

# Perceptions and Attitudes Toward Biosecurity Management among Smallholder Swine Farmers in The Mekong Delta, Vietnam

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**Abstract:** *Biosecurity is widely acknowledged worldwide as a core measure for preventing the spread of infectious diseases at the farm level. This study surveyed 240 smallholder swine farmers across Tra Vinh and Long An provinces to examine their sociodemographic characteristics, biosecurity management (BM) practices, perception, and attitudes toward BM. It further assessed how socioeconomic and psychological factors influence BM status. Descriptive statistics and multiple linear regression analyses were explored to examine all the relationships. The results indicated that farmers were more inclined to plan, implement, and adjust biosecurity measures than to adjust biosecurity practices. Planning the biosecurity practices accounted for the highest proportion (91.70%), whereas adjustment was the lowest (65.00%). In terms of attitudes, 62.10% of respondents expressed understanding well in adopting BM, and only 40.40% believed that biosecurity management improved their swine production. The factors, including education, occupation, and perception, were found to significantly positively influence the adoption of biosecurity management practices. Overall, this finding implies that policymakers should provide training short courses, awareness programs, and practical demonstrations to strengthen confidence in biosecurity management and promote its effective and long-term application.*

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## **I. Introduction**

The implementation of biosecurity measures is essential for swine farmers. In Vietnam, the government has identified improved biosecurity as a key approach to preventing future disease outbreaks. Biosecurity measures aim to reduce economic losses and minimize zoonotic risks to humans through the prevention and control of animal diseases [1]. Previous studies have demonstrated that biosecurity practices enhance the economic performance of livestock farms by reducing animal mortality and lowering the risk of farm abandonment [2].



Despite these benefits, biosecurity practices in swine farming remain insufficient and require further improvement. The study by [3] reported that the adoption of biosecurity measures on Vietnamese swine farms faces multiple challenges, including management constraints, geographic conditions, the predominance of small-scale household production systems, and limited farmer knowledge.

The adoption of agricultural technologies, including biosecurity measures, is influenced by several interrelated factors. Farmers' attitudes and personal characteristics play an important role in determining their willingness to implement biosecurity practices, particularly those targeting specific disease transmission pathways. According to [4] found that farmers were more likely to adopt biosecurity measures when they understood their benefits and felt a sense of responsibility for animal health. Socio-demographic factors such as age, education level, and farm size have also been shown to influence decisions related to technology adoption [5]. In addition, research by [6] highlighted that technology adoption is shaped by perceived innovativeness, usefulness, ease of use, access to information, social influence, and perceived cost.

Therefore, further research is needed to better understand the factors influencing biosecurity practices in Vietnam. In particular, gaining insight into farmers' perceptions of biosecurity and the reasons underlying these perceptions is crucial for developing effective biosecurity management strategies that support both farmer livelihoods and food security [7]. Moreover, understanding farmers' perceptions and attitudes toward specific biosecurity measures is essential for improving disease prevention and control strategies. Such evidence can inform government policies aimed at strengthening biosecurity practices among farmers in the Mekong Delta.

## **II. Materials and Methods**

### **2.1. Time and location**

The study was conducted in three provinces of the Mekong Delta, located in southern Vietnam. Tra Vinh and Long An were selected because of their relatively large swine populations and frequent occurrence of infectious disease outbreaks, making them representative areas for studying biosecurity management in smallholder pig farming systems. In addition, their geographical position along the main transportation routes to Ho Chi Minh City, the largest livestock market in southern Vietnam, contributes to high levels of animal movement and associated challenges in disease prevention and control. The field survey and data collection were carried out between January and June 2025, covering both the dry and early rainy seasons, which allowed for the observation of seasonal variations in farm activities and biosecurity practices.

### **2.2. Data collection**

The target respondents of this study comprised smallholder swine farmers, who often face challenges related to infectious disease outbreaks in their herds. As the total number of smallholder pig farmers in the study area was not available, a non-probability sampling approach was employed to select respondents. The research locations were selected based on the purpose of sampling. According to [8] for an unknown population, a minimum sample size of 30 respondents is considered sufficiently large to ensure reliable analysis. Based on this guideline, the present study selected four districts from each province, and within each district, 30 respondents were chosen. Consequently, a total of 120 respondents were surveyed per province, ensuring an adequate and representative sample size. In total, 240 swine farmers were interviewed across the two provinces.

