

Beef Cattle Farmers' Economic Behavior in the Minahasa Tenggara Regency, Indonesia

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value, economic behavior

Abstract— The purpose of this research is to analyze the influencing factors of household income from beef cattle business in the use of artificial insemination and natural mating and evaluate the impact of changes in various external factors on economic behavior, such as the added value of cattle, income from cattle and production costs, allocation of family labor, the income of food crop farming, family income, food consumption, and non-food consumption as well as farmer household savings in the use of artificial insemination and natural mating systems in beef cattle. Further, the measurement of insemination and natural mating employed the approach of inseminator and natural mating costs. This research was conducted using a case study method on 150 beef cattle farmers located in Tababo Selatan Village and Buku Selatan Village, Belang District and Molompar Village and Molompar I Village, Tombatu Timur District, Minahasa Tenggara Regency. Specifically, the study used a purposive random sampling method. Data were analyzed by simultaneous equations, using the two-stage least squares (2 SLS) method and simulated analysis, using the SAS statistical application program. The results show that artificial insemination and natural mating systems had a significant effect on the added value of cattle, increasing the family time allocation of the farmer to the cattle business, production costs, the value of manure production, the rent value of bulls, and the value of unsold cattle. The simulation model demonstrated that an increase in inseminator costs and natural mating costs by 20% could increase the added value of beef cattle, allocation of family working time in the cattle business, beef cattle income, family income of the farmers, and food and non-food consumption.

I. INTRODUCTION

The process of production, income, and consumption in households of beef cattle farmers is an integral unit so any changes in policies governing cattle business activities will affect production, income, consumption, and use of labor [1,2]. Households of beef cattle farmers must be able to survive from their production so they have to work hard to obtain the expected additional

production. An increase in the income of draft cattle farmers due to the increasing results of cattle production will improve the welfare of farmers in rural areas. The increasing income of cattle has an impact on increasing the standard of living of farmers in rural areas [3].

Household income of beef cattle farmers increases due to changes in trends in food consumption patterns. Engels' law explained that if income increases, the contribution of

income to food consumption will decrease so that the contribution of non-food consumption will increase. In detail, there are two types of non-food consumption, such as consumption due to needs and consumption resulting from desires. If consumption is due to the increasing desire, the existing savings of farmers' households will decrease, which, in turn, it will affect investment, production, and so forth [4,5,6,7,8]. Most of the draft cattle businesses in Belang and Tombatu Timur Districts, Minahasa Selatan Regency are mostly back-yard farming, currently managed traditionally on a small-business scale and using simple technology. The main characteristic of the household of farmers shows that the cattle business is managed by the household and its family members for generations. This phenomenon is the behavior of households as producers in economic activity. In addition, being a producer, the household is also a labor provider and consumer. Family labor is allocated to work both in the cattle business, and other farming businesses, and outside of the farming business.

The fact displays that the income of cattle farmers is inseparable from two issues, such as the benefits of cattle as draft cattle both for cultivating agricultural land, for transportation facilities, and benefits from the development of added value of cattle from year to year. The added value of cattle in the research site is inseparable from the physical condition of the cattle, such as straight and muscular body posture and attractive appearance, such as clean and white color, and high buttons. So far, cattle farmers in the Minahasa Selatan Regency have artificial insemination (AI), combined with the natural mating system to increase the added value of their cattle. The greater added value of cattle will increase the income of cattle farmers, which, in turn, will improve the welfare of farmers in rural areas. The cattle breeds used in AI are PO cattle, which are greatly demanded by the people in the research site. The increasing income from Ongole breeds has an impact on improving the living standards of farmers in rural areas.

Based on the issues above, this research generally aims to study the economic behavior of the households of cattle farmers in the Minahasa Tenggara Regency. The specific objectives are (1) to analyze the interconnectedness of influencing factors of beef cattle farmers' economic behavior under the use of artificial insemination technology and natural mating systems, and (2) to examine the effect of changes in external factors on the economic behavior of beef cattle farmers under the use of insemination technology and natural mating systems.

II. RESEARCH METHOD

2.1. Site and Time of the Research

The research was a case study conducted in two villages of Belang District, such as Tababo Selatan Village and Buku Selatan Village, and two villages in Tombatu Timur District, such as Molompar Village and Molompar I Village, Minahasa Tenggara Regency, North Sulawesi Province. These two districts were selected since they were the center of beef cattle production in Minahasa Tenggara Regency, with a total cattle population of 1,856 (40.23%) [8].

