

DISEASE RECOGNITION AND EARLY REPORTING OF SUSPECTED AFRICAN SWINE FEVER IN BAYBAY CITY, LEYTE, PHILIPPINES: A KAP STUDY

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ABSTRACT

Disease recognition and case reporting are key aspects of the prevention and control of African Swine Fever (ASF). This study assessed the knowledge, attitudes, and practices (KAP) toward ASF recognition and early reporting of selected stakeholders in Baybay City, Leyte. A KAP survey was conducted among farmers, meat sellers, butchers, and LGU personnel (N= 270). Logistic regression analysis was performed to identify factors associated with each KAP score. Most stakeholders demonstrated poor knowledge of ASF recognition, reflecting a poor understanding of ASF concepts. Good knowledge of ASF, college education, and young age were associated with good knowledge of case reporting. Most stakeholders demonstrated good attitudes toward early reporting, correlating to a high education level. Most stakeholders are unlikely to consume or sell potentially infected pigs; however, stakeholders' type and sex influenced these attitudes. Good knowledge and not good attitudes translate into good practices of ASF reporting. This KAP study reveals the need to improve knowledge and practices in ASF disease recognition and early case reporting, especially among farmers.

Keywords: *African Swine Fever, Disease recognition, Disease reporting, KAP survey, Pigs*



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INTRODUCTION

African Swine Fever (ASF) is a fatal, notifiable disease in pigs caused by the African Swine Fever virus (ASFV). The virus is stable in the environment and pork products and thus can spread quickly across susceptible pigs (Yoo et al., 2020). Despite efforts, ASFV has spread across continents, causing a global pandemic of domestic and wild pigs. In 2018, the virus breached Asia after reports of outbreaks in China (Zhou et al., 2018). In the Philippines, the first outbreak was reported in Luzon, affecting backyard farms in Rizal province on July 2019 (Bonquin, 2019). The disease reached the islands of Mindanao in January 2020 (Palicte, 2020) and Visayas in January 2021 (Marticio, 2021). With no available commercial vaccine, the current prevention and control measures against ASF rely on strict biosecurity and early case reporting (Dixon et al., 2020).

Early case reporting means informing the proper authorities immediately once a possible case is suspected. While it is universally recognized that early case reporting is the first step to controlling ASF, not all farmers are quick to report for various reasons. First, ASF clinical signs are non-pathognomonic, translating to farmers' notions that pigs might have systemic infections other than ASF (Sánchez-Vizcaíno et al., 2015). The non-specific clinical presentation can either lead to false reporting, which has been shown to affect farmers' behavior toward early reporting (Guinat et al., 2016), or to non-reporting, as farmers tend to manage the case within themselves (Vergne et al., 2014). Second, farmers' lack of knowledge of ASF clinical signs and outbreak awareness in neighboring localities have been identified as recurring barriers to early case reporting. Lastly, the perceived complexity of the reporting process and the bad image it entails of the community have also been associated with delayed reporting of ASF cases (Guinat et al., 2016; Vergne et al., 2014). Altogether, these findings underscore the importance of stakeholders' knowledge and attitudes toward disease recognition and early reporting, which can impact stakeholders' practices critical for ASF prevention and control. Unfortunately, these aspects have not been described yet in areas affected by ASF in the Philippines.

To provide baseline information, this study assessed the levels of knowledge, attitudes, and practices (KAP) toward ASF recognition and early reporting among stakeholders in one of the ASF-affected cities in the Philippines. A quantitative approach was employed in assessing KAP levels and identifying potential factors influencing variations in KAP scores among selected stakeholders. Here, stakeholders are leading actors in the Philippine pig value chain (e.g., farmers and meat vendors) and implementors of ASF-related programs or involved in pig regulation (e.g., the City Agriculture Office of the Local Government Unit).

METHODOLOGY

Study area

This study was conducted in Baybay City, Leyte, the second largest city in Eastern Visayas (Region VIII). Baybay City has a land area of 459.34 square kilometers, or about 7.25% of the province's total area. It is composed of 92 barangays, 24 of which are urban and 68 are rural. As of 2020, the city has a population of about 111,848 (Philippine Statistics Authority, 2021). Baybay is an agricultural city where farming and fishing are the standard means of livelihood (Portugaliza et al., 2019).

Study and sampling design

A cross-sectional survey was conducted to assess the levels of knowledge, attitudes, and practices of select pork value chain actors. Based on 2022 data from the Baybay City Agricultural Office, there were 1,354 documented backyard farmers, 39 meat sellers, 8 LGU personnel, and 12 butchers in the city slaughterhouse. The sample size was calculated using Cochran's (1977) sample size formula at a 5% margin of error, 95% confidence level, 1413 total stakeholders, and 50% response distribution; thus, a total of 303 respondents were targeted ([raosoft.com/sample_size.html](https://www.raosoft.com/sample_size.html)). The response rate from the target sample size was 89.12% (270 participants). A proportional allocation (Thrusfield, 2007) was performed to consider the uneven numbers of populations for each group of stakeholders; hence, 251 respondents were pig farmers, 14 were meat sellers, 3 were butchers, and 2 were LGU personnel.

Inclusion and exclusion criteria

The survey included pig farmers, pork meat vendors, and LGU personnel involved in the ASF program in Baybay City, Leyte. Both backyard and commercial farmers were included in the survey. Pork meat vendors owned meat stalls in Baybay City, including barangay markets. The LGU personnel included those working in the slaughterhouse and Baybay City Agricultural Office. Only those stakeholders who agreed to be interviewed were included in the survey.

Data collection

A survey questionnaire in English with Bisaya/Cebuano translation was designed following previous studies (Chenais et al., 2014; Bernardes & Peña, 2020) to capture respondents' information and KAP levels regarding ASF (Appendix A). Each survey included an informative section on the nature of the study and a consent form clarifying the integrity of participants' identities and the authorization to use and analyze the information given. In addition, a section on the socio-demographic characteristics of the participants included their age, sex, civil status, education level, role in the pork and swine industry, primary source of income, estimated income, and years of experience in pig raising or selling.

The KAP questionnaire was divided into three parts: (1) the knowledge section, which asked about their knowledge of ASF, disease recognition, and the protocols for reporting a suspected case to authorities; (2) the attitudes section, which asked about their thoughts on the early reporting of suspected ASF cases and willingness to follow proper protocols to prevent the spread of the disease; and (3) the practices section, which asked about actual activities performed with regards to reporting a suspected case.

