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Strategy for Accelerating Gamal Leaves as Forage Feed Additives in Migrant-Dense Areas: A Case Study in Jember

Evita Soliha Hani[*,a], **Wildan Muhlison**[a], **Tri Wahyu Saputra**[a], **Roni Yulianto**[a], **Laily Ilman Widuri**[a], **Fariz Kustiawan Alfarisy**[b], **Rizky Yanuarti**[a]

[a] University of Jember, Indonesia
[b] State University of Surabaya, Indonesia

Abstract

Small-scale livestock farmers face challenges in feed availability, particularly during the dry season. Gamal leaf forage, with its high protein content and durability, offers a sustainable solution to these issues. This study focuses on Klungkung, Sukorambi District, a migrant-dense area where economic empowerment through innovative business models is crucial. By exploring entrepreneurship-based gamal fertilizer production, the research assesses its potential to meet local economic needs and improve community welfare. The objectives are to analyze the business position, create a business plan, and formulate strategies to accelerate the adoption of environmentally friendly, location-specific gamal leaf forage in Jember Regency. The study surveyed 30 members of livestock farmer groups in high-potential areas, utilizing the Business Model Canvas (BMC) and SWOT methods for analysis. Results reveal the business position is highly promising, with strategies emphasizing leveraging group strengths to capitalize on opportunities.

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* *Corresponding author*: Evita Soliha Hani - Department of Agribusiness, Faculty of Agriculture - University of Jember. E-mail: ita_hani.faperta@unej.ac.id.

Introduction

Downstream processing is the process of transforming raw materials into a more valuable product that can be marketed and is ready for end consumers (Östensson & Löf, 2017). Downstream processing is a strategic industrial activity because it not only adds value to raw materials but also provides job opportunities and boosts economic growth from regional to national levels (Datar & Rosén, 2020). Downstream processing is crucial for the agricultural sector because it enhances the value of agricultural products and post-harvest waste from the perspective of raw materials. Raw materials typically have low value, but processing them will enhances their value and directly improving the income of farmers (Wong *et al*., 2020). Therefore, accelerating the downstream processing of agricultural raw materials is a strategic concept in efforts to improve the welfare of farmers and society in general.

Livestock is the agricultural sub-sector that utilizes plants, where plants are used as the primary feed for livestock. Livestock that require large amounts of plants as their main feed are ruminants (Blakely & Bade, 1998; Soetanto, 2019). Plants used as livestock feed are known as Forage. Ruminant livestock require that 75% of their feed consists of forage (Setiana. 2002) even up to 94% (Arifin & Hermansyah, 2019), the rest is in the form of concentrate. The types of forage needed are grass and legume. The availability of foreage in Indonesia is highly dependent on the season. Forage is abundant during the rainy season. Conversely, forage is difficult to obtain in the dry season. This seasonal dependence disrupts the continuity of forage availability. The inconsistency in the availability of forage will affect the quality of the feed. Impact of low quantity and quality of forage causes low livestock productivity (Olivares-Perez *et al*., 2011; Rusdiana & Hutasoit, 2014). Therefore, the availability of high-quality forage throughout the year is very important.

High-quality forage must have a balanced content of protein, fat, carbohydrates, minerals, and vitamins (Yessenamanova *et al*., 2021). Crude protein and crude fiber are very important substances for the growth and development of livestock. Crude protein is largely found in legume plants, while crude fiber is found in grass types (Widodo, 2017). One type of legume that is high in nutritional protein is gamal (Hartadi *et al*., 1990). Gamal can serve as the main forage for livestock or be given as a supplementary forage to meet protein needs when the primary feed is grass. The use of gamal as livestock feed is better when mixed or used as an additive to straw (Rosani, 2022).

