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Economic Impact of *African Swine Fever* (ASF) Disease on Pigs in Ngada Regency East Nusa Tenggara Province

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ABSTRACT: *African Swine Fever* (ASF) attacks pigs with a death rate reaching 100% of the population, cannot be treated, no vaccine has been found since 2020–2023. This research data consists of primary data and secondary data. Primary data is data from interviews with farmers, livestock technical officers in 6 (six) sub-districts, quarantine officers, pig traders, and policy makers in Ngada Regency. Secondary data is ASF pig mortality data (2020, 2021, 2022, and 2023), pig population, number of pig farmers, and population data at the Central Statistics Agency (BPS). Determination of sub-districts is done by ethnicity *stratified*, villages/sub-districts and livestock farmer respondents (KK) carried out a simple rationing proportionally in 6 (six) sub-districts, 33 villages/sub-districts and 325 respondent families. Data are presented in the form of mean values ± standard deviation. Risk factor analysis was carried out bivariately using chi square to determine the association (relationship) between two variables followed by calculation analysis *Odds Ratio* (OR) to determine the strength of association between two variables. Data analysis used the SPSS version 23. The data obtained in this research is presented using pictures and tables and then described descriptively. The average results obtained by households in the three ethnic groups raising pigs were the highest for the Bajawa ethnic group at 57.2%, followed by the Soa ethnic group at 10.5%, followed by a mixture of Ngada Regency and outside Ngada Regency at 9.5%, a mixture of ethnicities in Ngada Regency as much as 9.2% and the Riung ethnic group as much as 7.1%. The economic loss of ASF disease is IDR 8,691,148,548,700 (Eight Trillion Six Hundred Ninety One Billion One Hundred Forty Eight Million Seven Hundred Rupiah) assuming that 85% of families raise pigs (Leslie et al., 2015).

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INTRODUCTION

ASF disease is called African swine fever because it first occurred in Kenya, East Africa in 1921. This disease has clinical symptoms that are similar to *Classical Swine Fever* (CSF) which occurred in 1830 in the northern hemisphere (Montgomery, 1921; Penrith et al., 2013). In December 2019, 7 (seven) countries in Southeast Asia reported ASF cases, including Indonesia. In 2019, it was reported that more than 50 countries were affected by ASF (OIE, 2019). ASF disease in Indonesia was officially announced in 2019 through Decree of the Minister of Agriculture Number 820/KPTS/PK.320/M/12/2019 concerning Statement of African Swine Fever Outbreak (*African Swine Fever*) in several districts/cities in North Sumatra Province.

ASF disease attacks pigs in North Sumatra Province with a death rate of 64,446 in 465 pig farms (Mebus, 2020). The ASF outbreak in East Nusa Tenggara (NTT) occurred through the introduction of ASF disease into the State of Timor Leste which directly borders Timor Island, NTT Province. ASF disease in Timor Leste was first reported in Dili on 27 September 2019 (OIE, 2019). In 2020, there was an ASF outbreak in NTT Province. The NTT Provincial Livestock Service reported the death of 62,696 community-owned pigs due to African swine fever (ASF) (NTT Provincial Livestock Service Data dated 14 September 2023) in 22 (twenty two) districts/cities and 1 (one) Pig Farming Installation Government in Tarus Kupang. The ASF outbreak in Ngada Regency, based on the Ngada Regency Livestock Service Report, occurred in 2020. The Livestock Service reported 2,399 pig deaths, but not all ASF deaths were reported to the Ngada Regency Livestock Service. ASF positive sample data was obtained

from 1 (one) animal in 2020, 7 (seven) positive samples in 2022, and 2 (two) positive samples in 2023 (Disnak Ngada, 2023).

NTT Province is the province with the highest pig population in Indonesia, namely 2,325,020 heads. Pigs in NTT are also the most commonly kept livestock compared to cattle, buffalo, horses, goats and sheep. Data for 2022, pork production in NTT is 13.37 million kg (kilograms), which is higher than other livestock meat production. Based on district area, Ngada Regency has the third largest population in NTT Province with a pig population of 221,859 ("BPS Propinsi NTT," 2022).

