Open Access
J. Glob. Innov. Agric. Sci., 2025, 13(1):263-272
ISSN (Online): 2788-4546; ISSN (Print):2788-4538
DOI: https://doi.org/10.22194/JGIAS/25.1466
http://www.jgiass.com

Society for Innovative Agriculture

The Effect of Innovation Application on the Competitiveness of Small Pig Farm in Mekong Delta, Vietnam

Nguyen Hoang Qui[1,2], Budi Guntoro[1,*], Ahmad Romadhoni Surya Putra[1], Nguyen Thi Anh Thu[1,2] and Noemi C. Liangco[1]

[1]Department of Livestock Socio-economics, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta 55281, Indonesia; [2]Department of Animal Science and Veterinary Medicine, School of Agriculture and Aquaculture, Tra Vinh University, Tra Vinh City 87000, Vietnam.
*Corresponding author's e-mail: budiguntoro@ugm.ac.id

The growth in Vietnamese consumption and development has led to the expansion of the pig sector and increased competition from other markets. The study included 260 small-scale pig producers selected through a random sampling method. Multiple regression analysis was conducted to examine the impact of (1) social profiles on innovations at pig farms and (2) innovations on the competitiveness at pig farms. The findings revealed that predominantly male farmers, with an average age of 50 and a mean experience of 10 years. A total of 60% did not utilize new innovations for production, although they did have access to knowledge on the pig market. The survey found that production innovations received the greatest ranking compared to other innovations while market innovation were the lowest one. About 70% of farms exhibited a high level of competitiveness, while no farms were found to have a poor level of competitiveness. The study observed that gender, education, occupation, experience, and pig units affected innovation scores. Enhancing the perception of market innovation and organizational innovation leads to a higher degree of competitiveness for farmers. It can be concluded that competitiveness is influenced by innovations, and their farms were competitive based on self-evaluation.

Keywords: Pig farming, innovation, competitiveness, sustainable development, social demographics, farm management.

INTRODUCTION

The pig industry is a vital sector in Vietnam that primarily serves to provide Vietnamese food. Pig farming in Vietnam showcases the characteristics of agricultural production in emerging developing countries, characterized by a large number of producers but a relatively small scale of production. According to the data of (FAO, 2023), Vietnam is the second largest pig producer in the Asian-Pacific area, following China, which holds the first spot with a production of 406.5 million pigs. With the implementation of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CTTPP) and the European-Vietnam Free Trade Agreement (EVFTA), the cost of imported pork is expected to decrease. Initially, the tax rate on pork will decline from 15% to 11.2% as a result of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP). Subsequently, over the course of the next 7 years, the tax rate will gradually reduce to zero. Frozen pork will become exempt from taxes after a period of 7 years from the commencement date of the EVFTA (Nga *et al.*, 2021). Consequently, the cost of imported pork will decline in comparison to that of native pork. In addition, farmers primarily sell pigs to collectors as a result of insufficient demand in the local market (Nga *et al.*, 2021). In addition, due to the absence of a written contract with buyers, farmers encounter challenges in selling pigs, particularly when collectors establish low price points. This phenomenon frequently occurs in localized pork supply chains in Vietnam (Qui *et al.*, 2020). This will prompt the inquiry into the level of competitiveness that domestic pork production may achieve in the upcoming years.

A substantial proportion of pig farming in the Mekong Delta is attributed to unplanned and limited-scale breeding. Pig farmers have become part of the extensive supply chain and value chain. Specifically, farmers primarily sell their pork to local slaughterhouses through intermediaries, resulting in relatively low prices for both pork and hogs (Qui *et al.*, 2020).

Qui, N.H., B. Guntoro, A.R.S. Putra, N.T.A. Thu and N.C. Liangco. 2025. The Effect of Innovation Application on the Competitiveness of Small Pig Farm in Mekong Delta, Vietnam. Journal of Global Innovations in Agricultural Sciences 13:263-272.
[Received 31 Jul 2024; Accepted 7 Sep 2024; Published 1 Jan 2025]

Although the increasing demand for pork and the support provided by the government create opportunities for small-scale farmers to grow and expand, taking into account all parties involved, it also presents challenges to the economic stability of these farmers, the environment, and the overall social well-being of society. In the economic context of smallholder farmers, intense market competition during periods of peak domestic production could potentially lead to the failure of farmers to sell their pigs. The impact of increased supply on the market environment is evident (Ndwandwe and Weng, 2018). According to Läpple and Thorne (2019) as the supply of a product increases, it leads to unstable market circumstances. In addition to volatile market conditions, the potential expansion of the pig business may offer significant risks for small-scale farmers, who typically face resource constraints that hinder their ability to enhance production capacity and effectively compete in established markets. The main challenge faced by smallholder farmers in many developing nations is their vulnerability to market changes. This is mostly due to their restricted access to new technologies, underdeveloped marketplaces, and lack of insurance coverage (Di Falco, 2018).