Pilot Testing of the Questionnaire

A pilot test of the KAP questionnaire with 30 respondents was conducted to evaluate question ambiguity by checking whether respondents' answers corresponded to what the question needed to capture. Questions with unaligned answers were modified to avoid ambiguity. In addition, a Cronbach's α test was conducted to examine the internal consistency of the questionnaire's attitude portion (Likert scale). The value of Cronbach's alpha was 0.6, indicating adequate internal consistency.

KAP Scoring

In the knowledge section, a score of "1" was given to responses with accurate answers, "0.5" for lacking answers, and "0" for incorrect responses (Appendix B). In the attitudes section, a 5-point Likert scale was used. Respondents chose from five categories: "strongly agree" for "5," "agree" for "4," "neutral" for "3," "disagree" for "2," and "strongly disagree" for "1." For practices, score of "1" was given to responses that displayed good practices, "0.5" for acceptable practices, and "0" for poor practices (Appendix C). Answer keys for Knowledge and Practices were based on published data (World Organization for Animal Health, 2021) and the Philippine government protocols regarding ASF (Department of Agriculture Administrative Order No. 7, Series of 2021). For the Attitudes section, reverse coding was performed on selected items (Appendix A). KAP levels of each respondent were presented as percentages in relation to the perfect score based on the standard answers, followed by categorization into poor (0- 33.2%), moderate (33.3-66.6%), and good (66.7-100%) scores.

Data Management and Analysis

Data were managed in a spreadsheet program (Excel 2000, Microsoft Corporation, Redmond, Washington, USA) and analyzed using Epi Info™ Version 7.2 (Centers for Disease Control and Prevention, Atlanta, Georgia, USA). Socio-demographic characteristics were analyzed using descriptive statistics. Continuous variables were

described using the mean and median, and those categorical variables were presented through frequency and percentage.

A binary logistic regression analysis (LRA) was performed to determine the association between sociodemographic variables and categorized KAP scores (Francis et al., 2021; Guinat et al., 2016). Here, LRAs were performed based on the actual data of the dependent variables: K score (K CTC: poor vs. moderate scores, K recognition: poor vs. moderate scores, K reporting: poor vs. good scores, and K total: poor vs. moderate scores), A score (A reporting: moderate vs. good scores, A consuming & selling: poor and moderate vs. good scores, and A total: moderate vs. good scores), P score (P total: poor and moderate vs. good scores), and combined KAP scores (moderate vs. good scores).

In the LRA process, sociodemographic variables and other respondents' information were analyzed for relationships with the dependent variable using univariate LRA. Variables with $p < 0.20$ were included in the multivariable LRA model. Next, a stepwise regression following a backward elimination process was conducted. Independent variables with the least significant p -values were removed at each run until a model with significant covariates ($p < 0.05$) was obtained. However, all regression models were adjusted to include age and sex as intrinsic variables. The knowledge score was also forced into the regression models for attitudes and practices (Lañada et al., 2019).

Ethical Approval

The survey included a written consent form indicating the integrity of participants' identities and their authorization to use and analyze the information given. All collected data were treated according to the Philippine R.A. 10173, or the Data Privacy Act of 2012. This study was approved by the CVM-VSU Ad Hoc Research Ethics Committee.

RESULTS

Sociodemographic characteristics

The majority of stakeholders were pig farmers (92.97%), while the rest were meat sellers (5.19%), butchers (1.11%), and LGU personnel (0.74%), all of whom were stakeholders in ASF policy implementation. The ages of stakeholders ranged from 22 to 82 years (mean: 49.12; median: 49.00), with a relatively balanced distribution between males and females. Most were married (71.85%), and the highest educational level was high school (49.93%). The primary source of income for 44% of participants involved pigs, with an average experience in the swine sector of 11.13 years. The reported monthly income was 7730.6 PHP on average (Table 1).

Table 1

Sociodemographic characteristics of stakeholders (N = 270) in Baybay City

Variable	Range	N	%	95% CI
Age (years)				
(Mean: 49.12; Median: 49.00)	22-82			
Early working	15-24	5	1.85	0.60 - 4.27
Prime working	25-54	175	64.81	58.79 - 70.51
Mature working	55-64	52	19.26	14.73 - 24.48
Elderly	> 65	38	14.07	10.16 - 18.80
Sex				
Male		125	46.30	40.23 - 52.44
Female		145	53.70	47.56 - 59.77
Civil status				
Single		59	21.85	17.07 - 27.26
Married		194	71.85	66.08 - 77.13
Widowed		17	6.30	3.71 - 9.89
Education				
Elementary		89	32.96	27.39 - 38.92
High School		124	45.93	39.87 - 52.07
Vocational		9	3.30	1.54 - 6.23
College		48	17.78	13.41 - 22.87
Main income source				
Pigs		119	44.07	38.06 - 50.22
*Others		179	66.30	60.32 - 71.91
Monthly income (Php)				
(Mean: 7730.6; Median: 5000.00)	0-70,000.00			
Experience in swine sector (years)				
(Mean: 11.13; Median:7.00)	0.80-61.00			

Note. Asterisk (*) means government jobs, chicken farms, rice fields, significant other's income, and pension, etc.

Pig-raising and pig-selling information

On average, a pig farmer in Baybay City owned one sow and three grower-fatteners, with a few owning a boar or a mix of all pig types (Table 2). Their primary purpose was income generation (96.81%), although a few raised pigs for their consumption (21.91%), probably during celebrations and fiestas. Most farmers kept pigs in their backyard (72.51%) or inside a pigpen (99.20%). Participants (90.43%) were also the primary caretakers of pigs, although some acknowledged the help of relatives (46.61%). While all participants were using commercially available feeds, a few farmers practiced swill feeding (4.78%). Meat sellers reported that most of their products were derived from Baybay City (73.68%). They were selling pork and pig products in city markets, barangay markets, and meat shops within Baybay City.

Table 2

Pig raising information provided by farmers (N = 251) in Baybay City

Variable	Range	N	Mean	%	95% CI
Number of pigs per farmer					
Breeder sow	0-11		1		0.84 - 1.16
Breeder boar	0-7		0.08		0.01 - 0.15
Grower-Fattener	0-40		3.07		2.45 - 3.69
Mixed	0-13		0.21		0.06 - 0.35
Farm Location					
Backyard		182		72.51	66.54 - 77.94
Isolated		69		27.49	22.06 - 33.46
Pig confinement					
Pigpen		249		99.20	97.15 - 99.90
Tethered		2		0.80	0.10 - 2.85
Type of feeds					
Commercial Feed		251		100	98.54 - 100
Bran Feed		50		19.92	15.16 - 25.40
Swill Feed		12		4.78	2.49 - 8.20
Forage		18		7.17	4.31 - 11.10
Pig caretaker					
Self		227		90.43	86.11 - 93.78
Relative		117		46.61	40.32 - 52.99
Non-relative		1		0.40	0.01 - 2.20
Purpose of raising pigs					
Income		243		96.81	93.82 - 98.61
Consumption		55		21.91	16.95 - 27.55
Hobby		1		0.40	0.01 - 2.20

LGU butchers and personnel training

In the context of ASF policy implementation, stakeholders from the LGU, including workers in the slaughterhouse and agriculture office, reported getting relevant training on ASF. They described their educational backgrounds as being related to their current work. All participants were involved in fieldwork, such as ASF border control and outbreak response programs.

