



(RESEARCH ARTICLE)



Analysis of the role of food crop integration and beef cattle on the income of farmers in Tibawa Sub-District Gorontalo District

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Abstract

The objective of the present study is to formulate strategies for the integration of food crops and beef cattle on farmers' income in Tibawa District, Gorontalo Regency. The present study employs a quantitative research method. The study's participants comprised 30 individuals. The data were collected through the administration of questionnaires, which served as the primary data source. The collected data underwent a quantitative descriptive analysis (SWOT). The study's findings indicate that the development strategy for the crop and beef cattle integration system on farmers' income in Tibawa District, Gorontalo Regency, falls within quadrant 3, categorically identified as the Turn Around strategy or W-O strategy (Weaknesses-Opportunities). This strategy underscores that endeavors to enhance the development of an integrated system of food crops and beef cattle on the income of farmers in Tibawa District, Gorontalo Regency, can be centered on amplifying diverse opportunities to mitigate various weaknesses, thereby ensuring the effective and sustainable functioning of the integration system. The implementation of this strategy is predicated on three fundamental approaches: (1) training and skill development, (2) the reinforcement of cooperative networks, and (3) the forging of partnerships with academic institutions such as universities or research organizations.

Keywords: Farmer Income; Integration Role; Beef Cattle; Food Crops

1. Introduction

Beef cattle farming constitutes a pivotal component of the agribusiness sector in numerous regions, notably including the Tibawa Sub-district. It plays a significant role in providing meat for the community. However, factors such as fluctuating feed prices and market competition can impact their income. The financial returns from beef cattle farming are not uniform, and farmers may encounter substantial economic difficulties.

Concomitantly, beef cattle enterprises generate a range of organic byproducts, which, when judiciously managed, can be repurposed as organic fertilizers. The composting of agricultural waste from beef cattle farming can yield high-quality organic fertilizer, thereby enhancing agricultural productivity while concurrently reducing farmers' production costs. The integration of beef cattle farming with other agricultural enterprises offers substantial benefits to the farming community, including increased income. Beyond the financial benefits of beef cattle operations, farmers can also generate additional revenue from agricultural products and the effective management of organic waste.

Preliminary observations indicate a persistent increase in the beef cattle population within the Tibawa Sub-district of Gorontalo Regency. Despite this increase in the beef cattle population, there has been a concurrent decrease in green open space available for grazing. The underlying causes of this phenomenon have been identified as rapid population growth, conversion of agricultural land to residential land, and the establishment of Tibawa Sub-district as an industrial area. These developments pose significant challenges to effective resource and environmental management in the region. The integration of farming with beef cattle emerges as a pivotal strategy to address these challenges and

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maintain ecosystem balance in the region. The Gorontalo Regency Government's policy, since the beginning of its administration, has designated the Tibawa sub-district as an industrial area. The Detailed Spatial Plan (RDTR) is a component of the broader spatial plan. The RDTR serves as a foundational document for the issuance of building-related licensing documentation. Presently, the RDTR serves as a prerequisite for the establishment of business entities through the Online Single Submission (OSS) system. This policy is expected to incentivize farmers to adopt integrated farming practices, thereby unlocking the economic potential of both agricultural and beef cattle enterprises.

However, the utilization of organic fertilizers is constrained by the limited nutrient availability, necessitating the use of substantial quantities. A solution to this challenge lies in the integration of solid and liquid organic fertilizers with growth-promoting microorganisms. The integration of these organic fertilizers within arid regions has been demonstrated to enhance the quality of food crops and generate substantial biomass suitable for beef cattle feed. The nutrient-rich organic fertilizer formulation also improves soil fertility, ensuring high-quality crop yields and biomass for beef cattle feed. The constraints imposed by beef cattle development, particularly the scarcity of feed, can be surmounted by leveraging food crop biomass, such as straw, in conjunction with complete feed silage technology that is resilient and independent of seasonal variations.

2. Methods

This research was conducted in Tibawa District, Gorontalo Regency, over a period of two months, commencing in January 2024 and concluding in March 2024. The present study employs a quantitative research method. A sample size of 30 individuals was selected for this study. The data were collected through the administration of questionnaires, which served as the primary data source. The collected data underwent a thorough analysis, employing a descriptive quantitative descriptive analysis (SWOT) to provide a comprehensive understanding of the subject matter.