Elias and Evangelos (2016) argued that the concepts of innovation, productivity, and competitiveness are intrinsically interconnected. Pig farmers appear to be unconcerned about competition from the market or other factors that contribute to their low competitiveness. One factor contributing to the high transaction costs and poor revenue for farmers is as follows. Many farmers in the Mekong Delta region have only gotten a fraction of the earnings from pig farming due to the lengthy value chain. As a result of this lack of profitability, farmers are unable to invest in their farms with advanced technologies, which would enhance their competitiveness. In order to survive and succeed, farmers must find sustainable methods to improve their performance, as indicated by the increasing competitiveness in the industry (Nybom *et al.*, 2021). The combination of market orientation and the involvement of many family generations in management is a set of important, scarce, and difficult-to-replicate resources for a family farm. These resources can provide a competitive advantage by facilitating the emergence of creative ideas (Fuetsch, 2022). Moreover, information enables family farms to comprehend and predict consumer demands, recognize potential prospects, and foster inventive concepts, so establishing a competitive edge (Fuetsch, 2022). Investment support and improved access to loans are considered beneficial policy instruments for enhancing the innovativeness of farmers (Läpple and Kelley, 2015; Walder *et al.*, 2019). In fast-paced marketplaces, innovation plays a crucial role in enhancing the capacity and establishing a competitive edge for small-scale agriprenuers. This is because it allows them to introduce a novel or enhanced product to the market, hence expanding their market share (Distanont and Orapan, 2020).

Furthermore, the existing study on the perception of innovations and competitiveness appears to be inadequate for future initiatives, particularly in the Mekong Delta where a significant proportion of farms are modest in size. It is imperative to assess the correlation between innovation, social profiles, and farmers' perception of competitiveness in small-scale farms in the Mekong Delta based on these claims. The study aimed to examine the impact of social profiles on farmers' perception of innovations and the impact of farmers' perception of innovations on competitiveness.

MATERIALS AND METHODS

***Research place*:** The study was conducted in Tra Vinh Province and Ben Tre Province from January 2024 to May 2024. Three districts from 2 provinces were selected randomly. The research places were chosen basing on the productivity of pig farms in the Mekong delta.

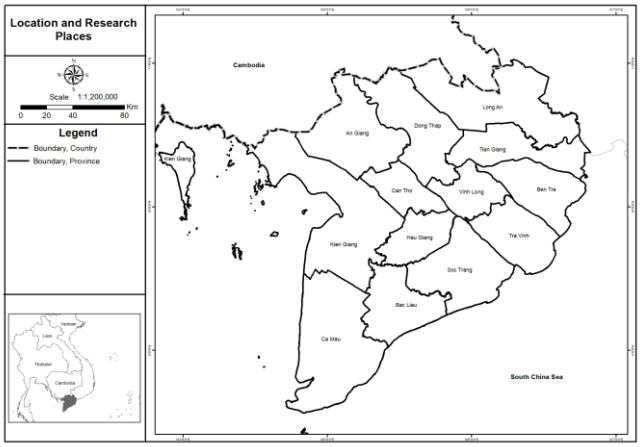

Figure 1. Map of research places.

***Conceptual framework*:** The competitiveness of a farm may be affected by many factors. According to Walder *et al.* (2019), on-farm innovation and innovation adoption have attracted attention as a means of enhancing competitiveness. Distanont and Orapan (2020) also added that innovation is key to increasing the capacity and creating a competitive advantage for small-scale agriprenuers since it enable them to present a new or improved product to the market thus increasing their market share. According to Abd Aziz and Samad (2016) innovation is a strategy that enables agriprenuers to create long term competition by gathering knowledge, experiences in creating and developing agrienterprises, using skills in technology, and introducing new ideas in form of product innovation, market innovation, or business model innovation. Based on these previous studies, the study transformed to new conceptual framework (Gen: Gender; Lab: Labour; Edu: Education; Ocu: Occupation; Exp: Experience; Pig: Pig number).

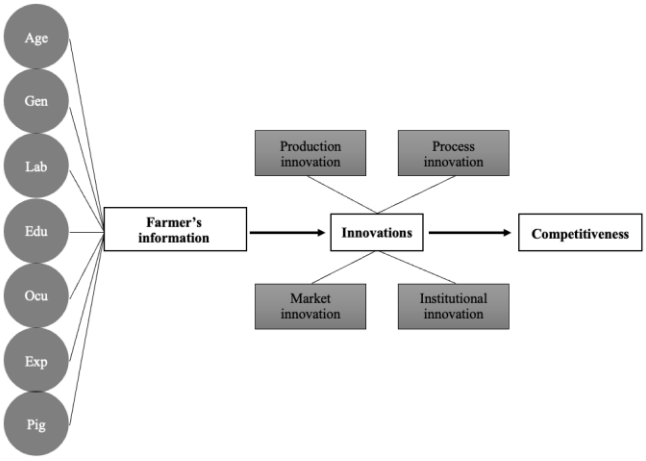

Figure 2. Conceptual framework of the study.

***Data collection*:** The random sampling method was used for this study to select respondents at small-scale farms. The study used small-scale farms with an average of 30 unit pigs to make sure farmers had basic knowledge in trading and producing pigs as well as to make sure pig production is one of their jobs. Besides, farmers thought the pig business was their part of income and gave more attention to their pig farm. Moreover, farmers tended to work and thought of their farms. Additionally, the number of pigs in small-scale farms was large enough to think about farm business.

According to Levine and Stephan (2010), for many population distributions, the number of respondents at least 30 was large enough. To provide accurate data, the number of respondents should be more than 30. Thus, the number of respondents in each province was chosen by quota sampling method with 90 respondents per each and a total of respondents were 270 respondents. After the survey, there were 10 responses not sufficient information for this study. Thus, the study used a total of 260 farmers' answers instead.