Knowledge (K) score

This study assessed the K scores regarding three critical concepts about ASF that would later relate to stakeholders' attitudes and practices on early disease reporting. These included assessments of knowledge of the ASF causative agent, transmission, and clinical signs (CTC), ASF recognition based on clinical presentation, and ASF reporting as described by the DA-BAI protocol.

The ASF CTC assessment (Table 3) showed that almost all stakeholders had heard of ASF (99.63%). However, most provided biomedically incorrect answers to the possible causative agent (68.52%) or needed to learn about its cause (20.74%). When asked about the routes of transmission, stakeholders were aware that ASF could spread through fomites or contaminated materials (31.85%), live pigs (20%), pig meat (15.93%), and food wastes (10.37%), while very few mentioned pig feeds (7.04%) and ticks (1.11%). Most stakeholders wrongly identified the transmission route of ASF (36.30%) or needed to learn how it is transmitted (17.78%). When asked about clinical signs, most stakeholders know that ASF is presented with a high fever (54.44%), skin rashes (47.41%), inappetence (34.44%), and lethargy (23.70%). Some stakeholders described lower respiratory signs (10.74%), sudden death (10%), and reddening of ears and flank (9.63%), while few (~4.00%) mentioned diarrhea, nosebleed, vomiting, and nasal secretions. Roughly 30% of stakeholders had no idea and could not identify ASF clinical signs. Altogether, the K score assessment on ASF CTC revealed that half of the participants had a poor K score, while the other half had a moderate score (Figure 1).

Table 3

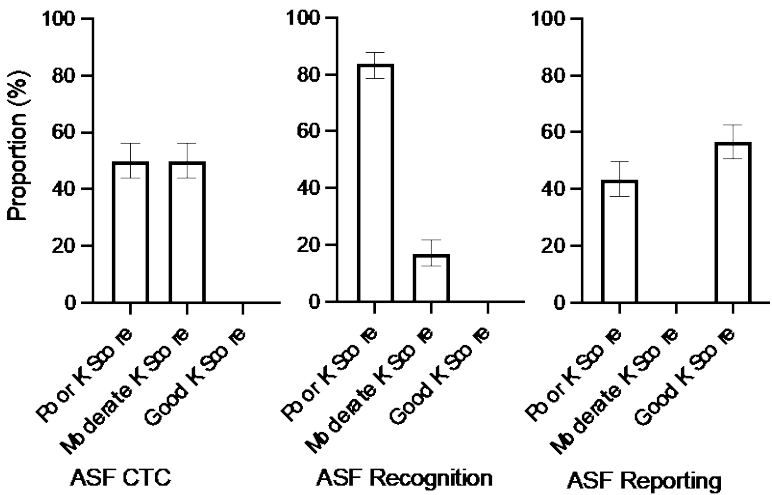
Knowledge score construct of stakeholders (N = 270) regarding ASF causative agent, transmission, and clinical signs

Knowledge Questions	Frequency	%	95% CI
Have you heard of ASF?			
Yes	269	99.63	97.95 - 99.99
No	1	0.37	0.01 - 2.05
What causes ASF?			
ASF virus	2	0.74	0.09 - 2.65
Virus	41	15.19	11.12 - 20.03
I don't know	56	20.74	16.06 - 26.07
Others	185	68.52	62.61 - 74.01
What are the routes of ASF spread?			
Fomites	86	31.85	26.34 - 37.77
Live pigs	54	20.00	15.40 - 25.28
Pig meat	43	15.93	11.77 - 20.85
Food wastes	28	10.37	7.00 - 14.64
Pig feeds	19	7.04	4.29 - 10.77
Ticks	3	1.11	0.23 - 3.21
I don't know	48	17.78	13.41 - 22.87
Others	98	36.30	30.55 - 42.34
What are the clinical signs of ASF?			
High Fever	147	54.44	48.30 - 60.49
Skin rashes	128	47.41	41.32 - 53.55
Inappetence	93	34.44	28.79 - 40.44
Lethargy	64	23.70	18.76 - 29.24
Difficulty breathing & coughing	29	10.74	7.31 - 15.06
Sudden death	27	10.00	6.69 - 14.22
Ears and flank reddening	26	9.63	6.39 - 13.79
Diarrhea	12	4.44	2.32 - 7.64
Nosebleed	11	4.07	2.05 - 7.17
Vomiting	11	4.07	2.05 - 7.17
Nasal secretions	11	4.07	2.05 - 7.17
I don't know	25	9.26	6.08 - 13.37
Others	54	20.00	15.40 - 25.28

Note. "Others" are biomedically incorrect answers.

Figure 1

The proportion of stakeholders (N = 270) with poor, moderate, and good knowledge (K) scores, encompassing ASF causative agent, transmission, and clinical signs (CTC), ASF disease recognition, and ASF reporting



Note. The error bar represents a 95% Confidence Interval.

Regarding ASF recognition (Table 4), most stakeholders had no idea how to recognize a pig with an ASF infection (43.33%). Also, a few could not distinguish a possible clinical presentation of ASF (10%). Of those who mentioned the correct clinical signs, roughly 30% may recognize ASF based on its syndrome or a combination of clinical signs. In terms of reporting, some participants generally had incorrect information (21.11%) and no knowledge (27.78%) of proper reporting on possible ASF cases. Nevertheless, the majority (~60%) knew the proper authorities to call and visit regarding ASF reporting. Altogether, 83.88% of participants showed a poor K score for ASF recognition, while 56.67% showed a good K score for ASF reporting (Figure 1).

