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Research Article

Impact of Diseases on Pig Farming Enterprises in Manokwari Regency

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Abstract

Background: Pig farming plays a crucial role in supporting food security, rural livelihoods, and socio-cultural traditions in West Papua, Indonesia. However, disease outbreaks have emerged as a major constraint to productivity and economic sustainability in smallholder pig production systems. **Purpose:** This study aimed to identify major diseases affecting pig farms in Manokwari Regency, analyse their impacts on productivity and farm income, quantify economic losses, and examine preventing the spread of diseases strategies adopted by farmers and government institutions. **Methods:** A quantitative descriptive approach was employed using a survey method involving 30 pig farmers selected through purposive sampling. Primary data were collected through structured questionnaires, in-depth interviews, and field observations. Data were analysed using descriptive statistics and multiple linear regression to examine the effects of morbidity and mortality on net farm income. **Results:** African Swine Fever, Classical Swine Fever, parasitic infections, and bacterial diarrhoea were the dominant diseases affecting pig farms. The average morbidity and mortality rates were 16.16% and 8.24%, respectively. Both morbidity and mortality had negative effects on net income, with mortality exerting a stronger economic impact. Each one percent increase in mortality reduced farmers' net income by approximately IDR 492,600, while a one percent increase in morbidity reduced income by about IDR 272,500. Disease outbreaks also increased treatment costs and caused substantial economic losses. **Conclusion:** Livestock diseases significantly undermine the economic performance of smallholder pig farming in Manokwari. Strengthening biosecurity systems, improving access to veterinary services, and enhancing farmer capacity in disease prevention are essential to promote sustainable pig production.
Keywords: economic impact; livestock disease; morbidity; mortality; pig farming

INTRODUCTION

The livestock sector plays a strategic role in national food security and economic development (Salmon et al. 2018; Nair et al. 2021; Ramanzin et al. 2014; Enahoro et al. 2019; Chau, Lebailly, and Trung 2017), particularly through its contribution to animal protein supply and rural livelihoods (Castellanos-Navarrete, de Castro, and Pacheco 2021; Santika et al. 2019a; Rist, Feintrenie, and Levang 2010; Santika et al. 2019b). The development of livestock farming has a positive impact on community nutrition and

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welfare, driven by population growth, rising educational levels, and increasing public awareness of balanced diets. Among livestock commodities, pig farming represents an important subsector, especially in regions where pigs hold strong socio-cultural and economic significance.

In West Papua, pig farming is deeply embedded in indigenous traditions and cultural practices. Pigs are not only valued as a source of meat and income but also function as cultural assets used in traditional ceremonies, dowry payments, and social exchanges. Consequently, pig ownership is often associated with social status and household wealth (Pattiselanno 2014; Iyai, Saragih, and Kayadoe 2013; Iyai et al. 2021; Rahayu, Widayati, and Logo 2020). In Manokwari Regency, pig farming remains a dominant livelihood activity, particularly among indigenous communities, due to its relatively fast growth rate, efficient feed conversion, and high carcass yield.

Despite its importance, pig farming in Manokwari has experienced severe challenges in recent years. Official statistics indicate a sharp decline in pig population from 38,560 heads in 2021 to only 6,003 heads in 2023, with only a slight recovery in 2024. This decline has been linked to disease outbreaks, limited access to veterinary services, suboptimal management practices, and insufficient farmer knowledge regarding animal health. Disease-related losses have become a major constraint on farm productivity and economic sustainability (Sorokowski, Sorokowska, and Danel 2013; Rinca et al. 2023; Nugroho et al. 2019; Muhlisin et al. 2014; Phiri 2012b).

Pigs are highly susceptible to both endemic and epidemic diseases due to several interrelated factors, including high stocking density, inadequate housing sanitation, nutritional imbalances, environmental stress, and weak biosecurity systems. Endemic diseases are diseases continuously present within a region at relatively stable levels, while epidemic diseases occur as sudden outbreaks with rapidly increasing incidence over a specific period. Major diseases such as African Swine Fever (ASF), Classical Swine Fever (CSF), Porcine Reproductive and Respiratory Syndrome (PRRS), and various bacterial and parasitic infections have been reported in the region in Manokwari Regency and other parts of West Papua Province (Azizah Primatika et al. 2021; Salas and Andrés 2013; Hombahomba, Purwanta, and Isty 2023; Rinca et al. 2023). These diseases significantly reduce growth performance, reproductive efficiency, and survival rates, thereby increasing production costs and reducing farm income.

