



Poverty Alleviation Model for Livestock Business Households in Gandus District, Palembang

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Abstract

Background: Since 2017, the Palembang City Agriculture and Food Security Office has implemented a *Pegagan* duck livestock assistance program to alleviate poverty in Gandus District. However, its impact on poverty alleviation has never been formally evaluated. This study is urgently needed to assess the program's effectiveness, provide evidence for improving its implementation, and support its potential replication in other districts of Palembang City.

Objective: This study aims to (i) develop a poverty alleviation model for livestock business households, (ii) evaluate the distribution of poverty alleviation program assistance by the Palembang City Agriculture and Food Security Office, and (iii) map poor families in Gandus District using Geographic Information System (GIS) software.

Methods: Data were collected through library research and field research. Two analytical techniques were employed: Structural Equation Modeling–Partial Least Squares (SEM-PLS) analysis and mapping of poor families using a Geographic Information System (GIS).

Results: The SEM-PLS analysis revealed that investment had a positive and significant effect on welfare (t-statistic = 3.744, p = 0.000), while poverty had a significant effect on income (t-statistic = 2.978, p = 0.003). However, the relationships between income and investment, income and consumption, and poverty and welfare were not statistically significant. Poverty mapping using GIS showed that Pulokerto Village had the highest poverty rate (10.25%), whereas Karang Jaya Village had the lowest (6.54%) among the five villages in Gandus District.

Conclusion: Investment significantly improves household welfare, while poverty significantly affects household income. GIS mapping also revealed spatial differences in poverty levels among villages in Gandus District, supporting more targeted poverty alleviation efforts.

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INTRODUCTION

The Indonesian government has implemented various programs aimed at alleviating poverty and improving community welfare (Nugroho et al., 2021). One such program is the *Program Bedah Kemiskinan Rakyat Sejahtera* (BEKERJA), an agricultural-based poverty alleviation program. The Ministry of Agriculture expects effective collaboration among government agencies, stakeholders, community organizations, and academic institutions (Ministry of Communication and Informatics, 2018).

This national government program was also implemented in Palembang City by the Palembang City Agriculture and Food Security Office, including in Gandus District (Lupikawaty, 2022). In implementing the program, the agency adopted several measures to reduce the risk of program failure. These measures included several stages of planning and decision-making, namely: (1) the program would be implemented beginning in 2017; (2) livestock would be distributed to poor households. There were still many poor households in Palembang City in 2017, totaling 44,864 underprivileged or very poor households. The largest number was recorded in Seberang Ulu II District, with 4,917 households, while the smallest number was recorded in Bukit Kecil District, with 882 households (BPS, 2018). Although poor households were distributed throughout Palembang City, the Palembang City Agriculture and Food Security Office selected Gandus District for the poverty alleviation program because it is also the location of the office, making it easier to provide assistance and monitor livestock businesses. The selected duck breed was *Pegagan* duck, which was considered suitable for the swampy geographical conditions of Gandus District.

The program has been implemented by the Palembang City Agriculture and Food Security Office since 2017. The distribution data for *Pegagan* ducks and associated assistance are presented in Table 1.

Table 1

Distribution of Poverty Alleviation Program Assistance for the Poor in Gandus District by the Palembang City Agriculture and Food Security Office, 2017

NO	Building Material Details	Units	Units	SINAR LESTARI 15 people	SINAR JAYA 10	SRI KEMBANG 23 org	KERTO WIJAYA I 10 Org	SANDA NG 10 Org
1	Gelam Wood 12 x 14	160	btg	15	10	23	10	10
2	Gelam Wood 12 x 10	320	btg	45	30	69	30	30
3	Gelam Wood 8 x 10	320	btg	45	30	69	30	30
4	3x4x4 Drum	320	btg	0	0	0	0	0
5	Board 2.5x25 x400	128	LBR	0	0	0	0	0
6	Fence board 2.5x7x400	112	LBR	0	0	0	0	0
7	Pop 5"	34	Kg	4	3	7	3	3
	4"	35	Kg	4	3	7	3	3
	3"	40	Kg	2	2	3	2	2
	2.5"	64	Kg	8	5	11	5	5
	2"	48	Kg	3	2	5	3	3
8	Zinc 7 feet	224	LBR	0	0	0	0	0
	6 feet	224	LBR	40	0	0	0	0
9	Bamboo Blade	280	tie	62	40	95	42	41
10	Stuttgart	40	Ball	9	6	13	6	6
	Duck Breeding Seeds	1020	Tail	225	150	348	150	150
	Animal Feed	1795	Kg	3950	2650	6050	2650	2650