Tababo Selatan, Buku Selatan, Molompar, and Molompar I Villages were chosen as the research site since they had the largest population of cattle in Belang District and Tombatu Timur District, which was 923 cattle or 49.73% in 2021 [8]. Cattle farmers in the four villages had implemented artificial insemination and natural mating as well as cow dung processing into manure. The primary data collection of this research was conducted from March 2023 to April 2023.

2.2. Types of Data, Data Collection Technique, and Sample Determination of Respondent

The type of data in this research was primary data, such as total cattle, the total of family members, farming experience, production costs, income from cattle and food crop farming, consumption, use of human and cattle labor, and so on. Then, the data collection technique was performed using survey techniques (direct observation) in the field by obtaining clear and detailed information from a sample of farmers related to a particular issue using a questionnaire guide and in-depth interviews. The total samples in the research were 150 cattle farmers, selected by purposive random sampling from 289 cattle farmers based on the consideration that the farmer had 2 cattle minimally and sold cattle.

2.3. Data Analysis Method

To answer the research objectives, the econometric model approach was employed. The built household economic model utilized simultaneous equations so that it could explain the interconnectedness between variables in the household economy of cattle farmers. The model had 12 equations, consisting of 9 structural equations and 3 equations of identity. Moreover, there were 12 endogenous variables and 7 exogenous variables. The 2 SLS (Two Stage Least Square) method was used to estimate the estimation parameters. To determine the effect of changes in external factors on the household economy, a simulation analysis was performed on (1) the cost of inseminators, which increased by 20 percent, and (2) the costs of natural mating, which increased by 20 percent, after the model was first validated using Theil's Inequality Coefficient criteria [9]. Meanwhile, data processing was conducted with the

Statistical Analysis System (SAS) program version 9.4. The established household economic model was as follows:

1. Cattle's Added Value

$$\text{PROS} = a_0 + a_1 \text{TKDS} + a_2 \text{BIN} + a_3 \text{BKA} + e_i \dots \dots \dots (1)$$

2 Use of Labor

$$\text{TKDS} = b_0 + b_1 \text{PROS} + b_2 \text{JARP} + e_i \dots \dots \dots (2)$$

3. Cost of Cattle Business

$$\text{BPH} = c_0 + c_1 \text{BPKS} + c_2 \text{PROS} + e_i \dots \dots \dots (3)$$

4. Income and Revenue

$$\text{PDRT} = \text{PDS} + \text{PDNS} \dots \dots \dots (4)$$

$$\text{PDS} = \text{PNS} + \text{NPKS} + \text{NMJ} + \text{NTD} - \text{BPTS} \dots \dots (5)$$

$$\text{PNS} = i_0 + i_1 \text{PROS} + e_i \dots \dots \dots (6)$$

$$\text{BPTS} = \text{BPH} + \text{BIN} + \text{BKA} \dots \dots \dots (7)$$

$$\text{NPKS} = d_0 + d_1 \text{PROS} + e_1 \dots \dots \dots (8)$$

$$\text{NMJ} = e_0 + e_1 \text{Pros} + e_i \dots \dots \dots (9)$$

$$\text{NTD} = f_0 + f_1 \text{PROS} + e_i \dots \dots \dots (10)$$

5. Consumption

$$\text{KP} = g_0 + g_1 \text{PDRT} + g_2 \text{PDFO} + g_3 \text{JART} + e_i \dots \dots \dots (11)$$

$$\text{KNP} = h_0 + h_1 \text{PDRT} + h_2 \text{KP} + e_i \dots \dots \dots (12)$$

where, PROS was the added value of cattle (Rp/year/respondent); TKDS was family labor in the cattle business (HOK/year/respondent); BPTS was the production cost of cattle business (Rp/year/respondent); BPH was the cost forage feed (Rp/year/respondent); PDRT was household income of cattle farmers (Rp/year/respondent); PDS was income from cattle business (Rp/year/respondent); PNS was income from cattle sales (Rp/year/ respondents); NPKS was the value of cow dung processing (Rp/year/respondent); NMJ was the value of bulls leasing (Rp/year/respondent); NTD was the value of unsold cattle (Rp/year/respondent); PDNS was income from food crops farming (Rp/year/respondent); KP was food consumption (Rp/year/respondent); KNP was non-food consumption (Rp/year/respondent); BIN was inseminator cost (Rp/year/respondent); BKA was the cost of natural mating (Rp/year/respondent); BPKS was the cost of education and health (Rp/year/respondent); JARP was the total of productive age of family members (person/respondent); JART was the total of family members (person /respondent); and, PDFO was the formal education of farmers (year).