The economic consequences of pig diseases extend beyond direct mortality (Henry, Eckard, and Beauchemin 2018; Sorokowski, Sorokowska, and Danel 2013; Primatika et al. 2022). Morbidity reduces feed efficiency and market value, while repeated disease outbreaks lead to escalating veterinary expenses and income instability. Furthermore, some pig diseases pose zoonotic risks, raising public health concerns. These challenges are compounded by traditional farming systems, limited vaccination coverage, and weak institutional support mechanisms.

Although several studies have documented the biological aspects of pig diseases in Indonesia, empirical evidence on their socio-economic impacts at the smallholder level remains limited, particularly in eastern Indonesia. In Manokwari, few studies have systematically quantified how morbidity and mortality affect farm income, productivity, and economic losses, as well as how farmers and government institutions respond to disease challenges.

Previous studies have primarily focused on technical disease diagnosis and control strategies (Gelolodo et al. 2023; Dione et al. 2016; Sendow et al. 2020, 2020),

with limited emphasis on integrated economic analysis and farmer-level impacts. There is a lack of comprehensive empirical studies that simultaneously examine disease incidence, productivity loss, financial consequences, and management responses in smallholder pig farming systems in Manokwari.

This study offers a novel contribution by integrating epidemiological indicators (morbidity and mortality) with economic performance indicators (production costs, revenue, income, and losses) and management strategies. It provides a holistic assessment of disease impacts and control responses within a culturally embedded pig farming system. Based on these considerations, this study aims to identify major diseases affecting pig farms in Manokwari Regency; Analyze the impact of morbidity and mortality on farm productivity and income; Quantify economic losses resulting from disease outbreaks; and Examine farmer and government strategies for disease control and disease prevention, control, and risk reduction strategies.

MATERIALS AND METHODS

Study Area and Period

This study was conducted in Manokwari Regency, West Papua, Indonesia. The research was carried out over a three-month period, from September to November 2025. The study was conducted during the transition period between the dry and rainy seasons in Manokwari Regency. The study area was selected due to the high incidence of pig diseases reported in recent years, which have significantly affected local pig farming activities.

Research Design

This study employed a quantitative descriptive research design. The approach was used to describe and analyze the characteristics, conditions, and impacts of disease on pig farming enterprises at the farmer level. A survey method was applied to collect quantitative and qualitative data from selected respondents. The research design enabled the identification of disease patterns, economic impacts, and management strategies adopted by pig farmers in response to disease outbreaks.

Population and Sample

The population of this study consisted of all pig farmers in Manokwari Regency who had experienced disease outbreaks in their livestock. A purposive sampling method was used to select the study locations and respondents. Sampling was focused on areas that had experienced major disease outbreaks in 2021 and subsequent years. This method was chosen to ensure that respondents had sufficient experience with disease-related problems.

The research subjects were pig farmers directly affected by livestock diseases. The final sample size was determined based on preliminary field surveys and data obtained from relevant local government agencies. secondary data were obtained from local government livestock service reports and statistical databases from 2021–2025.

Research Instruments and Materials

The instruments used in this study included Structured questionnaires, Interview guidelines, Writing tools (pens and pencils), Digital camera for documentation, and Disinfectant for biosecurity during fieldwork. The research

materials consisted of pig farmers who had experienced disease outbreaks in Manokwari Regency and their livestock production records.

Data Collection Methods

Data were collected using the following methods, i.e. In-depth interviews with pig farmers, using Structured questionnaires, Field observations of farming conditions, and Documentation of disease symptoms and management practices. We also collected secondary data from Government reports and databases, Previous scientific studies, Books and academic publications, and Relevant institutional documents.

Research Variables

The variables examined in this study were classified into independent and dependent variables (Table 1).