Source: Palembang City Agriculture and Food Security Office, 2019

The distribution of *Pegagan* ducks to the Gandus community (Table 1) included not only the provision of ducks but also materials for constructing livestock cages and animal feed. The distribution was carried out in 2017. According to an interview with an official from the veterinary authority, Dr. Jafrizal, DVM, the data had not been updated for similar activities through 2020 because the outcomes of the assistance program were still being monitored. The Palembang City Agriculture and Food Security Office also continued to provide business assistance by deploying Field Agricultural Extension Officers (*Penyuluh Pertanian Lapangan*, PPL) on a daily basis and by periodically vaccinating the livestock.

A livestock assistance program can be considered successful if the ducks are able to lay eggs and reproduce (Arias, 2021). However, these indicators alone may not adequately measure program success; therefore, an economic evaluation of poverty and household welfare is also necessary. Poverty is a condition of limited capacity to adequately meet basic needs, characterized

by insufficient income, limited access to basic services, and inadequate productive resources (Dos Santos, 2017; Gweshengwe & Hassan, 2020; Suresh, 2023). Welfare, in contrast, refers to the extent to which a household can meet its basic needs and achieve an adequate standard of living. This study seeks to measure the welfare level of livestock business households that received assistance from the Palembang City Agriculture and Food Security Office. Several previous studies have also highlighted government efforts to alleviate poverty, such as Li (2021) who stated that poverty alleviation in China is important, as it is for other countries around the world, and is consistent with the United Nations Sustainable Development Goals, particularly the goal to “end poverty in all its forms everywhere.” Diatmika (2021) examined the impact of government village fund assistance on family welfare in Bali, while Osei (2020) examined the social capital of formal and non-formal institutions utilized by women entrepreneurs in villages to improve the welfare of rural communities in Ghana.

An evaluation of the government program in Gandus District is needed to formulate a poverty alleviation model that can serve as a reference for improving similar livestock-based interventions. Geographic Information Systems (GIS) can support this evaluation by visualizing the spatial distribution of poverty and differences in poverty levels among villages (Hu et al., 2022; Putri et al., 2022; Wang et al., 2019). In this study, GIS mapping focuses on Gandus District using available population and poverty data to support more targeted poverty alleviation planning. Several indicators are needed for poverty mapping, including the number of family members, the dependency ratio (productive and nonproductive population), population density, literacy rate, formal education, employment status, occupation and industry, access to credit, urban/rural characteristics, asset ownership, housing quality, and access to electricity, gas, and sanitation (Suparta, 2024).

Based on the description above, this study focuses on developing a poverty alleviation model for livestock business households in Gandus District, evaluating the distribution of poverty alleviation program assistance provided by the Palembang City Agriculture and Food Security Office, and mapping poor households in Gandus District using Geographic Information System (GIS) software. Accordingly, the study aims to provide an empirical basis for strengthening the evaluation and targeting of poverty alleviation efforts in Gandus District.

The urgency of this research lies in evaluating the *Pegagan* duck distribution program as an effort to alleviate community poverty. According to interviews with the program partner, namely the Palembang City Agriculture and Food Security Office, no formal measurement of the poverty alleviation program's outcomes had previously been conducted. Therefore, the partner institution required assistance from academics to evaluate the impact of a program that had been implemented for five years (2017–2021). If the evaluation demonstrates that the poverty alleviation program is effective, the program is expected to serve as a *pilot project* for subsequent poverty alleviation programs in other districts in Palembang City. The evaluation results can serve as a reference for the implementation of future programs conducted by the Palembang City Agriculture and Food Security Office.

METHOD

This research was conducted in Gandus District, Palembang City, where the Poverty Alleviation Program through *Pegagan* duck business assistance has been implemented by the Palembang City Agriculture and Food Security Office since 2017. The study focused on households participating in the program and examined the relationships among poverty, income, consumption, investment, and welfare, together with the spatial distribution of poverty in Gandus District.