Forage additive is an essence that is added to staple foods (Utomo *et al*., 2021). The purpose of adding this additive is to obtain better feed quality, especially protein. It is recommended to provide gamal in a fresh state (Disnakkeswan Prov. NTB., 2020) but it can still be good if provided in a

dry and chopped condition (Sudirman *et al.*, 2023). Recent research on gamal as forage additive have not been focusing in its downstream processing, its mainly focusing on gamal as supplementary substance towards livestock health conditions (body weight, diseases, meat quality) (Aryanto *et al.*, 2020; Sawitri *et al.*, 2023; Sofyan *et al.*, 2020). In order to address the scarcity of both quantity and quality of forage during the dry season, downstream processing that lead to the provision of multi-nutritional supplements (feed additives) like gamal to straw are necessary.

Moreover, the use of supplementary feed for ruminants has not been extensively studied over the past 20 years, from 2000 to 2021, including supplementary feed from gamal. Research focusing on the utilization of gamal leaves is seen as an important and strategic step. This is because, in addition to gamal easily growing in various types of soil, it is also beneficial in addressing issues of nutrient deficiency and food (Michalak *et al.*, 2021), mitigating methane gas emissions (Herliatika & Widyawati, 2021), and controlling erosion (Jermias *et al.*, 2021; Disnakkeswan Prov. NTB, 2020). Ultimately, it can improve the welfare of farmers (Dahlanuddin & Hermansyah, 2022). The ruminant livestock cultivated by Indonesian farmers include beef cattle, goats, sheep, dairy cattle, and buffalo (PPID Agriculture, 2020). These livestock have economic value and play a complex role, both as meat producers supporting the provision of national meat needs and as manure producers to maintain soil fertility, thereby aiding in the acceleration of environmentally sustainable development.

Among the areas with high potential in natural resources, Jember stands out as a center of agricultural activities in Indonesia. Located in East Java, Jember's geographical features include canyon areas surrounded by mountains (Salim, 2022). The formation of these canyons is caused by river flow erosion. Most residents of Jember Regency still rely on farming and livestock cultivation as their main source of income. One specific location of interest is Klungkung, Sukorambi District, which is characterized by a high level of migrant population (Badan Pusat Statistik, 2024). This demographic dynamic makes it crucial to assess whether innovative business models, such as entrepreneurship-based production of gamal-derived fertilizers, are necessary and beneficial for the community. Such models could potentially address local economic challenges and provide sustainable solutions to improve the economic welfare of both local and migrant populations. Therefore, the management of natural resources with an environmental perspective becomes a top priority in the community's economic development. The objectives of this research are (1) to analyze the business prospects of gamal leaf additive forage and (2) to develop an environmentally sustainable strategy for advancing gamal leaf additive forage in Jember Regency. Jember has unique combination of geographical features

(Salim, 2022), agricultural potential (Astuti, 2017; Retnani & Bukhori, 2017), and high migrant population (Juddi *et al*., 2021; Nurdin *et al*., 2018) makes it an ideal location for research and innovation in downstream processing of agricultural products like gamal forage.

Methodology and analysis

Research Area Determination. This study was conducted in Klungkung, Sukorambi District, Jember Regency, in 2023. The research area was determined purposively where Klungkung is known for its high potential in ruminant livestock farming, supported by the presence of organized farmer groups actively engaged in livestock cultivation. Additionally, the area is prone to environmental challenges such as landslides and floods, which exacerbate the seasonal scarcity of high-quality forage. One specific aspect of interest in Klungkung is its high level of migrant population. By focusing on Klungkung, this study not only addresses the technical challenges of forage scarcity but also explores the socio-economic potential of integrating migrant populations into sustainable agricultural value chains.

Respondent and Sampling. The study population comprised members of the "Tumbuh Sejahtera Lereng Mujan" Farmer Group, totaling 30 individuals. Farmer group Maju Tumbuh Sejahtera is the only group who active in producing forage feed especially using gamal based on field observations and information from local agricultural extension workers. A total sampling method was employed, involving all members of the group as respondents. This approach was chosen to comprehensively capture the perspectives and practices within the group, ensuring robust and representative data collection.

Data Sources and Data Collection. Primary data were gathered directly from respondents through structured interviews, group discussions, and observations. Secondary data were obtained from institutional records. Data inclue farmer activity and active farmer group data were obtained from the Jember Regency Agriculture Office (via agricultural extension workers). Interactive methods (interviews and discussions) were used to explore respondents' knowledge, attitudes, and practices related to gamal leaf forage feed additives, while non-interactive methods (document review and observation) provided supplementary insights.

