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The Impact of Production Center Policy on Bali Cattle Farming in Southeast Sulawesi, Indonesia: A Policy Analysis Matrix Approach

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ABSTRACT

Implementing government policies aims to enhance Bali cattle farming and exports while protecting domestic production to ensure competitiveness against imported cattle and meat. This study aims to analyze the impact of production center policy on Bali cattle farming in Southeast Sulawesi, Indonesia, using the Policy Analysis Matrix (PAM) approach. Data were collected from June to October 2024 through direct interviews with 240 cattle farmers, field surveys, and focus group discussions with relevant stakeholders. This involved discussions with policymakers in Bali cattle development centers in Southeast Sulawesi, specifically in the regency of South Konawe and Muna. The collected data were analyzed using the PAM. The analysis was conducted per average number of cattle reared and then converted to per cow, with farmers using a combined breeding and fattening system for 12 months (1 year) to produce slaughter-ready cattle. The results showed that the government policy's impact on output had a negative effect on Bali cattle farming, as the domestic output price was lower than the world price. The policy's impact on input had a positive effect, as the government supported producers through input subsidies and protection of domestic input prices, which created additional surplus for farmers, protected domestic production, and reduced input costs. The policy's combined impact on both input and output also had a positive effect, as it provided incentives for farmers, generated additional surplus, effectively protected production, and lowered production costs compared to opportunity costs. The study concluded that government policy was more beneficial through its support on input and combined input-output interventions than on output alone. Therefore, government policies remain key in regulating Bali cattle development in Southeast Sulawesi to maintain competitiveness and benefit farmers.

Keywords: *Bali cattle; input-output; pam; policy*

INTRODUCTION

The implementation of government policies aims to enhance the beef cattle farming industry and exports while protecting domestic beef cattle to ensure competitiveness against imported cattle and beef. The government has introduced local beef cattle production policies through the *"Beef Self Sufficiency Programme"* by initiating the *"Special Efforts for Mandatory Breeding Cows Programme"* (Agus & Widi, 2018). This program was later refined into the *"Cattle and Water Buffalo are the Country's Main Commodity Programme"*, launched in 2020. According to Rusdiana *et al.* (2018), these programs were designed to boost local beef production within the country. The study by Liu *et al.* (2023) and Bukifan *et al.* (2021) highlights that effective government policies targeting inputs and outputs in beef cattle farming are crucial for improving production efficiency at the farmer level.

Bali cattle are domesticated descendants of wild *banteng* and represent a highly potential genetic resource for development. Originating from Bali Island, these indigenous Indonesian cattle possess numerous advantages, making them a popular choice for farmers (Firman & Nono, 2021). The advantages of Bali cattle compared to other breeds include rapid growth rates, excellent environmental adaptability, and superior reproductive performance (Baco *et al.*, 2020; Hikmawaty *et al.*, 2020). Bali cattle are predominantly raised in small-scale farms due to their high fertility and low mortality rates (Abadi *et al.*, 2023). They are an essential source of meat, providing high economic value and playing a significant role in community life. Bali cattle farming is highly profitable as it not only produces meat but also manure for fertilizer and serves as a potential source of labor (Hilmiati *et al.*, 2024). As a native Indonesian cattle breed, Bali cattle have spread across the country and play a vital role in meeting the national meat supply. The increasing demand for animal protein, driven by population growth, further emphasizes the importance of Bali cattle in ensuring food security (Valerio *et al.*, 2024).

Southeast Sulawesi is one of the provinces in eastern Indonesia, covering a land area of 36,159.71 km² (BPS, 2024). As of 2023, the administrative region of Southeast Sulawesi consists of 15 regencies and 2 cities, as outlined in the Minister of Home Affairs Decree No. 100.1.1-6117 of 2023 regarding the assignment and updating of administrative region codes, data, and islands. Among the 17 regencies/cities in Southeast Sulawesi, two regencies, South Konawe and Muna, have been designated as centers for Bali cattle development. This initiative supports the national *"Beef Self Sufficiency Program"* by focusing on Bali cattle, a native Indonesian cattle breed. The Bali cattle population in South Konawe and Muna Regencies has shown significant annual growth from 2018 to 2022 (BPS Southeast Sulawesi, 2023). According to the Provincial Livestock Service Office (Disnak) of Southeast Sulawesi (2023), the distribution of Bali cattle populations in South Konawe and Muna stands at 69,157 head (16.40%) and 74,386 head (17.64%), respectively, out of the total Bali cattle population in Southeast Sulawesi, which averages 360,757 head.

The policy analysis matrix (PAM) approach assists in policy-making at both the national and regional levels by examining central issues in agricultural policy analysis (Priyanka *et al.,* 2015; Nurmalina *et al.,* 2023), including policies related to Bali cattle farming. Conceptually, PAM is an economic analysis method used to assess policies related to the utilization of domestic resources in various sectors, including the livestock sector. Several studies have been conducted on the impact of government policies on beef cattle development in different regions of Indonesia, such as Hitani *et al.* (2017), on local beef cattle in Mempawah Regency, Lestari *et al.* (2017), on local beef cattle in Bojonegoro Regency, East Java, Sudirman *et al.* (2018), on Bali cattle in Plampang Regency, Sumbawa Regency, NTB, Yani (2018), on Bali cattle in Moyo Watershed, Sumbawa Regency, NTB, and Bukifan *et al.* (2021) on Bali cattle in Kupang, NTT. This study targets farmers who adopt a semi-intensive system (breeding and fattening) or an intensive system (fattening only) in two main Bali cattle development areas: South Konawe Regency, representing the mainland region, and Muna Regency, representing the island region in Southeast Sulawesi. Therefore, this study aims to analyze the impact of government policies on Bali cattle farming in Southeast Sulawesi using the PAM approach.