Table 1. Measured and calculated parameters observed in this study.

Variable Group	Indicator	Measurement Unit / Description	Example Source
Farmer Characteristics	Farmer name	Text	Primary data
	Age	Years	Primary data
	Gender	Male / Female	Primary data
	Main occupation	Category	Primary data
	Secondary occupation	Category	Primary data
	Farming experience	Years	Primary data
	Formal education	Last education level	Primary data
Disease Identification	Disease types	List of disease names	Primary data
	Disease frequency	Cases per year	Primary data
	New diseases	Name(s) of new disease(s) found	Primary data
	Morbidity rate	%	(Wabacha et al. 2004)
	Mortality rate	%	(Sorokowski, Sorokowska, and Danel 2013)
	Population decline	%	Calculated
	Productivity decline	%	Calculated
	Treatment cost	IDR	Primary data
	Pig deaths	Heads per farmer per year	Primary data
	Total production cost	IDR	Calculated
	Revenue	IDR	Calculated
	Net income	IDR	Calculated
	Income decline	IDR	Calculated
	Economic loss	IDR	(Thomson et al., 2019)
Management Strategies	Farmer disease control efforts	Text & coded categories	Primary data
	Government interventions	Text & coded categories	Primary data
	Effectiveness	Subjective rating / outcome	Primary data / Secondary reports

Data Analysis

This study employs descriptive statistical analysis to describe the characteristics of the research data. Data analysis is conducted using both descriptive and inferential

statistics (Snedecor and Cochran 1989). Descriptive statistics are applied by presenting measures of central tendency and variability. Inferential statistical analysis is conducted using multiple linear regression to examine the relationship between livestock productivity (Y) and the independent variables, namely morbidity (X1) and mortality (X2). The regression model is expressed as follows $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$, Where (Y) = Livestock productivity / net income, (X1) = Morbidity rate, (X2) = Mortality rate, (α) = Constant, (β1, β2) = Regression coefficients, (ε) = Error term. The results of the analysis are presented in the form of tables, graphs, diagrams, and documentary images.

Validity and Reliability

To ensure data validity and reliability, the study employed Pre-testing of questionnaires, Cross-checking interview data with field observations, Triangulation between primary and secondary sources, and Verification with local livestock officers. These measures were taken to minimize bias and enhance the credibility of the research findings.

Ethical Considerations

All respondents participated voluntarily and provided informed consent prior to data collection. Confidentiality of personal information was maintained throughout the research process. The study complied with ethical standards for social and agricultural research. Pig farming in Manokwari involves both locally bred pigs and pigs introduced from other regions of Papua and Indonesia through trade and livestock distribution networks.

RESULTS AND DISCUSSIONS

Characteristics of Pig Farmers

The pig farming respondents in Manokwari Regency consisted of 30 farmers with diverse characteristics, including age, gender, education level, farming experience, and farming motivation. These characteristics are described as follows.

Age of Pig Farmers

The age distribution of pig farmers in this study is presented in Table 2. The results indicate that 100% of the pig farmers were between 26 and 60 years old. According to Statistics Indonesia (BPS, 2014), the productive age range in Indonesia is 15–64 years, while non-productive age includes individuals below 15 years and above 64 years. Therefore, the respondents in this study were within the productive age group.

Wurmanto (2008) stated that farmers in the productive age group are generally capable of working actively, adopting innovations, and utilizing opportunities to develop their enterprises. Similar findings were reported by Otampi et al. (2017), who classified productive age as 15–64 years and non-productive age as above 65 years. The study found that most respondents were male, totaling 25 farmers (83.33%), while female farmers accounted for 5 respondents (16.67%). These findings are consistent with Iyai and Saragih (2015), who reported that male pig farmers among the Arfak ethnic group in coastal, lowland, and highland areas tend to dominate pre-production

activities that require substantial physical strength, while females are less involved in physically demanding tasks.