3. Results

3.1. Identification of Internal and External Factors

3.1.1. Identification of internal factors

Strengths

- Farmers have demonstrated a commitment to operating an environmentally based livestock business.
- The integration of food crops and beef cattle has the potential to enhance operational efficiency.
- The integration of agricultural practices with the raising of beef cattle offers agricultural producers the potential for income diversification, thereby mitigating financial risk by establishing a multifaceted stream of revenue.
- Integration has the potential to enhance the management of the quality of agricultural and livestock products, thereby increasing competitiveness in the market.
- Farmer-ranchers adopt local wisdom values in the integration of food crops and beef cattle as part of the development of cooperation (strengthening social capital).

Weaknesses

- Farmers' knowledge of the integration system of food crops and beef cattle remains limited.
- Lack of farmer skills in adopting new technologies and understanding integrated farming and livestock management.
- Inadequate availability of supporting infrastructure such as irrigation and transportation to support the sustainability of the integration system.
- Management problems in coordination between the farming and beef cattle sectors, especially between farmer-ranchers-institutional-stakeholders.
- There are no SOP models and various standardized technical guidelines on integrating food crops and beef cattle.

The following table presents a rating of the internal factors that become strengths and weaknesses in the strategy of developing an integrated system of food crops and beef cattle on the income of farmers in Tibawa District, Gorontalo Regency.

Table 1 Internal Strategic Factor Analysis Summary/IFAS (Strengths and Weaknesses)

No.	Description	Actual Points	Weight	Rating	Score
1	Strength - 1	66.00%	0.092	2.000	0.184
2	Strength - 2	72.00%	0.100	3.000	0.300
3	Strength - 3	72.67%	0.101	4.000	0.404
4	Strength - 4	63.33%	0.088	1.000	0.088
5	Strength - 5	74.67%	0.104	4.000	0.415
Total of Strengths			0.485		1.391
1	Weakness - 1	74.67%	0.104	4,000	0.415
2	Weakness - 2	81.33%	0.113	4,000	0.452
3	Weakness - 3	73.33%	0.102	3,000	0.306
4	Weakness - 4	73.33%	0.102	2,000	0.204
5	Weakness - 5	68.00%	0.095	1,000	0.095
Total of Weaknesses			0.515		1.472
Total of IFAS		7.19	1.000		
Score of IFAS					-0.081

Source: Processed data, 2024

As illustrated in Table 1, the internal factors received a strength score of 1.391, while the weakness score was 1.472. The discrepancy between the internal and external factors is -0.081, indicating that the strength of the internal factors is less than that of the external factors. This suggests that the development of an integrated system of food crops and beef cattle on the income of farmers in Tibawa District, Gorontalo Regency, is accompanied by various weaknesses. Optimizing these weaknesses is a necessity for all parties involved.

3.1.2. Identification of external factors

Opportunities

- Stakeholders' support in the development of an integrated system of food crops with beef cattle.
- Continued technological developments can open up new opportunities to improve productivity and efficiency through innovations in farm and livestock management.
- There are many consumers with preferences for organic agricultural products, which are certainly obtained from the integration of food crops and beef cattle as organic fertilizer.
- Potential cooperation with the private sector or research institutions for innovation and development.
- Opportunities for diversification of products and services from the results of integration such as the Tibawa area can become Edu-tourism of food crops-cow slaughter integration.

Threats

- Farmers' skepticism over the nutritional content of silage derived from agricultural waste for animal feed.
- Climate uncertainty and climate change can pose a serious threat to agricultural production, disrupting the integration process.
- Fluctuations in the price of feedstuffs and agricultural inputs that can affect integration outcomes.
- The condition of some farmers who do not want to bother with the system of integrating food crops with beef cattle.
- Farmers think that the price of beef cattle with an integrated system is not higher than beef cattle without an integrated system, as well as in the case of rice and corn crops.

The following section presents a rating of external factors that become opportunities and threats in the strategy of developing an integrated system of food crops and beef cattle on the income of farmers in Tibawa District, Gorontalo Regency (see Table 2).