The variables observed included poverty, income, consumption, investment, and welfare level. The poverty variable was measured using indicators of household resources, natural resources, skills, and capital. The income variable is measured based on livestock productivity and the selling price of livestock products, while the consumption variable includes food and non-food expenditure. The investment variables consist of real investment and financial investment, while the level of welfare is measured using poverty line indicators and the ability of households to meet basic needs.

Data collection was carried out through literature studies and field studies. Literature

studies are carried out by examining various books, scientific journals, and relevant documents as the theoretical basis for research. The field study was carried out through structured interviews with the Palembang City Agriculture and Food Security Office as well as the distribution of questionnaires to the households of farmers receiving program assistance to obtain primary data in accordance with the research objectives.

The respondents comprised 68 Pegagan duck farmers from five beneficiary groups in Gandus District. Given that the population is less than 100 people, the study uses a census sampling technique so that all members of the population are used as research samples.

Data analysis was carried out using two approaches. First, Structural Equation Modeling-Partial Least Squares (SEM-PLS) was used to analyze the relationship between latent variables through testing structural models (inner model), measurement models (outer models), and weight relationships so that a model of poverty alleviation in livestock businesses was obtained. Second, the Geographic Information System (GIS) is used to map the spatial distribution of poverty levels by integrating demographic data, geographical conditions, infrastructure, services, and regional resources to produce a more comprehensive visualization of the program's target areas.

RESULTS AND DISCUSSION

Description of Respondent Characteristics

The respondents in this study comprised 68 livestock farmers from five beneficiary groups that received subsidies from the Palembang City Agriculture and Food Security Office.

Table 2

Distribution of Respondents by Livestock Group

		Livestock Group			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	KW	10	14.7	14.7	14.7
	SJ	7	10.3	10.3	25.0
	Stuart	17	25.0	25.0	50.0
	O'T				
	SL	24	35.3	35.3	85.3
	SS	10	14.7	14.7	100.0
	Total	68	100.0	100.0	

Source: data processed, 2021

There were 5 livestock groups that became respondents, namely i) Kerto Wijaya 1 group with 10 members (14.7%), ii) Sinar Jaya group with 7 members (10.3%), iii) Sri Kembang group with 17 members (25%), (iv) Sinar Lestari group with 24 members (35.3%) and v) Sandang Sarana group with 10 members (14.7%). The most respondents were in the Sinar Lestari group and the least respondents were in the Sinar Jaya group.

Table 3

Distribution of Respondents by Age Class

		Age Class			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	22-29	2	2.9	2.9	2.9
	30-37	17	25.0	25.0	27.9
	38-45	23	33.8	33.8	61.8
	46-53	9	13.2	13.2	75.0
	54-61	12	17.6	17.6	92.6
	62-69	3	4.4	4.4	97.1
	70-78	2	2.9	2.9	100.0
	Total	68	100.0	100.0	

Source: data processed, 2021

The respondents ranged in age from 22 to 78 years. Using the calculation of the youngest and oldest age ratio (Range), the calculation of the class group (K) and the width of the class interval (i) was obtained by respondents with the most age group in the age group of 38-45 years (33.8%) and the least age group in 2 age groups, namely i) 22-29 years (2.9%) and ii) 70-78 years (2.9%).

Table 4
Distribution of Respondents by Occupation

		Jobs			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Labor	8	11.8	11.8	11.8
	IRT	20	29.4	29.4	41.2
	Merchant	6	8.8	8.8	50.0
	Employees	2	2.9	2.9	52.9
	Songket Artisans	3	4.4	4.4	57.4
	Farmer	29	42.6	42.6	100.0
	Total	68	100.0	100.0	

Source: data processed, 2021

In addition to being duck farmers, respondents also have other jobs, namely farmers (42.6%), housewives (29.4%), laborers (11.8%), traders (8.8%), songket craftsmen (4.4%), and employees (2.9%).

Table 5
Distribution of Respondents by Education Level

		Education Level			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	28	41.2	41.2	41.2
	High School	13	19.1	19.1	60.3
	Junior High School	25	36.8	36.8	97.1
	No School	2	2.9	2.9	100.0
	Total	68	100.0	100.0	

Source: data processed, 2021

The highest educational attainment of respondents was elementary school (41.2%), followed by junior high school (36.8%), high school (19.1%), and no formal schooling (2.9%).