Table 4

Knowledge score construct of stakeholders (N = 270) regarding ASF recognition and reporting

Knowledge Questions	Frequency	%	95% CI
How to recognize ASF in live pigs?			
Number of Clinical signs			
1	63	23.33	18.42 - 28.84
2	45	16.67	12.42 - 21.66
3	31	11.48	7.94 - 15.90
4	12	4.44	2.32 - 7.64
5	1	0.37	0.01 - 2.05
I don't know	117	43.33	37.34 - 49.48
Others	27	10.00	6.69 - 14.22
How to recognize ASF in meat?			
Clots and bruises	46	17.04	12.75 - 22.06
I don't know	197	72.96	67.25 - 78.17
Others	40	14.82	10.80 - 19.62
How to report suspected ASF case?			
Through the city agriculture office	97	35.93	30.20 - 41.96
Through barangay biosec. officers	53	19.63	15.06 - 24.88
Through the city veterinarian	6	2.22	0.82 - 4.77
Through other veterinarians	5	1.85	0.60 - 4.27
I don't know	75	27.78	22.52 - 33.53
Others	57	21.11	16.40 - 26.47

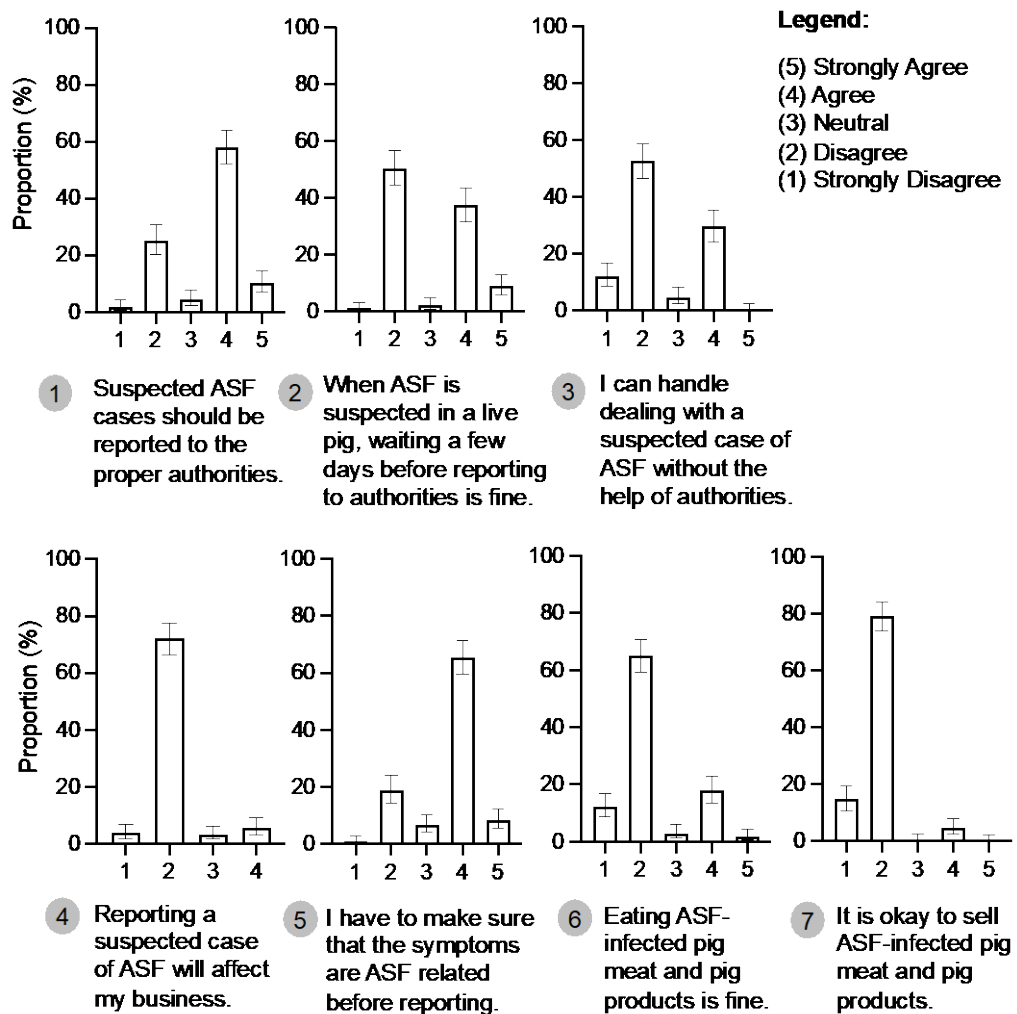
Note. "Others" are incorrect answers.

Attitudes (A) score

Using a Likert scale, this study assessed stakeholders' attitudes regarding ASF reporting (Figure 2). Here, attitudes refer to stakeholders' willingness to report a suspected ASF case and attitudes toward selling and consuming possibly infected pigs or meat. The latter are proxies of non-reporting, as stakeholders can otherwise dispose of pigs and meat showing signs of ASF.

Figure 2

Attitudes score construct of stakeholders (N = 270) on reporting ASF cases, with each number representing the attitude questions and proportion of responses



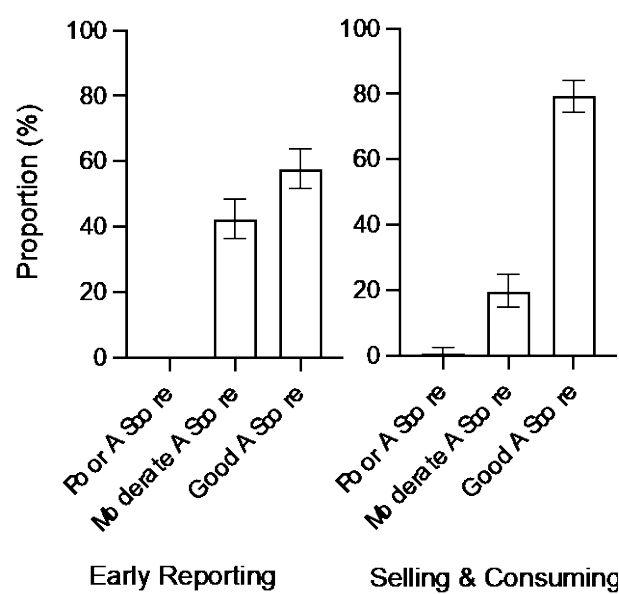
Note. The error bar represents a 95% Confidence Interval.

Attitudes assessment toward reporting showed that most would likely report to proper authorities on possible ASF cases (58.81% Agree + 10.4% Strongly Agree). However, stakeholders' attitudes toward early reporting were relatively divided, suggesting that almost half preferred not to report early. Indeed, most of them would need assurance that the clinical signs are related to ASF in order to call the proper authorities (65.56% Agree + 8.15% Strongly Agree). However, most (64.71%) acknowledged that they could only handle ASF with government assistance through the LGU. They also showed positive attitudes regarding ASF reporting and its impact on their business, with the majority disagreeing (62.96%) that case reporting would affect their source of income. Overall, stakeholders showed moderate to good A scores in ASF reporting (Figure 3), suggesting their willingness to report a suspected ASF case through proper channels.