Table 2. Age Distribution of Pig Farmers (Respondents) in Manokwari Regency

Parameters	Number of Farmers (Persons)	Percentage (%)
Age Group (Years)		
0–25	0	0
26–60	30	100
>61	0	0
Gender		Percentage (%)
Male	25	83.33
Female	5	16.67
Education Level		
Elementary School	1	3.33
Junior High School	9	30.00
Senior High School	10	33.33
Bachelor's Degree	10	33.33
Farming Experience (Years)		
< 5	10	33.33
5–10	17	56.67
> 10	3	10.00
Farming Motivation		
Main Occupation	21	70
Secondary Occupation	9	30

Table 2 shows that most farmers had completed senior high school and bachelor's education (33.33% each), followed by junior high school (30.00%), while only one farmer had elementary-level education (3.33%). Overall, the education level of respondents was relatively high. Education strongly influences knowledge acquisition, mindset, and technology adoption. It plays an important role in improving livestock productivity, particularly in management and feeding practices. Winarno (1985) stated that education significantly affects livestock productivity. However, higher education does not automatically guarantee business success. According to Notoatmodjo (2007), education facilitates learning processes and enhances individuals' ability to access and manage information, particularly through extension services.

Farming experience affects skill development and work efficiency (Cahyono, 1995). The data show that most farmers (56.67%) had 5–10 years of farming experience, while 33.33% had 1–5 years and 10% had more than 10 years. Longer farming experience reflects greater knowledge and skills in livestock management and problem-solving. Nursida et al. (2020) reported that experienced farmers generally possess better management capacity. Lestari et al. (2009, cited in Wenda, 2019) emphasized that pig farming success is strongly influenced by farming experience, as experienced farmers tend to make better decisions and handle challenges more patiently. Traditional and semi-intensive feeding systems, feed hygiene practices, cage sanitation conditions, and their relationship with disease outbreaks and biosecurity weaknesses become barriers.

Table 2 indicates that most respondents (70%) considered pig farming as their primary source of income, while 30% regarded it as a secondary activity. This finding

highlights the significant role of pig farming in household economic structures. The dominance of pig farming as a main occupation reflects that pigs are not merely savings assets but constitute a principal livelihood source. This aligns with the socio-economic characteristics of Papuan communities, where pigs hold high economic, social, and cultural value (Babo et al., 2019; Manansang et al., 2021). Farmers who rely primarily on pig farming generally invest more time and labor in feeding, housing management, and disease control. However, this dependence also makes them more vulnerable to risks, such as African Swine Fever (ASF), feed price fluctuations, and limited veterinary services (FAO, 2020).

In contrast, farmers who raise pigs as a secondary occupation usually have alternative income sources, such as crop farming or informal employment. This reflects livelihood diversification strategies aimed at reducing economic risk. Although their farming scale is relatively small, pig farming still serves as an economic buffer for urgent household needs (Suroso & Iyai, 2018).

Identification of Disease Types

Table 3 presents the occurrence of pig diseases in Manokwari Regency over the last three years (2023–2025), including disease types, incidence levels, impacts, and control measures. The data illustrate that pig diseases remain a major constraint affecting animal health, productivity, and the sustainability of smallholder pig farming.

In 2023, African Swine Fever (ASF) had the most severe impact, with morbidity reaching 22.5% and mortality 10.8%. High mortality caused major production disruptions and livestock losses. Helminthiasis recorded the highest morbidity (42.0%) but relatively low mortality (1.8%), indicating greater impact on growth performance than survival. Other diseases, such as bacterial diarrhea, hog cholera, and respiratory disorders, also contributed to productivity losses.

In 2024, ASF cases increased to 18, with morbidity and mortality rising to 24.0% and 11.2%, respectively. This indicates the persistent nature of ASF and the need for strengthened biosecurity. Hog cholera and bacterial diarrhea also increased, affecting productivity and digestion. Diarrheal disease in pigs may be associated with bacterial, viral (including CSFV-related infections), and parasitic causes. Helminthiasis remained prevalent (34.7%), suggesting that parasite control programs were not yet fully effective.