Ngada Regency is one of 22 (twenty two) regencies/cities in East Nusa Tenggara (NTT) Province. Ngada Regency is located at coordinates 8°20'24.28"–8°57'28.39" South Latitude and 120°48"–121°11' East Longitude. Ngada Regency consists of 12 (twelve) sub-districts, 16 (sixteen) sub-districts , and 135 (one hundred and thirty five) villages as follows: Aimere, Bajawa, North Bajawa, Golewa, West Golewa, South Golewa, Inerie, Jerebu'u, Riung, West Riung, Soa and Wolomeze ("BPS Propinsi NTT," 2022). Ngada Regency has three large tribes, namely the Bajawa Tribe, Soa Tribe and Riung Tribe, which have high socio-cultural value where pigs are used in various events such as traditional ceremonies, weddings, funerals and other important celebrations (Christie, 2007; Johns, C., 2009). Each tribe has its own culture which is still maintained to this day, such as: traditional houses, language, dances, traditional clothing and traditional ceremonies which are different from each other. The Ngada area was included as *World Heritage Tentative List* UNESCO (*The United Nations Educational Scientific and Cultural Organization*) on October 19, 1995 in the cultural category (Alamendah, 2011).

RESEARCH METHODS

This research will be conducted in Ngada Regency, East Nusa Tenggara Province. This research will be carried out in October–November 2023. The data in this research is in the form of primary data and secondary data. Primary data in this research is data from interviews with breeders, pig traders and pig buyers. Secondary data in this research are ASF pig mortality data in (2020, 2021, 2022, and 2023), pig population, number of pig farmers, and Central Statistics Agency (BPS) data The sample size for the economic loss analysis study interviewed as a sample of farmer respondents was household. The sample size was calculated using the study formula *cross sectional* which is implemented with *stratified* based on ethnicity in Ngada Regency.

The multiple stage sampling method in Ngada Regency is spread across 6 (six) sub-districts and 33 villages/districts. The selection of sub-districts consisted of 4 sub-districts from the Bajawa ethnic group, 1 sub-district from the Soa ethnic group and 1 sub-district from the Riung ethnic group. Based on proportional calculations, the Bajawa Ethnic group is in 8 sub-districts, the Soa Ethnic group is in 2 sub-districts, and the Riung Ethnic group is in 2 sub-districts. Determination of sub-districts, villages/sub-districts, and the number of samples in each sub-district was carried out proportionally at random. The selection of farmer respondents was carried out systematically. Risk factors are identified through direct observation, interviews with owners, traders, policy makers, and filling out questionnaires by breeders.

The sample size is where the target population is 213,028 pigs and 88,929,047 families (Dinas Dukcapil Ngada, 2023), with the smallest sampling unit being the household. Sample data in each sub-district is carried out proportionally. The sample size was determined using the cross sectional study formula (Martin et al., 1987): $n = 4PQ/L^2$ (n = Number of samples, P = Base estimate, Q = 1 – P, L = Error). The confidence level was 95%, the desired error was 0.05, and with an ASF pig prevalence of 22.8% in smallholder farmers in the South Kivu Province of the Democratic Republic of the Congo in 2019 (Bisimwa et al., 2021), the number of respondents was 282 farmer families. To reduce bias due to using double stage sampling, the sample size is used *Design Effect* (DE) to obtain the number of samples; n = 282 x 1.15 = 325 respondent families

Variables in economic losses in Ngada Regency, which are independent variables, are factors that are found in direct costs of pig farming (seed, feed, cages, labor, equipment, facilities and infrastructure) and indirectly due to outbreaks and incidents of ASF disease (social and cultural losses). The dependent variable that will be studied is the analysis of economic losses in pig farming.

The tools used in this research are tools for data collection and data analysis. The data analysis tool used is software (*software)* program *Statistical Package for the Social Sciences*/SPSS version 23 (SPSS Inc.). Calculation of ASF economic losses, both direct and indirect, through analysis of questionnaire results so that the average number of pig deaths per family is known. Furthermore, the families of livestock owners are grouped according to the average length of time keeping dead pigs, and other accompanying conditions related to economic losses caused by ASF disease. The method for calculating losses comes from direct and indirect loss sources In ASF disease, direct losses include the death of pigs, disinfection costs, and burial of pigs. Indirect economic losses are the extra costs that must be incurred in the form of costs for monitoring livestock traffic, quarantine, IEC (Education Information Communication) costs, and ASF disease eradication costs (Putt et al., 1988). The presentation of data in this research will be qualitative and quantitative.