Poverty Alleviation Model for Livestock Business Households in Gandus District

The poverty alleviation model was analyzed using PLS-SEM. The SEM PLS model is analyzed in two stages, namely first, Evaluation of the measurement (outer) model and second, Evaluation of the Structural Model (Inner Model). The stages of analyzing the model are:

Evaluation of (outer) model measurements

The outer model can be evaluated through three criteria, namely 1) convergent validity, 2) discriminant validity, and 3) composite reliability. Convergent validity tests the correlation between an item/indicator and its construct score. To test the validity of the items from the questionnaire using the outer loading test of the PLS Algorithm. The following are the results of the instrument test (See Table 6):

Table 6
Outer Loading

	Investment	Poverty	Well-being	Consumption	Revenue
X1		0.664			
X2		0.785			
X3.1		-0,012			

	Investment	Poverty	Well-being	Consumption	Revenue
X3.2		0.139			
X3.3		0.025			
X3.4		0.378			
X3.5		-0.053			
X3.6		0.179			
X5.2					0.119
X6.2					1.000
X7				-0.974	
X8				-0.238	
X9	0.629				
X10	0.836				
Y1			0.776		
Y2			0.955		

Source: primary data processed

The outer loading value is said to be high if it correlates more than 0.70, but according to Chin in Ghozali (2006) for the initial stage of research from the development of the measurement scale of the loading factor value of 0.5 to 0.6 is considered sufficient. From Table 6, the results of the loading factor test that have results above 0.5 are indicators X1, X2, X6.2, X9, X10, Y1 and Y2, while results below 0.5 can be deleted and data reprocessed.

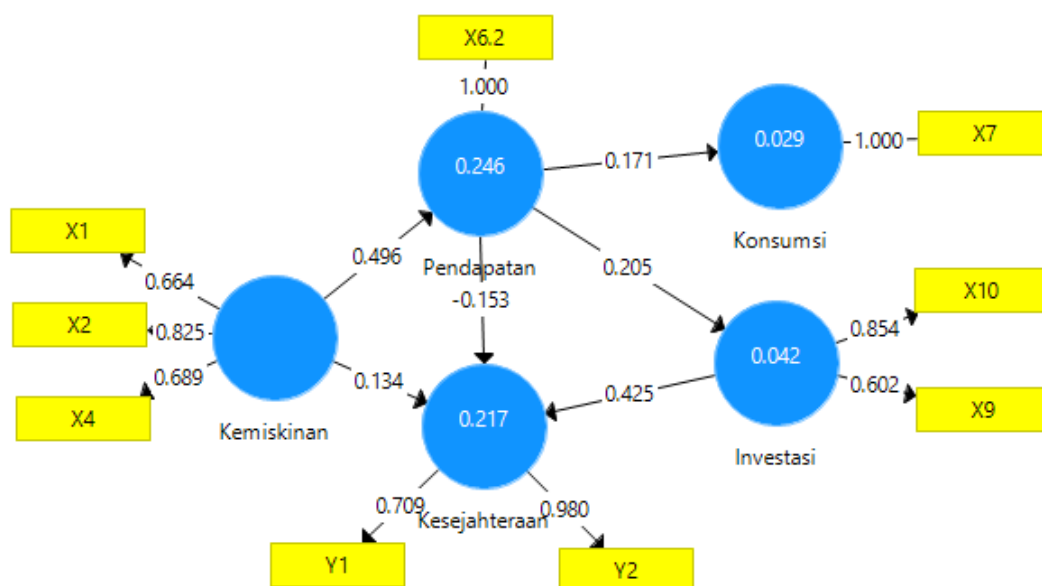


Figure 1. SEM-PLS Model of Poverty Alleviation for Livestock Business Households
Source: primary data processed

The revised measurement model met the convergent validity criterion because all loading factors are above 0.5.

Discriminant validity aims to predict the size of one block over the size of another. The evaluation of the discriminant validity measurement model can be seen from the recommended Average Variance Extracted (AVE) value must be above 0.50.