METHODS

The research was conducted in the Bali cattle production center of Southeast Sulawesi, specifically in the South Konawe and Muna Regencies. The research location was determined using purposive sampling, as done in previous studies (Bukifan *et al.,* 2021; Abadi *et al.,* 2023). Four sub-Regency in each regency were selected as the focus of Bali cattle production. In South Konawe Regency, the selected sub-Regency are Baito, Buke, Palangga, and Tinanggea, while in Muna Regency, they are Tongkuno, Parigi, Kabangka, and Napabalano. The selection of these four (4) regencies in South Konawe was based on their designation as priority areas for Bali cattle development, according to the Minister of Agriculture's Decree of the Republic of Indonesia in 2016. The four (4) regencies in Muna were chosen because they are local centers for Bali cattle development and have the highest population of Bali cattle in the region.

Table 1. Allocation of tradable and domestic cost components in Bali cattle farming in Southeast Sulawesi

No	Input	Domestic (%)	Tradable (%)
1	Feeder cattle	100	0
2	Calf cow	100	0
3	Grass	100	0
4	Paddy/corn straw	100	0
5	Rice bran	100	0
6	Tofu dregs	100	0
7	Water	100	0
8	Salt[a)]	44	56
9	Vitamin[b)]	65	35
10	Traditional medicine	100	0
11	Labor	100	0
12	Cowshed and land	100	0
13	Well	100	0
14	Hoe	100	0
15	Shovel	100	0
16	Sickle/machete	100	0
17	Basket	100	0
18	Bag	100	0
19	Rope	100	0
20	Electricity and lights	100	0
21	Fuel[c)]	29	71

Note: Primary data (interviews with farmers and government); [a)]Kemko Marves (2023); [b)]Kemendag (2024); [c)]Kementerian ESDM (2024).

Data collection was carried out from June to October 2024. Primary data were obtained from Bali cattle farmers through questionnaires and focus group discussions (FGD) conducted directly with relevant stakeholders. Secondary data were gathered from various related institutions such as the Central Statistics Agency, the Agriculture or Livestock Service Office, Agricultural Extension Centers, Village Livestock Data, and other necessary sources. A total of 240 Bali cattle farmers were interviewed, with 30 respondents from each of the eight regencies. The analysis was conducted per average number of cattle reared and then converted to per cow, with farmers using a combined breeding and fattening system for 12 months (1 year) to produce slaughter-ready cattle.

Determining the Input-Output of Bali Cattle Farming and Allocation of Tradable and Domestic Cost Components

Bali cattle farming can be conducted by inputting production inputs that result in production outputs such as revenue and business income (Indrawirawan *et al.,* 2022; Thaal *et al.,* 2022). Inputs utilized in traditional Bali cattle farming include calves and heifers, green fodder, rice/corn straw, rice bran, tofu waste, water, salt, vitamins and traditional medicines, labor, depreciation and economic life of pens and equipment, electricity and lighting, fuel, taxes, slaughtering costs, marketing costs (meat from slaughterhouses and transportation and handling costs), and other expenses. Meanwhile, outputs produced include Bali cattle in the form of live cattle ready for sale and manure (additional revenue). The allocation of tradable and domestic cost components in Bali cattle farming in Southeast Sulawesi is presented in Table 1.

According to Ferrari *et al.* (2023), for exported commodities, the free on board (FOB) price is used, while for imported commodities, the cost insurance freight (CIF) price is applied. Since the FOB price represents the price at the export port, transportation and handling costs from wholesalers to the port must be deducted. Meanwhile, transportation and handling costs from the port to the research location must be added to the CIF price, which reflects the price at the import port.

Shadow Price of Output

The shadow price of output is calculated based on the price of imported output goods when received at the port, converted into the shadow rupiah value, and added to the marketing costs. In this study, the shadow price of output includes feeder cattle or live cattle ready for sale.

Shadow Price of Input

The shadow price of inputs in this study includes salt, vitamins, fuel, and beef. The shadow price of salt is derived from the price of imported goods upon arrival at the port, converted into the shadow rupiah value, and added to the marketing costs. The shadow price of vitamins is calculated from the highest retail price (HRP) plus the price at wholesalers and additional marketing costs. The shadow fuel price is based on the non-subsidized fuel price plus marketing costs. Meanwhile, the shadow price of beef is determined by the price of imported input goods upon arrival at the port, converted into the shadow rupiah value, and added to the marketing costs.

Shadow Exchange Rate

According to Cwik and Winter (2024), the shadow exchange rate represents the domestic currency value of foreign currencies in a perfectly competitive foreign exchange market. The standard conversion factor (SCF) is one approach used to estimate the equilibrium shadow exchange rate. Squire and Tak (1982) proposed the following formula:

$$SER_t = \frac{OER_t}{SCF_t}$$

With explanation, SERt is the shadow exchange rate (IDR/US$), OERt is the official exchange rate (IDR/US$), and SCFt is the standard conversion factor.