The selection criteria for respondents were as follows: farmers were required to own at least 10 swine units on their farm, in accordance with Decree No. 13/2020/ND-CP of Vietnam and to have a minimum of one year of experience in swine production. In addition, to ensure that respondents were knowledgeable about biosecurity, only farmers who had received training related to the national regulations on swine farm biosecurity standards (QCVN 01-14:2010/BNNPTNT) were included in the survey. These criteria were established to ensure that the selected participants were representative of the target population. The questionnaire was initially developed in English and then translated into Vietnamese including four sections.



Section 1: the respondents were asked about their socio-demographic characteristics (i.e. age, gender, education, labor, income, occupation and experience) will be collected, which are collected following in Table 1.

Section 2: the BM measures were categorized into four key components as described by [9]: planning, implementation, control, and adjustment. According this approach offers an integrative perspective in management biosecurity activities that captures behavioral in manage dimensions of biosecurity activities, which are often underrepresented in biosecurity practices disease-specific biosecurity scoring tools used in other studies. Based on the conceptual frameworks of previous studies, the statements under each category were developed, including planning (6 statements), implementation (4 statements), control (4 statements), and adjustment (5 statements). In total, 19 statements were used to collect scores reflecting the level of biosecurity management practices. Each response was assigned a score of 1 point if the respondent agreed with the statement or performed the action on their farm, and 0 points if they did not.

Section 3: Famers were surveyed about their perceptions of implementing biosecurity management (BM). The respondent was asked to rate 10 statements related to the perception of usefulness and cost of applying the BM in their farm. The Likert scale was utilized in this section, which ranged from 1 (strongly disagree) to 5 (strongly agree) for each statement.

Section 4: Farmers were surveyed regarding their attitudes toward implementing biosecurity management (BM) practices. Respondents were asked to rate 6 statements reflecting their attitude toward applying BM measures on their farms. A five point Likert scale was used, ranging from 1 (strongly disagree) to 5 (strongly agree).

Table 1: Definition of socio-dermographic characteristics

No.	Variables	Description
1	Age	Age of the farmers of the year (continuous)
2	Gender	Gender of swine farmers who were chosen as respondents (1= Male, 0= Female)
3	Education	The education of farmers in the school (1= primary school, 2= secondary school, 3= high school, 4= bachelor, 5= graduate)
4	Labour	The number of family members participating in farming activities (Continuous)
5	Income	Income that swine farmers earned from raising swine per month (Continuous)
6	Occupation	The primary occupation of farmers (0 = other job, 1 = swine production)
7	Experience	Number of years farmers have raised swine

### III. Data analysis

In terms of biosecurity management (BM) practices, each item within the four categories was scored as 1 if the respondent applied the practice on their farm, and 0 if not. The adoption rate for each practice was then calculated by dividing the number of farms applying the measure by the total number of farms surveyed, and the result was expressed as a percentage [10].

Regarding attitude of farmers toward BM, a five-point Likert scale was used to measure attitude (6 statements) of farmers toward biosecurity management, with scores ranging from a minimum of 6 to a maximum



of 30. Likewise, perception of farmers toward BM, a five-point Likert scale was used to measure perception of farmers toward biosecurity management, with scores ranging from a minimum of 7 to a maximum of 35.

Data were analyzed using IBM SPSS 26.0 (IBM Corp, Armonk, NY, USA), and statistical significance was determined at a 5% level. Descriptive statistics were used to analyze these socio-demographic characteristics, BM status, the attitude and perception toward biosecurity management

Multiple linear regression was used to analyze the relationship between a socio-demographic characteristics, perception and attitude characteristics variable and farmers' biosecurity management practices (BM). Statistical significance was determined at  $p < 0.05$  or  $p < 0.01$ . The model is presented in the formulation as follow:

$$Y_{BM} = b_1 x_1 + b_2 x_2 + \dots + b_n x_n + c. \text{ Here, } b_i\text{'s (} i= 1, 2 \dots n\text{)}$$

Where;  $Y_{BM}$  is the BM index is a dependent variable that is the total value of the BM on each farm.  $x$  is independent variables including  $x_1$ : Age,  $x_2$ : gender,  $x_3$ : education,  $x_4$ : labour,  $x_5$ : income,  $x_6$ : occupation,  $x_7$ : experience,  $x_8$ : perception,  $x_9$ : attitude toward BM.