We also assessed stakeholders' attitudes toward selling and consuming live pigs and meat from suspected ASF-infected pigs. While most participants (65.18%) disagreed with consuming meat from potentially infected pigs, some (19.55%) agreed with eating infected meat. Furthermore, an almost similar pattern can be observed when asked about selling infected pigs and meat, of which most (79.25%) disagreed with selling potentially infected products. Altogether, participants showed moderate to good A scores toward disposing of infected pigs and meat, with the majority preferring not to sell and consume these products (Figure 3).

Figure 3

The proportion of stakeholders (N = 270) with poor, moderate, and good attitude (A) scores on reporting suspected ASF cases



Note. The error bar represents a 95% Confidence Interval.

Practices (P) score

To assess the P score toward early reporting, we filtered and selected those stakeholders who reportedly observed a suspected ASF case in pigs, which accounted for 34.07% of the total participants (Table 5). Of these participants, the majority (64.13%) acknowledged not reporting a possible ASF case. For those who reported a case, 16.30% acknowledged a delay in reporting to the proper authorities, while 11.95% for early reporting. Very few (8.70%) had reported cases to non-proper authorities. We further asked whether participants had sold potentially ASF-infected pigs. While most (86.96%) reported not selling potentially infected pigs or pig products, 13.04% recalled selling them. Overall, 61.96% of participants had a moderate P score, 26.09% had a good P score, and 11.96% with a poor P score (Figure 4).

Table 5*Practices score construct of stakeholders (N = 270) on ASF reporting*

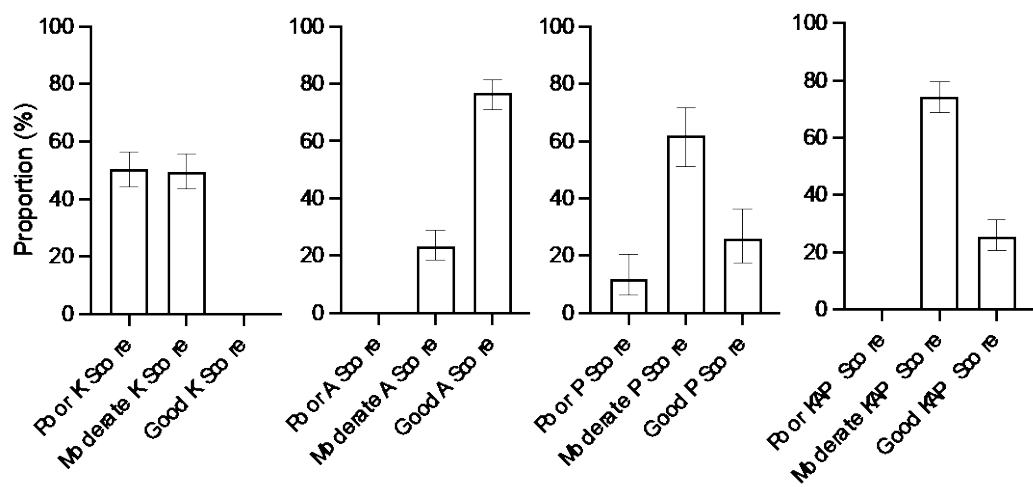
Practices Questions	Frequency	%	95% CI
Have you seen signs of suspected ASF in live pigs before?			
Yes	92	34.07	28.43 - 40.06
No	178	65.93	59.94 - 71.56
*How did you report suspected ASF cases?			
Early reporting to proper authority	11	11.95	6.12 - 20.29
Delayed reporting to proper authority	15	16.30	9.42 - 25.46
Reporting to non-proper authorities	8	8.70	3.83 - 16.42
Not reporting	59	64.13	53.46 - 73.87
*Have you sold live pigs/pig products with signs of suspected ASF?			
Yes	12	13.04	6.93 - 21.68
No	80	86.96	78.32 - 93.08

Note. Asterisk (*) means a follow-up question for participants who have seen signs of suspected ASF (n = 92).

Overall KAP scores

In this study, relatively half (~50%) of participants had either poor or moderate K scores toward key ASF concepts. However, most had a good A score (76.67%) and a moderate P score (61.96%) toward early ASF case reporting. Altogether, most stakeholders (74.44%) showed an overall moderate KAP score, with some (25.56%) showing an overall good KAP score (Figure 4). The KAP score is based on the overall ranking of K, A, and P scores.

Figure 4
The proportion of stakeholders (N = 92) with poor, moderate, and good knowledge (K), Attitudes (A), and Practices (P) scores on reporting suspected ASF cases



Note. The error bar represents a 95% Confidence Interval.

Factors influencing knowledge (K) score

To determine which factors influenced each KAP component, we performed an LRA of each KAP (as an outcome variable) with sociodemographic data as predictor variables. First, we analyzed factors associated with the categorized K score on the ASF causative agent, transmission, and clinical signs (CTC) (Table 5). In the multivariable LRA, only the level of education significantly influenced the K score of ASF CTC (poor vs. moderate), with participants' age and sex held constant in the model. Stakeholders with high school (AOR=2.415; $p=0.007$) and college (AOR=7.226; $p<0.001$) education levels were likely more knowledgeable on ASF CTC compared to those with an elementary education level. Meanwhile, no predictor variable was associated with knowledge of ASF case recognition (Table 6).

In the multivariable LRA of ASF reporting (Table 7), we found that its K score (poor vs. good) was significantly associated with education level, knowledge of ASF CTC, and the age of participants, with age and sex variables forced in the model. Stakeholders with high school (AOR=2.516; $p=0.004$) and college (AOR=3.383; $p=0.005$) education levels were likely more knowledgeable on ASF reporting compared to those with elementary education. In addition, knowledge of ASF CTC was associated with good knowledge of ASF reporting (AOR=7.968; $p<0.001$). Lastly, we found that younger participants were significantly knowledgeable about the reporting process compared to older stakeholders (AOR=1.029; $p=0.007$).

Taking all knowledge components, we created an LRA model for the overall K score (Table 8), showing a significant association with education level as adjusted to participants' age and sex. Here, the overall K score of participants (poor vs. moderate) who attained high school (AOR=2.460; $p=0.003$) and college levels (AOR=3.728; $p<0.001$) was significantly higher than those with an elementary education level.