The survey used the questionnaire to collect the data. The questionnaire included four sections. The first section was the social economic demographic characteristics of pig farmers consisting of age, gender, education, occupation, labor, experience, access to information, market distance, and pig number. The second section involved innovation application. The third section was the perceptions of farmers towards good competitiveness and the perception of farmers towards government policy support in pig production. The fourth section was the accessibility of farmers to 4 pillars of competitiveness.

***Data definitions*:** Table 1 shows the definitions of variables used for analysis in this study.

***Data analysis*:** For the perception of farmers towards innovations with 4 indicators and 14 questions, and the perception of farmers towards competitiveness with 4 indicators and 17 questions, were used to record data. All questions were partly adapted from the theory of Rogers, (2003) regarding innovation distributions. However, this study just focused on the perception of farmers towards the innovations of their farms, another part of the theory might be out of the scope of the study. The Likert scale was used for this case with the score from 1-5 which is equal to very low to very high. For innovations, the total value indicated the perception of farmers towards the innovation of their farms. The Cronbach's alpha of the scale was 0.782 indicating good

Table 1. Definitions of variables in the study.

No.	Variables	Data definitions	Type of data
X_1	Age of farmers	Age refers to the age of pig farmers who joined in the interview and replied to the questionnaire	Continuous variable, years
X_2	Gender of farmers	Gender refers to farmers are male or female.	Dummy variable (1, male; 2, female)
X_3	Number of labors at farm	Labors refers to how many workers are working at pig farm.	Continuous variable, person
X_4	Education	Education refers to the highest educational level that farmers had.	Categorical variable (1, primary school; 2, secondary school; 3, high school; 4, bachelor)
X_5	Occupation	Occupation refers to main job status that farmers are currently working.	Dummy variable (1, pig farmer; 0, not work as pig farmer)
X_6	Experience	Experience refers to how many years that farmers have worked in pig farming.	Continuous variable, years
X_7	Market distance	Distance to the market refers to the distance from farm to the market.	Continuous variable, kilometers
X_8	Pig number	Number of pig refers to total pig that farmers have at farm, calculated by unit pig	Continuous variable, unit*
	Innovations	Perception of farmers towards innovations	Likert scale
	Competitiveness	Perception of farmers towards competitiveness	Likert scale

* pig unit, > 25 kg is equal to 0.4 unit, < 25 kg is equal to 0.1 unit.

reliability. For competitiveness, the total value of the competitiveness from each indicator was obtained by adding up all the values from the weight of the backwardness of each question in the indicators. The higher the value, the better the level of innovation and competitiveness.

Furthermore, the level of pig production competitiveness is done by dividing into 3 categories of competitiveness, with the criteria: (1) High, the average value of Likert scale will be > 3.67, (2) Medium, the average value of value of Likert scale will be ranged 2.34-3.66 and (3) Low, the average value degree of Likert scale will be < 2.33.

Data were analyzed through descriptive and multiple logistic regression (MLR) analyses using the Statistical Package for the Social Sciences (IBM SPSS) 26.0 (IBM Corp, Armonk, NY, USA). For the first hypothesis, the effect of social profiles on the perception of farmers towards innovation was analyzed by MLR analysis. While, for the second hypothesis, MLR was also used to determine the effect of the perception of farmers towards innovations on the perception of farmers towards competitiveness.

The formulation (Eq.1) was the following:

$Y_{inno} = b_1x_1 + b_2x_2 + \dots + b_nx_n + c$. Here, b_i's (i=1,2…n) (Eq.1)

Where:

Y_{inno}: a dependent variable which is the innovation capacity of farmers including the score of four variables.

X is the independent variables which are

Social demographic characteristics include X_1: Age of farmers, X_2: Gender of farmers, X_3: Number of labors at farm, X_4: Education, X_5: Occupation, X_6: Experience, X_7: Market distance, X_8: Pig number.

The formulation (Eq.2) was the following:

$Y_{compe} = b_1x_1 + b_2x_2 + \dots + b_nx_n + c$. Here, b_i's (i=1,2…n) (Eq.2)

Where:

Y_{compe} is the dependent variable which is the perception of the competitiveness of pig farms.

X is independent variables including X_1: Production innovation, X_2: Process innovation, X_3: Market innovation, X_4: Organizational innovation

RESULTS

Table 2 shows that farmers with an average of 50 years old were mostly working at farms who have had more other 10 years of experience. Male farmers were dominant in pig farming activities and almost 70% of farmers completed their high school. No hired labour recorded in this study with around 1-2 family labourers was doing farming jobs. Surprisingly, farmers declared that raising pigs is not their main occupation. Farmers have joined in training activities for pig production technical skills. Additionally, more than 85% did not join in farmer groups.

Table 2. Social profiles and farm characteristics of small pig farmers in Mekong Delta.

Criteria	Categories	Results	
		N	Percentage
Age		50.20±7.260	
Gender	Female	39	15.0
	Male	221	85.0
Labor		1.49±0.612	
Experience		10.78±6.865	
Education	Primary school	14	5.4
	Secondary school	52	20.0
	High school	181	69.6
	Bachelor	13	5.0
Main occupation	Raising pigs	44	16.9
	Not raising pigs	216	83.1
Training	Yes	243	93.5
	No	17	6.5
Pig unit	Unit[1]	31.83±53.16	
Farmer colaborative[2]	Yes	34	13.1
	No	226	86.9
Access to information[3]	Yes	187	71.9
	No	73	28.1

***Noted*:** [1]pig unit: > 25 kg is equal to 0.4 unit, < 25 kg is equal to 0.1 unit; [2]Farmer Collaborative is a farmer group where farmers can share information and knowledge; [3]Access to information: access to both information on innovations and the market.