#### **IV. Results and Discussion**

##### **4.1. Social profile characteristics and the status of biosecurity management of farmers in the Mekong Delta**

Socio-demographic characteristics and the status of biosecurity management of farmers in the Mekong Delta Table 2 shows that the average age of the farmers was 49.57 years, most respondents (75.00%) were male, highlighting that males played an important role in raising swine. Second, the level of education was high, with 48.80% graduating from highschool. Most respondents (70.8%) stated that animal husbandry as their main occupation, with over 10.31 years of experience in swine farming. More than one laborer participating in their swine production. The average income reflected limited profitability that the average farm income was just 349.57 USD.

Table 2: Socio-demographic profile of small-scale swine farmers (n = 240)

<b>Variables</b>	<b>Categories</b>	<b>N</b>	<b>Result</b>
Age	Mean ± SD	240	49.57±7.22
	Min	240	30.00
	Max	240	67.00
Gender (%)	Female	60	25.00
	Male	180	75.00
Education (%)	Primary school	14	5.80
	Secondary	17	7.10
	High school	117	48.80
	Bachelor	70	29.20
	Graduate	22	9.20
Labour	Mean ± SD	240	1.40±0.64
	Min	240	0.00
	Max	240	4.00
Income (USD)	Mean ± SD	240	349.57±293.61
	Min	240	40.65
	Max	240	1219.51
Occupation	0	70	29.20
	1	170	70.8



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Experience	Mean ± SD	240	10.31±6.309
	Min	240	2
	Max	240	30

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Regarding biosecurity management practices the results indicate that most farmers practiced key components of biosecurity management, although the level of engagement varied across components (Fig. 1). Planning was the most commonly practiced activity, with 91.7% of respondents reporting participation, followed by control measures (85.8%) and implementation of biosecurity practices (81.7%). In contrast, adjustment of biosecurity measures was less frequently practiced, with only 65.0% of farmers reporting active engagement, while 35.0% did not implement adjustment practices. These findings suggest that routine and structured activities such as planning, implementation, and control are more widely adopted, whereas adaptive biosecurity management through regular adjustment receives comparatively less attention.

These findings highlight the importance of considering farmers' socio-demographic characteristics when examining their decisions to adopt biosecurity management practices. In line with this finding [11] emphasized that each farmer operates within a unique set of personal and contextual factors that shape agricultural decision-making. The average age of respondents suggests that swine farming is largely managed by older farmers. One possible explanation is that younger individuals often pursue higher education or employment opportunities in urban areas, leaving agricultural activities to the older generation (Uddin et al., 2016). A similar pattern was reported by [12], who found that most farm owners were male. This trend may reflect the traditional division of labor in rural areas, where men are more directly involved in livestock production and farm management. In addition, farmers in this study reported a moderate level of income. Income is an important factor influencing the adoption of agricultural practices, as it affects farmers' capacity to invest in improved management strategies [13]. Therefore, recognizing these socio-demographic differences is essential for designing effective agricultural interventions and providing appropriate support to farmers in their decision-making processes. The results on biosecurity management practices indicate that farmers generally apply a structured approach that includes four key functions: planning, implementing, controlling, and adjusting. This finding is consistent with the concept of management described by [14], who defined management as a process involving several functions—such as planning, organizing, motivating, and controlling—performed to achieve organizational objectives through the effective use of human and material resources.