The value of the standard conversion factor, which is the ratio of the value of imports and exports plus taxes, can be determined as follows:

$$SCF_t = \frac{X_t + M_t}{(X_t - Tx_t) + (M_t + Tm_t)}$$

Where SCFt is the standard conversion factor for year t (IDR), Xt is Indonesia's export value for year t (IDR), Mt is Indonesia's import value for year t (IDR), Txt is the government revenue from export taxes for year t (IDR), and Tmt is the government revenue from import taxes for year t (IDR).

The analytical method used in this study to assess the impact of government policies on Bali cattle farming is the policy analysis matrix (PAM) (Nurmalina *et al.*, 2023). This method is highly suitable for analyzing policies in the agricultural sector, particularly in Bali cattle farming.

Each column in the third row of Table 2 contains the difference between the values calculated based on private prices (first row) and those calculated using social prices (second row). If market failure has minimal impact, the difference is attributed to the effects of government policy. The impact of this policy is the primary focus of this study. The effects of government policy include the following (Nurmalina *et al.*, 2023):

Policies on inputs. The impact of policies on inputs can be analyzed based on three factors, namely: (1) Input transfer (J) or TI= (B) – (F), where if the value of IT > 0, it indicates a transfer from farmers (producers) to producers of tradable inputs, and vice versa; (2) Nominal protection coefficient on input (NPCI)= (B) / (F), where the policy is protective towards inputs if the value of NPCI < 1, meaning there is a subsidy policy for tradable inputs, and vice versa; and (3) Factor transfer (K) or TF= (C) – (G), where if FT > 0, it indicates a transfer from farmers (producers) to producers of non-tradable inputs, and vice versa.

Policies on output. The impact of policies on output can be analyzed based on two factors, namely: (1) Output transfer (I) or TO= (A) – (E), where if the value of OT > 0, it indicates a transfer from the community (consumers) to producers, meaning producers will receive a higher selling price than they should, which harms consumers,

Table 2. Variables and calculation of policy impact indicators using the policy analysis matrix (PAM) for Bali cattle farming

Description	Revenue	Input cost		Profitability
		Tradable	Non tradable	
Private cost	A	B	C	D
Social cost	E	F	G	H
Policy impact	I	J	K	L

Note: Source: Nurmalina *et al*. (2023). Transfer output (I)= (A) - (E); transfer input (J)= (B) - (F); transfer factor (K)= (C) - (G); net transfer (L)= (D) - (H)); nominal protection coefficient for output (NPCO)= (A) / (E); nominal protection coefficient for input (NPCI)= (B) / (F); effective protection coefficient (EPC)= (A - B) / (E - F); profit coefficient (PC)= (D) / (H); producer subsidy ratio (SRP)= (L) / (E).

and vice versa; and (2) Nominal protection coefficient on output (NPCO)= (A) / (E), where the policy is protective towards output if the value of NPCO > 1, meaning producers receive a subsidy for output in the domestic market above its efficient price, and conversely, the policy is disincentive if NPCO < 1, meaning a reduction in producers' income due to output policies such as taxes.

Policies on input-output. The impact of policies on input-output can be analyzed based on four factors, namely: (1) Effective protection coefficient (EPC)= (A - B) / (E - F), where the policy remains protective if the value of EPC > 1, meaning the higher the EPC value, the higher the level of government protection for local (domestic) livestock commodities; (2) Net transfer (L) or TB= (D) – (H), where if the value of TB > 0, it indicates an increase in producer surplus caused by government policies applied to input and output, and vice versa; (3) Profitability coefficient (PC)= (D) / (H), where if PC > 0, it means that overall, government policies provide incentives to producers, and vice versa; and (4) Subsidy ratio to producer (SRP)= (L) / (E), an indicator that shows the proportion of income at the social price required if subsidies or taxes are used as a substitute for the policy.

RESULTS

Based on the data obtained, the combination of breeding and fattening has become the main livelihood for Bali cattle farmers in the development centers in Southeast Sulawesi. Communities undertake this farming practice with an average rearing period of about 12 months or 1 year. This duration depends on the age of the cattle when purchased for breeding and fattening. For example, if the cattle purchased are 12 months old, the fattening period usually lasts 12 months. The breeding and fattening systems are combined in one cycle for 12 months (1 year) to produce slaughter-ready cattle. In the breeding system, the calculation starts after the calf is born, while in the fattening system, purchased calves are immediately fattened for 12 months. Both types of cattle are then sold together as slaughter-ready cattle. The average number of Bali cattle kept was 4 heads in the South Konawe district and 5 heads in the Muna district. Therefore, in calculating input-output costs, the average number of cattle ready for slaughter or sale was used. When converted to per-cattle costs and revenues, these were divided by 4 and 5, respectively. Bali cattle farming can be carried out by utilizing production inputs that generate production outputs. Table 3 shows input-output costs categorized as private and social costs at Bali cattle farmers in the development centers of Southeast Sulawesi.

