

# The role of local pigs for economic and socio-cultural in East Flores District, East Nusa Tenggara, Indonesia

ARKADIUS SUBAN KERAY, RINI WIDIATI, TRI ANGGRAENI KUSUMASTUTI\*

Department of Livestock Social Economics, Faculty of Animal Science, Universitas Gadjah Mada. Jl. Fauna No. 3, Bulaksumur, Sleman 55281, Yogyakarta, Indonesia. Tel. + 62-274-513363, \*email: trianggraeni@ugm.ac.id

Manuscript received: 30 October 2023. Revision accepted: 23 January 2024.

**Abstract.** Keray AS, Widiati R, Kusumastuti TA. 2024. *The role of local pigs for economic and socio-cultural in East Flores District, East Nusa Tenggara, Indonesia. Biodiversitas 25: 214-222.* This study was conducted to identify the cultural activities related to swine rearing in East Flores District and analyze the decision making in choosing the types of rearing practice. Based on the survey using questionnaires from 120 pig farmers, which was conducted purposive, were those who had at least three sows for breeding, fattening with five heads of pigs, and combined with sows and sires. To identify the role of local pigs, as many as 3 informants consist of traditional leaders, farmers, and Agriculture Extension Officers, and analyzed by multinomial logistic regression model. The results showed that the traditional rituals that required the sacrifice of pigs included the ceremonies marking the start of building residential and traditional community buildings and dowry (*belis*) presentation in a wedding ceremony. The decision-making in choosing the rearing practice was influenced by pig ownership, care system ( $P < 0.01$ ), and income ( $P < 0.05$ ). Farmers who have small scale will choose extensive and fattening systems to reduce feed costs. Those practicing breeding are still maintaining local breeds because traditional rituals require it. Further efforts are needed to increase the populations of local breeds as well as cross-bred pigs to maintain the ceremonies in traditional rituals and income generation.

**Keywords:** Breeding, combined, fattening, multinomial logistic, traditional ritual

## INTRODUCTION

Farmed swine has the potential to become a source of income for families because the sale price is high, and it is always needed for daily and, especially, cultural needs as sacrificial animals (Widayati et al. 2018). Pig farming in Mesopotamia provided an efficient source of meat for urban populations and produced high-quality fertilizer (Price et al. 2017). Farmed swine is one of the superior commodities with the potential for further development in the Nusa Tenggara Timur (East Nusa Tenggara) province, particularly in East Flores District. The population of farmed pigs in East Flores District has increased by 8.00% or 87,217 heads in the past five years (BPS East Flores 2022). This growth indicates that the demand for pork has always been growing, making swine rearing a promising enterprise for community members.

Pig farms are traditionally divided into two types: sow farms, where new piglets are raised, and fattening farms, where piglets weighing more than 20 kg (about 8 weeks) are fattened to over 100 kg, weighed by the carcass (Valiño et al. 2019). The swine-rearing practices in Nusa Tenggara Timur comprise breeding, fattening, and combining both (Santa et al. 2021). For breeding operations, farmers raise several sires and bred sows to produce piglets that, in turn, are sold after weaning. Farmers in the fattening operations care for their pigs for four to five months to be sold at the market based on weights. The combined operations are conducted by farmers who practice both breeding and fattening.

Qui et al. (2020) stated that experience, education, diseases, and price fluctuation affect swine rearing. The larger scale of ownership leads to a better income but worsened environmental consequences (Wang et al. 2016). In addition, experience, swine rearing reason, and increasing income affect animal care (Ritchie et al. 2014). Swine-rearing practices are generally carried out in traditional methods (Santa and Wantasen 2018), in which farmers are not fully aware of the economic and technical aspects, they mainly utilize inputs for production such as feed, health, and sanitation. The challenges in small-scale swine rearing include infectious diseases, feed knowledge, and lack of good breed breeding (Islam et al. 2016).

Farmers chose the rearing practice, especially breeding type of local breed, to maintain local customs; this choice was related to the socio-cultural conditions that require the presence of farmed swine. Nugroho et al. (2015) stated that In Jayawijaya Papua, farmers used pigs for their own consumption (62.4%), as a gift (56.6%), or for sale (50.7%). This finding is supported by Leslie et al. (2015) that pigs are presented as gifts in religious holiday celebrations (34%), funerals (32%), traditional rituals (27%), and weddings (10%) where The percentage does not indicate the total of activities but is based on the percentage of respondents who chose each activity. In Timor Leste, pigs have a role in many rituals and social responsibilities (funerals, sacrifice rituals, and wedding gift) of families and communities, formally and informally, such as the *estilos* ceremony (Bettencourt et al. 2015). Tulak et al. (2019) reported that farmed pigs in Papua occupy important roles in cultures and traditions; for

example, mountainous communities use them to solve conflicts and celebrate traditional rituals. Moreover, farmed swine has a good prospect for development, particularly in East Flores District, because, from the socio-cultural viewpoint, this livestock is one of the main animals to be sacrificed in traditional rituals (Mengu et al. 2017). Additionally, the residents of East Flores have the potential to become potential consumers as they are mostly non-moslem.