Table 3 indicates that the perception of farmers towards innovation applications at farms was mostly higher than 3 points. For the one-by-one statement, most farmers had a level 4 for perception. Particularly, more than 68% for all statements of production innovations. It is more than 75% statement 1 and 2 of process innovation. In contrast, farmers did not think investing techniques/equipment could improve farm production with 55.7% from level 3 and less. Compared to other statements, market innovations had a lower score of perception, only exploring new market channels recorded more than 80% of the high level of perception. Similarly, organizational innovation statements showed that labor/workers can innovate their farms with more than 80% of farmers from level 4.

Table 4 shows that the average score of competitiveness pillars were from 2.853 to 3.271. The economic efficiency showed the lowest level of farmer perception which was less than level 3. High perception was recorded in labor productivity when asked about economic efficiency. The financial source of pig farms is mostly from liquidity which was declared by more than 78% of farmers from point 4. The adaptability of farms was mostly from point 3. Similarly, the index of sustainability was from point 3. According to the results of Table 5, there were no farms with a low level of competitiveness following the declaration of farmers. Almost 70% of farms had a high level of competitiveness and more than 30% of farms with a medium level of competitiveness.

Table 3. The perceptions of farmers towards innovations.

Statements	Degree of perceptions				
	1	2	3	4	5
Production innovation					
Pigs from my farm are often considered as high quality (less fat) by customers.	4.2	0.8	19.2	75.8	-
In comparison to other farms. my pig farm has introduced more innovations in the past few years.	3.8	2.7	24.6	68.8	-
Breeds of my pig farm recently is significantly different from previous productions.	3.8	14.2	-	80.0	1.9
In comparison to other farms my pig farm is successful.	-	0.4	18.5	79.2	1.9
Average			3.701±0.505		
Process innovation					
My pig farm has flexible production management which can be changed efficiently.	-	0.8	19.2	75.0	5.0
My farm uses short supply chain and distribution network.	3.8	-	11.9	81.5	2.7
My farm invests in new techniques/equipment to improve its activities.	3.8	8.8	43.1	43.1	1.2
Average			3.642±0.453		
Market innovation					
Pork from my farm is often more competitive than other farms.	-	14.6	47.7	33.8	3.8
My farm produces hog with lower price and higher quality of meat to the market.	2.7	25.0	46.5	21.5	4.2
My farm produces products that address customer needs.	-	13.5	37.3	46.9	2.3
My farm explores new market channel.	-	1.9	11.2	84.2	2.7
Average			3.381±0.480		
Organizational innovation					
My farm has joined in group of farmers to stabilize the price.	0.4	14.6	49.2	31.5	4.2
My farm has a relationship to middleman or market sellers.	-	14.2	42.7	40.8	2.3
In my farm, labor/workers should have ability to innovate the farm	-	1.9	14.2	83.8	-
Average			3.459±0.419		

Table 4. The competitiveness indicators evaluated by farmers.

Statements	Degree of perceptions				
	1	2	3	4	5
Economic efficiency of pig farm includes:					
Labor productivity in pig farm	6.5	15.4	16.2	60.8	1.2
Land and pig productivity	3.5	46.2	18.5	31.2	0.8
Income per pig.	4.2	52.7	19.6	20.0	3.5
Profitability of pig farm	3.8	55.4	18.1	20.8	1.9
			2.853±0.746		
Financial endowment (source) of pig farm includes:					
Profitability of own capital	3.8	52.7	15.8	26.9	0.8
Liquidity	0.4	1.9	15.0	78.1	4.6
Level of Financial autonomy	3.5	53.5	20.4	19.2	3.5
			3.063±0.582		
Adaptability of pig farm includes:					
Level of Adaptability of pig production to natural environment	0.8	6.9	53.5	38.1	0.8
Level of Adaptability of pig production to market environment	0.4	8.5	56.9	33.1	1.2
Level of Adaptability of pig production to institutional environment	0.4	7.7	61.5	28.5	1.9
			3.271±0.546		
Sustainability in pig farm					
Level of Sustainability of pig production in supply natural resources	-	14.6	48.8	35.4	1.2
Level of sustainability of pig production in supply of labor	-	28.8	22.3	48.5	0.4
Level of sustainability of pig production in inputs supply	-	2.7	18.8	76.9	1.5
Level of sustainability of pig production in supply with innovations	-	13.1	43.8	42.7	0.4
Level of sustainability in pig production in fundings	0.8	16.2	48.1	32.7	2.3
Level of sustainability of pig production in supply with production and health services	0.4	27.3	37.7	32.7	1.9
Level of sustainability of pig production in marketing	0.8	32.7	35.4	29.2	1.9
			3.253±0.517		

The results of Table 6 showed that gender, education, occupation, experience, and pig unit affected the production innovation while gender, education, and pig unit affected process innovation, market innovation, and organizational

innovation. For labor, only market innovation was affected by. The effect of experience on organizational innovation was also recorded in this study. Particularly, an increase in gender from female to male led to a 0.267 time increase in production innovation, 0.339 times increase in process innovation, 0.283 times in market innovation, and 0.161 times in organizational innovation. An increase in education level increases 0.292-time production innovation and 0.150 process innovation while decrease 0.145 times of market innovation and 0.150 organizational innovation. Overall, an increase in pig units led to an increase in all aspects of innovation. Besides, an increase in occupation increases production innovation while an increase in experience led to a decrease in production innovation. In contrast, an increase in experience led to an increase in organizational innovation. Older farmers tend to have less organizational innovation. Additionally, an increase in labor number also increases market innovation

Table 5. Level of competitiveness.