As an area designated as a production center, the government subsidizes livestock business inputs, such as vitamins, medicines, beef cattle vaccinations, and young productive cows. The implementation of this policy aims to increase business activities or exports while protecting domestic products to be able to compete with foreign products. Government policy factors play an important role in the development of the beef cattle industry. These policies are also applied to identify the causes of differences between input and output prices received by producers (private prices) and prices prevailing under free trade conditions (social prices).

Impact of Policies on Inputs

The implementation of commodity policies can be differentiated based on tradable inputs and non-tradable inputs. Government policies such as subsidies or taxes on tradable inputs affect producers, whereas policies on non-tradable inputs impact both producers and consumers. Providing subsidies for inputs can increase input usage and benefit producers, and vice versa. The impact of government policies is determined by the value of transfer input (TI) and transfer factor (TF). Meanwhile, the ratio of input transfer can be assessed through the nominal protection coefficient on input (NPCI). If the TI value is positive, it indicates a government policy that causes the input price to be higher than its social price and vice versa. Similarly, if the NPCI value exceeds one (NPCI > 1), livestock farmers must pay an actual input price higher than its social price, and vice versa; if it is negative or TF < 0, then the policy is more in favor of producers or farmer-livestock. Table 4 presents the impact of government policies on inputs for Bali cattle farming in the development centers of Southeast Sulawesi.

Impact of Policies on Output

Policy impacts are typically related to the prices of domestic commodity outputs and those marketed internationally. Factors such as minimal transfer costs, market failures, and changes in demand and supply do not influence global prices. There are two main policy instruments: subsidy policies and trade policies. Subsidy policies affect government budget flows. A subsidy is considered positive if it reduces government expenditure, while it is deemed negative (or a tax) if it increases government spending. The purpose of subsidies is to protect beneficiaries, primarily producers, by creating a domestic price that differs from the international price. On the other hand, trade policies involve restrictions on the export and import of commodities through price controls such as taxes or quotas on traded commodities. The application of trade policies can target export commodities to regulate their flow, thereby reducing domestic commodity prices below international levels. To evaluate the extent of policy impacts on Bali cattle output, the values of the transfer output (TO) and nominal protection coefficient on output (NPCO) are utilized. Table 5 shows the impact of government policies on output for Bali cattle farming in the development centers of southeast Sulawesi.

Impact of Policies on Input-Output

The impact of policies on input-output reflects the combination of input and output policies. The

Table 3. Input-output costs categorized as private and social costs in Bali cattle farming in Southeast Sulawesi

Description	South Konawe				Muna			
	Private price		Shadow price		Private price		Shadow price	
	Non tradable (IDR)	(Tradable) (IDR)	Non tradable (IDR)	(Tradable) (IDR)	Non tradable (IDR)	(Tradable) (IDR)	Non tradable (IDR)	(Tradable) (IDR)
I. Farmer revenue: cattle (head)	50,229,688	-	76,353,117	-	65,288,451	-	92,441,458	-
II. Cost:								
1. Cattle (head)								
- Feeder cattle	12,210,000	-	17,731,988	-	11,875,000	-	17,731,749	-
- Calf	6,000,000	-	6,000,000	-	7,250,000	-	7,250,000	-
2. Feed and vitamin (IDR/head/ year):		-						
- Grass	2,882,188	-	2,882,188	-	2,797,500	-	2,797,500	-
- Paddy/corn straw	176,000	-	176,000	-	466,250	-	466,250	-
- Rice bran	612,750	-	612,750	-	233,125	-	233,125	-
- Tofu dregs	480,000	-	480,000	-	61,688	-	61,688	-
- Water	200,500	-	200,500	-	279,750	-	279,750	-
- Salt	351,627	447,525	577,031	710,997	21,599	27,490	591,267	752,522
- Vitamin	607,154	326,929	790,075	425,425	88,903	47,871	870,675	468,825
- Traditional medicine	242,103	-	242,103	-	101,250	-	101,250	-
3. Labor	1,423,311	-	1,060,863	-	1,419,143	-	1,057,756	-
4. Depreciation (IDR/year):								
- Cowshed and land	1,413,888	-	1,413,888	-	778,318	-	778,318	-
- Well	358,918	-	358,918	-	257,292	-	257,292	-
- Hoe	131,208	-	131,208	-	151,789	-	151,789	-
- Shovel	109,899	-	109,899	-	95,278	-	95,278	-
- Sickle/machete	40,625	-	40,625	-	151,138	-	151,138	-
- Basket	84,958	-	84,958	-	223,333	-	223,333	-
- Bag	142,438	-	142,438	-	146,104	-	146,104	-
- Rope	144,958	-	144,958	-	180,167	-	180,167	-
5. Electricity and lights	620,500	-	620,500	-	621,000	-	621,000	-
6. Fuel	2,833,513	6,937,220	830,810	2,034,052	2,026,448	4,961,303	632,252	1,547,926
7. Tax	36,000	-	36,000	-	30,000	-	30,000	-
8. Transportation costs	-	-	-	-	-	-	-	-
9. Cattle slaughtering cost	193,750	-	193,750	-	234,583	-	234,583	-
10. Other fees	-	-	-	-	351,633	-	351,633	-
III. Revenue: feces, dll	16,376	-	16,376	-	80,568	-	80,568	-
IV. Marketing market								
1. Beef from slaughterhouse	1,437,000	-	-	30,567,714	1,440,000	-	-	30,567,714
2. Transportation and handling	199,240	-	199,240	-	326,462	-	326,462	
Total revenue	50,246,063	-	76,369,493	-	65,369,019	-	92,522,026	-
Total cost	32,932,528	7,711,674	35,060,689	33,738,188	31,607,753	5,036,664	35,620,358	33,336,988
Total profit	17,313,536		41,308,803		33,761,267		56,901,668	
Total Revenue/head	12,561,515	-	19,092,373	-	13,073,804	-	18,504,405	-
Total Cost/head	8,233,131	1,927,918	8,765,172	8,434,547,10	6,321,551	1,007,333	7,124,072	6,667,398
Total Profit/head	4,328,383	-	10,327,200	-	6,752,253	-	11,380,334	-