Not many studies focused on socio-cultural characteristics requiring local breed swine related to farmers' choices in swine rearing. Along with the increase in population and the low type of breeding business, it can threaten the potential of local pig germplasm. Swine farmers in Nusa Tenggara Timur raise local and cross-bred pigs, but only the local breed is used for the traditional ceremonies. Mfewou et al. (2018) reported that farmers raise local, exotic (Large White and Danish Berkshire) and cross-breeds in south Cameroon. Pig production centers in other regions of Indonesia, namely Bali, Papua, and South Sulawesi people, do not specialize in local pigs as a requirement for traditional ceremonies but can be replaced by cross-breed pigs or other types of livestock. That was the reason why the study was conducted. The novelty of this research is that it illustrates the importance of maintaining the presence of local pigs as the main requirement for traditional rituals and marriages in Indonesia's largest pig production center. This research is

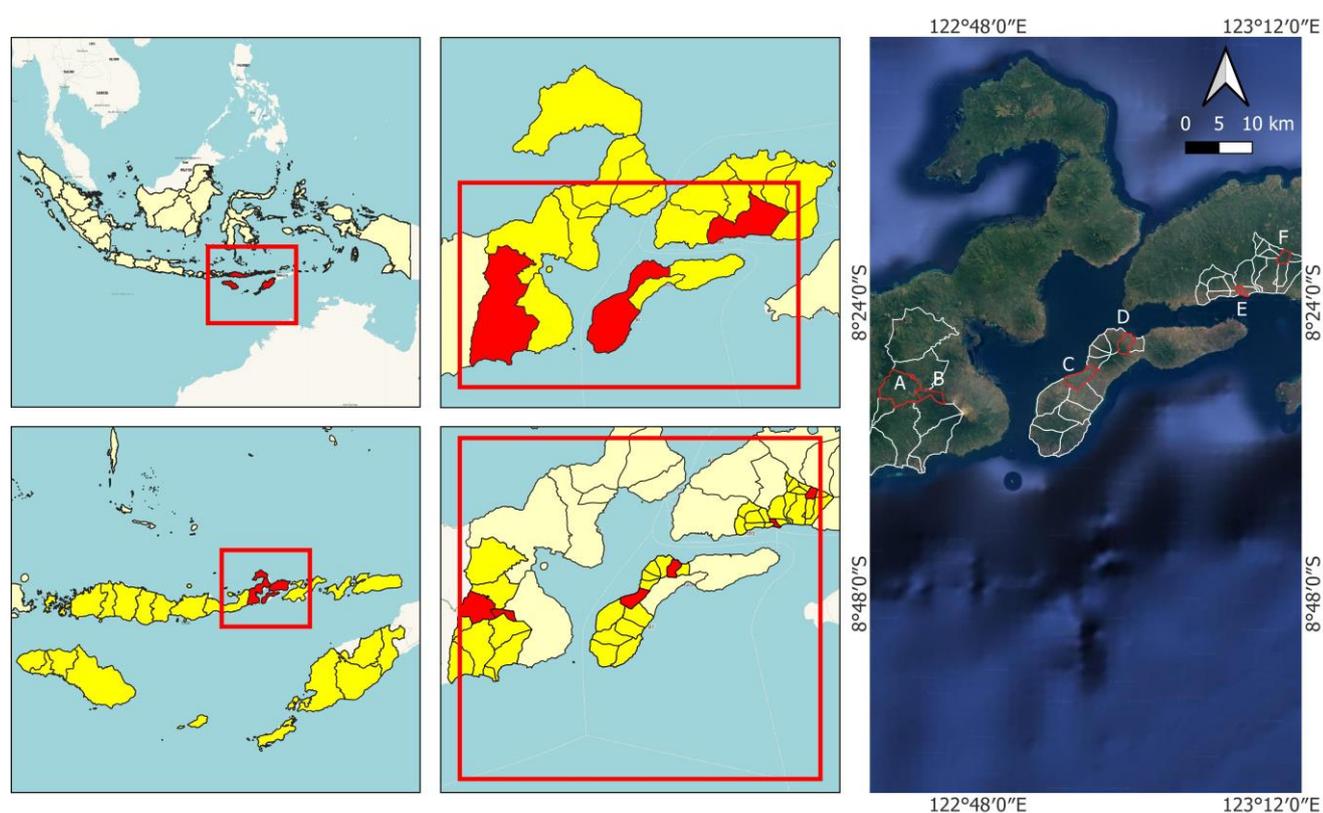
important as a basis for farmers planning to run a profitable business from an economic and environmental perspective and as an initial recommendation for the government in developing local pigs.

This study aimed to identify the cultural activities related to swine rearing in East Flores District and analyze the decision making in choosing the types of rearing practice .

## MATERIALS AND METHODS

### Study area

Based on the 2020 Central Statistics Agency report, East Nusa Tenggara is the province with the largest population of pigs in Indonesia, with a total of 2,432,501 heads (BPS 2020). East Flores District is one of the municipalities in Nusa Tenggara Timur Province, encompassing three islands of Solor, Adonara, and the eastern part of Flores, consisting of 22 Sub-districts. The study was conducted in three Sub-districts: Wulang Gitang, Adonara Timur, and Solor Barat. Three sub-districts were chosen from each of these islands, considering that this area is on the outskirts of Larantuka City. There is still open space for livestock businesses, and the number of pig farmers is quite large (Figure 1).



**Figure 1.** Location of field study in East Flores District, East Nusa Tenggara Province, Indonesia. A. Boru and B. Hokeng Jaya Villages, Wulanggintang Sub-district; C. Nuhalon and D. Ongalereng Villages, West Solor Sub-district; E. Waiwerang Kota and F. Karinglamalouk Villages, East Adonara Sub-district

**Procedures**

This study took place from September to November 2021, employing a multistage sampling method in six villages: Boru, Hokeng Jaya, Waiwerang, Karing Lamalouk, Ongalereng, and Nuhalolon. Six villages were chosen with the consideration of having the largest number of pig farmers. Next, 20 farmers were chosen from each village, a total of 120 based on the criteria of owning at least two breeding sows, five fattening heads, and sows and sires in combined operations. Informants to identify the role of local pigs are as many as 3 people consisting of traditional leaders, farmers, and an Agriculture Extension Officer.