Table 5

Logistic regression analysis (LRA) of factors associated with stakeholders' knowledge of ASF causative agent, transmission, and clinical signs (CTC)

Variable	Univariate LRA			Multivariable LRA		
	OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)	0.979	0.962 to 0.997	0.023	0.992	0.972 to 1.012	0.416
Sex						
	Male	Referent				
	Female	0.812	0.393	0.915	0.547 to 1.528	0.733
Civil status						
	Single	Referent				
	Married	2.327	0.139			
	Widowed	1.796	0.267			
Education						
	Elementary	Referent				
	High School	2.613	0.001	2.415	1.319 to 4.422	0.004
	Vocational	2.296	0.263	2.087	0.478 to 9.109	0.328
	College	7.933	<0.001	7.226	3.141 to 16.626	<0.001
Role in swine sector						
	Farmers	Referent				
	Pig/meat sellers	1.873	0.272			
	Butchers	0.520	0.596			
	LGU	2.204x10 ⁶	0.981			
Experience (years)		0.999	0.906			
Estimated income (Php)		1.000	0.015			
Main income source						
	Not pig-related	Referent				
	Pig-related	1.234	0.391			

Note. OR = Odds Ratio

Table 6
Logistic regression analysis (LRA) of factors associated with stakeholders' knowledge of ASF disease recognition

Variable	Univariate LRA			Multivariable LRA		
	OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)	0.989	0.966 to 1.013	0.358	0.991	0.968 to 1.015	0.476
Sex						
Male	Referent					
Female	0.713	0.375 to 1.354	0.310	0.742	0.388 to 1.419	0.367
Civil status						
Single	Referent					
Married	4.522	0.547 to 37.370	0.161			
Widowed	3.043	0.389 to 23.790	0.289			
Education						
Elementary	Referent					
High School	1.974	0.921 to 4.228	0.080			
Vocational	1.013	0.114 to 9.036	0.991			
College	0.989	0.342 to 2.862	0.984			
Role in swine sector						
Farmers	Referent					
Pig/meat sellers	1.397	0.373 to 5.228	0.620			
Butchers	2.561	0.227 to 28.906	0.447			
LGU	8.896x10 ⁻⁷	0.000 to ∞	0.989			
ASF CTC knowledge score	2.544	0.861 to 7.514	0.091	2.287	0.761 to 6.870	0.141
Experience (years)	0.989	0.961 to 1.019	0.477			
Estimated income (Php)	1.000	1.000 to 1.000	0.306			
Main income source						
Not pig-related	Referent					
Pig-related	1.134	0.597 to 2.155	0.701			

Note. OR = Odds Ratio

Table 7
Logistic regression analysis (LRA) of factors associated with stakeholders' knowledge of ASF case reporting

Variable	Univariate LRA			Multivariable LRA		
	OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)	1.008	0.991 to 1.026	0.361	1.029	1.008 to 1.050	0.007
Sex						
	Male					
	Female	0.776	0.478 to 1.260	0.305	0.517 to 1.473	0.609
Civil status						
	Single	Referent				
	Married	0.803	0.273 to 2.366	0.691		
	Widowed	1.322	0.489 to 3.574	0.582		
Education						
	Elementary	Referent				
	High School	2.225	1.277 to 3.877	0.005	2.516	0.004
	Vocational	1.405	0.330 to 5.983	0.645	1.609	0.537
	College	3.892	1.817 to 8.335	<0.001	3.383	0.005
Role in swine sector						
	Farmers	Referent				
	Pig/meat sellers	1.040	0.351 to 3.086	0.943		
	Butchers	1.560	0.140 to 17.431	0.718		
	LGU	1.652x10 ⁶	0.000 to ∞	0.982		
ASF CTC knowledge score	9.704	3.404 to 27.664	<0.001	7.968	2.584 to 24.570	<0.001
Experience (years)	1.004	0.984 to 1.025	0.692			
Estimated income (Php)	1.000	1.000 to 1.000	0.021			
Main income source						
	Not pig-related	Referent				
	Pig-related	1.699	1.039 to 2.777	0.035		

Note. OR = Odds Ratio

Table 8

Logistic regression analysis (LRA) of factors associated with stakeholders' overall knowledge of ASF, including case reporting

Variable	Univariate LRA			Multivariable LRA		
	OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)	0.988	0.971 to 1.005	0.164	1.000	0.980 to 1.019	0.412
Sex						
	Male					
	Female	0.659	0.408 to 1.067	0.090	0.423 to 1.158	0.165
Civil status						
	Single	Referent				
	Married	2.844	0.890 to 9.094	0.078		
	Widowed	2.400	0.815 to 7.071	0.112		
Education						
	Elementary	Referent				
	High School	2.432	1.380 to 4.286	0.001	2.460	0.003
	Vocational	2.069	0.483 to 8.865	0.327	0.878	0.380
	College	4.690	2.211 to 9.948	<0.001	3.728	<0.001
Role in swine sector						
	Farmers	Referent				
	Pig/meat sellers	1.934	0.630 to 5.932	0.394	1.346 to 4.499	0.003
	Butchers	2.149	0.192 to 24.001	0.473	0.443 to 8.471	0.380
	LGU	2.276x10 ⁶	0.000 to ∞	0.981	2.027 to 9.708	<0.001
Experience (years)	0.979	0.959 to 1.000	0.053			
Estimated income (Ph)	1.000	1.000 to 1.000	0.022			
Main income source						
	Not pig-related	Referent				
	Pig-related	1.346	0.832 to 2.180	0.226		

Note: OR = Odds Ratio

Factors influencing attitudes (A) score

In the multivariable LRA model, we identified which factors significantly influenced stakeholders' attitudes toward ASF reporting and selling and consuming potentially infected pigs or pig products, which are subcomponents of the overall attitudes score on ASF case reporting. In the ASF reporting subcomponent (Table 9), stakeholders' attitudes (moderate vs. good) were associated with education level when adjusted to age and sex variables, as well as forcing the total K score in the model. Participants with a college education level were likely to have better attitudes toward ASF reporting than those with an elementary education level (AOR=3.648; $p=0.004$). In the subcomponent of attitudes (moderate vs. good) toward selling and consuming (Table 10), pig/meat sellers were less likely to sell and consume pigs and pig products possibly infected with ASF compared to pig farmers (AOR=0.195; $p=0.005$). Moreover, female participants were more likely to sell and consume pigs and pig products possibly infected with ASF than males (AOR= 1.925; $p=0.044$).

Lastly, the overall attitudes score (moderate vs. good) showed a significant association with the role of stakeholders in the swine sector, with a model adjusted to age, sex, and overall K score (force variable) (Table 11). Pig/meat sellers were less likely to have good attitudes toward proper reporting of possible ASF cases compared to pig farmers (AOR=0.313; $p=0.044$).