Criteria	Categories	Results	
		N	Percentage
Level of competitiveness	High level	180	69.2
	Medium level	80	30.8
	Low level	-	-

Note: The level of competitiveness consisted of <1.66 = low level of competitiveness; 1.66-3.33 = medium level of competitiveness; >3.33 = high level of competitiveness

Table 6. The effect of social profiles on the competitiveness.

Criteria	Innovations			
	Production innovation	Process innovation	Market innovation	Organizational innovation
Age	0.006	0.000	0.000	**-0.009***
Gender	**0.267****	**0.339****	**0.283****	**0.161***
Labour	-0.021	0.070	**0.118***	0.045
Education	**0.292****	**0.150****	**-0.145****	**-0.150****
Occupation	**0.216****	0.067	0.048	-0.009
Experience	**-0.015****	-0.004	-0.002	**0.013****
Pig unit	**0.002****	**0.002****	**0.002****	**0.001****
Constant	2.344	2.775	3.331	3.924

Table 7. The effects of perception towards innovations on competitiveness.

Criteria	Regression result				
	B	Std. Error	Beta	t	Sig.
Production innovation	-0.010	0.075	-0.010	-0.130	0.896
Process innovation	0.021	0.098	0.019	0.212	0.832
Market innovation	**0.405**	0.069	0.397	5.889	**0.000**
Organizational innovation	**0.343**	0.074	0.294	4.610	**0.000**
Constant	0.516	0.270	-	1.912	0.057

Table 7 shows that an increase in the perception level of market innovation increases the 0.405-time competitiveness level of farms. Similarly, the increase in the perception of farmers towards organizational innovation increases the 0.343-time level of competitiveness of farms. All other variables are kept constant. The study did not record any effects of production innovation and process innovation on the farm's competitiveness.

DISCUSSION

Social profiles are one of the important factors that should be examined before doing other analysis for farm management (Guntoro *et al.*, 2023). Male farmers were more dominant with high average years old and high experience. Accordingly, the social profile results in this study were consistent with those of previous studies in the Mekong Delta, Vietnam (Qui *et al.*, 2021; Qui *et al.*, 2020; Qui *et al.*, 2024). Besides, in this study, the perception of farmers towards innovations at their farm and the competitiveness of farms are slightly high. It could partly show that farmers understand how important innovations are in their farms and partly show the relationship between social profile, innovation, and competitiveness. Technologies undergo continuous evolution and adaptation in different locations and time periods, driven by local circumstances and facilitated by social learning and progress (Glover *et al.*, 2019). During this continuous process of transformation, farm trials and farmer field schools serve as a platform where social and technical innovation dynamics intersect. According to Smith *et al.* (2021b), the current reporting methods are inadequate in capturing the dynamic processes and unexpected repercussions. Their focus is on highlighting the active involvement of farmers in the innovation process.

For innovations, Gottschall and Woods (2020) demonstrate that in small family enterprises, the family assumes a pivotal role in driving innovative activities. Innovation has the potential to enhance the efficiency and effectiveness of producing, processing, selling, and distributing agricultural goods (Smith *et al.*, 2021a). The findings indicated that both gender and the quantity of pigs had an impact on individuals' impression of innovations. As to the findings of Ritter *et al.* (2017), each farmer possesses a unique blend of demographic attributes (such as gender, age, and education), previous experiences, personality traits, daily habits, goals, and cultural, economic, and familial influences. The distinctive characteristics of these attributes influence the way farmers perceive preventive measures, management strategies, and decision-making. The study found a correlation between the gender distribution of participants in any given group and their choices about farm improvements. Moreover, it has been observed that men possess a higher degree of dominion over larger creatures, whereas women have a greater level of authority over smaller animals (Ransom *et al.*, 2017).

Although male farmers are more prominent and have a higher effect on household decisions, they typically do not participate in domestic duties. As a result, men farmers have more leisure time than female farmers after completing their farming operations. This enables individuals to engage with extension officials and facilitate the sharing of information (Qui *et al.*, 2021). Farmers argued that livestock rearing differed based on their attitude and expertise, access to resources and funds, relationship with animals, and engagement with extension staff for encouragement to purchase and utilize technologies (Quddus, 2022).