Table 2 External Strategic Factor Analysis Summary/EFAS (Opportunities and Threats)

No.	Description	Actual Points	Weight	Rating	Score
1	Opportunity - 1	78.00%	0.097	1.000	0.097
2	Opportunity - 2	79.33%	0.098	2.000	0.197
3	Opportunity - 3	89.33%	0.111	4.000	0.443
4	Opportunity - 4	83.33%	0.103	3.000	0.310
5	Opportunity - 5	84.00%	0.104	4.000	0.417
Total of Opportunities			0.514		1.464
1	Threat - 1	80.00%	0.099	4.000	0.397
2	Threat - 2	78.00%	0.097	3.000	0.290
3	Threat - 3	77.33%	0.096	4.000	0.384
4	Threat - 4	79.33%	0.098	2.000	0.197
5	Threat - 5	77.33%	0.096	1.000	0.096
Total of Threats			0.486		1.364
Total of EFAS		8.06	1.000		
Score of EFAS					0.100

Source: Processed data, 2024

As illustrated in Table 2, the opportunity factor associated with the strategy of developing an integrated system of food crops and beef cattle on the income of farmers in Tibawa District, Gorontalo Regency, is 1.464, while the threat factor is 1.364. A comparison of these values reveals that the opportunity factor exceeds the threat score. This finding underscores the significance of capitalizing on numerous pivotal opportunities in the development of an integrated system of food crops and beef cattle on the income of farmers in Tibawa District, Gorontalo Regency.

3.2. SWOT Matrix

The SWOT matrix is a situation analysis tool that has the advantage of producing diverse results or implementations when applied by one party to another, even with the same factors. Furthermore, the SWOT matrix produces numerous feasible alternative strategies according to internal conditions, allowing users to maximize strengths and opportunities, reduce weaknesses and threats, and integrate various sources of information related to the SWOT matrix.

The subsequent section will present the results of alternative strategies for developing strategies for developing integrated crop and beef cattle systems on the income of farmers in Tibawa District, Gorontalo Regency.

Table 3 SWOT Matrix of Development Strategies of Food Crop and Beef Cattle Integration System towards Farmers' Income in Tibawa District, Gorontalo Regency

Aspect	Internal	
External	S-O	W-O
	-Utilization of IT -Product diversification -Development of local infrastructure	-Skills training and development -Strengthening of network -Partnerships with universities or research institutions
	S-T	W-T
	-Agricultural insurance -Development of local institutional -technical counseling and assistance	-Diversification of source of income -Local supply chain development -Implementation of sustainable agricultural practices

Source: Processed data, 2024

As illustrated in Table 3, four alternative strategy cells can be implemented under the strategy of developing an integrated system of food crops and beef cattle on the income of farmers in Tibawa District, Gorontalo Regency. These cells include the S-O strategy (Strength-Opportunities), W-O strategy (Weaknesses-Opportunities), S-T strategy (Strength-Threats), and W-T strategy (Weaknesses-Threats). However, for the development strategy of the integration system of food crops and beef cattle on the income of farmers, it is more ideal to use the W-O (Weaknesses-Opportunities) strategy because there are circumstances where the magnitude of weaknesses can be reduced by developing external capacity (opportunities). The following is a detailed explanation of the W-O model strategy:

3.2.1. Skills training and development

It is imperative to implement training and skills development programs for farmers and breeders. These initiatives are designed to address deficiencies in farm management and livestock rearing. The primary objective is to empower individuals to capitalize on existing opportunities with greater efficacy.

3.2.2. Strengthening of network

The establishment of a collaborative network among farmers, breeders, and relevant parties, including financial institutions, marketing entities, and research organizations, is imperative to enhance market access opportunities and technological capabilities.

3.2.3. Partnerships with universities or research institutions

Establishing collaborative relationships with academic institutions, such as universities and research organizations, is a strategic initiative that facilitates access to cutting-edge research and technological advancements in the domains of agriculture and livestock production.