Table 9

Logistic regression analysis (LRA) of factors associated with stakeholders' attitudes toward reporting possible ASF cases

Variable	Univariate LRA			Multivariable LRA		
	OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)	0.993	0.976 to 1.011	0.451	0.995	0.976 to 1.014	0.592
Sex						
	Male					
	Female	1.014	0.625 to 1.645	0.956		0.632
Civil status						
	Single	Referent				
	Married	3.008	0.992 to 9.122	0.052		
	Widowed	1.832	0.669 to 5.013	0.239		
Education						
	Elementary	Referent				
	High School	0.843	0.488 to 1.456	0.540	0.481 to 1.608	0.676
	Vocational	1.361	0.306 to 6.043	0.686	0.303 to 6.265	0.716
	College	3.184	1.415 to 7.161	0.005	1.517 to 8.770	0.004
Role in swine sector						
	Farmers	Referent				
	Pig/meat sellers	0.959	0.323 to 2.846	0.940		
	Butchers	0.360	0.323 to 4.018	0.406		
	LGU	0.719	0.044 to 11.629	0.816		
ASF total knowledge score		0.881	0.652 to 1.192	0.413	0.567 to 1.102	0.165
Experience (years)		0.988	0.968 to 1.008	0.233		
Estimated income (Ph)		1.000	1.000 to 1.000	0.825		
Main income source						
	Not pig-related	Referent				
	Pig-related	1.671	1.020 to 2.736	0.041		

Note. OR = Odds Ratio

Table 10

Logistic regression analysis (LRA) of factors associated with stakeholders' attitudes toward selling and consuming suspected ASF pigs

Variable	Univariate LRA			Multivariable LRA		
	OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)	1.003	0.981 to 1.025	0.810	0.993	0.969 to 1.016	0.533
Sex						
	Male					
	Female	2.101	1.141 to 3.867	0.017		0.044
Civil status				1.925	1.017 to 3.645	
	Single	Referent				
	Married	0.179	0.022 to 1.469	0.109		
	Widowed	0.257	0.033 to 1.995	0.194		
Education						
	Elementary	Referent				
	High School	1.331	0.667 to 2.656	0.417		
	Vocational	1.900	0.220 to 16.405	0.560		
	College	0.731	0.324 to 1.649	0.450		
Role in swine sector						
	Farmers	Referent				
	Pig/meat sellers	0.213	0.071 to 0.637	0.006	0.195	0.005
	Butchers	0.106	0.009 to 1.198	0.070	0.131	0.113
	LGU	1.004x10 ⁻⁷	0.000 to ∞	0.985	1.731x10 ⁻⁷	0.986
ASF total knowledge score		0.708	0.489 to 1.025	0.067	0.776	0.202
Experience (years)		1.014	0.986 to 1.043			
Estimated income (Ph)		1.000	1.000 to 1.000			
Main income source						
	Not pig-related	Referent				
	Pig-related	0.971	0.533 to 1.770			0.924

Note: OR = Odds Ratio

Table 11

Logistic regression analysis (LRA) of factors associated with stakeholders' overall attitudes toward ASF reporting

Variable	Univariate LRA			Multivariable LRA		
	OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)	0.991	0.971 to 1.012	0.389	0.983	0.962 to 1.005	0.132
Sex						
	Male					
	Female	1.072	0.609 to 1.886	0.810	0.586 to 1.897	0.859
Civil status						
	Single	Referent				
	Married	0.582	0.116 to 2.923	0.511		
	Widowed	0.384	0.085 to 1.738	0.214		
Education						
	Elementary	Referent				
	High School	1.392	0.736 to 2.632	0.309		
	Vocational	0.615	0.136 to 2.774	0.537		
	College	1.440	0.623 to 3.328	0.394		
Role in swine sector						
	Farmers	Referent				
	Pig/meat sellers	0.365	0.122 to 1.099	0.073	0.313	0.101 to 0.968
	Butchers	0.548	0.049 to 6.161	0.626	0.382	0.032 to 4.634
	LGU	4.761x10 ⁻⁸	0.000 to ∞	0.987	2.820x10 ⁻⁴	0.000 to ∞
ASF total knowledge score						
		0.978	0.688 to 1.391	0.903		0.987
Experience (years)						
		0.994	0.971 to 1.017	0.586		
Estimated income (Ph)						
		1.000	1.000 to 1.000	0.768		
Main income source						
	Not pig-related	Referent				
	Pig-related	1.264	0.712 to 2.245	0.423		

Note. OR = Odds Ratio

Factors influencing practices (P) score

The overall practices score (poor and moderate vs. good score) toward ASF reporting was significantly associated with stakeholders' knowledge score, encompassing knowledge about ASF CTC, disease recognition, and disease reporting (AOR= 2.466; $p=0.014$), when adjusted to age and sex variables. Of note, our data on stakeholders' overall attitudes toward ASF reporting did not show a significant association with ASF reporting practices (Table 12).

Factors influencing the overall KAP score

In the multivariable LRA, the overall KAP score of stakeholders regarding suspected ASF cases recognition and reporting was significantly associated with education, with participants' age and sex variables held constant (Table 13). Participants with college (AOR=2.639; $p=0.024$) and high school (AOR=2.052; $p=0.049$) education levels had a better KAP score than those with an elementary education level.

Table 12
Logistic regression analysis (LRA) of factors associated with stakeholders' practices toward ASF reporting

Variable	Univariate LRA			Multivariable LRA		
	OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)	1.002	0.971 to 1.034	0.912	1.002	0.969 to 1.036	0.897
Sex						
	Male	Referent				
	Female	1.209	0.474 to 3.085	0.692	0.528 to 3.806	0.488
Civil status						
	Single	Referent				
	Married	0.750	0.088 to 6.388	0.792		
	Widowed	0.241	0.031 to 1.873	0.174		
Education						
	Elementary	Referent				
	High School	1.313	0.422 to 4.086	0.638		
	Vocational	3.250	0.816 to 12.397	0.094		
	College	8.667	0.670 to 112.035	0.098		
Role in swine sector						
	Farmers	Referent				
	Pig/meat sellers	1.778	0.301 to 10.501	0.525		
	Butchers	1.105x10 ⁻⁴	0.000 to ∞	0.992		
	LGU	1.105x10 ⁻⁴	0.000 to ∞	0.992		
ASF total knowledge score		2.091	1.148 to 3.805	0.016	1.171 to 3.984	0.014
ASF total attitude score		1.161	0.966 to 1.395	0.111		
Experience (years)		0.968	0.919 to 1.019	0.210		
Estimated income (Ph)		1.000	1.000 to 1.000	0.725		
Main income source						
	Not pig-related	Referent				
	Pig-related	1.285	0.503 to 3.284	0.601		