Data Analysis. The analysis involved two main tools: the Business Model Canvas (BMC) and SWOT analysis. Business Model Canvas (BMC) used to determine the prospects and downstream strategy of gamal leaf additive livestock feed focusing on environmentally sustainable village-specific (one village one product). Business Model Canvas (BMC) was selected as

the primary analytical tool for this study due to its ability to provide a comprehensive, visual, and structured framework for evaluating business prospects and developing downstream strategies (Cardeal *et al.*, 2020; Khodaei & Ortt, 2019). Unlike traditional business analysis tools which often focus on isolated aspects of a business, BMC offers a holistic view of the entire business ecosystem (Joyce & Paquin, 2016). This is particularly important for assessing the potential of gamal leaf forage feed additives, as it involves multiple interconnected components, including value creation, customer segments, supply chains, and revenue streams. The analysis covered nine elements (Alexander & Yves, 2012): customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, cost structure.

Following the BMC, SWOT framework was employed to integrate internal and external factors influencing the business. Strengths (S) and weaknesses (W) were identified from the internal environment, while opportunities (O) and threats (T) were derived from the external environment (Ciarmiello & Mansi, 2016). Each factor was assigned a weight (importance level) and a rating (influence level). Weights ranged from 1 to 5, indicating the relative importance of each variable, and ratings ranged from 1 to 5, indicating their influence. The use of a 1-5 scale for weighting and rating SWOT factors was chosen for its simplicity, practicality, and alignment with the study's participatory approach (Ciarmiello & Mansi, 2016). The weights were determined through a structured process involving stakeholder consultation, expert judgment, consensus building, and validation, ensuring that they accurately reflect the importance of each factor in the local context (Qayyum *et al.*, 2023; Stacchini *et al.*, 2022). This approach not only enhances the credibility of the analysis but also ensures that the results are actionable and relevant to the stakeholders involved (Khalilzadeh *et al.*, 2021; Ma *et al.*, 2018). Scores for each variable were calculated by multiplying weights and ratings. Moreover Lastina & Sunarni (2019) further argue that BMC and SWOT analysis are complementary tools because SWOT analysis identifies internal and external factors of each BMC element currently in operation within a company, subsequently facilitating strategy development for its enhancement.

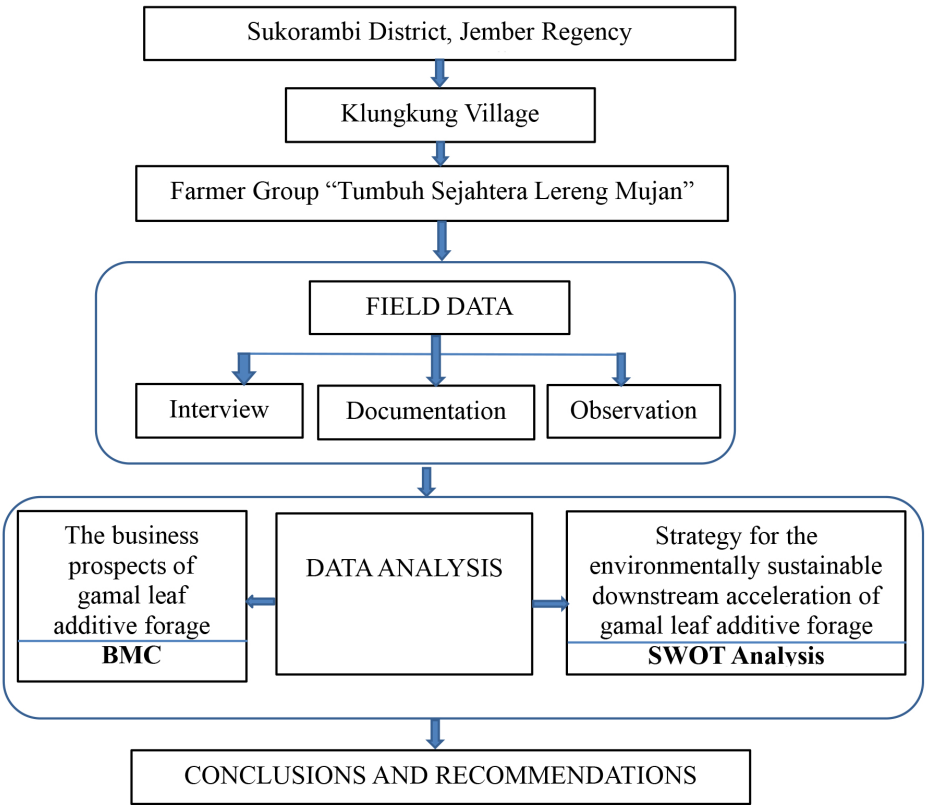
Furthermore, to ensure data quality, validity and reliability tests were conducted:

1. Validity Testing: Correlation analysis was used to assess the validity of each variable in the internal and external factors. Data were considered valid if the computed correlation coefficient exceeded the critical r-value (0.361 at $\alpha = 0.05$, df = 28) (Sugiono, 2008)
2. Reliability Testing: Cronbach's Alpha was employed to evaluate data reliability. A Cronbach's Alpha value greater than 0.60 was considered

acceptable. In this study, the Cronbach's Alpha value of 0.841 indicated high reliability (Ghozali, 2005).

Figure 1 shows the overall research method which used in this research. Data interpretation for SWOT analysis then used to construct Internal Factor Analysis Strategy (IFAS) and External Factor Analysis Strategy (EFAS) matrices. The total scores from these matrices were plotted on a SWOT quadrant to determine the strategic position of the gamal leaf forage feed additive business. The findings positioned the business in Quadrant I (aggressive strategy), suggesting favorable conditions for leveraging internal strengths to exploit external opportunities effectively.

Figure 1 - Research design mindmap



Results and discussion

Livestock Husbandry and Ownership System in Research Area

Livestock management systems consist of three types: extensive, intensive, and semi-intensive (Pugliese *et al*., 2021). In an extensive system, livestock graze freely on large open areas such as pastures or rangelands, relying primarily on natural forage with minimal human intervention (Confessore *et al*., 2022). This system is low-cost but often results in lower productivity due to limited control over nutrition and health. In contrast, a semi-intensive system combines grazing with supplemental feeding and housing (Pugliese *et al*., 2021). Intensive farming systems are often used in Indonesia due to their efficiency in terms of feed provision, stall cleaning, disease management, and livestock bathing. All respondents (100%) indicated that all livestock farmers in their development activities use intensive systems, where animals are kept in stalls. Farmers opt for intensive systems due to limited land availability, absence of communal grazing lands for cattle/goat herding, and to prevent theft.

On average, small-scale farmers in Jember Regency raise 9 goats per household and 4 cows per household. Ownership of cows varies; some are jointly owned ("gaduhan"), meaning the cow's owner and caretaker share the profits equally after deducting the initial purchase cost borne by the owner. Others use a "perang buduk" system, where the second calf becomes the property of the caretaker. In contrast, all goats raised by farmers are owned outright. The cattle breeds raised include Limousin and Metal, while the goat breeds include Dormas and Malibu. Meanwhile. the average experience of respondents in livestock farming is 13.5 years. The shortest experience reported is 2 years, and the longest is 42 years. Farmers in Jember integrate gamal into their farming systems by planting it along field boundaries or in agroforestry systems, where it serves as a dual-purpose crop. Gamal leaves are harvested as a high-protein forage supplement for livestock, while its roots help prevent soil erosion and improve soil fertility (Aryanto *et al*., 2020; Roza *et al*., n.d.). Gamal is particularly valued for its adaptability to marginal soils, low maintenance requirements, and ability to grow year-round, making it a sustainable solution for small-scale farmers with limited land and resources.