Table 7
AVE variable values

Variable	AVE	Remarks
Investment	0.546	Valid
Poverty	0.532	Valid
Revenue	1.000	Valid

Variable	AVE	Remarks
Consumption	1.000	Valid
Well-being	0.731	Valid

Source: primary data processed

In Table 7, the AVE value is above 0.50 for all variables, meaning that the variance of the indicator can be explained by 50% or more, so that it is in accordance with the model's assessment criteria.

Composite reliability assesses the internal consistency of the measurement items, and the value must be above 0.60. With the composite reliability criteria in the PLS Algorithm test were shown in Table 8.

Table 8

Composite Reliability

Variable	Composite Reliability	Remarks
Investment	0.700	Reliable
Poverty	0.772	Reliable
Revenue	1.000	Reliable
Consumption	1.000	Reliable
Well-being	0.841	Reliable

Source: primary data processed

Based on Table 8, all variables above 0.60 have met the reliability criteria, meaning that the questionnaire questions are consistent.

Evaluation of Structural Models (Inner Model)

In assessing models with PLS can see the R-square for each dependent latent variable. The change in the value of R-square can be used to assess the influence of a certain independent latent variable on whether it has a substantive influence.

Table 9

R-Square Values

Variable	R-Square	Remarks
Investment	0.042	Weak
Revenue	0.246	Weak
Consumption	0.029	Weak
Well-being	0.217	Weak

Source: primary data processed

According to Ghazali (2014), the R-square results of 0.67, 0.33 and 0.19 for endogenous variables in the structural model indicate that the model is categorized as good, moderate and weak. In Table 9, the calculation results show that the model is categorized as low.

Evaluation of the Distribution of Poverty Alleviation Program Assistance from the Palembang City Agriculture and Food Security Office

Hypothesis Testing

Hypothesis test using the bootstrapping method. This hypothesis test was carried out by analyzing the p-value. The hypothesis testing criterion is a p-value with a significant level of $\leq 5\%$

Table 10

P-value

	Original sample	Std. Deviation	T Statistics	P Values	Verdict
Investing -> Welfare	0.425	0.114	3.744	0.000	Accepted
Poverty -> well-being	0.209	0.132	1.587	0.113	Rejected
Poverty -> income	0.496	0.166	2.978	0.003	Accepted

	Original sample	Std. Deviation	T Statistics	P Values	Verdict
Income -> investment	0.205	0.245	1.809	1.809	Rejected
Welfare > income	-0.240	0.124	1.935	0.054	Rejected
Revenue -> consumption	0.171	0.144	1.078	0.282	Rejected

Source: primary data processed

Based on Table 10, two relationships are statistically significant. Investment has a positive and significant effect on welfare ($t = 3.744$; $p = 0.000$), while poverty has a positive and significant effect on income ($t = 2.978$; $p = 0.003$). In contrast, poverty does not have a statistically significant effect on welfare ($t = 1.587$; $p = 0.113$), welfare does not have a statistically significant effect on income ($t = 1.935$; $p = 0.054$), and income does not have a statistically significant effect on consumption ($t = 1.078$; $p = 0.282$). The relationship between income and investment is also reported as statistically insignificant based on its t-statistic of 1.809.

Overall, the accepted relationships indicate that investment is significantly associated with household welfare, while poverty is significantly associated with household income. In this study, the investment construct reflects household assets such as land and housing assets, motor vehicles, and savings. Therefore, the findings demonstrate the relevance of household investment and asset ownership to welfare but should not be interpreted as a direct comparison between household investment and government livestock assistance because government assistance was not modeled as a separate construct in the SEM-PLS analysis.

Mapping of Poor Families Using Geographic Information Systems

To analyze the poverty mapping of an area using Geographic Information System software using secondary data that can be taken from several agencies such as BPS, Geoportal and Bappeda. The calculation and analysis of data in this study uses data from Geoportals, because there is no data at the BPS level at the sub-district level. BPS data only reaches the district/city level because surveys require large funds, especially for poverty data. Poverty is measured based on eating calories per day so that data collection is very detailed on what respondents eat per day per household.

The data on the number of people in Gandus District and data on the number of poor people in Gandus district, Palembang City can be seen in the table 11.