Data were collected through interviews using questionnaires to gather information from the farmers. The information collected included respondents' characteristics, ownership scale, experience, sale age, mortality, and types of traditional rituals that required swine farming. Before surveying with breeders, the questionnaire was tested with several other breeders outside of the respondents through structured interviews to determine the level of understanding of the contents of the questionnaire. Therefore, to obtain information on socio-cultural conditions, this research determined 3 informants: traditional leaders, farmers, and agricultural instructors. These three informants describe business stakeholders, government and key persons who know cultural rules in East Flores District; in-depth interviews using an unstructured interview method to obtain qualitative data.

**Data analysis**

Quantitative data were analyzed using a combination of descriptive and qualitative; inferential statistical procedures by the STATA™ software (www.stata.com). Therefore, in-depth interviews were conducted with informants of cultural elders, village officials, and community leaders to obtain the primary data on swine farming.

Multinomial logistic regression (Hermosilla et al. 2020) was used to analyze the decision-making in swine rearing with the formula:

$$P_{i,j,k}(x) = \frac{1}{1 + \exp g(x)}$$

$$P_i(x) = \frac{e^{\beta_1}}{1 + e^{\beta_1} + e^{\beta_2}}$$

$$P_j(x) = \frac{e^{\beta_2}}{1 + e^{\beta_1} + e^{\beta_2}}$$

$$P_k(x) = \frac{1}{1 + e^{\beta_1} + e^{\beta_2}}$$

Where:

$P_i(x)$  : the probability of choosing a fattening practice

$P_j(x)$  : the probability of choosing a combined practice

$P_k(x)$  : the probability of choosing a breeding practice

As logit transformation was used for  $P_{ijkl}(x)$ , therefore the logit function regression could be defined as follows:

$$g(X) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + D + e$$

Where:

$g(x)$  : the option to decide the rearing practice

3 : breeding

2 : combined practice

1 : fattening,  $\beta_0$  is a constant

$\beta_{1-5}$  : regression coefficients

$e$  : an error

Multinomial logistic regression shows the interactions between the dependent variable (options in rearing practices) and independent variables (number of swine, education level, swine breed, experience, care system, and income) and is summarized in Table 1.

**RESULTS AND DISCUSSION**

**The description of demographic characteristics of pig farmers**

The socio-demographic profiles of pig farmers include age, rearing experience, formal education, main occupation, swine breed, and ownership of swine. Table 2 shows that most farmers fall into the productive age category (15-60 y.o.). Formal education was conducted for pig-rearing farmers with a low education or dominant elementary school. In addition, farmers in this study had high experience in raising pigs for breeding, fattening, and combined were 11.53±5.07, 10.34±5.16, and 11.25±4.10 years. Some pig farmers also practiced agriculture, while others were civil servants and entrepreneurs. The income of rearing breeders was IDR 750,770/month, fattening was IDR 870,607/month, and combined was IDR 954,610/month.

**Table 1.** Operational definitions for the study

Variables	Definition
Dependent variable	
Decision to choose a rearing practice (Y)	Farmers' choice category scale in rearing swine, 3: breeding, 2: combined, 1: fattening
Independent variables	
Number of pig ownership (X1)	Number of pigs owned by farmers (AU)
Formal education level (X2)	Highest formal education level of farmers (1: no school, 2: elementary, 3: middle school, 4: high school, and 5: higher education)
Swine breed (X3)	Swine breeds available (1: local, 2: cross-bred, 3: exotic)
Business experience (X4)	Farmers' pig-rearing experience (years)
Income (X5)	Farmers' income from pig rearing (Rupiah/year)
Rearing dummy (D)	Farmers' options on care system (1: extensive, 0: others)
Descriptive variables	
Sociocultural effects	The social conditions of a community that requires farmed pigs as the main part of traditional rituals
Farmers' decision to choose	Farmers' decision to choose a rearing practice based on the aspects of the economy and socio-cultural conditions of communities

The swine breeds in East Flores District were local, landrace (white with floppy ears), duroc (brownish red), and crosses of those three breeds. Based on the livestock heterogeneity, rearing was geared more towards breeding, in which farmers raised male and female piglets (Table 3). Most breeders choose the type of combined business of 13.54 heads or 2.72 UT. Many breeders keep young males because they are used as potential pigs ready for slaughter.

### Social culture conditions associated with swine rearing

The in-depth interviews with the informants provided information on what traditional rituals pigs were for. Those ceremonies included the blessings at the beginning of building homes, residential and traditional. While a sacrificial pig was required to present the dowry (locally known as *hantaran belis*) (Figure 2) during a wedding.



**Figure 2.** Local pigs (*Wawe kiwan*: Lamaholot language) in the East Flores District, East Nusa Tenggara, Indonesia

**Table 2.** Profiles of farmers

Component	Breeding (n= 26)		Fattening (n= 23)		Combined (n=71)	
	Frequency	%	Frequency	%	Frequency	%
Age (year)						
Productive	23	88.46	19	82.61	64	90.14
Non-productive	3	11.54	4	17.39	7	9.86
Formal education						
Elementary	9	34.62	8	34.78	31	43.66
Middle school	4	15.38	4	17.39	21	29.58
High school	8	30.77	7	30.44	10	14.10
Higher education	5	19.23	4	17.39	9	12.66
Work experience (year)						
≤10	2	7.69	4	17.39	5	7.04
>10	24	92.31	19	82.61	66	92.96
Main occupation						
Farmers	13	50.00	16	69.56	55	77.46
Civil servants	6	23.08	4	17.40	10	14.09
Entrepreneurs	7	26.92	3	13.04	6	8.45
Swine breeds						
Local	2	7.69	3	13.04	4	5.63
Landrace	6	23.08	5	21.73	7	9.86
Duroc	5	19.23	5	21.73	10	14.08
Crossed	13	50.00	10	43.50	50	70.43

**Table 1.** Ownership of farmed swine in East Flores District, East Nusa Tenggara, Indonesia

Population structure	Breeding (n= 26)		Fattening (n= 23)		Combined (n=71)	
	Head	AU	Head	AU	Head	AU
Sows/adult female	2.46	0.98	1.21	0.48	2.50	1
Sires/adult male	0.69	0.27	1.95	0.78	1.29	0.51
Young male			2.13	0.42	1.26	0.25
Gilts			1.65	0.33	1.22	0.24
Male piglets	4.50	0.45	0	0	3.67	0.36
Female piglets	4.92	0.49	0	0	3.60	0.36
Total	12.57	2.19	6.94	2.01	13.54	2.72

Note: AU: Animal Unit

*Informant I (Maria Prudensia Kolin, pig farmer, 29 February 2023):*

It is very important to raise local pigs because they are cheaper and can be afforded by the public. Apart from that, local pigs also have many uses, especially for traditional rituals such as building houses, churches and construction activities for other public places.