3.3. SWOT Analysis Diagram

The primary objective of implementing this approach is to discern one of four distinguishing patterns in the alignment of internal and external circumstances encountered by the Strategy for the advancement of integrated crop and beef cattle systems on the revenue of farmers in Tibawa District, Gorontalo Regency. The results of the testing of internal and external factors are as follows:

- The total score for factor (S) is : 1,562
- The total score for factor (W) is : 1,382
- The total score for factor (O) is : 1,367
- The total score for factor (T) is : 1,435

According to the internal and external factors previously delineated, the coordinate points of the SWOT diagram can be arranged as indicated in Table 4.

Table 4 Coordinates of Internal and External Analysis

No.	Description	Score
1	Internal Factor	
	a. Strengths	1,391
	b. Weaknesses	1,472
	The difference	-0,081
2	External Factor	
	a. Opportunities	1,464
	b. Threats	1,364
	The difference	0,100
X, Y Coordinates		(-0,081 ; 0,100)

Source: Processed data, 2024

As illustrated in Figure 4, which is based on the data presented in Table 4, the location of the strategy quadrant is delineated as follows:

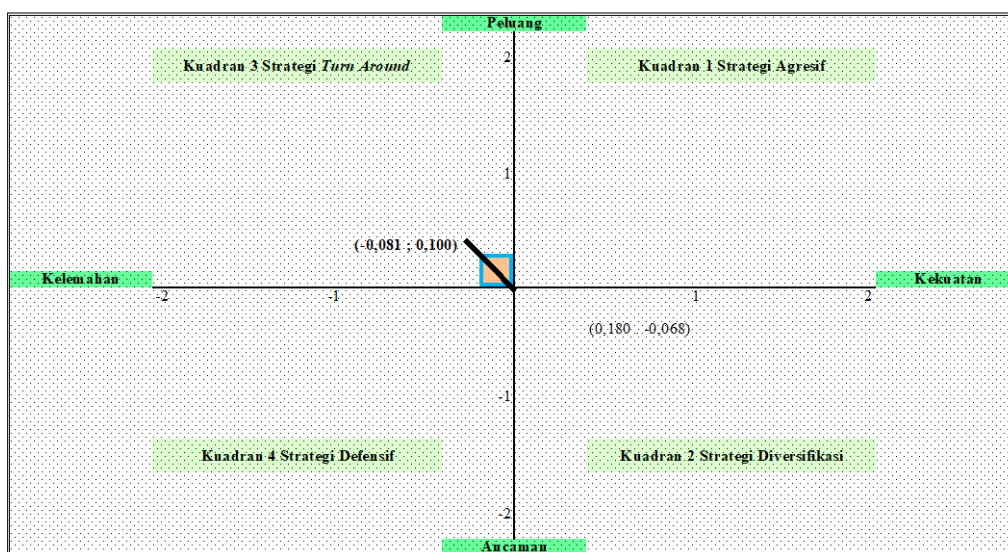


Figure 1 SWOT Diagram Analysis

As illustrated in Figure 1, the strategy for cultivating an integrated system of food crops and beef cattle on the income of farmers in Tibawa District, Gorontalo Regency, occupies the third quadrant, designated as the "Turn Around" strategy. This strategy underscores that endeavors to enhance the development of an integrated system of farming and beef cattle on the income of farmers in Tibawa District, Gorontalo Regency, should prioritize the utilization of diverse opportunities by mitigating inherent weaknesses. This approach ensures the effective and sustainable operation of the integration system. The comprehensive development of an integrated system of food crops and beef cattle on the income of farmers in Tibawa District, Gorontalo Regency, necessitates concerted efforts to:

3.3.1. Skills training and development

Training and skills development initiatives targeting farmers and breeders are crucial for enhancing their competencies in farm management and livestock rearing. These initiatives are instrumental in empowering individuals to capitalize on existing opportunities more effectively. Training and skill development are identified as pivotal strategies to address the deficiencies among farmers and herders in the Tibawa Sub-district. The implementation of structured and sustainable training programs within communities is instrumental in facilitating the acquisition of new knowledge and skills in farm management and livestock rearing. This, in turn, will better equip communities to address the challenges

associated with farming and livestock activities, leading to the optimization of existing resources. Moreover, training can encompass marketing and financial management, empowering communities to manage their businesses with greater professionalism and efficiency.