#### **4.2 The perception of farmers toward biosecurity management**

The results (Table 3) pointed that farmers perceived biosecurity management (BM) differently across two key dimensions: usefulness and cost. For the statement that BM helps manage farm facilities and time more effectively reported moderate to high agreement, with 35.8% selecting level 4 and 10.8% selecting level 5. Similarly, perceptions that biosecurity management reduces the risk of infectious disease spread were generally favorable, as 25.0% and 23.8% of respondents chose levels 3 and 4, respectively, while only a small proportion strongly disagreed. Most respondents selected higher agreement levels for the statement that biosecurity management provide clear guidance for implementing biosecurity measures (43.3%). Likewise, the statement that BM supports improvements in farm biosecurity received the highest positive response (57.9%). The findings indicated that farmers believed BM as a valuable and effective practice. Regarding cost perception, while most respondents believed that implementing biosecurity management does not require high costs with 92.9% selecting level 3 and 41.3% selecting level 4. However, some respondents acknowledged that biosecurity management involves yearly maintenance expenses, as reflected by 32.1% and 33.8% of farmers selecting levels 2 and 4, respectively. Despite concerns about ongoing costs, farmers largely believed that the benefits of biosecurity management outweigh its costs. A considerable proportion of respondents expressed agreement, with 40.4% selecting level 4, indicating that farmers perceive biosecurity management as a worthwhile investment for disease prevention and farm sustainability. Overall, the findings suggest that although farmers recognize the benefits of biosecurity management, financial considerations and perceived risks may still influence their adoption decisions.



Table 3: The perception of farmers toward biosecurity management

Statements	Degree of perception				
	1	2	3	4	5
Manage facilities and time more effectively	6.3	30.4	16.7	35.8	10.8
Reduce the risk of infectious disease spread	6.3	36.3	25.0	23.8	8.8
Provide clear guidance for implementing biosecurity measures	2.1	6.3	43.3	40.4	7.9
Supports improvements in farm biosecurity	0.4	1.3	30.8	57.9	9.6
Implementing biosecurity management does not require high costs	0.4	3.8	42.9	41.3	11.7
Implementing biosecurity management requires yearly maintenance expenses	4.6	32.1	23.8	33.8	5.8
Biosecurity management offers greater benefits than its costs	4.6	22.5	26.7	40.4	5.8
Mean ± SD					

Farmers' perceptions of biosecurity management (BM) indicated that most respondents were highly aware of the benefits of adopting these practices. Many farmers reported that biosecurity management provides clear guidance for implementing disease prevention measures on farms. This perception aligns with the concept of management described by Tovmasyan (2017), who explained that management involves functions such as planning, organizing, motivating, and controlling, which enable managers to effectively use available resources to achieve specific goals. In addition, most farmers recognized that implementing biosecurity management does not necessarily require substantial financial investment. This perception is important because cost is often identified as a major barrier to adopting biosecurity practices, particularly among smallholder farmers. According to Qui et al. (2024) reported that financial constraints are one of the main obstacles to implementing disease prevention and treatment measures.

#### 4.3 The attitude of farmers toward biosecurity management

The results presented in Table 4 demonstrate a generally high level of positive attitude among farmers to apply biosecurity measures in swine production. A considerable majority of respondents (60.8%) demonstrated a strong interest in the application of BM, with an additional 35.8% showing very strong agreement, suggesting a willingness to adopt these practices. Similarly, most farmers reported that they understand biosecurity management well, with 62.1% agreeing and 27.5% strongly agreeing, suggesting a generally good level of awareness and comprehension. Similarly, 61.7% of respondents showed positive attitudes toward knowing how biosecurity management is practiced. A majority of respondents (44.6% neutral, 40.4% agree and 13.3% strongly agree) believed that BM is an effective approach to improving swine production. Regarding community acceptance, 56.3% of respondents agreed and 17.9% strongly agreed that biosecurity management activities are accepted by their communities, although nearly 25.4% remained neutral. Notably, almost all respondents (89.2% agree and strongly agree) supported the promotion of BM among farm households, reflecting strong willingness to encourage wider adoption across the swine sector. Overall, these findings demonstrate that farmers hold a favorable attitude toward biosecurity management, characterized by a strong willingness to adopt, adequate understanding, and broad support for its wider implementation within farming communities.

Table 4: The attitude of farmers toward biosecurity management.

Statements	Degree of perception				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am willing to apply biosecurity management on my farm	0.0	0.0	3.3	60.8	35.8
I understand biosecurity management well	0.0	0.4	10.0	62.1	27.5
I understand how biosecurity management is practiced	0.0	1.3	24.2	61.7	12.9
Biosecurity management helps improve swine production	0.0	1.7	44.6	40.4	13.3



Biosecurity management has community acceptance	0.0	0.4	25.4	56.3	17.9
Biosecurity management should be actively promoted among farm households	0.0	0.4	10.4	60.0	29.2