*Informant II (Markus M Keray, traditional dan village leader, 4 March 2023):*

In my opinion, the presence of local pigs is very important because it fulfills the needs of traditional rituals in the village.

*Informant III (Matius Sare Herin, Agriculture Extension Officer, 7 March 2023):*

In my opinion, the role of local pigs is very important in our area (East Flores) because they can be used for various traditional rituals, building houses and parties.

### **The reason is that local pigs are still kept alongside cross-bred pigs**

*Informant I (Maria Prudensia Kolin, pig farmer, 29 February 2023)*

Even though the price of local pigs is much cheaper than other cross-bred pigs, local pigs have many uses for traditional rituals. Several traditional rituals in East Flores require the use of local pork. However, since the emergence of ASF in East Flores, the local pig population has almost disappeared, so certain traditional rituals have been forced to use cross-bred pigs

If we look at the price, local pigs are much cheaper than other cross-bred pigs. However, many traditional rituals and party events require local pigs, so it is necessary to raise local pigs.

*Informant III (Matius Sare Herin, Agriculture Extension Officer 7 March 2023):*

People still have to raise local pigs because of traditional demands, and the price is still affordable because local pigs are cheap. So, if needed, it won't be too burdensome for the community

### **A traditional ceremony that requires the presence of local pigs**

*Informant I ( Maria Prudensia Kolin , 29 Februari 2023 )*

Some traditional rituals that require local pigs are making traditional houses building houses and other public buildings. But in recent years, because the local pig population has decreased due to ASF, people have been forced to use cross-breed pigs. Apart from that, because it is difficult to get local pigs, it is permitted to use cross-bred pigs. However, it is hoped that the local pig population will need to be increased to preserve the local wisdom that our ancestors have passed down.

*Informant II (Markus M Keray, traditional dan village leader, 4 March 2023)*

Local pigs are used during the construction of traditional houses, community houses, and other buildings,

as well as fines that someone must pay when committing a customary violation or in communities that require blood from local pigs. It is also used during the ritual of delivering belis to women, wedding parties, and welcoming parties (receiving first communion or religious parties).

*Informant III (Matius Sare Herin, Agriculture Extension Officer, 7 March 2023)*

The construction of houses, traditional houses, churches, schools, and other public buildings must use local pig's blood. Meanwhile, meat is usually used for consumption for deliveries and party events.

### **Local pig rearing system**

*Informant I (Maria Prudensia Kolin, 29 February 2023)*

Based on narrative and tradition, most local pigs are tied under trees (cashew trees or tamarind trees), and some are also kept in cages. But this local pig has its own uniqueness: it is fiercer compared to other cross-breed pigs. If it suddenly comes out of the cage or is separated from a tree, it is difficult to catch and can damage people's field crops. Some breeders who use cages usually use wood, bamboo, coconut fronds, or palm trees to make the cages. However, generally, local pigs are kept extensively or tied to trees.

*Informant II (Markus M Keray, traditional dan village leader, 4 March 2023)*

Because it has been a tradition passed down from generation to generation, local pigs are usually tied to trees or wood so that they can move more freely. However, as time passed, some started to be kept in cages using makeshift materials, such as used boards, zinc, and coconut fronds and did not use permanent cages because the breeders lacked capital or funds.

*Informant III (Matius Sare Herin, Agriculture Extension Officer, 7 March 2023)*

For generations, local pigs are usually kept tied under trees. But some are kept in cages because local pigs are very wild, so they fear they could damage local agricultural crops.

### **A way to ensure that local pigs do not become extinct**

*Informant I (Maria Prudensia Kolin, 29 February 2023)*

The way to maintain local pigs is that there needs to be development in the future. It's just that the problem currently being faced by farmers is the limited availability of local pig breeds. Thus, it is recommended that existing local pig farmers sell their piglets to be used for future development.

*Informant II (Markus M Keray, traditional dan village leader, 7 March, 2023 )*

Current local pig farmers, both male and female, are not allowed to sell them until they run out or are slaughtered. Both female and male pigs must be allowed to increase the population. When the population increases, it can be distributed to families or communities to care for.

*Informant III (Matius Sare Herin, Agriculture Extension Officer, 7 March 2023)*

The way to maintain local pigs is by not selling them carelessly, in the sense of selling them for slaughter. However, the remaining existing local pigs should be kept for traditional purposes. Apart from that, it is hoped that the government will also play a role in maintaining our traditional values or local wisdom by carrying out special breeding of local pig seeds so that they can be distributed to the community.

From the interviews with several informants, it can be concluded that the role of local pigs is to support traditional ritual needs such as the construction of traditional houses, residences, and other public buildings. Apart from being a sacrificial animal in traditional rituals, local pigs are also often used to deliver *belis* and as a customary sanction for indigenous peoples who commit customary violations.

To start building a residential home, a local breed pig must be sacrificed on the right foundation ditch by a cultural elder, *Tuan Tanah*, in East Flores. The blood is then dripped on the four corners of the foundations.