In 2025, an increasing trend in disease incidence was still observed, particularly for African Swine Fever (ASF) and bacterial diarrhea. ASF reached the highest number of cases during the observation period, with 20 cases, a morbidity rate of 25.8%, and a mortality rate of 12.0%. This finding confirms that ASF is the most economically damaging disease in pig farming in Manokwari Regency, as it causes high mortality and direct loss of livestock assets. In addition, bacterial diarrhea showed an increase in morbidity to 32.3% and mortality to 5.0%, indicating increasingly chronic digestive health problems. Respiratory disorders also increased, with morbidity rising to 19.4% and mortality to 3.5%, reflecting the need for improvements in sanitation and housing management.

Table 3. Pig Diseases in Manokwari Regency (2023–2025)

Year	Disease Type	Number of Cases (Estimated)	Morbidity Rate (%)	Mortality Rate (%)	Main Impact	Intervention / Management
2023	African Swine Fever (ASF)	15	22.5	10.8	High mortality, production disruption	Biosecurity and farmer education
	Hog Cholera	8	12.0	5.2	Decreased productivity	Vaccination and supportive therapy
	Helminthiasis	28	42.0	1.8	Low body weight	Periodic deworming
	Bacterial Diarrhea	19	28.5	4.2	Dehydration and risk of death	Rehydration and antibiotics
	Respiratory Disease (Pneumonia)	10	15.0	2.5	Reduced growth	Improved ventilation
2024	African Swine Fever (ASF)	18	24.0	11.2	Mortality and asset loss	Intensive biosecurity
	Hog Cholera	10	14.5	6.0	Reduced productivity	Routine vaccination
	Helminthiasis	26	34.7	2.0	Suboptimal body weight	Regular deworming
	Bacterial Diarrhea	22	29.3	4.5	Digestive disorders	Rational antibiotic use
	Respiratory Disease	13	17.3	3.2	Risk of breathing problems	Housing management
2025	African Swine Fever (ASF)	20	25.8	12.0	High mortality	Strengthened biosecurity
	Hog Cholera	9	13.1	5.4	Reduced production	Vaccine certification
	Helminthiasis	24	31.0	2.3	Low feed efficiency	Deworming and nutrition improvement
	Bacterial Diarrhea	25	32.3	5.0	Chronic digestive disorders	Supportive therapy
	Respiratory Disease	15	19.4	3.5	Breathing difficulty and stress	Housing sanitation

These consist of management responses by farmers and veterinary health services aimed at reducing disease impacts. African Swine Fever (ASF) consistently remained the disease with the highest morbidity and mortality across the study period. Helminthiasis recorded the highest morbidity but low mortality, yet still reduced productivity. Bacterial diarrhea and respiratory diseases showed increasing trends, indicating the need for improved feeding management and ventilation systems.

Relationship Between Morbidity and Net Income

The regression graph between morbidity rate (%) and net income from pig farming shows a negative relationship, in which increasing morbidity is associated with declining net income. The scatter distribution indicates that at low morbidity

levels, net income tends to be higher and more stable, whereas at higher morbidity levels, net income declines. From an economic perspective, sick animals experience reduced production performance in terms of growth rate, feed efficiency, and market quality. Moreover, increasing morbidity leads to higher treatment and healthcare costs, further reducing profit margins. Therefore, morbidity functions as a risk factor that indirectly reduces efficiency and sustainability in smallholder pig farming in Manokwari Regency.

Relationship Between Mortality and Net Income in Pig Farming

The regression analysis between mortality rate (%) and net income reveals a stronger negative relationship compared to morbidity. Each increase in mortality is associated with a greater decline in net income, as reflected in the steeper regression slope and the concentration of low-income values at higher mortality levels. This phenomenon can be explained by the direct loss of productive assets resulting from animal deaths. Dead pigs not only fail to generate revenue but also represent a loss of all previously invested production costs. Consequently, mortality constitutes the primary source of economic loss, particularly for small- and medium-scale farmers with limited capital recovery capacity. These results emphasize that mortality control plays a strategic role in maintaining income stability and ensuring the sustainability of pig farming in Manokwari Regency.