effects can be analyzed through the values of the effective protection coefficient (EPC), net transfer (NT), profitability coefficient (PC), and subsidy ratio to producer (SRP). The EPC value indicates the extent to which government policies effectively protect domestic production. If the EPC value is less than one (EPC < 1), the policy is ineffective or hinders producers from engaging in production. Conversely, an EPC value greater than one (EPC > 1) signifies effective protection for domestic production. The impact of government policies on input-output for Bali cattle farming in the development centers of Southeast Sulawesi can be seen in Table 6.

Sensitivity

After understanding the impact of government policies, the next analysis is a sensitivity analysis. This is conducted because one of the weaknesses of the PAM method is its static nature. Therefore, further analysis is needed to achieve a higher level of accuracy. Sensitivity analysis complements the PAM analysis in observing the changes in various factors affecting economic feasibility when there is an event different from the assumptions made, specifically regarding the competitiveness of Bali cattle in Southeast Sulawesi. Table 7 presents the sensitivity analysis results of Bali cattle farming in Southeast Sulawesi based on four changes in several input and output variables.

Table 4. Impact of government policies on inputs for Bali cattle farming (per head)

Regency	Impact of policy on input		
	TI	TF	NPCI
South Konawe	-6,506,629	-532,040	0.23
Muna	-5,660,065	-802,521	0.15

Note: TI= transfer input; TF= transfer factor; NPCI= nominal protection coefficient for input.

Table 5. Impact of government policies on output for Bali cattle farming (per head)

Regency	Impact of policy on output	
	TO	NPCO
South Konawe	-6,530,857	0.66
Muna	-5,430,601	0.71

Note: TO= transfer output; NPCO= nominal protection coefficient for output.

Table 6. Impact of government policies on input-output for Bali cattle farming (per head)

Regency	Impact of policy on input-output			
	NT	EPC	PC	SRP
South Konawe	507,812	1.00	1.27	0.03
Muna	1,031,985	1.02	1.22	0.06

Note: NT= net transfer; EPC= effective protection coefficient; PC= profit coefficient; SRP= producer subsidy ratio.

The purpose of this analysis is to observe how the results of an economic activity change if there are changes in the calculation of costs and benefits. Sensitivity analysis reviews the impacts that will occur due to fluctuating conditions, including input policies, output policies, and input-output policies within the PAM matrix. Figure 1 presents the ratio sensitivity analysis of Bali cattle farming in Southeast Sulawesi based on four changes in several input and output variables.

Sensitivity analysis is carried out by altering the values of inputs and outputs and observing the effects on profits and the competitiveness of Bali cattle. The analysis process involves addressing the weakness of the PAM method, which uses only a single price level, while in reality, the prices for inputs and outputs are highly variable. In this study, a sensitivity analysis of smallholder Bali cattle farming in the development center region of Southeast Sulawesi was conducted based on four scenarios of changes in several input and output variables, namely: (1) a 15% increase in the purchase price of Bali feeder cattle (input), (2) a 10% decrease in the selling price of ready-to-slaughter cattle (output), (3) a 15% increase in the price of fuel, and (4) a 5% appreciation of the rupiah against the dollar.

Bali feeder cattle serve as the primary input in production, making it essential to analyze their

Table 7. Transfer Sensitivity analysis of Bali cattle farming in Southeast Sulawesi is based on four changes in several input and output variables (per head)

No	Sensitivity	Regency	Input and output variables			
			TI	TF	TO	NT
1	Increase in purchase price of Bali cattle (input) by 15%	South Konawe	-6,506,629	-315,763	-9,630,857	-2,808,466
		Muna	-5,660,065	-1,303,964	-8,245,601	-1,281,573
2	Decrease in selling price of live cattle (output) by 10%	South Konawe	-6,506,629	-532,040	-5,877,772	1,160,897
		Muna	-5,575,006	-802,674	-4,887,541	1,490,140
3	Increase in fuel prices (gasoline) by 15%	South Konawe	-6,322,760	-88,806	-9,630,857	-3,219,291
		Muna	-5,557,663	-1,078,382	-8,245,601	-1,609,556
4	Increase in the rupiah exchange rate against the dollar by 5%	South Konawe	-7,061,517	-443,176	-8,744,653	-1,239,960
		Muna	-6,648,683	-1,041,571	-9,382,368	-1,692,114

Note: TI= transfer input; TF= transfer factor; TO= transfer output; NT= net transfer.