Table 11

Number of Poor Population of Gandus District

Districts	Village name	Number of people who do not Poor	Number of poor people	Total population per village
Gandus	36 Ilir	11126	1085	12211
	Karang Anyar	11255	975	12230
	Pulo Kerto	10520	1204	11724
	Gandus	6898	738	7636
	Karang Jaya	8573	599	9172
Total				52973

Source: Palembang city geoportal

In mapping the poor population in Gandus sub-district with data sources based on the Palembang Geoportal, the total number of poor people in Gandus sub-district was 4601 residents out of a total of 52973 residents of Gandus sub-district consisting of five sub-districts with the following details:

- 36 Ilir Village: 1085 residents out of 12211 residents
- Karang Anyar: 975 inhabitants out of 12230 inhabitants
- Pulokerto: 1204 inhabitants out of 11724 inhabitants
- Gandus: 738 inhabitants out of 7636 inhabitants
- Karang Jaya: 599 inhabitants out of 9172 inhabitants

Then from the data above, the number of poor inhabitant in each village was compared with the total population in each village, so it is necessary to calculate the percentage of poor people with the following formula:

$$\text{poor inhabitant percentage} = \frac{\text{number of poor inhabitant}}{\text{total number of inhabitant}} \times 100\%$$

The following is a calculation of the percentage of poverty in a village in Gandus sub-district:

1. Percentage of poor people in 36 Ilir village
$$= \frac{\text{number of poor inhabitant (per village)}}{\text{total number of inhabitant (per village)}} \times 100\%$$
$$= \times 100\% \frac{1085}{12211}$$
$$= 8.9\%$$
2. Percentage of poor people in Karang Anyar village
$$\times 100\% = \frac{\text{number of poor inhabitant (per village)}}{\text{total number of inhabitant (per village)}}$$
$$= \times 100\% \frac{975}{12230}$$
$$= 7.98\%$$
3. Percentage of poor people in Pulokerto village
$$\times 100\% = \frac{\text{number of poor inhabitant (per village)}}{\text{total number of inhabitant (per village)}}$$
$$= \times 100\% \frac{1204}{11724}$$
$$= 10.25\%$$
4. Percentage of poor people in Gandus village
$$\times 100\% = \frac{\text{number of poor inhabitant (per village)}}{\text{total number of inhabitant (per village)}}$$
$$= \times 100\% \frac{738}{7636}$$
$$= 9.67\%$$
5. Percentage of poor people in Karang Jaya village
$$\times 100\% = \frac{\text{number of poor inhabitant (per village)}}{\text{total number of inhabitant (per village)}}$$
$$= \times 100\% \frac{599}{9172}$$
$$= 6.54\%$$

From the calculation above the percentage of poor people in each village in Gandus sub-district with the following details:

- a) 36 Ilir Village: 8.9% of the population is poor
- b) Karang Anyar Village: There are 7.98% of the poor population
- c) Pulokerto Village: There are 10.25% of the poor population
- d) Gandus Village: There are 9.67% of the poor population
- e) Karang Jaya Village: There are 6.54% of the poor population

After obtaining the percentage of poor people in each village in Gandus sub-district, we conducted calculations to determine the data interval. Before creating the interval, the number of classes is calculated with the following calculations:

Known :

$n=5$

Minimum=6.54

Maximum=10.25

Sum=43.34

Mean=8.668

Median= 8.9

Standard Deviation=1.463069

Asked : number of classes

Answer :

$$\begin{aligned} K &= 1 + 3.3 \log n \\ &= 1 + 3.3 \log(5) \\ &= 1 + 3.3 (0.69) \\ &= 1 + 2,277 \\ &= 3,277 \end{aligned}$$

$$K \approx 3$$

With the calculation above, the number of classes is 3

After the number of classes is created, it is necessary to calculate the width of the class interval with the calculation: Equal Interval

$$\begin{aligned} &= \frac{\text{Range}}{\text{Class}} \\ &= \frac{\text{highest } f. - \text{lowest } f.}{\text{Class}} \\ &= \frac{10.25 - 6.54}{3} \\ &= \frac{3.71}{3} \\ &= 1.26 \end{aligned}$$

Calculating the breaks of each class:

1. Break 1 = f. lowest + interval
= 6.54 + 1.26
= 7.8
2. Break 1 = Break 1 + interval
= 7.8 + 1.26
= 9.06
3. Break 1 = f. lowest + interval
= 9.06 + 1.26
= 10.32

After obtaining the number of classes, the width of the class interval and the edge of the lower class can be grouped into villages with the highest, medium, and low poverty percentages as follows:

- a. Low: 6.54%-7.8%
- b. Medium: 7.81 % - 9.06 %
- c. Severe: 9.06% - 10.32%

From this interval range, Pulokerto Village (10.25%) and Gandus Village (9.67%) are included in the category with the highest/severe percentage of poverty in Gandus District. Karang Anyar Village (7.98%) and 36 Ilir Village (8.9%) are included in the medium category with a poverty percentage in Gandus District. Karang Jaya Village (6.54%) is included in the category of the lowest poverty percentage in Gandus District.

From the results of the calculation above and using the Geographic Information System, Figure 2 is a poverty map of the residents of Gandus sub-district, Palembang City:

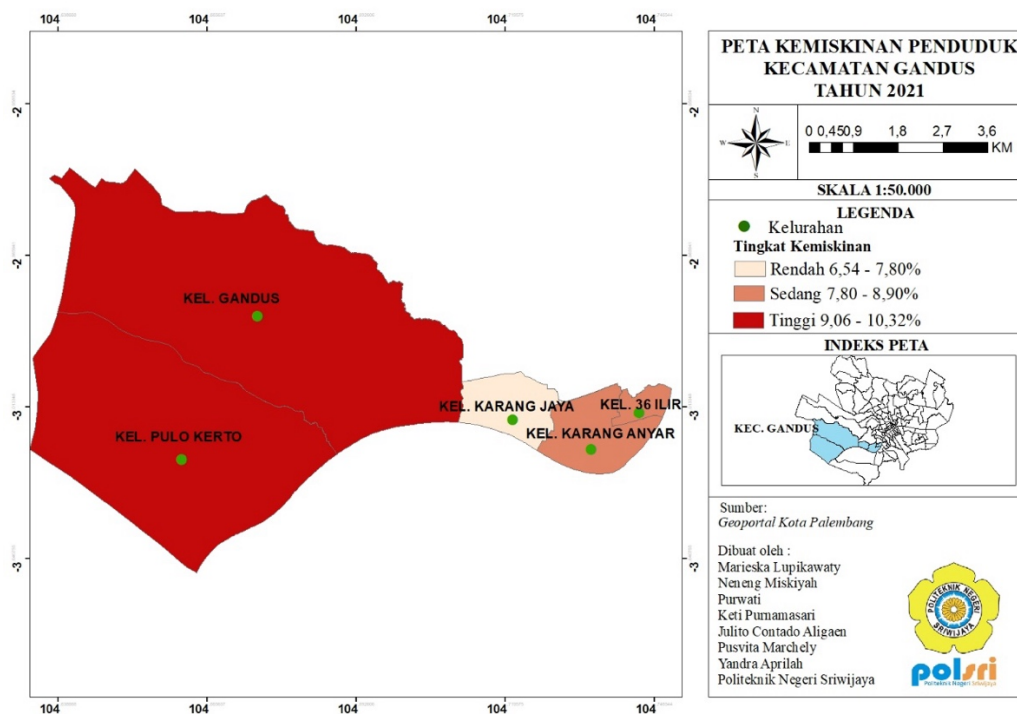


Figure 2. Poverty Map of Gandus District, Palembang City

Discussion

The results of the study show that the poverty alleviation model for livestock business households in Gandus District has a complex relationship among the factors of poverty, income, investment, consumption, and welfare. Although the R-square values for the endogenous variables are relatively weak, the results indicate that the welfare of farmers' households is influenced not only by the variables analyzed in this study but also by other factors, such as market access, the quality of assistance, socioeconomic conditions, government policies, and households' ability to manage livestock businesses sustainably. Thus, poverty alleviation is a multidimensional process that requires intervention across various aspects, rather than merely the provision of livestock business assistance. This finding is consistent with Alkire and Foster (2011), who emphasized that poverty is inherently multidimensional and cannot be adequately captured by a single indicator, necessitating comprehensive intervention strategies that address multiple dimensions of deprivation simultaneously.