Relationship Between Morbidity and Mortality in Pig Farming

The regression graph between morbidity rate (%) and mortality rate (%) demonstrates a positive relationship, whereby increasing morbidity is followed by increasing mortality. This pattern indicates that animals experiencing repeated illness or inadequate treatment are at a higher risk of death. This relationship reflects weaknesses in disease prevention and treatment systems and highlights the importance of early detection and timely intervention to reduce mortality and economic losses.

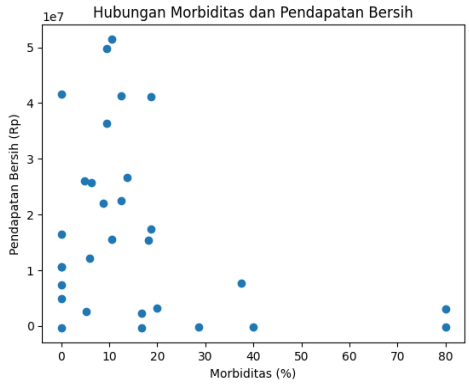

Figure 1. Relationship between net income with pig morbidity.

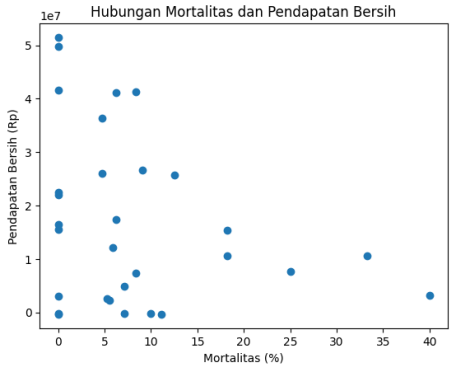

Figure 2. Relationship between net income with mortality

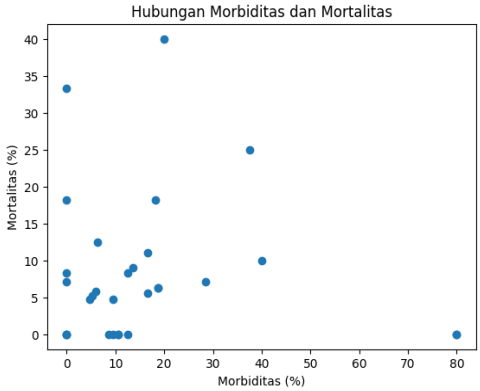

Figure 3. Relationship between mortality and morbidity.

This relationship reflects weaknesses in disease prevention and control systems, particularly in traditional farming systems characterized by low levels of biosecurity (Figure 1, 2, and 3). High morbidity can serve as an early indicator of inadequate livestock health management, which may subsequently develop into increased mortality if health interventions are not implemented in a timely and effective manner. Therefore, morbidity can be regarded as an early warning indicator of mortality risk and greater economic losses. Overall, the three regression graphs demonstrate that pig diseases exert a systemic impact on farm performance. Morbidity reduces production efficiency and increases operational costs, while mortality directly decreases income and intensifies economic losses. The positive relationship between morbidity and mortality emphasizes that early-stage disease prevention is a critical strategy for minimizing business risks.

These findings reinforce the argument that disease control strategies—through improved biosecurity, strengthened veterinary services, and enhanced farmer education—are essential for supporting the sustainability of pig farming enterprises in Manokwari Regency.

Table 4. Average Values of Research Parameters for Pig Farming Enterprises in Manokwari Regency

Variable	Unit	Average Value
Morbidity Rate	%	16.16
Mortality Rate	%	8.24
Disease Frequency	Cases/year	2.87
Population Decline	%	8.24
Productivity	%	75.61
Treatment Cost	IDR	294,902
Total Production Cost	IDR	294,902
Revenue	IDR	17,358,920
Net Income	IDR	17,064,010
Economic Loss	IDR	3,181,100

Table 4 shows that pig diseases remain a major limiting factor in the development of smallholder pig farming enterprises in Manokwari Regency. Relatively high levels of morbidity and mortality have a direct impact on the decline of livestock population, productivity, and farmers' income.