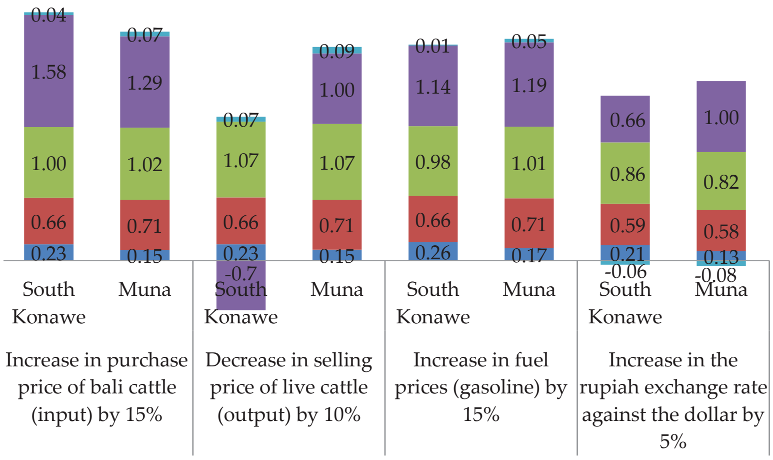

Figure 1. Ratio sensitivity analysis of Bali cattle farming in Southeast Sulawesi is based on four changes in several input and output variables. NPCI, ■= nominal protection coefficient for input; NPCO, ■= nominal protection coefficient for output; EPC, ■ = effective protection coefficient; PC, ■= profit coefficient; SRP, ■= producer subsidy ratio.

sensitivity in case of a significant increase in purchase prices for farmers. Meanwhile, ready-to-slaughter cattle are the main output and a key source of income for farmers, highlighting the importance of assessing their sensitivity to fluctuations in selling prices. The simulation of a 15% increase in the purchase price of Bali feeder cattle (input) and a 10% decrease in the selling price of ready-to-slaughter cattle (output) is based on the capacity of smallholder Bali cattle farmers in the development center region of Southeast Sulawesi Province to remain competitive and profitable. Additionally, the price of gasoline fuel is a crucial variable to consider, as farmers regularly use motorcycles in their livestock activities. The recent increase in subsidized fuel prices, including the rise in prices from IDR 7,650 per liter to IDR 10,000 per liter (approximately a 30% increase), underscores the need for a sensitivity analysis of this variable. Consequently, this study employs a 15% simulation for the increase in gasoline fuel prices (half of the previous 30% increase). Another analyzed variable is the exchange rate of the rupiah against the dollar, which tends to fluctuate and remain uncertain. This exchange rate affects several aspects of the study, particularly in calculating shadow prices related to production costs. Each scenario in this analysis is conducted under the assumption that changes occur in only one variable while all other variables remain constant (ceteris paribus).

DISCUSSION

Transfer Input (TI)

The TI is the difference between the cost of tradable inputs at private prices and social prices. The TI value reflects the existence of government policies applied to tradable inputs (Saptana *et al.,* 2021). If TI > 0 (positive), it indicates a transfer from livestock producers to tradable input producers and vice versa. In other words, it reflects the magnitude of the transfer (incentive) from producers to the government by implementing import tariff policies. The TI value provides insight into the impact of government policies on the cost of tradable inputs in the livestock sector. Data analysis has shown that the value of TI in South Konawe Regency is IDR -6,506,629, and in Muna Regency is IDR -5,660,065 (Table 4). This indicates that government policies result in traded input costs being lower at the private prices than at the social prices. The negative TI values imply that there is no transfer from producer farmers to tradable input producers, showing that producers in both regions do not have to bear higher input costs due to policies such as import tariffs. The higher TI value in Muna Regency suggests that producers in that area face higher input costs compared to the South Konawe Regency. These findings are similar to the situation in Bojonegoro Regency, East Java, where the input transfer indicator is less than zero (negative), indicating that farmers there pay less for tradable inputs compared to their social costs, thus avoiding full social costs (Lestari *et al.,* 2017). For the Bali cattle development center in Southeast Sulawesi, policies related to inputs, such as fuel, medicines, and vitamins subsidies, are suspected to make tradable inputs cheaper at private prices than their social prices.

Transfer Factor (TF)

The TF reflects government policies affecting producers and consumers, differing from tradable input policies. If TF > 0 (positive), it indicates a transfer from producers to domestic input producers or, in other words, government policies protecting domestic factor producers through positive subsidies. Conversely, if TF < 0 (negative), policies favor producers or livestock farmers. Based on Table 4, the TF value in South Konawe Regency is IDR -532,040, and in Muna Regency, it is IDR -802,521, indicating that government policies in both regencies are more favorable to producers or farmers. A negative TF value means domestic input producers benefit compared to tradable input producers because government policies lower the cost of domestic factors for producers (Dewi & Yulianti, 2021). The more negative (lower) TF value in Muna Regency (IDR -802,521) indicates greater policy support for producers or farmers compared to South Konawe Regency, which has a TF value of IDR -532,040. The lower domestic input costs at private prices are suspected to be due to government policies providing direct assistance, such as breeding cattle, and support for livestock medicines and vitamins in both study areas. Additionally, the abundant availability of forage utilized by farmers also contributes to this condition.

