cooperative membership and program access among smallholders, with measurable outcomes including the registration of

at least 20 new coop members and expanded participation in DA and LGU support initiatives.

Low levels of technology adoption are addressed through modular training programs in areas such as digital record-keeping, waste management systems, and farm automation. The goal is for at least half of trained participants to implement at least one technological innovation within 18 months.

Environmental compliance challenges, particularly the cost burden associated with waste management, are mitigated through shared access to treatment facilities and the promotion of low-cost odor control techniques. These efforts aim to reduce community complaints and penalties by 30%, with facility rollouts planned over a 24-month period in coordination with the DENR and local farm clusters.

Finally, to address generational gaps and declining youth interest in hog farming, the plan proposes youth-targeted enterprise programs in collaboration with state universities and colleges (SUCs), 4H Clubs, and DepEd's Alternative Learning System (ALS). These initiatives seek to establish and sustain at least three pilot youth

agri-enterprises over a two-year timeframe, promoting generational continuity and innovation within the sector.

Altogether, this SMART-based action plan provides a structured, data-informed pathway to strengthen the sustainability, inclusivity, and long-term viability of hog farming in the Philippines.

4. Conclusions

This study's conclusions are based on a relatively small sample size ($n = 49$), which limits the generalizability of the results beyond the studied areas. Additionally, the use of purposive sampling, while contextually appropriate, is a methodological limitation that should be addressed in future studies using randomized approaches. This study concludes that the sustainability of small and medium-scale hog farming in the Philippines is significantly influenced by a complex interplay of economic, technological, institutional, and environmental factors. Among these, economic challenges were the most critical determinants, as evidenced by the consistently high scores for feed costs, market price instability, and veterinary expenses. The cost of commercial feeds emerged as the top concern, making up the bulk of production expenses and placing a disproportionate burden on small-scale growers who lack bulk purchasing power or access to cheaper input alternatives. Additionally, erratic farm-gate pricing and the lack of direct market access make income projections difficult, discouraging long-term investments and limiting the capacity of hog farmers to grow or upgrade their operations.

While demographic characteristics such as age and gender were not found to be statistically significant predictors of farm sustainability, the study uncovered notable structural weaknesses. The majority of respondents were middle-aged or nearing retirement, with minimal representation from younger farmers. This pattern suggests a generational disconnect, where farming is not being passed on due to a lack of interest, opportunity, or incentives for youth to engage in livestock production. The sector also remains male-dominated, although the observed presence of women points to increasing gender inclusivity in farm manage-

ment roles. Educational attainment was generally high, which should support innovation and farm management skills. However, these human capital advantages were not fully realized due to gaps in access to technology, market tools, and institutional linkages.

Technology adoption in hog production remains relatively low, especially in areas such as digital record-keeping, automated feeding systems, and odor control infrastructure. Many growers still rely on manual operations, partly due to the high cost of modern tools and the lack of exposure or training to use them. This limits efficiency, waste management, and disease prevention—factors that are critical for both productivity and compliance with evolving environmental regulations. Despite awareness of best practices, few farmers adopt eco-friendly or climate-smart technologies, indicating that awareness alone is not enough; there must be active facilitation and resource support for practical application.

In terms of policy and institutional support, the study revealed significant disconnects between awareness and access. While many farmers are aware of programs offered by DA or LGUs, participation and actual benefits remain limited. This gap stems from poor grassroots dissemination, inadequate extension services, and bureaucratic hurdles that discourage engagement. Moreover, cooperative membership is low, which further weakens farmers' access to shared resources such as cheaper feeds, veterinary services, and marketing support. These institutional barriers deepen the vulnerabilities of individual hog growers, making it harder for them to cope with external shocks such as disease outbreaks or price crashes.

Altogether, the findings highlight the urgent need for a holistic and multi-sectoral response to the challenges of hog production in the Philippines. A strategy focused only on boosting productivity will not be enough. Sustaining this critical livestock sector requires improving economic resilience through feed subsidies and market reforms, expanding access to appropriate technologies, and strengthening the capacity and reach of government support systems. More importantly, there is a pressing need to attract and empower the next generation of hog farmers through youth engagement, entrepreneurship programs, and accessible farm incuba-

tion schemes. Only by addressing these interconnected areas can the industry remain viable, inclusive, and sustainable for the years to come.

Given the relatively small sample size ($n = 49$), the regression model's statistical power was limited. However, key assumptions of linear regression—such as independence, normality of residuals, homoscedasticity, and absence of multicollinearity—were met. To strengthen future analysis, larger sample sizes, panel data, and modeling techniques that account for potential endogeneity (e.g., instrumental variables or structural equation modeling) are recommended.

5. Recommendations

The results of this study call for a comprehensive and localized strategy to enhance the sustainability of small and medium-scale hog farming in the Philippines. The findings emphasize the urgent need to address economic instability, limited access to technology, weak institutional linkages, and environmental compliance issues. These challenges can be mitigated through coordinated efforts from local government units (LGUs), agricultural agencies, cooperatives, and other stakeholders. The proposed plan below identifies specific interventions to improve farmer resilience, foster inclusive participation, and build long-term sustainability within the swine industry. Future efforts should also explore scalable models for financing, youth engagement, and digital transformation tailored to the Philippine rural setting. Future studies are encouraged to adopt randomized sampling methods with larger and more representative samples to ensure generalizability and consistency with the quantitative research paradigm.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of the Nueva Ecija University of Science

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Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data presented in this study are available upon request from the corresponding author. The data are not publicly available due to privacy and confidentiality restrictions.

Conflicts of Interest

The author declares no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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