The findings of the study show that investment has a positive and significant effect on the welfare of farmers' households. These results indicate that ownership of productive assets, such as land, houses, vehicles, and savings, is an important factor in improving household welfare. These assets function as economic capital that provides a sense of security, increases production capacity, and expands opportunities to earn income. In other words, improvements in welfare do not result solely from government assistance in the form of duck livestock but are also determined by households' ability to build and maintain productive assets. This result aligns with the findings of Moser (2016), who demonstrated that asset accumulation is a critical pathway out of poverty, as productive assets provide households with the capacity to generate income, manage risks, and build resilience against economic shocks.

This study also found that poverty has a significant effect on household income. The findings indicate that characteristics associated with poverty, such as limited capital, low skill levels, lack of resource ownership, and fewer productive household members, contribute to households' limited ability to generate income. This condition shows that increasing income cannot be achieved through short-term economic assistance alone but requires strengthening human resource capacity, improving business skills, expanding access to financing, and providing sustainable business assistance so that households can escape the poverty trap. Similar findings were reported by Banerjee et al. (2015), who found that comprehensive livelihood programs

combining asset transfers with skills training and business coaching produced sustained income improvements among ultra-poor households in multiple developing countries.

On the other hand, the relationships between income and investment, welfare and income, and income and consumption were not statistically significant in the model. These findings indicate that the observed data do not provide sufficient statistical evidence to support direct relationships among these variables through the specified structural paths. Therefore, interpretations regarding how household income is allocated to consumption or investment should be made cautiously because these allocation mechanisms were not directly examined beyond the variables included in the SEM-PLS model.

In addition to analyzing the relationships among variables, this study reinforces the importance of a spatial approach using Geographic Information Systems (GIS). The mapping results show that poverty is not evenly distributed throughout Gandus District. Pulokerto and Gandus Villages have relatively higher poverty rates than the other areas, whereas Karang Jaya has a lower poverty rate. These differences indicate that regional characteristics, geographical conditions, and resource distribution also affect the success of poverty alleviation programs. Therefore, government policies should be developed based on the spatial characteristics of each area so that assistance can be more targeted and efficient. The use of GIS for poverty mapping has been widely validated in previous studies, including by Bedi et al. (2007), who demonstrated that spatial analysis enables more precise targeting of poverty interventions by identifying geographic clusters of deprivation that may be overlooked by conventional household surveys.

Overall, the results show that the Pegagan duck livestock assistance program should be evaluated in conjunction with household economic conditions and the spatial distribution of poverty in Gandus District. The SEM-PLS findings highlight the significant relationship between investment and welfare and between poverty and income, while the GIS results identify differences in poverty percentages across villages. Accordingly, the model developed in this study combines household-level economic relationships with spatial poverty mapping to support more targeted program evaluation and poverty alleviation planning.

CONCLUSION

This study developed a poverty alleviation model for livestock business households in Gandus District, Palembang, by integrating SEM-PLS analysis and GIS-based poverty mapping. The SEM-PLS results show that investment has a positive and significant effect on welfare and that poverty has a positive and significant effect on income, while the other tested structural relationships are not statistically significant. These findings indicate that household assets and resource conditions are important components in understanding welfare and income among program beneficiaries. The GIS results further demonstrate spatial differences in poverty, with Pulokerto and Gandus Villages recording the highest poverty percentages and Karang Jaya Village recording the lowest among the five villages analyzed.

The findings suggest that future program improvements should consider household economic conditions together with village-level poverty patterns. GIS-based targeting can support the identification of areas with relatively higher poverty percentages, while the SEM-PLS findings highlight the relevance of investment, household resources, and income conditions in program evaluation. Because the endogenous variables in the structural model have relatively weak R-square values, the model should be interpreted as explaining only part of the variation in household outcomes. Therefore, further evaluation is needed before the model is applied more broadly beyond Gandus District.

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AUTHOR CONTRIBUTION STATEMENT

Marieska Lupikawaty, Neneng Miskiyah, Purwati, Ketu Purnamasari, and Julito Contado Aligaen contributed to the preparation of the study and manuscript. All authors contributed to the development of the final manuscript and approved the final version for publication.

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