Nominal Protection Coefficient on Input (NPCI)

The NPCI indicates the level of government protection for domestic input prices. Protective policies toward inputs are reflected when NPCI < 1, indicating subsidies on tradable inputs or export restrictions that encourage domestic input use in production processes. Conversely, if NPCI > 1, it means the government has raised the price of tradable inputs in the domestic market above their efficient (world) price, disadvantaged sectors relying on those inputs due to higher production input costs. Based on Table 4, the NPCI value in South Konawe Regency is 0.23, while in Muna Regency, it is 0.15, indicating that government policies in both regions do not raise the price of tradable inputs in the domestic market above the world price. An NPCI value below 1 signifies that sectors using these inputs benefit from lower input costs. Input price subsidies reduce production costs (Kumbhakar *et al.,* 2023). The higher NPCI value in South Konawe (0.23) compared to Muna (0.15) suggests that farmers in South Konawe face lower input costs and experience greater positive impacts from this policy than those in Muna. This contrasts with Yani (2018) study in Sumbawa Regency, West Nusa Tenggara, where input policies for three typologies of Bali cattle farming had an NPCI value greater than 1, indicating that domestic input prices were higher than world prices, likely due to tax policies affecting the Bali cattle farming system in that region.

Transfer Output (TO)

The TO refers to the difference between revenue calculated based on private prices and revenue calculated based on shadow or social prices. The TO value indicates that government policies applied to outputs result in differences between private and social output prices. If TO > 0, it indicates a transfer from society (consumers) to producers and vice versa. Based on Table 5, the TO value in South Konawe Regency is IDR -6,530,857, while in Muna Regency, it is IDR -5,430,601, indicating that government policies have a negative impact on farmers in both regions. A negative TO value means farmers receive lower incomes than they would under social pricing. In other words, there is a transfer from farmers (producers) to society (consumers). The lower TO value in South Konawe reflects a greater transfer burden, with a loss of IDR 6,530,857, compared to Muna, which experiences a loss of IDR 5,430,601. These findings differ from those of Bukifan *et al.* (2021) in Kupang Regency, East Nusa Tenggara, where TO was positive, indicating that the price of domestically bred Bali cattle was higher than the world price. This was due to government-imposed import quota restrictions and reduced import tariffs, which increased domestic cattle prices. In the development center region of Southeast Sulawesi, based on information from farmers, there has been a decline in domestic Bali cattle sales due to low demand for ready-to-slaughter Bali cattle during national holidays, especially during Eid al-Adha in recent years. Additionally, the absence of government intervention in cattle sales has contributed to the lower domestic prices of Bali cattle. A similar situation occurred in Sumbawa Regency, West Nusa Tenggara Sudirman *et al.* (2018), but the findings differ from Rouf *et al.* (2019) in Gorontalo City, Gorontalo.

Nominal Protection Coefficient on Output (NPCO)

The NPCO is the ratio of revenue calculated based on private prices to revenue calculated based on social prices, serving as an indicator of transfer output. Policies are considered protective if NPCO > 1, meaning the government increases domestic market output prices above their efficient (world) prices. Conversely, policies are considered disincentives if NPCO < 1. The purpose of subsidies is to protect beneficiaries, namely producers, by creating domestic prices that differ from international prices (Amaglobeli *et al.*, 2024). NPCO is a critical indicator for assessing the impact of government policies on the livestock sector, particularly regarding transfer output. Based on Table 5, the NPCO value in South Konawe Regency is 0.66, while in Muna Regency, it is 0.71, indicating that government policies in both regions act as a disincentive to the livestock sector. This means that output prices in the domestic market are lower than world prices, exerting negative pressure on farmers' incomes. The lower NPCO value in South Konawe (0.66) suggests a greater disincentive compared to Muna (0.71). In actual conditions, Bali cattle farmers receive 0.66 and 0.71 times their potential income based on social prices. In contrast, Bali cattle farmers in Kupang Regency receive 1.11 times their social price-based income (Bukifan *et al.*, 2021). This indicates that government policies in Kupang Regency have resulted in higher private prices compared to social prices.

Net Transfer (NT)

The NT represents the difference between private net profits and social net profits, serving as an indicator of the impact on producer surplus. A positive NT value (NT > 0) indicates an increase in producer surplus due to input-output policies, whereas a negative NT value (NT < 0) signifies a reduction in producer surplus caused by these policies. Based on Table 6, the NT value in South Konawe Regency is IDR 507,812, while in Muna Regency, it is IDR 1,031,985, indicating that government policies provide an additional surplus for farmers in both regions. A positive NT value signifies that producers or farmers earn a higher net profit compared to the ideal condition based on social prices. The difference in NT between the two regencies shows that farmers in Muna Regency experience a greater surplus increase (IDR 1,031,985) compared to those in South Konawe (IDR 507,812). Nonetheless, the input-output policies implemented in both regions still positively impact farmers' surplus. These findings differ from those of Lestari *et al.* (2017) and Rouf *et al.* (2019), which reported negative NT values (IDR -1,969,880 and IDR -184,717 per head, respectively), indicating losses for farmers due to government policies. A negative NT value suggests that private profits are lower than social profits, meaning that the policies at the time reduced producer surplus.