3.3.2. Strengthening of network

The establishment of a collaborative network between farmers and breeders, along with relevant stakeholders such as financial institutions, marketing entities, and research organizations, is imperative to enhance market access and technological capabilities. The enhancement of collaborative networks is imperative to facilitate market access and technological dissemination for farmers and breeders. By forging close collaborations with relevant entities, such as financial institutions, marketing entities, and research institutions, farmers can garner broader support in developing their business enterprises. This collaborative environment fosters the exchange of knowledge and experience among network members, enabling communities to learn from each other and adopt best practices in agriculture and livestock activities. Furthermore, collaboration with financial institutions can facilitate farmers' access to the capital required for business operations.

3.3.3. Partnerships with universities or research institutions

The establishment of partnerships with academic institutions in the field of agriculture and livestock husbandry has been identified as a strategic approach to accessing cutting-edge research and technological advancements. These collaborative endeavors have been shown to facilitate the acquisition of state-of-the-art knowledge and equipment, thereby enhancing the productivity and quality of agricultural products and livestock rearing. Furthermore, these partnerships can facilitate the initiation of collaborative research endeavors or the implementation of innovation development programs, which have the potential to address the challenges confronting farming communities and breeders.

4. Discussion

The integration system has been shown to be beneficial in that livestock can utilize grass and forage growing wild, straw, or agricultural waste as feed. In addition to producing manure as organic fertilizer to improve soil fertility, the integration system has been demonstrated to have other advantages. Rohaeni et al. (2010) provide a comprehensive overview of corn cultivation, cow dung fermentation, and cattle farming technology. The corn cultivation technique that was introduced involved the use of fine compost as a base fertilizer. The findings of the study demonstrated that the integration of food crops, specifically corn, with cattle husbandry on dry land can generate added value by repurposing cow dung as fine compost, thereby reducing the cost of purchasing fertilizers. The corn residue can be utilized, particularly during the dry season, as an alternative feed source, such as leaves, stems, and cobs.

Furthermore, the urine of bovines can be utilized as a liquid organic fertilizer, thereby enhancing the overall utility of the agricultural product. This urine is colloquially referred to as "cow urine POC." Given the substantial population of cattle, the generation of livestock waste, including solid waste and urine, is significant, yet its optimal utilization is limited. The utilization of livestock urine as a component of zero waste management has emerged as a significant application in this context. Typically, livestock urine is discarded without being utilized, yet it possesses significant potential as a liquid organic fertilizer. It has been estimated that a herd of 100 cows can produce 1,500 to 2,000 liters of urine daily. The utilization of liquid organic fertilizer confers numerous benefits, including the capacity to be applied directly to the roots of plants or as a foliar spray, thereby conserving energy. This approach contributes to the maintenance of soil moisture, as evidenced by Hendriyatno et al. (2019).

A close interaction exists between land (soil), maize (crop), and cattle (source of organic fertilizer) in a farming system, wherein this interaction contributes to productivity. The deterioration of soil quality is a matter of grave concern that must be addressed within the framework of an integrated agricultural system. Such a system is characterized by the interconnection of soil, plants, and livestock, which collectively form a symbiotic relationship within the agricultural ecosystem. As Putra et al. (2016) have articulated, the integration of technology is imperative in the processing of agricultural and industrial waste into high-quality animal feed. Similarly, the processing of fecal waste into bio gas, biorganic fertilizer, and urine into biourin is crucial in reducing environmental pollution (zero waste). The integration of these three components—namely, land as a container in the planting process, corn planting, and the production of corn with a high yield—with environmentally friendly fertilizer, namely cow dung fertilizer, is essential. Furthermore, it is imperative to recognize that cows require corn for feed and land for maintenance.