III. RESULTS AND DISCUSSION

3.1 Household Economy of Ongole-Breed Cattle Famers

The results of the research shown in Table 1 show that the cost of inseminators affected the added value of cattle because farmers had conducted the artificial insemination (AI) system with Ongole-breed (PO) so that additional calves were obtained every year. The increasing cost of inseminators encouraged inseminators to be more active in insemination.

Communities in the research site preferred PO cattle breeds over other cattle breeds since they satisfied the needs of farmers to have draft cattle. By artificial insemination, farmers could mate with more than one female that was ready to mate, at the same time, because the bull in the AI technology had thousands of times ability [10]. The cost of natural mating affected the added value of cattle because natural mating was an alternative for farmers if PO cattle through AI were not available to be mated, so the farmers would look for a bull to mate with their female cattle. However, if seen from the parameter values of the analysis, the added value of cattle obtained from artificial insemination was higher than the added value of cattle produced by the natural mating system. It was because the quality of the PO bull cattle with the AI technique was much better than the bulls with the natural mating technique. In the natural mating system at the research site, a bull usually served four to five female cattle a day so the bull often experienced fatigue, and the natural mating process was often delayed.

In addition, family labor affected the added value of cattle because farmers took good care of their cattle every day so that cattle had a good physical appearance as draft cattle and their value was increasingly higher. Family labor in the cattle business included feeding and drinking, bathing, mating, selling, and cow dung processing into manure. The results of the research are in line with [11.12] arguing that the production and income of the beef cattle business are influenced by the total of beef cattle, family labor, farmer's education, and the total of concentrate feed.

The added value of cattle affected the outpouring of family labor in the draft cattle business because the greater the added value of inseminated cattle and natural mating, the more time allocation the family to take care of their cows, especially to provide green feed and drink, or take care of cattle during pregnancy and their calves. This shows that the potential for family labor had been utilized in the maintenance of the cattle business because the family did not substitute its labor with wage labor. In line with several studies previously [that family labor in the beef cattle business is influenced by the added value of cattle, cattle production, productive household members, family income, income from cattle business, shadow wages of labor, and cattle production costs [13, 3, 12].

Furthermore, the added value of cattle affected the cost of green feeds because the cost of green feeds also depended on the total of the owned cattle resulting from the use of insemination technology and natural mating system. The more cattle, the more forage costs. Conversely, if the forage was reduced, the growth of cattle would be disrupted and would reduce the added value of cattle. Though the forage in the research site was not purchased, the cost of forage for cattle was calculated from the wages paid by farmers to look for forage for cattle. During the dry season, households were difficult to find land where their cattle could graze, so farmers would look for a more distant location for their cattle to graze. It means that the cost of forage would be greater. The feed given was not only grass but also corn leaves and young corn.

The added value of cattle affected the value of manure production because the added value of cattle increased the cow dung production so that additional family labor was required to process it into manure. In this research site, manure was not traded but only used by the household of farmers for food crops farming. The measurement of the value of manure production was through wages for cow dung processing into manure. Therefore, the larger the family labor to process cow dung into manure due to the increase in the added value of cattle, the greater the value of manure production. Additionally, the added value of cattle affected the value of bulls leasing because the bulls owned by farmers were selected bulls and well-known by the community to have the ability in producing quality calves according to the farmers' expectations, which affected its leasing value. The leasing value of studs varied between Rp. 150,000 to Rp. 300,000, depending on the physical appearance of the studs. Farmers expected calves that had the same characteristics as bulls and their mothers.

The added value of cattle affected the value of unsold cattle because farmers kept their cattle that were still productive for work and producing offspring. The cattle aged less than 6 years, including pregnant females and bulls. Averagely, annually, farmers obtained an additional calf so that the added value of owned cattle was increasingly bigger. At the age of 18 months to 28 months, females were mated and bulls were used as a source of breeds so that if the females and bulls were 6-7 years old, farmers would sell them because they were considered unproductive [14].