RESULTS AND DISCUSSION

From the results of the analysis of 325 respondents, data was obtained on the age range of pig breeders, where the lowest age was 20 years to 77 years old and the highest was 5.8% at 47 years old and the lowest was 20 years old, 23 years old, 71 years

old, 72 years and 77 years as much as 1%. The majority of pig breeders come from the Bajawa ethnic group at 57.2%, followed by the Soa ethnic group at 10.5%, followed by a mixture of Ngada Regency and outside Ngada Regency at 9.5%, a mixture of ethnicities in Ngada Regency at 9.2% and the Riung ethnic group. as much as 7.1%. The highest aim of the people of Ngada Regency to raise pigs is to fulfill economic, traditional and religious needs at 38.2%. Maintenance with the aim of sale fulfills economic needs as much as 21.8%; for economic and traditional needs 21.8%; to specifically meet customary needs as much as 12.3%; to fulfill traditional and religious needs 3.4%; for economic and religious purposes as much as 1.2%; and for religious parties as much as 1.2%. The highest number of pigs kept is 3-5 heads as much as 30.8%, < 3 heads as much as 25.5%, 6-8 heads as much as 24.6%, ≥ 12 heads as much as 11.7%, 9 - 11 heads as much as 5 .5%, and > 12 tails as much as 0.3%. In previous research in NTT, the main reason farmers sold pigs was to obtain main income (52.4%) and additional income (43.5%; n=292). Most additional income is needed to meet household needs (10.2%), education costs (9.4%), and only a small percentage report selling pigs due to the high demand for pigs (2.4%) (Edwina & Crompton, 2012).

Pigs are most needed in July-August at 48.6%, January-February at 26.2%, followed by September-October at 9.5%, November-December and May-June at 6.5% , and March-April as much as 2.8%. The highest number of pigs sold for various purposes was in July-August at 49.8%, January-February at 19.4%, September-October at 8.6%, May-June and November-December at 7.4%, and March-April 7.1%. The number of pigs needed for socio-cultural activities in a year starting from the highest in each farmer's family is 1 – 5 heads as much as 91.1%, >5 – 10 heads as much as 4.9%, >10 – 15 heads as much as 1.8 %, and >15 – 20 heads as much as 1.5%. The dominant pig color required for traditional ceremonies in Ngada Regency is 84.6% black, 14.2% of all pig colors, 0.6% striped and 0.3% red. The gender that is most needed for social and cultural activities is castrated males as much as 78.8%, castrated males and females as much as 20.3%, and females as much as 0.9%. In certain months, the demand for pigs increases and the increase in pig sales is related to pigs being raised for economic purposes and meeting socio-cultural needs. Weddings and funerals usually require a minimum of 5 (five) pigs to feed the family members who come. The need for pigs at a wedding does not include the dowry for the bride who needs a number of pigs according to the woman's social status (Edwina & Crompton, 2012).