The presence of a negative coefficient on the age of the household head indicates that the age of the household head has a diminishing effect on the pace at which innovation is adopted. This finding aligns with existing literature indicating that younger farmers exhibit a higher propensity to embrace technology compared to their elder counterparts (Dhraief *et al.*, 2019). According to Dhraief *et al.* (2019), younger farmers tend to be less cautious about taking risks and more open to trying out new technology compared to older farmers. In contrast, older farmers are more cautious about taking risks and less inclined to make long-term investments in their farms. Greater experience results in fewer manufacturing innovations. According to the study conducted by Dhraief *et al.* (2019), it was shown that younger livestock owners are more likely to adopt advanced innovations, while those with extensive experience tend to stick to traditional livestock farming ways and are less open to using current innovations. Within this study, it was observed that farmers who mostly engage in pig farming demonstrate a notable comprehension of the significance of innovations. According to the study conducted by Dhraief *et al.* (2019), non-pig farming enhances farmers' capacity to implement innovations. This phenomenon can be attributed to the fact that farmers primarily rely on non-farm activities as their major source of income, which therefore increases their propensity to invest in agricultural technology. Nevertheless, affluent farmers do not require loan access and are more inclined to embrace advancements. Farmers primarily engaged in pig production tend to prioritize maximizing pig profitability, which can be achieved through the use of innovative practices.

The livestock farms in Vietnam are classified based on the number of livestock they have, with categories including commercial farms and small farms (Ly *et al.*, 2016). Our results demonstrate that farmers who had a greater number of pigs exhibited a higher level of innovation capacity on their farms. Increasing the number of pigs kept on a farm directly correlates with the farmer's focus on maximizing earnings. Thompson *et al.* (2019) found that agricultural advances are linked to enhanced financial returns. It results in a higher pig population and enhances farmers' sense of advance. In line with the research conducted by Dhraief *et al.* (2019), farmers who have larger-scale operations and own large herds are more inclined to embrace innovations, particularly those that involve high costs. Furthermore, as stated in Qui *et al.* (2020), the number of pigs has a relationship on experience and education. The results of this study also showed an increase in the education of farmers affected the production innovations and process innovations while an increase in education led to a decrease in two rest indicators. This implies that more years of education, expose farmers to several different innovations, their application, and their benefits. Through this, farmers can use the innovations exposed to effectively. The results concurred with several studies suggesting that educated farmers are alleged to have a higher capability to attain, infer, and respond to information on available innovations (Judith *et al.*, 2021). Most farmers in this study had access to information regarding innovation and market trends. The study conducted by Jerop *et al.* (2018) revealed that educated agriprenuers had a higher probability of obtaining knowledge and guidance from extension providers, which in turn affects their adoption of innovative practices. An illustration of market innovativeness is contract farming, a concept not acknowledged by farmers (Judith *et al.*, 2021) In addition, the level of organizational creativity tends to decline as education levels grow. Indeed, farmers with a strong educational background possess a comprehensive understanding of the significance and advantages of novel advancements. Nevertheless, a study conducted by Quddus (2022) revealed that farmers exhibited a lack of confidence in utilizing innovations. They found that technology did not effectively streamline their work processes, and they displayed a reluctance to adapt innovations to align with their established methods. Furthermore, farmers demonstrated resistance to implementing innovations, particularly in the areas of market and organizational advancements.

Hendayana *et al.* (2019) study asserts that innovation has a significant impact on competitiveness. Innovation is crucial as it enables the acquisition of knowledge and facilitates its integration and adaptation to technological advancements. Innovation is a catalyst for enhancing competitiveness. Frederick *et al.* (2016) state that economic drivers, including economic efficiency and innovation, are key factors that promote competitiveness. The impact on innovation is much greater in environments with higher levels of competition, yet there is only limited evidence to suggest that it is the leaders who are the most innovative. When competition is at an intermediate level, the peak of innovation is larger. However, this phenomenon is also observed at higher levels of rivalry (Negassi *et al.*, 2019). Due to the correlation between innovation and competitiveness, it has been deduced that the output of knowledge-technology and creative output has a favorable impact on competitiveness. According to Doğan (2016), an increase of 1 unit in knowledge-technology production leads to a 0.0045 unit increase in competitiveness, whereas an increase of 1 unit in creative output leads to a 0.0046 unit improvement in competitiveness. Chursin *et al.*

(2017) assert that innovation serves as the foundation for competitiveness. The level of competitiveness of a company is directly proportional to the level of innovation it can generate. This demonstrates that using innovative strategies is a surefire way for a firm or organization to enhance its competitiveness. The findings of this study further corroborate the research carried out by Abd Aziz and Samad (2016), which shows that innovation exerts a robust and favorable impact on the competitiveness of small and medium-sized enterprises in the food industry in Malaysia. Technology and innovation processes have increasingly become decisive factors in competition. The use of new technologies and the ability to innovate have become essential for companies to remain competitive and survive in the global economy (Akis, 2015)

The marketing innovation approach is centered around a firm's ability to utilize modified methods to reach the appropriate target segment for its product in a competitive market. This approach also focuses on improving communication about the product and the firm itself, allowing for easier comparison between the product and its competitors. Additionally, it aims to ensure efficient delivery of the product or service in order to cultivate satisfied customers (Gupta *et al*., 2016). The study conducted by Wakgari *et al*. (2024) found a clear correlation between organizational innovation and competitiveness. Market innovation enhances competitiveness. Competitiveness is directly associated with the market mechanism and refers to the ability to efficiently manufacture and sell items in order to meet the demands of competition (Shirinyan *et al*., 2021).