Meanwhile, in building a cultural community building, there are three phases of the ceremony: the installation of the main post, the slaughter of the sacrificial animals, and the slaughter of pigs on the roof peak after roof installation. The ceremony is similar to a residential home building in the first phase. In the second phase, each tribe in a village brings the largest pig of the local breed in their community to the ceremony, where the animals are immediately sacrificed. The number of pigs depends on the number of tribes in the village. The third phase occurs once the roof is installed, as in residential buildings. The community members in East Flores (Lamaholot ethnicity) believe that soil and rocks are animated beings. Digging on Earth is considered to injure the soil and rocks and, therefore, requires a sacrifice; in this case, the best pigs in the community. The pigs' blood represents the community's respect for their land. Additionally, they ask for the ancestors' blessing so that the building process goes without challenges and brings comfort.

Pigs are also required in a wedding ceremony; the day before the wedding, the groom's family brings the dowry (*belis/gading*) accompanied by pigs and goats. The number of pigs varies from three to five, and these animals will be slaughtered and prepared for the wedding reception.

Religious ceremonies are also the occasions when pork is consumed. Since most East Flores residents are non-moslem, pork is served during Christmas, New Year, Easter, and *Sambut Baru*, a celebration for the first eucharist.

### Decision-making on swine rearing based on the practice types

The variable response in this study was the practice types, consisting of three categories: breeding, fattening, and combined. The combined practice was also used as the baseline or control group in the data analyses. In Table 4, A likelihood ratio of Chi-square at 48.35 with a  $p < 0.00$  demonstrated that the model as a whole fit significantly better than an empty model with the pseudo- $R^2$  of 0.2102

(El-Habil 2012). Furthermore, farmers with fewer animals chose fattening compared to the other practices; if income decreased, farmers chose to practice breeding and extensive systems. This phenomenon could be explained by the fact that the local breed was not reared mainly for commercial purposes but could be used in traditional rituals and, therefore, are assets. Based on the results of the Multinomial logistic analysis, the highest opportunity for farmers in the rearing system is fattening. The relationship with local pigs for traditional ceremonies is that the maintenance time is shorter than in the breeding system, so that they can be used for traditional ceremonies at any time, whether their blood or meat is taken.

### Discussion

In Nusa Tenggara Timur only the local breed swine is used for the traditional ceremonies. Furthermore, 3 cultural activities required local pigs and were not found in other regions with pig production centers such as Papua, South Sulawesi, Bali, and Timor Leste. Traditional culture in other areas, namely Papua, Toraja, Bali, and Timor Leste, does not require local pigs to be present in ceremonies. Many traditional ceremonies use pigs and other livestock, such as buffalo ). In addition, the customary culture of using pigs is only found in certain regions and tribes. For example, in Papua, pigs support traditional ceremonies in mountainous or highland areas (Suroto 2014). Small-scale pig farmers in Thailand are scattered in remote rural areas and highlands (Thanapongtharm et al. 2016), and geographical differences affect pigs' rearing and ceremonial roles (Hunter et al. 2022).

**Table 4.** Multinomial logistic regression on farmers' decision to choose a rearing practice

Variable	Coefficient	SE	Z	Probability
Fattening				
Swine number	-2.204	0.780	-2.83	0.005**
Education	0.1168	0.213	0.55	0.584
Breed	0.350	0.478	0.73	0.464
Work	-0.029	0.064	-0.46	0.648
experience	2.570	0.641	4.01	0.000***
Care system	-2.03e	7.80	-0.26	0.795
Income	2.369	2.149	1.10	0.270
-cons				
Breeding				
Swine number	-0.444	0.651	-0.68	0.495
Education	0.189	0.186	0.97	0.332
Breed	0.714	0.462	1.55	0.122
Work	0.027	0.060	0.45	0.653
experience	2.138	0.610	3.50	0.000***
Care system	-1.77	7.24	-2.45	0.014**
income	-0.910	1.937	-0.47	0.638
-cons				

Notes: Number of observations = 120;  $\chi^2 = 48.35$ ; Prob  $\chi^2 = 0.0000$ ; Pseudo  $R^2 = 0.2102$ ; \*\*\* =  $p < 0.01$ ; \*\* =  $p < 0.05$ . Combined practice was the baseline choice; The opportunity for pig farmers to choose the highest rearing system is fattening at 1.11, breeding at 0.07 and combination at 0.04. Source: primary data.

The demographic characteristics of income, pig ownership, and rearing systems influenced the choice of business type, whether it was breeding, fattening, or a combined. Those in productive age would be compelled to apply ideas and knowledge to grow their enterprise. Prasetyo et al. (2020) and Liu et al. (2021) reported that farmers at the productive age adopt ideas and knowledge to meet their economic needs more easily than other age groups. Education level and experience also affect the success of a swine-rearing business. Ninh (2020) and Roches et al. (2016) revealed that education influences farmers' ability to use new technologies, facilitate access to market information, and improve livestock management. The main income for farmers is the sales of their animal livestock; thus they develop rearing plans to maximize earnings (Akouegnonhou and Demirbas 2021). Swine farming is economically profitable if the production costs can be minimized (Bjornlunc et al. 2019); therefore, farmers can use household organic waste for feed to feed efficiently. Harikumar et al. (2016) and Sharma et al. (2015) reported that most swine farmers rear cross-bred animals, use kitchen waste as feed, and rarely provide concentrate. Meanwhile, Wea (2015) reported that kitchen waste fed to pigs is not nutritionally monitored, negatively impacting the reproduction system and meat production and reducing earnings. The number of livestock is related to income (Taruvinga et al. 2022). The limited ownership numbers of pigs, whether in breeding or fattening, compel the farmers to adopt an extensive rearing system. This means allowing farmers to reduce the production costs of pen building and feed provision, increasing earnings, and facilitating care. However, Delattre et al. (2020) and Gaona et al. (2021) reported that the weakness of an extensive livestock system is the requirement for an ample supply of input to maintain good livestock productivity. An extensive care system also tends to increase the risks of caring for and spreading diseases (Temple and Manteca 2020; Delsart et al. 2020).