Effect of Morbidity Rate

The average morbidity rate of 16.16% indicates that a considerable proportion of livestock experienced experiencing disease symptoms during the rearing period. Morbidity increases the risk of population decline through delayed growth and potential subsequent mortality. Sick animals reduce productivity, as reflected by the average productivity rate of only 75.61%. Morbidity also directly contributes to increased treatment costs and total production expenses. Consequently, morbidity negatively affects net income because operational costs rise while output declines. Therefore, higher morbidity leads to lower production efficiency in pig farming. The relatively high morbidity rate reflects weaknesses in livestock health management, particularly in traditional and semi-intensive production systems. High morbidity reduces animal performance, including weight gain, feed efficiency, and market quality. This finding is consistent with livestock production economics theory, which emphasizes animal health as a key determinant of productivity and operational efficiency (Ugochukwu and Phillips 2018; Alemayehu et al. 2012; Quisumbing 1996).

Effect of Mortality Rate

The average mortality rate of 8.24% indicates a substantial loss of livestock. Mortality directly contributes to population decline, as dead animals generate no revenue. It represents the largest contributor to farmers' economic losses. Compared with morbidity, mortality has a greater economic impact because it causes permanent loss of livestock assets (Anderson 2003). In contrast, mortality has a more severe economic impact than morbidity. Animal deaths not only eliminate potential revenue but also result in the loss of all production costs previously invested. Regression analysis confirms that mortality has a larger negative coefficient than morbidity, highlighting mortality as the primary source of economic loss in smallholder pig farming in Manokwari.

Effect of Disease Frequency

The average disease frequency of 2.87 cases per year indicates that disease outbreaks are recurrent. The more frequently diseases occur, the higher the health-related expenditures incurred by farmers. Diseases causes increase variable production costs, exacerbates economic losses, and suppresses farmers' income (Chau, Lebailly, and Trung 2017; Petrus et al. 2011; Iqubal et al. 2021). The high and recurrent frequency of disease outbreaks indicates that preventive measures have not been optimally implemented. Strategic diseases such as African Swine Fever (ASF) showed increasing trends in cases and mortality, leading to substantial livestock losses and income instability. Endemic diseases such as helminthiasis and bacterial diarrhea, although associated with low mortality, still significantly reduce productivity and feed efficiency.

The results indicate that disease-related variables (morbidity, mortality, and disease frequency) are strongly associated with the performance of pig farming enterprises. Mortality is the most detrimental factor because it directly reduces livestock population and leads to income loss. Meanwhile, morbidity and disease frequency increase production costs and reduce business efficiency. These findings confirm that livestock diseases constitute a major risk in smallholder pig farming in Manokwari Regency, particularly in traditional production systems characterized by

low biosecurity levels (Leslie et al. 2015; Malo Bulu, Robertson, and Geong 2015; Penrith et al. 2013; Correia-Gomes et al. 2017).

Regression Analysis and Statistical Testing

Multiple linear regression analysis was employed to examine the effect of livestock diseases on pig farming income, using the following model (Table 5).

Table 5. Results of Multiple Linear Regression Analysis on the Effect of Disease on Net Income

Variable	Coefficient (β)	Std. Error	t-value	Sig. (p-value)	Remark
Constant	25,520,000	4,260,000	5.989	0.000	Significant
Morbidity Rate (%)	−272,500	137,000	−1.991	0.057	Not significant (α = 5%)
Mortality Rate (%)	−492,600	278,000	−1.772	0.088	Not significant (α = 5%)

Source: Primary data processed, 2026

The morbidity coefficient is negative, indicating that an increase in morbidity tends to reduce net income. The mortality coefficient is also negative and has a larger magnitude, suggesting that mortality has a stronger impact on income compared to morbidity. At the 5% significance level, both variables are not statistically significant; however, they approach significance at the 10% level, which is still acceptable in applied socio-economic research (Phiri 2012b; Fiore et al. 2024; Ojiem et al. 2006; Abah and Petja 2015). The F-test was conducted to examine the joint effect of morbidity and mortality on net income. The results indicate that the regression model is statistically acceptable and capable of explaining variations in net income at the 10% significance level (Table 6).