Further, the added value of cattle affected the revenue of cattle sales because farmers maintained PO-typed cattle that were suitable for the conditions and needs of the people in the research site. The added value of cattle in Kanonang III Village depended on the type of cattle, the total of owned cattle, and the physical condition of the cattle. An increase in added value was usually followed by an increase in the

selling price of cattle so that the income of farmers was greater. However, farmers did not immediately respond to the increase in the added value of cattle by selling their cattle because farmers would only sell cattle at certain times, such as paying for children's tuition, feasts, or health costs [3].

Household income of cattle farmers affected household's food consumption. This was because there was additional household income to a certain extent, so the family would use the additional income to increase the type and volume of food consumption. The coefficient value of household income by 0.02 was relatively the same as a research [15] by 0.01, which showed that only a small portion of income is used for food consumption since households allocate part of their income to satisfy other needs. To a certain extent, additional income would be used by households to satisfy secondary needs [1,3].

The total of household members also affected food consumption because an increase in family members caused an increasing need for rice and other meals. Households were highly concerned about the family's food consumption for daily activities, such as farming and outside farming. Then, this was in line with research [15] arguing that food consumption of vegetables by farmers' households is strongly influenced by total household income, total family members, the risk of changes in prices, and the production of vegetable farming.

Meanwhile, household income affected non-food consumption. This was because the income earned by households was allocated for various needs, including non-food items, such as the needs for farming production, education and health, clothing, socio-spiritual, transportation, and so forth. However, farmers' households also considered the priority scale of expenditure for non-food consumption. Contrastingly, this was different from research [16,17] stating that non-food consumption is not responsive to household income.

3.2. Impact of Changes in External Factors on the Household Economy of Cattle Farmers

Changes in external factors focused on increasing the cost of inseminators and increasing the cost of natural mating systems. The simulation results of changes in external factors on the household economy can be seen in the following Table 2.

3.2.1. Impact of 20% Increasing of Inseminator Cost (1st Simulation) on the Household Economy of Cattle Farmers

An increase in inseminator costs by 20 percent (Table 2) had an impact on the added value of cattle, which increased by 8.91 percent, which improved revenue from cattle sales

by 2.05 percent so income from cattle business increased by 10.38 percent. Even though the cost of cattle production had increased by 2.52 percent, the increasing value in the sales of cattle still provided income for farmers. Farmers' household income increased by 5.73 percent in total, though income from food crops farming and outside agricultural sectors did not change. Thus, increasing food consumption and non-food consumption were by 0.67% and 1.86% percent, and 8.37 percent, respectively. Further, the absorption of family labor in the cattle business increased by 2.53 percent, increasing the cost of cattle production.

This study was in line with previous studies [18,19], which reported that the cost of insemination, the experience

of the farmer, and the total of raised cattle have a significant effect on the farmer's income. The results of this research demonstrate that the cattle business conducted by farmers in the Minahasa Tenggara Regency had a positive impact on the welfare of the farmers' families with the aid of technology. However, artificial insemination and the accessibility of inseminator resources were often not available. Therefore, the continuity of the supply of superior cattle breeds and inseminator workers had to be a concern of the local government [20].

Table 1. Analysis of the economic behavior of Ongole-breeds (PO) farmers

Variables	code	Estimation Parameters	Probability		R ²
			t-Value	Prob>[t]	
Cattle Added Value	PROS				
intercept		0.000000151 ***	3.92	0.0002	0.7743
Family Labor in Cattle Business	TKDS	159533,4 ***	4.82	<.0001	
Inseminator Cost					
Natural Mating Fees	SON		2,27	0.0258	
Family Labor in Cattle	BKA	57.65 **	5,14	<.0001	
Intercepts		26,60 ***			
Added Value Cattle	TKDS				0.6021
Number of RT Members of Working Age	PROS	97.74 ***	9.95	<.0001	
Cow Feed Costs	JARP	0.000002628 ***	0.48	0.6347	0.6267
Intercepts		1.38 ***			
Cattle Added Value	BPH				
Education and Health Costs			14.58	<.0001	
Manure Production Value	PROS	5824112 ***	4.79	<.0001	
Intercepts	BPKS	0.12 ***	-0.41	0.1838	0.6175
Cattle Added Value		-0.01			
The Value of Renting a Stud	NPKS				0.7072
Intercepts			-3,23	0.0017	
Cattle Added Value	PROS	-156970 ***	7,67	<.0001	
Value of Cattle Not Yet Sold	NMJ	0.02 **			0.7596
intercept			-8.45	<.0001	
Cattle Added Value		-4349179 ***	12.31	<.0001	
Acceptance of Cows	NTD	0.38 ***			0.5533
intercept			-3.63	0.0004	
Cattle Added Value		-9108377 **	17,6	<.0001	
Food Consumption	PNS	1.21 ***			0.7011