The highest mortality from piglet heads in young and adult pigs is mainly caused by diarrhea, low birth weight, being crushed by the sows, and getting caught in the fence. Other causes of mortality in young and adult pigs include shortness of breath, decreased appetite, pandemics of Classical Swine Fever (ASF), or hog cholera, while African swine fever is a deadly porcine disease that has spread into East Asia, which has a detrimental effect on pork production (Mason-D'Croz et al. 2020). Leslie et al. (2015) said that the majority of farmers in Nusa Tenggara Province had no knowledge of classical swine fever (91%). Classical swine fever has been negatively impacting pig production in Nusa Tenggara Timur province in eastern Indonesia since its introduction in the 1990 (Leslie et al. 2016). Moreover, the high mortality in swine is influenced by the rearing system, feed, and amount of the animal reared (Wea 2015). Therefore, education by the government through extension agents is needed to promote the adoption of livestock management and health services (Ahmed et al. 2017; Balasubramanyam et al. 2020; Beltran-Alcrudo et al. 2020; Qui et al. 2020). In addition, tribal

treaties are important for good systems in quarantining and disposal of deceased animals (Barnes et al. 2020).

In East Flores, combined types were the most cultivated besides breeding and pig fattening. This follows the opinion of Sinulingga et al. (2020) that the type of business most widely farmed is the combined type because it can adjust to feed prices. If the price of feed rises, breeders will reduce the number of pigs kept by selling pigs at younger ages. Another opinion, according to Suranjaya et al. (2017) if the breeding business has not yet been harvested but the breeder requires funds for livestock maintenance, the breeder can sell adult pigs from the fattening business. The same phenomenon occurs in cattle farming; if there is an increase in the demand for beef and meat livestock, the good-quality seeds produced will not be sold but kept as beef cattle. This business strategy has to be done because it is more profitable and reliable to support the family economy.

The community in East Flores needs local pigs to increase income and other purposes, especially concerning ceremonial activities, therefore, the local breed pigs must be protected. Sahu and Gupta (2022) and Silva et al. (2016) stated that governments must maintain local breed phenotypes for conservation purposes. However, other breeds should be introduced to produce more productive cross-breeding to continue their increasing income generation in the community; the cross-bred animals often bring higher sale prices than local breeds. Therefore, combined rearing practices can be carried out by having the same proportions of local and cross-bred animals in the same operations to balance phenotypic conservation and income generation. The introduction of cross-breeding with exotic breeds through Artificial Insemination (AI) is supposed to produce superior animals and increase the population of farm swine. Meanwhile, Tochwang and Rewani (2013) reported that the local breeding system must be improved to increase the population because cross-bred inseminated breeds were unavailable, and semen for AI was difficult to obtain. The genetic improvement of indigenous pigs must be prioritized to produce superior germplasm; therefore, selective and cross-breeding must be broadened to increase production and productivity (Chauhan et al. 2016). On the other hand, mobile insemination facilities and vaccination services, pork processing, and pig waste utilization can improve the population and provide more employment (Patr et al. 2014). It is necessary to develop models from environmental, economic, and social dimensions to build a more efficient and profitable pig farming chain (Secco et al. 2020).

Local pigs in East Nusa Tenggara, especially East Flores District, support traditional ritual needs such as constructing houses, residences, and other public buildings. Apart from being a sacrificial animal in traditional rituals, local pigs are also often used to deliver *belis* and as a customary sanction for indigenous peoples who commit customary violations. Local pigs have cultural and sacred value in certain beliefs where pig blood reflects peace so it cannot be directly related to animal welfare. Pigs are connected to the spirit world where they can communicate

with the Great Spirit (Janowski 2021). Therefore, to maintain the existence of local pigs, government assistance is crucial to improve sows and support the introduction of technology, the Animal Husbandry Service, educational institutions availability, and supporting private sector business.

## ACKNOWLEDGEMENTS

The authors would like to thank the Faculty of Animal Science, Universitas Gadjah Mada, through the *Rekognisi Tugas Akhir* Scheme in 2022 (contract number: 1525/UN1/DITLIT/Dit-Lit/PT.01.05/2022. Our gratitude is also extended to all farmers, especially in Wulang Gitang, East Adonara, and West Solor Sub-district, East Flores, Indonesia.