The findings of this study are consistent with the assertion posited by Bahri (2019) that the attainment of national food security necessitates the implementation of sustainable measures, methodologies, and stratagems. A strategic approach

to achieving national food security involves the implementation of an integrated livestock-plant agricultural system. This integrated system is a model for increasing production with high quality, supported by technological innovations that are oriented towards a zero waste production system. The integration of livestock and crops, both horizontally and vertically, represents a symbiotic relationship between the pursuit of productivity and the conservation of natural resources. In the context of livestock farming, the integration of livestock, such as cattle, into crop production entails the placement of livestock within crop fields without compromising crop growth and productivity. The coexistence of livestock and crops can enhance crop productivity, thereby increasing the overall output of both sectors. The integration of cattle with crops facilitates the utilization of by-products and plant by-products (crop residues) as cattle fodder, thereby ensuring the sustainable use of natural resources. In addition, cattle can serve as a source of raw materials for the production of organic fertilizers, providing essential nutrients to support plant growth.

A variety of approaches can be adopted in the livestock-crop integration system. These include the regional zone approach and regionalization of superior commodities, the upstream/on farm approach, the downstream (post-harvest) approach, and the market approach. Strategies for livestock-crop integrated farming systems that can be carried out include selecting/designating locations for livestock-crop integrated farming development, utilizing suboptimal land for livestock, optimizing LEISA and zero waste patterns, building a mini feed mill industry made from local raw materials, increasing research activities and technology adoption towards the development of livestock-crop integrated system areas, improving farmer performance through extension and farmer-livestock group institutional approaches, and market sales and marketing strategies.

The strategy for developing an integrated system of farming and beef cattle on farmers' income can be achieved through the Turn Around strategy. The Turn Around strategy prioritizes the enhancement and augmentation of existing productivity, whereas the W-O strategy emphasizes the identification and cultivation of strengths, as well as the development of new business ventures. It is anticipated that farmers in the Tibawa Sub-district will be able to strengthen their capabilities and capitalize on existing opportunities more efficiently. This transformation is expected to have a positive impact on increasing farmer income and improving farmer welfare.

The integration of food crops and beef cattle is of paramount importance in terms of enhancing farmers' income, necessitating constant optimization. The integration of food crops and livestock rearing fosters synergies between the two sectors. For instance, agricultural waste can be utilized as animal feed, while livestock manure can be employed as a fertilizer to enhance crop productivity. This symbiotic relationship fosters a multifaceted enhancement in overall productivity and optimized resource utilization. Farmers operating within an integrated system are able to produce processed or derivative products from their agricultural and livestock products. For instance, beef cattle milk can be processed into processed dairy products, or beef cattle meat can be processed into ready-to-eat products. This approach has the potential to enhance the added value of the product and broaden market opportunities. Bahri (2023) underscores the significance of leveraging residual agricultural products and the agricultural industry by cultivating quality forage on land that is not dedicated to food crops, thereby creating a symbiotic relationship between feed crops and food. This is particularly salient given the variability in the provision of agricultural and industrial residues, and the recognized need for 60-70% of forage to be allocated to ruminant livestock.

5. Conclusion

The strategy for cultivating an integrated system of food crops and beef cattle on the income of farmers in Tibawa District, Gorontalo Regency is situated in quadrant 3, designated as the Turn Around strategy or W-O (Weaknesses-Opportunities) strategy. This strategy underscores the necessity to prioritize the enhancement of opportunities while concurrently addressing weaknesses, thereby ensuring the optimal functioning of the integrated system and the sustainability of its benefits. The implementation of this strategy is predicated on three fundamental approaches:

- Training and skill development,
- The reinforcement of cooperative networks, and
- The forging of partnerships with academic institutions such as universities or research organizations.

5.1. Suggestion

In light of the aforementioned research results and conclusions, the following recommendations are proposed for future studies:

- It is incumbent upon the Gorontalo District government to persist in its encouragement of the development of programs that combine agricultural and livestock activities in an integrated system. Moreover, the government

should organize regular training and technical guidance to improve the knowledge and skills of farmers in effective and sustainable agricultural and livestock practices. To ensure the availability of adequate agricultural and livestock facilities and infrastructure, the government must provide such things as irrigation, road access, storage and processing facilities for agricultural products, and animal health facilities.

- Farmers in the Tibawa Sub-district of Gorontalo District should enhance their understanding and expertise in effective and sustainable agricultural practices, as well as in livestock husbandry. Furthermore, they should demonstrate a willingness and readiness to engage in collaborative efforts with various stakeholders to implement crop and beef cattle integration systems in a consistent manner

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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