Costs for building cages and repairing cages from 2020 to 2023 are < IDR 1,000,000 as much as 47.4%, > IDR 5,000,000 as much as 15.4%, > IDR 3,000,000-5,000,000 as much as 10.2%, and IDR 1,000,000-3,000,000 as much as 27.1%. The highest biosecurity costs were >Rp 100,000-300,000 at 31.4%, <Rp 100,000 at 19.7%, >Rp 300,000-500,000 at 11.7%, >Rp 500,000 - Rp 1,000,000 at 7.1%, >Rp 1,000,000 - IDR 2,000,000 as much as 1.8%, > IDR 2,000,000 - IDR 3,000,000 as much as 0.9%, and > IDR 3,000,000 as much as 0.3%. Costs of medicines, vitamins and minerals per year from the highest < IDR 100,000 by 37.2%, > IDR 100,000-300,000 by 23.7%, > IDR 300,000-500,000 by 13.2%, > IDR 500,000 - IDR 1,000,000 by 9.8%, > IDR 1,000,000 - IDR 2,000,000 by 2.8%, > IDR 3,000,000 by 1.8%, > IDR 2,000,000 - IDR 3,000,000 by 0, 6%, and >Rp 300,000-500,000 at 0.3%. Cost of cage equipment (buckets, brooms, electricity, etc.) from the highest > IDR 100,000-300,000 30.2%, > IDR 300,000-500,000 to 15.1%, > IDR 1,000,000 - IDR 2,000,000 and > IDR 3,000,000 is 0.9%, and < IDR 500,000 - IDR 1,000,000 and > IDR 2,000,000 - IDR 3,000,000 is IDR 0.6%. The cost of burying pigs from the highest is >Rp 100,000-300,000 as much as 23.4%, < Rp. 100,000 as much as 21.2%, > Rp. 300,000-500,000 as much as 6.2%, > Rp. 500,000 - Rp. 1,000,000 as much as 3, 7%, and > IDR 1,000,000 as much as 1.2%. Economic profit if the value of revenue is greater than costs, conversely, economic loss if revenue is lower than costs incurred. Profit or profit = Revenue/TR–cost (*cost*) (Klein et al., 2023). Pig feed is cooked before being given to pigs as much as 63.1% and not cooked as much as 20% and sometimes cooked as much as 16.9%. Cooked pig feed will kill the ASF virus in pig feed (Kivumbi et al., 2019), so there are additional costs for cooking pig feed and direct and indirect losses are the total calculation of the amount of expenses or losses due to direct or indirect results. ASF disease (Barratt et al., 2019; Zhukovskyi & Nedosekov, 2022).

The number of pig deaths in 2020 from the highest < 3 heads as much as 14.2%, 3-5 heads as much as 5.2%, 6-8 heads as much as 4.6%, >12 heads as much as 4.3%, and 9 -11 heads as much as 0.6%. In 2021, the number of pigs that died was 12.0%, 3-5 pigs, 4.6%, 12 pigs 2.8%, 6-8 pigs 1.8%, and 9-11 heads as much as 0.6%. In 2023, the number of pigs that will die at most < 3 will be 11.7%. 6-8 tails as much as 4.6%, 3-5 tails as much as 4%, and >12 tails as much as 2.5%. The ASF outbreak caused huge losses due to the death of pigs and people's fear of consuming pork and other pork products (Daki et al., 2021). Swine disease outbreaks also pose a significant threat to the profitability of pig farming production, both in terms of the economic impact of the disease itself and in terms of the steps taken to reduce the risk of disease introduction and the actions implemented in the event of an outbreak (Id et al., 2019) .

Table 1. Economic Losses of Pig Deaths

No	Kerugian Ekonomi Kematian Babi														
	Ternak Mati									Penguburan Babi					
	Tahun 2020		Tahun 2021		Tahun 2022		Tahun 2023		JUMLAH KERUGIAN	Biaya	Rata-rata	Data	Jumlah KK Peternak	Kerugian	TOTAL KERUGIAN
1	< 3 ekor	291.439.380.000	< 3 ekor	239.847.600.000	< 3 ekor	279.542.340.000	< 3 ekor	259.575.030.000	1.070.404.350.000,00	>Rp 100.000-300.000	200.000	23,40%	46764	2.188.555.200,00	**2.142.997.501.965,23**
2	3-5 ekor	213.448.560.000	3-5 ekor	183.883.160.000	3-5 ekor	204.110.280.000	3-5 ekor	177.487.200.000	778.929.200.000,00	< Rp 100.000	50.000	21,20%	46764	495.698.400,00	**1.558.354.195.166,21**
3	6-8 ekor	330.434.790.000	6-8 ekor	125.919.900.000	6-8 ekor	139.771.170.000	6-8 ekor	357.192.990.000	953.318.850.000,00	>Rp 300.000-500.000	400.000	6,20%	46764	1.159.747.200,00	**1.907.797.893.967,06**
4	>12 ekor	661.895.775.000	>12 ekor	419.733.300.000	>12 ekor	99.836.550.000	>12 ekor	415.985.625.000	1.597.451.250.000,00	>Rp 500.000 - Rp 1.000.000	750.000	3,70%	46764	1.297.701.000,00	**3.196.200.997.768,04**
5	9-11 ekor	61.571.700.000	9-11 ekor	59.961.900.000	9-11 ekor	99.836.550.000	9-11 ekor		221.370.150.000,00	> Rp 1.000.000	2.000.000	1,20%	46764	1.122.336.000,00	**443.864.682.769,01**
		1.558.790.205.000,00		**1.029.345.860.000,00**				**1.210.240.845.000,00**	**4.621.473.800.000,00**					**4.075.482.600,00**	**8.423.926.192.600,00**