## REFERENCES

- Ahmed K, Ahmed N, Kalita D, Barman D. 2017. Housing practices for small scale pig production in rural communities of Assam. *Intl J Chem Stud* 5: 519-521.
- Akouegnonhou O, Demirbas N. 2021. Factors affecting the income of farmers participating in traditional and modern livestock markets: Case study from Benin Republic. *Selcuk J Agr Food Sci* 35 (3): 210-217. DOI:10.15316/SJAFS.2021.250.
- BPS. 2020. Provinsi Nusa Tenggara Timur Dalam Angka 2022. Badan Pusat Statistika NTT, Kupang. [Indonesian]
- BPS East Flores. 2022. Flores Timur Dalam Angka 2022. Badan Pusat Statistika, Flores Timur. [Indonesian]
- Balasubramanyam D, Mohanapriya M, Senthilkumar K, Devaki K, Jothika C. 2020. Socio economic status of pig farmers in Tamil Nadu. *Intl J Environ Sci Technol* 94: 656-659.
- Barnes TS, Morais O, Cargill C, Parke CR, Urlings A. 2020. First steps in managing the challenge of African Swine Fever in Timor-Leste. *One Health* 10: 100151. DOI: 10.1016/j.onehlt.2020.100151.
- Beltran-Alcrudo D, Falco JR, Raizman E, Dietze K. 2019. Transboundary spread of pig diseases: the role of international trade and travel. *BMC Vet Res* 15: 1-14. DOI: 10.1186/s12917-019-1800-5.
- Bettencourt EMV, Tilman M, Narciso V, Carvalho MLDS, Henriques PDDS. 2015. The livestock roles in the wellbeing of rural communities of Timor-Leste. *Rev de Econ e Sociol Rural* 53: 63-80. DOI:10.1590/1234-56781806-94790053s01005.
- Bjornlunc H, Zuo A, Wheeler SA, Parry K, Pittock J, Mdemu M, Moyo M. 2019. The dynamics of the relationship between household decision-making and farm household income in small-scale irrigation schemes in southern Africa. *Agric Water Manag* 213: 135-145. DOI: 10.1016/j.agwat.2018.10.002.
- Chauhan A, Patel BHM, Maurya R, Kumar S, Shukla S, Kumar S. 2016. Pig production system as a source of livelihood in Indian scenario: An overview. *Int J Sci Environ Technol* 5 (4): 2089-2096.
- Delattre L, Debolini M, Paoli JC, Napoleone C, Moulery M, Leonelli L, Santucci P. 2020. Understanding the relationships between extensive livestock systems, land-cover changes, and CAP support in less-favored Mediterranean Areas. *Land* 9: 1-20. DOI: 10.3390/land9120518.
- Delsart M, Pol F, Dufour B, Rose N, Fablet C. 2020. Pig farming in alternative systems: strengths and challenges in terms of animal welfare, biosecurity, animal health and pork safety. *Agriculture* 10 (7): 261. DOI: 10.3390/agriculture10070261.
- El-Habil AM. 2012. An application on multinomial logistic regression model. *Pak J Stat Oper Res* 3 (2): 271-291. DOI: 10.18187/pjsor.v8i2.234.
- Gaona CD, Rodriguez MS, Estévez VR. 2021. Assessment of the sustainability of extensive livestock farms on the common grasslands of the Natural Park Sierra de Grazalema. *Sustainability* 13: 1-19. DOI: 10.3390/su13041818.
- Harikumar S, Davis J, Anil KS. 2016. Use of unconventional feed in pig production. *J Indian Vet Assoc* 14 (3): 5-11.
- Hunter CL, Millar J, Toribio LML JA. 2022. More than meat: The role of pigs in Timorese culture and the household economy. *Intl J Agric Sustain* 20 (2): 184-198. DOI: 10.1080/14735903.2021.1923285.
- Islam R, Nath P, Bharali A. 2016. Constraints perceived by the small scale pig farmers in Sivasagar district of Assam: An analysis. *Asian J Anim Sci* 11 (1): 73-77. DOI: 10.15740/HAS/TAJAS/11.1/73-77.
- Janowski M. 2021. Prey into kin: The cosmological role of the pig in the Kelabit Highlands, Sarawak. *Anthropozoologica* 56 (11): 167-180.
- Leslie EE, Geong M, Abdurrahman M, Ward MP, Toribio JAL. 2015. A description of smallholder pig production systems in eastern Indonesia. *Prev Vet Med* 118 (4): 319-327. DOI: 10.1016/j.prevetmed.2014.12.006.
- Leslie EE, Geong M, Abdurrahman M, Ward MP, Toribio JAL. 2016. Live pig markets in eastern Indonesia: Trader characteristics, biosecurity and implications for disease spread. *Acta Trop* 155: 95-103. DOI: 10.1016/j.actatropica.2015.12.014.
- Liu J, Du S, Fu Z. 2021. The impact of rural population aging on farmers' cleaner production behavior: evidence from five provinces of The North China Plain. *Sustainability* 13: 1-16. DOI: 10.3390/su132112199.
- Mason-D'Croz D, Bogard JR, Herrero M, Robinson S, Sulser TB, Wiebe K, Willenbockel D, Godfray HCJ. 2020. Modelling the global economic consequences of a major African swine fever outbreak in China. *Nat Food* 1 (4): 221-228. DOI: 10.1038/s43016-020-0057-2.
- Mengu YS, Lole UR, Niron SS. 2017. Kinerja produksi dan ekonomi usaha finishing ternak babi program pengembangan usaha agribisnis perdesaan (PUAP) di Kecamatan Adonara Timur. *Jurnal Nukleus Peternakan* 4 (1): 71-82. [Indonesian]
- Mfewou A, Lendzele SS. 2018. Urban-pig farming: easy gain and danger to the environment (Yaounde-Cameroon). *Agric Stud* 2: 190-198. DOI: 10.31058/j.as.2018.24018.
- Ninh LK. 2020. Economic role of education in agriculture: Evidence from rural Vietnam. *J Econ Dev* 23 (1): 47-58. DOI: 10.1108/JED-05-2020-0052.
- Nugroho W, Cargill CF, Putra IM et al. 2015. Traditional pig farming practices and productivity in the Jayawijaya region, Papua Province, Indonesia. *Trop Anim Health Prod* 47: 495-502. DOI: 10.1007/s11250-014-0748-5
- Patr MK, Begum S, Deka BC. 2014. Problems and prospects of traditional pig farming for tribal livelihood in Nagaland. *Indian Res J Ext Education* 14 (4): 6-11.
- Prasetyo E, Ekowati T, Gayatri S. 2020. An income analysis of beef cattle fattening system and its contribution to the total household income in Central Java Province. *J Indonesian Trop Anim Agric* 45 (4): 365-372. DOI: 10.14710/jitaa.45.4.365-372.
- Price M, Grossman K, Paulette T. 2017. Pigs and the pastoral bias: The other animal economy in Northern Mesopotamia (3000-2000 BCE). *J Anthropol Archaeol* 48: 46-62. DOI: 10.1016/j.jaa.2017.06.001.
- Qui NH, Guntoro B, Syahlani SP, Linh NT. 2020. Factor affecting the information sources and communication channels toward pig farmer's perception of African swine fever in Tra Vinh Province, Vietnam. *Trop Anim Sci J* 44 (2): 248-254. DOI: 10.5398/tasj.2021.44.2.248.
- Ritchil CH, Faruque MO, Tabassum F, Hossain MM, Bhuiyan AKFH. 2013. Socio-economic status of pig rearers and management system of native pigs in Bangladesh. *Indian J Anim Sci* 83 (11): 1226-1228.
- Roches ADBD, Veissier I, Boivin X, Fromont EG, Mounier L. 2016. A prospective exploration of farm, farmer, and animal characteristics in human-animal relationships: An epidemiological survey. *J Dairy Sci* 99: 5573-5585. DOI: 10.3168/jds.2015-10633.
- Sahu K, Gupta S. 2022. Status of pig farming and its multi-factorial assessment in the urban districts of Uttarakhand: A case study about its sustainability and ecological implications. *Research Square* [Preprint]. DOI: 10.21203/rs.3.rs-1532060/v1.
- Santa NM, Manese MAV, Waleleng POV. 2021. The efficiency of pig farming inputs in Minahasa Regency of North Sulawesi. *J Indonesian Trop Anim Agric* 46 (1): 84-90. DOI: 10.14710/jitaa.46.1.84-90.
- Santa NM, Wantasen E. 2018. Profit analysis of pig farming in rural communities in Minahasa Regency of North Sulawesi. *J Indones Trop Anim Agric* 43: 289- 295. DOI: 10.14710/jitaa.43.3.289-295.
- Secco C, da Luz LM, Pinheiro E, de Francisco AC, Puglieri FN, Piekarski CM, Freire FMCS. 2020. Circular economy in the pig farming chain: Proposing a model for measurement. *J Clean Prod* 260: 121003. DOI: 10.1016/j.jclepro.2020.121003.