***Conclusion*:** The survey revealed that farmers possess a positive perspective of innovations and their role in enhancing the competitiveness of farms. Perception towards innovation implementation at the farm was influenced by social profiles, including age, gender, labor, education, occupation, pig unit, and experience. Furthermore, the level of competitiveness among farms in the Mekong Delta was found to be high based on farmers' self-evaluation. The study also found that both market innovations and organizational innovations had a partial impact on the competitiveness of a farm. Based on the above research results, we can see that, within the framework of small farms, the application of improvements to farm competitiveness has an interactive relationship and seems to be partly affected by the sociological information of pig farmers. Therefore, the following policies need to focus on transmitting and diffusing information to farmers in various forms to ensure that farmers can access and apply new innovations on their farms. To do this, factors related to age, gender, education, occupation, number of pigs, and experience need to be approached and given top priority in communicating and distributing new policies. In addition, the introduction of policies to encourage the application of new improvements should be considered because exposure to these improvements can support farmers to accept them more easily later, thereby increasing the production capacity as well as the competitiveness of the farm. To clarify the application of new innovations in pig farming, impact policies as well as studies on external factors need to be conducted, in order to be able to come up with specific policies for each situation and each pig farming model.

***Authors' contributions*:** N.H Qui, B. Guntoro, A.R.S. Putra designed the study; N.H. Qui N.T.A. Thu implemented the survey and collected data; N.H. Qui, B. Guntoro, A.R.S. Putra, N.T.A. Thu, N. Liangco prepared the draft; B. Guntoro, A.R.S. Putra reviewed and finalized the manuscript.

***Conflict of interest*:** The authors declared that there are no conflicts of interest.

***Acknowledgment*:** This study was supported by Universitas Gadjah Mada, Indonesia in 2024 with a letter of assignment No. 4971/UN1.P1/PT.01.01/2024. Besides, we acknowledge the support of time and facility from Tra Vinh University (TVU) for this study.

***Funding*:** The authors acknowledged Universitas Gadjah Mada, Indonesia for providing grant though Rekognisi Tugas Akhir (RTA) with a letter of assignment No. 4971/UN1.P1/PT.01.01/2024

***Ethical statement*:** All procedures carried out in studies involving animals adhered to the ethical standards of the conducting institution or practice vide letter of assignment No. 4971/UN1.P1/PT.01.01/2024.

***Availability of data*:** All data used are within the manuscript.

***Informed consent*:** Written informed consent was obtained from all participants regarding publishing their data.

***Consent for publication*:** All authors submitted consent to publish this research article in JGIAS.

***SDGs addressed*:** Zero Hunger, Decent Work and Economic Growth

REFERENCES

Abd Aziz, N.N. and S. Samad. 2016. Innovation and competitive advantage: Moderating effects of firm age in foods manufacturing SMEs in Malaysia. Procedia Economics and Finance 35:256-266.

Akis, E. 2015. Innovation and competitive power. Procedia-Social and Behavioral Sciences 195:1311-1320.

Chursin, A., Y. Vlasov and Y. Makarov. 2017. Innovation as a Basis for Competitiveness: Theory and Practice. 1st ed. Springer Cham, Switzerland.

Dhraief, M.Z., S. Bedhiaf, B. Dhehibi, M. Oueslati-Zlaoui, O. Jebali and S. Ben-Youssef. 2019. Factors affecting innovative technologies adoption by livestock holders in arid area of Tunisia. Journal of Economics, Agriculture and Environment 4:3-18.

Di Falco, S. 2018. Adaptation to climate change in sub-Saharan agriculture: Assessing the evidence and

rethinking the drivers, In: Berck, C. S., P. Berck and S. D. Falco (Ed), Agricultural Adaptation to Climate Change in Africa. Routledge, Abingdon, UK pp. 83-106.

Distanont, A. and K. Orapan. 2020. The role of innovation in creating a competitive advantage. Kasetsart Journal of Social Sciences 41:15-21.

Doğan, E. 2016. The effect of innovation on competitiveness. Istanbul University Econometrics and Statistics e-Journal 24:60-81.

Elias, C. and G. Evangelos. 2016. Quadruple innovation helix and smart specialization: knowledge production and national competitiveness. Journal of the National Research University Higher School of Economics 10:31-42.

FAO. 2023. Pig production in Vietnam from 2005 to 2021 (in million heads). https://www.statista.com/statistics/661016/vietnam-pig-production/. Accessed December 22 2022.

Frederick, H., A. O'connor and D.F. Kuratko. 2016. Entrepreneurship: Theory, Process, and Practice. 9th ed. Cengage Learning, US.

Fuetsch, E. 2022. Innovation in family farms: the roles of the market, the family, and farm performance. Journal of Small Business Strategy 32:83-103.

Glover, D., J. Sumberg, G. Ton, J. Andersson and L. Badstue. 2019. Rethinking technological change in smallholder agriculture. Outlook on Agriculture 48:169-180.

Gottschall, R.L. and J.A. Woods. 2020. Family human capital and the championing of innovation in small firms. Journal of Small Business Strategy 30:1-15.

Guntoro, B., A. Triatmojo, B. Ariyadi and N.H. Qui. 2023. Risk analysis in cattle farmers' prevention practices of anthrax and foot and mouth disease in yogyakarta province, Indonesia. Advances in Animal and Veterinary Sciences 11:987-997.

Gupta, S., N.K. Malhotra, M. Czinkota and P. Foroudi. 2016. Marketing innovation: A consequence of competitiveness. Journal of business research 69:5671-5681.