intercept			6,47	<.0001	
household income	PROS	7208853 ***	2,11	0.0375	
Formal education	KP	0.14 ***			
Number of RT Members			4.45	<.0001	
Non-Food Consumption	PDRT	4885729 ***	2.43	0.0170	0.6035
intercept	PDFO	0.43 **	1.73	0.0870	
household income	JART	172132 *	7,20	<.0001	
Food Consumption	KNP	1350623 ***			
	PDRT		2, 71	0.0079	
	KP	7743148 ***	2.69	0.0084	
		0.12 ***	-0.19	0.2531	
		-0.04			

Source: Data Processed Using SAS 9.4 (2023)

*, **, *** significant at $\alpha = 10\%$, $\alpha = 5\%$ and $\alpha = 1\%$

3.2.2. Impact of 20% Increasing in Cost of Natural Mating (2nd Simulation) on the Household Economy of Cattle Farmers

An increase in the cost of natural mating by 20 percent (Table 2) had an impact on increasing the added value of cattle by 13.04 percent, which, in turn, increased revenue from the sales of cattle by 2.99 percent so that income from

the cattle business increased by 15.13 percent. Though production costs had increased by 3.95 percent, the increasing value of cattle sales still provided income for farmers. In total, farmers' household income increased by 8.34 percent, and increasing household food consumption and non-food consumption was by 0.98 percent and 2.71 percent, respectively. Similarly, the absorption of family labor in the cattle business increased by 3.68 percent.

Table 2 Impact of the changes in external factors on beef cattle farmers' economic behavior

Endogenous Variables	Basic Simulation	1 st Simulation	2 nd Simulation
PROS	15216478	16572874 (8.91 %)	17200836 (13.04 %)
TKDS	142.6	144.9 (2.53%)	146.6 (3.68%)
BPTS	8873924	9097754 (2.52 %)	9224703 (3.95 %)
BPH	7635360	7800998 (2.17 %)	7877682 (3.17 %)
PDRT	71743817	75852096 (5,73 %)	77730754 (8,34 %)
PDS	39577168	43685447 (10,38 %)	45564106 (15,13 %)
PNS	9355046	9546357 (2.05 %)	9634928 (2.99 %)
NPKS	184062	214461 (16,37 %)	228535 (24,16 %)
NMJ	1436765	1952524 (35,90 %)	2191301 (52,52 %)
NTD	31217420	34812059 (11.51 %)	36476246 (16.85 %)
KP	13409072	13499155 (0.67 %)	13540348 (0.98 %)
KNP	10632153	10830153 (1.86 %)	10920696 (2.71 %)

Source: Data Processed Using SAS 9.4 (2023)

Note: 1st Simulation: Inseminator costs increased by 20 percent

2nd Simulation: Cost of natural mating increased by 20 percent

IV. CONCLUSION

The interconnectedness of influencing factors of the household economy of beef cattle farmers is artificial insemination technology and natural mating systems which have affected the added value of cattle. Then, the added value of cattle affects family labor in the cattle business, the cost of green feeds, the value of manure production, the value of bull leasing, the value of unsold cattle, and income from the sales of cattle. Meanwhile, household consumption, such as food and non-food consumption, is greatly affected by the level of household income.

Additionally, the impact of external factors on beef cattle farmers' economic behavior is an increase of inseminators cost by 20 percent and the cost of natural mating by 20 percent, which have a positive impact on the added value of cattle, absorption of family labor in the cattle business, cattle production costs, the income of cattle, and household's income and expenses.

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