- Sharma A, Debarma N, Pramanik PS. 2015. Pig management practices in Tripura, India. *Indian J Anim Res* 49 (6): 863-865. DOI: 10.18805/ijar.7052.
- Silva GLLP, Thuy LT, Abeykoon ND, Hanh NTH, Bett RC, Okeyo M, Ibrahim MN. 2016. Comparative study of Indigenous pig production in Vietnam and Sri Lanka. *Intl J Livest Prod* 7 (10): 84-93. DOI: /10.5897/IJLP2016.0306.
- Sinulingga YP, Santa NM, Kalangi LS, Manase M. 2020. Analisis pendapatan usaha ternak babi di Kecamatan Tombulu Kabupaten Minahasa. *Jurnal Zootec* 41 (2): 471-481. DOI: 10.35792/zot.40.2.2020.28613. [Indonesian]
- Suranjaya IG, Dewantari M, Parimartha IKW, Sukanata IW. 2017. Profile usaha peternakan babi skala kecil di Desa Puhu, Kecamatan Payangan, Kabupaten Gianyar. *Majalah Ilmiah Peternakan* 20 (2):79-83. DOI: 10.24843/MIP.2017.v20.i02.p08.
- Suroto H. 2014. Babi dalam budaya Papua. *Jurnal Penelitian Arkeologi Papua dan Papua Barat* 6(1):37-44. DOI: 10.24832/papua.v6i1.41. [Indonesian]
- Taruvinga A, Kambanje A, Muchunje A, Mukarumbwa P. 2022. Determinants of livestock species ownership at household level: Evidence from rural OR Tambo District Municipality, South Africa. *Pastoralism: Res Pol Pract* 12: 1-11. DOI: 10.1186/s13570-021-00220-6.
- Temple D, Manteca X. 2020. Animal welfare in extensive production systems is still an area of concern. *Frontiers* 4: 1-18. DOI: 10.3389/fsufs.2020.545902.
- Thanapongtharm W, Linard C, Chinson P, Kasemsuwan S, Visser M, Gaughan AE, Epprech M, Robinson TP, Gilbert M. 2016. Spatial analysis and characteristics of pig farming in Thailand. *BMC Vet Res* 12 (1): 1-15. DOI: 10.1186/s12917-016-0849-7.
- Tochhawng L, Rewani SK. 2016. Constraint analysis of backyard pig farming in tribal areas of Mizoram. *Indian Res J Ext Educ* 13 (2):123-125.
- Tulak A, Khaerunnisa, Landius. 2019. Strategi pengembangan peternakan babi di Distrik Hubikiak, Kabupaten Jayawijaya. *Jurnal Ilmiah Agribisnis Ekonomi dan Sosial* 3 (1):91-102. DOI: 10.33366/optima.v3i1.1254. [Indonesian]
- Valiño L, Sarasa C, Duarte R. 2019. Economy-wide effects of a sustainable pathway in the pig sector: A case study in Aragon (Spain). *J Environ Manage* 239: 84-89. DOI: 10.1016/j.jenvman.2019.03.041.
- Wang X, Wu X, Yan P, Gao W, Chen Y, Sui P. 2016. Integrated analysis on economic and environmental consequences of livestock husbandry on different scale in China. *J Clean Prod* 119: 1-12. DOI: 10.1016/j.jclepro.2016.01.084.
- Wea R. 2015. Karakteristik peternak dan manajemen pemeliharaan babi lokal di Kecamatan Alak, Kota Kupang. *Jurnal Partner* 2: 178-184. [Indonesian]
- Widayati TW, Sumpe I, Irianti BW, Iyayi DA, Randa SY. 2018. Faktor-faktor yang mempengaruhi produksi usaha ternak babi di Teluk Doreri, Kabupaten Manokwari. *Jurnal Ilmu-Ilmu Pertanian Agrika* 2 (1): 73-82. DOI: 10.32585/ags.v2i1.220. [Indonesian]