Table 6. Results of the F-Test (Simultaneous Test)

Criteria	Value
F-value	3.342
Probability (Sig.)	0.0505
Significance Level (α)	0.05
Decision	Model significant at α ≈ 10%

The probability value of the F-test (0.0505) indicates that, simultaneously, morbidity and mortality significantly affect net income, particularly at the 90% confidence level. This result suggests that the regression model is appropriate for explaining the relationship between livestock diseases and pig farming income (Boogaard et al. 2011; Leslie et al. 2015; Phiri 2012a; Lay et al. 2022; Iyai et al. 2011).

Table 7. Coefficient of Determination

Indicator	Value
R-square (R^2)	0.198
Adjusted R^2	0.139

The R^2 value of 0.198 indicates that 19.8% of the variation in net income can be explained by morbidity and mortality rates, while the remaining 80.2% is influenced by other factors outside the model (Table 7), such as feed prices, farm scale, management practices, access to veterinary services, and market price fluctuations.

The findings also show that variations in farmers' net income are not fully explained by disease factors alone. The moderate R^2 value suggests that other factors, including farm scale, feed prices, production systems, access to veterinary services, and market fluctuations, also influence income. Nevertheless, the consistent negative relationship between disease incidence and income highlights the importance of disease control as a primary strategy for improving farm performance (Iyai et al. 2013, 2011, 2011; Leen et al. 2018).

Table 8. Summary of Classical Assumption Tests

Statistical Test	Indicator	Value	Decision
Normality	Jarque–Bera	1.207 (p = 0.547)	Data are normally distributed
Autocorrelation	Durbin–Watson	1.836	No autocorrelation
Multicollinearity	Condition Number	41.1	No serious multicollinearity

The results of the classical assumption tests indicate that the regression model satisfies the basic assumptions of linear regression. Therefore, the estimated coefficients are reliable and suitable for interpretation.

Table 9. Summary of Regression Findings

Variable	Direction of Effect	Magnitude of Impact
Morbidity (%)	Negative	Reduces income by ± IDR 272,500 per 1% increase
Mortality (%)	Negative	Reduces income by ± IDR 492,600 per 1% increase

The regression analysis results (Table 9) indicate that pig diseases, represented by morbidity and mortality rates, have a negative effect on net income in pig farming enterprises in Manokwari Regency. Mortality has a greater economic impact than morbidity because it causes direct loss of livestock assets. Although the statistical effects are not significant at the 5% level, the consistent negative relationship suggests that livestock diseases are an important risk factor that requires serious attention in the development of smallholder pig farming.This study aimed to analyze the impact of pig diseases on the performance of smallholder pig farming enterprises in Manokwari Regency, as measured by morbidity (Whitehead and Roberts 2014; Wabacha et al. 2004), mortality (Sorokowski, Sorokowska, and Danel 2013; Daodu, Babayemi, and Iyayi 2009; Temple and Manteca 2020; Wabacha et al. 2004), productivity, income, and economic losses. The results demonstrate that livestock diseases remain a major risk factor affecting the sustainability of pig farming in the study area. Overall, this study reinforces the view that livestock diseases are not merely technical animal health issues (Dumont, Groot, and Tichit 2018; Temple and Manteca 2020) but also economic and institutional challenges that require integrated approaches involving farmers, local government, and other stakeholders.

CONCLUSION

Based on the results and discussion of this study, the following conclusions can be drawn, i.e. pig diseases remain a major problem in smallholder pig farming in Manokwari Regency, as indicated by relatively high morbidity and mortality rates. Morbidity leads to reduced livestock productivity and increased treatment costs, thereby lowering production efficiency. Mortality has the greatest economic impact because it causes direct losses of livestock assets and potential income. The recurrent

occurrence of diseases indicates that prevention and control efforts have not been optimally implemented. Pig diseases have a negative effect on farmers' net income, although other non-disease factors also influence farm performance. Effective disease control is a key factor in enhancing the sustainability and economic resilience of pig farming enterprises in Manokwari Regency.

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AUTHORS' CONTRIBUTIONS

APEW shares ideas, data analysis, and manuscript preparation. RT took field data, and MM provided funding and edited final manuscript.

CONFLICT OF INTEREST

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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