In Table 1, the total loss due to the death and burial of pigs is IDR 8,423,864,682,769.01 (Eight Trillion Four Hundred Twenty Three Billion Nine Hundred Twenty Six Million One Hundred Ninety Two Thousand Six Hundred Rupiah).

Table 2. Economic Losses of Pig Production Costs

No	Kerugian Ekonomi Biaya Produksi															
	Biaya Biosecurity			Biaya Pemangunan Kandang			Biaya Obat,Vitamin, Mineral (per tahun)			Biaya Perlengkapan Kandang			Biaya Masak Makanan Babi			TOTAL KERUGIAN
	Biaya	Data	Kerugian	Biaya	Data	Kerugian	Data	Hasil	Kerugian	Data	Hasil	Kerugian	Data	Hasil	Kerugian	
1	Rp 50.000 - Rp 100.000	30,20%	1.059.204.600	< Rp 1.000.000	47,40%	110.830.680.000	< Rp 100.000	37,20%	869.810.400	>Rp 100.000-300.000	30,20%	2.824.545.600	Pakan dimasak	63,10%	29.508.084.000	**145.092.324.603,08**
2	< Rp 50.000	22,50%	263.047.500	> Rp 5.000.000	15,40%	50.411.592.000	>Rp 100.000-300.000	23,70%	2.216.613.600	>Rp 300.000-500.000	15,10%	2.824.545.600	Kadang dimasak	16,90%	2.370.934.800	**58.086.733.502,94**
3	>Rp100.000 - Rp 500.000	16,60%	1.940.706.000	>Rp 3.000.000-5.000.000	10,20%	19.079.712.000	>Rp 300.000-500.000	13,20%	2.469.139.200	>Rp 1.000.000 - Rp 2.000.000	0,90%	631.314.000				**24.120.871.203,41**
4	>Rp 500.000 - Rp 1.000.000	1,80%	631.314.000	Rp 1.000.000-3.000.000	27,10%	25.346.088.000	>Rp 500.000 - Rp 1.000.000	9,80%	3.437.154.000	> Rp 3.000.000	0,90%	2.104.380.000				**31.518.936.004,40**
5	> Rp 1.000.000	0,60%	561.168.000				>Rp 1.000.000 - Rp 2.000.000	2,80%	1.964.088.000	< Rp 500.000 - Rp 1.000.000	0,60%	210.438.000				**2.735.694.005,04**
							> Rp 3.000.000	1,80%	4.208.760.000	>Rp 2.000.000 - Rp 3.000.000	0,60%	701.460.000				**4.910.220.000,02**
							>Rp 2.000.000 - Rp 3.000.000	0,60%	701.460.000							**701.460.000,01**
							>Rp 300.000-500.000	0,30%	56.116.800							**56.116.800,00**
												9.296.683.200,00			**31.879.018.800,00**	**41.175.702.000,00**

Table 2, the amount of loss due to the death and burial of pigs is IDR 41,175,702,000 (Forty One Billion One Hundred Seventy Five Seven Hundred Two Thousand). The total loss of ASF disease, namely the total loss of pig deaths and pig production costs, is IDR 8,691,148,548,700,- (Eight Trillion Six Hundred Ninety One Billion One Hundred Forty Eight Million Seven Hundred Rupiah).

CONCLUSIONS AND RECOMMENDATIONS

Based on the research results, it can be concluded that the economic losses from ASF disease from 2020 to 2023 are very high and the highest losses are due to pig deaths and costs related to pig deaths, namely pig burials. This is due to high pork prices. The need for pigs is as an economic and socio-cultural resource because pigs are needed for socio-cultural activities as well as being a source of income.

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