Note. OR = Odds Ratio

Table 13
Logistic regression analysis (LRA) of factors associated with stakeholders' overall KAP level toward ASF reporting

Variable	Univariate LRA			Multivariable LRA		
	OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)	0.993	0.973 to 1.013	0.494	1.001	0.048 to 0.765	0.895
Sex						
	Male					
	Female	0.921	0.532 to 1.592	0.768	0.543 to 1.675	0.869
Civil status						
	Single	Referent				
	Married	2.791	0.573 to 13.591	0.204		
	Widowed	2.674	0.591 to 12.104	0.201		
Education						
	Elementary	Referent				
	High School	2.018	1.025 to 3.972	0.042	1.005 to 4.191	0.049
	Vocational	0.705	0.081 to 6.157	0.752	0.080 to 6.280	0.757
	College	2.621	1.167 to 5.883	0.020	1.133 to 6.146	0.024
Role in swine sector						
	Farmers	Referent				
	Pig/meat sellers	0.764	0.207 to 2.825	0.687		
	Butchers	4.869x10 ⁻⁷	0.000 to ∞	0.986		
	LGU	4.869x10 ⁻⁷	0.000 to ∞	0.986		
Experience (years)						
	0.996	0.973 to 1.020	0.749			
Estimated income (Ph)	1.000	0.999 to 1.000	0.404			
Main income source						
	Not pig-related	Referent				
	Pig-related	1.816	1.046 to 3.153	0.034		

Note. OR = Odds Ratio

DISCUSSION

Previous experience with ASF suggests that stakeholders' knowledge, attitudes, and behaviors or practices toward early case reporting, which are key aspects of early case detection, facilitate a prompt measure to contain outbreaks and halt the geographical spread of infection (Kim et al., 2021; Vergne et al., 2016). Here, we examine multistakeholders' knowledge of disease recognition and early reporting and assess their attitudes toward reporting suspected cases, which influence correct practices critical for ASF prevention and control (Sánchez-Vizcaíno et al., 2012).

Participants showed a lack of knowledge regarding ASF CTC and disease recognition but sufficient knowledge of ASF reporting. This suggests that information on ASF CTC and disease recognition may be complex to deliver compared to the general ASF reporting protocol. It further suggests that Information, Education, and Communication (IEC) campaigns targeting key stakeholders are likely concentrated on where to report cases, or possibly the only information farmers selectively remember because it entails free government assistance. Muñoz-Gómez et al. (2021) reported that backyard farmers would likely experience difficulty understanding ASF concepts, suggesting the need for better delivery of information to these stakeholders. In Baybay City, for example, massive IECs that emphasize swill feeding may contribute to the six-fold decrease in swill feeding practice when we compared the data between Bernardes & Peña (2020) and the present study. ASF IEC campaigns should therefore undergo continuous reassessment to incorporate creative ways of informing farmers (Nantima et al., 2016). In fact, our LRA model suggests that stakeholders' knowledge of ASF CTC correlates with the knowledge of case reporting, underscoring the importance of informing stakeholders about ASF CTC concepts.

Our results showed that younger participants and those with higher educational attainment likely possess good knowledge about proper channels in ASF reporting. Previous studies have shown that educated young farmers are likely open to new

information and adaptive to new technologies (Islam et al., 2023; McKillop et al., 2018). Overall, the level of education appears to be the main driver for better stakeholders' understanding of ASF disease recognition and reporting. These results have implications for the current Philippine farming situation, where Filipino farmers are aging (57 years old on average) and oftentimes have low educational attainment (Palis, 2020).

Our results also showed that the majority of participants are willing to report ASF through proper channels. The tendency to have good attitudes toward early case reporting correlates with high educational attainment, again indicating a link between a better understanding of ASF and a willingness to report. Participants have the tendency not to consume or sell potentially infected pork and pigs. However, pig farmers and females have the tendency to consume and sell possibly infected pork and pigs. These are closely related to the socioeconomic status of most Filipino farmers, the role of mothers in managing finances, and the concept of "not wasting food" in Asian culture (Wang et al., 2014). In the Philippine Statistics Authority (2009) report, females dominate entrepreneurial activities in the agriculture sectors of the Philippines, implying their significance in backyard pig production. Hence, the government must also create and support programs that empower female farmers.

In this study, overall knowledge of ASF translated to good reporting practices, but overall good attitudes did not translate into good practices. One plausible explanation for delayed and non-reporting is the ongoing implementation of pig depopulation (with or without clinical signs) within the 500-meter radius of a confirmed case (Department of Agriculture Memorandum Order No. 24, series 2020). In the Philippines, local chief executives and pig farmers may have difficulty grasping the idea of depopulating pigs, especially those without clinical signs, arguing that this depopulation policy is anti-poor and detrimental to the local and national economy (Saavedra, 2023a). In some cases, this mentality has resulted in the non-reporting of cases and even halting ASF testing protocols (Saavedra, 2023b).

A similar concept regarding the nonacceptance of pig depopulation has also been raised by pig farmers in Estonia (Moskalenko et al., 2022). They argued that apparently healthy pigs could be used to produce heat-treated canned meat rather than buried along with clinically infected pigs. Stakeholders underscore that the depopulation policy causes mental stress for affected farmers.

Our study has strengths and limitations inherent to the KAP methodology. We acknowledge that the data rely on stakeholders' responses, encompassing views and opinions, which may be dynamic across time and geographical locations. The questionnaire may not be exhaustive enough to cover all information related to ASF for all stakeholders. One of the strengths of this KAP study is that it captures the baseline knowledge, attitudes, and practices of critical stakeholders in Baybay City, which are essential when planning ASF-related programs. Such programs can be tailored to the local setting by capitalizing on insights derived from KAP results.

CONCLUSION AND RECOMMENDATION

This KAP study reveals the need to improve knowledge and practices of ASF disease recognition and early case reporting in Baybay City. Of the stakeholders involved in ASF programs, extra efforts must be made to inform and educate backyard farmers, who are frontline stakeholders, on proper disease recognition and early case reporting. Our analysis pinpoints that good KAP levels can be seen in stakeholders with high educational attainment. With results showing an overall good attitude toward reporting ASF cases, we expect that programs aimed at educating and capacitating stakeholders on ASF could yield high participation from the community. Lastly, there is a need to re-examine the depopulation policy of the government, as it may have resulted in delayed and non-report of ASF cases.

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DECLARATION OF COMPETING INTEREST

The authors declare no competing interests that can influence the work reported in this paper.

AUTHORS CONTRIBUTION

SMSW conducted the interview, performed data management and initial data analysis, and wrote the first draft. HPP conceptualized the study, performed the analysis, and wrote the paper.

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