The results indicate a consistently positive attitude of biosecurity management (BM) among swine farmers, reflecting a strong willingness to apply these practices on their farms. A substantial proportion of respondents expressed strong interest in adopting BM, suggesting that biosecurity is widely recognized as a practical and beneficial strategy for protecting herd health. This high level of interest also reflects increasing awareness among farmers of the importance of preventing the introduction and spread of diseases within swine herds. Moreover, nearly 90% of respondents reported that they understood biosecurity management well, indicating that communication and extension efforts have been relatively effective. This finding is consistent with previous studies showing that participatory training programs can significantly improve farmers' knowledge of biosecurity practices [15]. In addition, many respondents agreed that biosecurity management should be promoted among farm households. This shared perspective suggests that farmers not only recognize the individual benefits of BM but also acknowledge its broader value for the farming community. These findings are consistent with the study of [16], which highlighted that collective motivation and perceived social benefits play an important role in sustaining the adoption of biosecurity practices.

#### 4.4. The effect of socio-demographic characteristics and psychological factors on biosecurity management

The result of Table 5 revealed that social characteristics such as education and occupation significantly influence BM practice, meanwhile, other characteristics did not effect on BM. The results showed that famer with high level education and their primary work focus on swine production tend to implement BM compared the other part, with B = 0.150 and B = 0.548. Likewise, perception toward BM also positively affected BM, an increase in perception (B = 0.043) increased in applying BM.

Table 5: The effect of socio-demographic characteristics and psychological factors on biosecurity management.

Variables	Regression				
	B	Std. Error	Beta	t	Sig.
Age	-0.014	0.010	-0.101	-1.352	0.178
Gender	-0.236	0.152	-0.102	-1.556	0.121
Labour	0.131	0.099	0.084	1.324	0.187
Income USD	0.000	0.000	-0.112	-1.507	0.133
Education	0.150*	0.069	0.140	2.159	0.032
Occupation	0.548**	0.136	0.249	4.028	0.000
Experience	-0.017	0.013	-0.109	-1.379	0.169
Perception	0.043*	0.018	0.219	2.426	0.016
Attitude	0.005	0.029	0.012	0.161	0.872

The study found that several socio-demographic characteristics were significantly associated with biosecurity management (BM), including education, occupation, and farmers' perceptions. Education, in particular, plays an important role in the successful implementation of BM. The results are partially consistent with the findings of Ajewole and Akinwumi (2014), who reported that farmers' education levels have a significant positive influence on biosecurity practices on livestock farms. Similarly, findings from Can et al. (2020) found a strong relationship between education level, income, and biosecurity scores, indicating that farmers with higher education levels are more likely to adopt biosecurity management practices.

In addition, the findings show that farmers whose primary occupation is animal husbandry demonstrate stronger engagement in BM. This result highlights the influence of livelihood dependency on biosecurity compliance. Farmers who rely mainly on livestock production are more likely to be aware of disease risks and are therefore more motivated to invest in preventive measures. Since their income and farm sustainability depend



directly on herd health and productivity, these farmers tend to place greater emphasis on effective biosecurity practices. This pattern is consistent with previous studies by [17], which reported that occupational specialization positively influences the adoption of biosecurity measures and improves overall farm management efficiency. Additionally, farmers' perceptions were found to influence the implementation of biosecurity management (BM). These findings highlight the important role of psychosocial factors—such as awareness and understanding—in shaping farmers' behavior and decision-making at the farm level. Similar results were reported by [18], who identified several barriers to the implementation of biosecurity measures, including management constraints, psychosocial factors, and economic limitations.

## V. Conclusion

The findings indicate that farmers demonstrated a stronger tendency to plan and implement biosecurity measures than to consistently adjust and refine their practices. Planning biosecurity measures showed the highest adoption rate, whereas adjustment practices recorded the lowest proportion (65.00%), suggesting that continuous improvement remains a challenge. Regarding attitudes, although respondents reported a good understanding of biosecurity management (BM), only 40.40% believed that BM contributed to improvements in swine production performance. This gap highlights a disconnect between knowledge and perceived economic benefits. Furthermore, education level, occupation, and farmers' perceptions were identified as significant factors influencing biosecurity management adoption. These findings suggest that strengthening farmer education, improving awareness of the economic advantages of BM, and enhancing positive perceptions toward biosecurity practices are essential to promote more consistent and effective implementation among smallholder swine farmers.

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