Effective Protection Coefficient (EPC)

The EPC combines the nominal protection coefficients of both output and input (Lindawati *et al.*, 2021). It reflects how government policies protect or hinder domestic production and measures the level of policy transfers from tradable input and output markets. An EPC value greater than one (EPC > 1) indicates that government policies effectively protect domestic producers by raising output and/or input prices above their efficient levels. Conversely, an EPC value of less than one (EPC < 1) signifies ineffective policies. Based on Table 6, the EPC value in South Konawe Regency is 1.00, while in Muna Regency, it is 1.02. This indicates that government policies in both regions do not harm domestic production, with a slightly higher level of protection in Muna. An EPC value of 1.00 in South Konawe suggests that the implemented policies neither provide additional protection nor impose barriers on farmers, whereas an EPC value of 1.02 in Muna indicates slight additional protection for producers. The small difference in EPC values between the two regions suggests that government policies remain relatively neutral without offering excessive incentives or significant disincentives. Although the EPC in Muna is slightly higher, the overall level of government protection for domestic production in both regions is nearly the same.

Profitability Coefficient (PC)

The PC is the ratio of private net profits to social net profits, indicating the overall impact of all policies on producer incentives. A PC value greater than one (PC > 1) suggests that government policies provide incentives to producers, while a value less than one (PC < 1) implies that policies reduce producer profits compared to a no-policy scenario. Based on Table 6, the PC value in South Konawe Regency is 1.27, while in Muna Regency, it is 1.22. This indicates that government policies in both regions generally provide incentives to producers. The higher PC value in South Konawe (1.27) suggests that government policies significantly increase farmers' profits compared to a scenario without these policies. A similar effect is observed in Muna Regency, although with a slightly lower PC value (1.22), still indicating government policy incentives but to a lesser extent than in South Konawe. According to Lestari *et al.* (2017), the policies implemented so far have supported the beef cattle industry; however, there are still gaps in output-related policies that need improvement.

Subsidy Ratio to Producer (SRP)

The SRP measures the proportion of total revenue at social prices required if subsidies were the sole policy replacing all commodity and macroeconomic policies. A negative SRP value indicates that government policies cause producers to incur production costs exceeding their opportunity costs, whereas a positive SRP means that production costs are lower than opportunity costs. Based on the analysis, the SRP value in South Konawe Regency is 0.03, while in Muna Regency, it is 0.06. This indicates that government policies in both regions allow farmers to incur lower production costs compared to their opportunity costs. A positive SRP value suggests that the implemented policies provide sufficient subsidies to cover production costs partially. These policies do not burden farmers, but their impact is greater in Muna (6%) than in South Konawe (3%), meaning that farmers in Muna face lower production costs than those in South Konawe. In the Bali cattle development centers in Southeast Sulawesi, the relevant input policies are suspected to include subsidies for fuel, medicine, and vitamins. Additionally, the government implements a direct assistance policy in breeding feeder cattle, which helps reduce the production costs of Bali cattle farming. The SRP values found in this study differ significantly from those reported by Sudirman *et al.* (2018), where cattle farmers in Plampang Sub-Regency showed varying SRP indicators: -99% for free-range farming, 6% for tethered farming, and -10% for confined farming. Meanwhile, Lestari *et al.* (2017) reported an SRP value of -20%. In contrast, Bukifan *et al.* (2021) found a more favorable condition with an SRP of 30%, as did Rouf *et al.* (2019), who recorded a value of 23%.

Sensitivity

From these conditions, it can be observed that when there is a 10% decrease in output prices (selling price of slaughter-ready cattle) and a 15% increase in input prices (purchase price of feeder cattle and fuel prices), and along with a 5% increase in the exchange rate. Bali cattle farmers in the development centers of Southeast Sulawesi continue to maximize the potential of available feed resources, such as forage and rice/corn straw, which remain accessible year-round.

Based on the results of the policy analysis matrix (PAM) and sensitivity analysis, it is evident that the implemented policies, whether related to input, output, or a combination of both, have an impact on Bali cattle farming in Southeast Sulawesi. The impact on output shows a negative effect on Bali cattle farming, while the impact on input and input-output has a positive effect on the business.

Subsidies for production inputs, such as feeder cows, medicines, vitamins, and Bali cattle vaccines, need to be strengthened to keep production costs affordable for farmers. Additionally, subsidy policies and Bali cattle output prices should be evaluated and improved for greater effectiveness and better targeting. The government should also implement a purchasing policy based on cattle weight to encourage livestock quality improvement and protect domestic prices. Farmers are advised to focus on increasing daily weight gain and live weight to achieve better selling prices. Effective policies are needed for livestock development (Igirisa *et al.*, 2020; Mehrabi *et al.*, 2020). Rustinsyah (2019) and Liu *et al.* (2023) stated that the government policy factor in beef cattle farming is an important point. Nevertheless, the government needs to strengthen specific policies in the beef cattle sector. In doing so, the self-sufficiency program can be achieved, helping to meet the national beef consumption needs.

CONCLUSION

The findings indicate that the production center policy significantly impacts Bali cattle farming in Southeast Sulawesi. It disincentives output due to lower domestic prices compared to global markets, reducing farmers' income. However, it positively supports input costs through subsidies and price protection, enhancing farmers' surplus and protecting domestic production. Overall, the policy provides incentives, protects production, and lowers costs, which is crucial for the competitiveness and profitability of Bali cattle farming in the region.

CONFLICT OF INTEREST

We certify that there is no conflict of interest with any financial, personal, or other relationships with other people or organizations related to the material discussed in the manuscript.

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