Hendayana, Y., E. Ahman and H. Mulyadi. 2019. The effect of innovation on business competitiveness of small and medium enterprise in Indonesia, International Conference on Organizational Innovation (ICOI 2019). 20-22 July 2019. University of Ulsan, South Korea pp. 116-120.

Jerop, R., P. Dannenberg, G. Owuor, P. Mshenga, P. Kimurto, M. Willkomm and G. Hartmann. 2018. Factors affecting the adoption of agricultural innovations on underutilized cereals: The case of finger millet among smallholder farmers in Kenya. African Journal of Agricultural Research 13:1888-1900.

Judith, K., E. Gathungu, O.I. Ayuya and P. Kimurto. 2021. Effects of production and market innovations on the level of competitiveness of sorghum small scale agrienterprises. Modern Economy 12:1137-1159.

Läpple, D. and H. Kelley. 2015. Spatial dependence in the adoption of organic drystock farming in Ireland. European Review of Agricultural Economics 42:315-337.

Läpple, D. and F. Thorne. 2019. The role of innovation in farm economic sustainability: Generalised propensity score evidence from Irish dairy farms. Journal of agricultural economics 70:178-197.

Levine, D.M., and D.F. Stephan. 2010. Even you can learn statistics: A guide for everyone who has ever been afraid of statistics. 2nd ed. FT Press, New Jersey.

Ly, N.T., T. Nanseki and Y. Chomei. 2016. Technical efficiency and its determinants in household pig production in Vietnam: A DEA approach. The Japanese Journal of Rural Economics 18:56-61.

Ndwandwe, S.B. and R.C. Weng. 2018. Competitive analyses of the pig industry in swaziland. Sustainability 10:4402.

Negassi, S., S. Lhuillery, J.F. Sattin, T.Y. Hung and F. Pratlong. 2019. Does the relationship between innovation and competition vary across industries? Comparison of public and private research enterprises. Economics of Innovation and New Technology 28:465-482.

Nga, N.T.D., P. Van Hung, L.T.L. Vy, N.T.T. Huyen, D.N.Ha and G. Huong. 2021. Swine production and challenges in Vietnam a fter African wine fever: a case study in peri-urban hanoi, Vietnam. Vietnam Journal of Agricultural Sciences 4:965-977.

Nybom, J., E. Hunter, E. Micheels and M. Melin. 2021. Farmers' strategic responses to competitive intensity and the impact on perceived performance. SN Business & Economics 1:74.

Quddus, M.A. 2022. Dissemination of technological innovations of livestock in Bangladesh: adoption levels and behavioral precision. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences 92:461-472.

Qui, N.H., B. Guntoro, S. Syahlani and N. Linh. 2021. Factor affecting the information Sources and communication channels toward pig farmer's perception of African swine fever in Tra Vinh province, Vietnam. Tropical Animal Science Journal 44:248-254.

Qui, N.H., B. Guntoro and S.P. Syahlani. 2020. The social profile, constraints, and its impact on swine herd size in Tra Vinh Province, Vietnam. Tropical Animal Science Journal 43:385-390.

Qui, N.H., N.T.A. Thu, and N.T. Linh. 2024. Factors affecting highly pathogenic avian influenza vaccination practices at poultry farms in Tra Vinh, Vietnam. Open Veterinary Journal 14:794-804.

Ransom, E., C. Bain and I. Halimatusa'Diyah. 2017. Livestock-livelihood linkages in Uganda: the benefits for

women and rural households? Journal of Rural Social Sciences 32:3.

Ritter, C., J. Jansen, S. Roche, D.F. Kelton, C.L. Adams, K. Orsel, R.J. Erskine, G. Benedictus, T.J. Lam and H.W. Barkema. 2017. Invited review: Determinants of farmers' adoption of management-based strategies for infectious disease prevention and control. Journal of Dairy Science 100:3329-3347.

Rogers, E.M. 2003. Diffusion of innovations. 5th ed ed. NY: Free Press., New York.

Shirinyan, L., M. Arych and H. Rohanova. 2021. Influence of insurance on competitiveness of food enterprises in Ukraine. Management Theory and Studies for Rural Business and Infrastructure Development 43:5-12.

Smith, A.M., P. Duncan, D. Edgar and J. McColl. 2021a. Responsible and sustainable farm business: Contextual duality as the moderating influence on entrepreneurial orientation. The International Journal of Entrepreneurship and Innovation 22:88-99.

Smith, H.E., S.M. Sallu, S. Whitfield, M.F. Gaworek-Michalczenia, J.W. Recha, G.J. Sayula and S. Mziray. 2021b. Innovation systems and affordances in climate smart agriculture. Journal of Rural Studies 87:199-212.

Thompson, N.M., C. Bir, D.A. Widmar and J.R. Mintert. 2019. Farmer perceptions of precision agriculture technology benefits. Journal of Agricultural and Applied Economics 51:142-163.

Wakgari, G., C. Amentie and N. Bali. 2024. Effect of Innovation capability on Competitiveness: A Study on Manufacturing Firms in Ethiopia. Journal of Science, Technology and Arts Research 13:119-148.

Walder, P., F. Sinabell, F. Unterlass, A. Niedermayr, D. Fulgeanu, M. Kapfer, M. Melcher and J. Kantelhardt. 2019. Exploring the relationship between farmers' innovativeness and their values and aims. Sustainability 11:5571.