Business Canvas Model (BMC)

The Business Model Canvas (BMC) for the gamal leaf additive forage business highlights several critical components essential for the operation and success of the venture (Seufert *et al*., 2023; Zanella *et al*., 2024). This BMC provides a comprehensive overview of the gamal leaf additive forage business, outlining its key components and how they interact to create value and generate revenue.

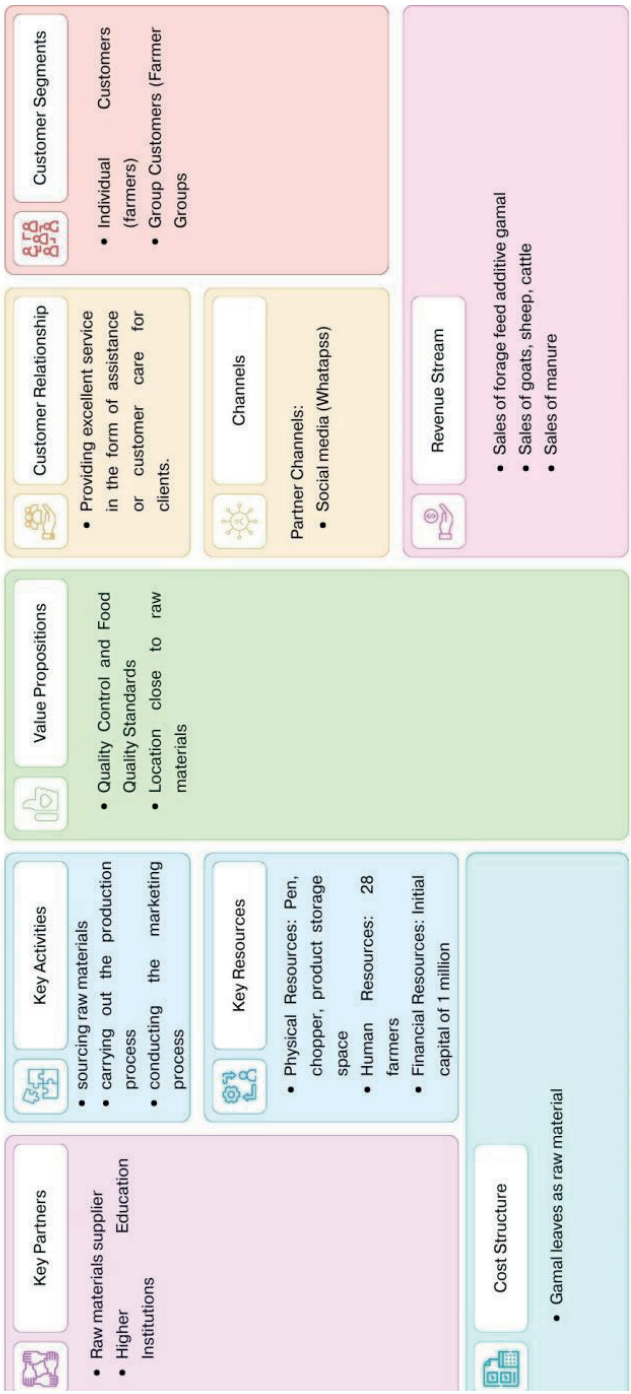


Figure 2 - Business Model Canvas for Gamal Forage Feed Additive

Below are the explanation the nine keys element:

1. Key Partners include raw materials suppliers and higher education institutions. These partners are crucial for ensuring a steady supply of necessary inputs and providing expertise and research support for the business.
2. Key Activities focus on three primary areas: sourcing raw materials, carrying out the production process, and conducting the marketing process. These activities are fundamental for transforming raw materials into marketable products and ensuring these products reach the target customers effectively.
3. Key Resources are divided into physical, human, and financial resources. Physical resources include the pen, chopper, and product storage space necessary for production. Human resources consist of 30 farmers who are involved in the cultivation and processing of the forage. Financial resources involve an initial capital of 1 million, which is used to fund the start-up and operational activities.
4. Value Propositions emphasize quality control and food quality standards, ensuring that the products meet the required benchmarks for safety and efficacy. Additionally, the location close to raw materials is highlighted as a significant advantage, reducing transportation costs and ensuring fresh inputs.
5. Customer Relationships are built by providing excellent service in the form of assistance or customer care for clients. This approach helps in maintaining customer loyalty and satisfaction by addressing their needs promptly and effectively.
6. Channels include partner channels such as social media (WhatsApp), which are used to communicate with and reach out to customers. These channels help in marketing the products and maintaining customer engagement.
7. Customer Segments target individual customers (farmers) and group customers (farmer groups). These segments are the primary market for the gamal leaf additive forage products, providing them with high-quality feed additives for their livestock.
8. Cost Structure is centered around the use of gamal leaves as the primary raw material. This cost is a significant part of the business expenses and is crucial for budgeting and financial planning.
9. Revenue Streams are generated from the sales of forage feed additive gamal, sales of goats, sheep, and cattle, as well as sales of manure. These diverse revenue streams help in sustaining the business and ensuring profitability by tapping into different aspects of the agricultural market.

Prospects for Downstream Processing of Gamal Leaf Forage Feed Additive

Farmers who raise ruminant animals are generally crop and horticulture farmers. Ruminant farming is a side job. Since most ruminant farmers in

Jember are small-scale farmers (Hani *et al*., 2023), including the respondents in this study, farmers have been producing animal feed from processed straw with legumes for approximately one year. Business model evaluation with SWOT analysis is conducted to determine the position of the gamal leaf additive feed business as a business unit (Puglieri *et al*., 2022). Market conditions and other conditions are assessed so that farmer groups can adapt to the situations they face. The items in the BMC elements (Figure 2) are grouped into internal and external factors. The results of the grouping are shown in Table 1.

Table 1 - Variables in the Internal and External Factors

STRENGTHS		**WEAKNESS**	
Variable	**Description**	**Variable**	**Description**
S1	Chopper	**W1**	Knowledge of the best formula between straw and gamal leaves
S2	Response to downstreaming of gamal leaf additive forage feed	**W2**	Financial management
S3	Networking	**W3**	Storage facilities for production results
S4	Knowledge about the gamal tree	**W4**	Member participation in group activities
S5	Leadership of farmer groups	**W5**	Optimization of gamal leaf additive forage feed processing
S6	Durable product	**W6**	Business capital
OPPORTUNITIES		**TREATHS**	
Variable	**Description**	**Variable**	**Description**
O1	Availability of gamal trees	**T1**	Reforestation activities of gamal trees
O2	Product price	**T2**	Habit of feeding fresh fodder
O3	Soil topography	**T3**	Technology
O4	Availability of chopper equipment	**T4**	Financial assistance
O5	Higher education institutions	**T5**	Training as a project
O6	Demand for gamal leaf additive supplements	**T6**	Competitors of forage feed supplements

The results of the correlation test to assess data validity indicate that all internal variables (strengths and weaknesses factors) and external variables (opportunities and threats factors) have correlation values above the critical r value (0.361) at 99% and 95% confidence levels, meaning all data are valid (Table 2).

Table 2 - Results of data validity test

IFAS				EFAS			
Variable	**Value of r-Table**	**Pearson Correlation**	**Validity**	**Variable**	**Value of r-Table**	**Pearson Correlation**	**Validity**
S1	0.361	.726**	Valid	O1	0.361	.722**	Valid
S2	0.361	.835**	Valid	O2	0.361	.658**	Valid
S3	0.361	.766**	Valid	O3	0.361	.851**	Valid
S4	0.361	.683**	Valid	O4	0.361	.676**	Valid
S5	0.361	.877**	Valid	O5	0.361	.822**	Valid
S6	0.361	.766**	Valid	O6	0.361	.702**	Valid
W1	0.361	.674**	Valid	T1	0.361	.708**	Valid
W2	0.361	.646**	Valid	T2	0.361	.711**	Valid
W3	0.361	.659**	Valid	T3	0.361	.711**	Valid
W4	0.361	.816**	Valid	T4	0.361	.667**	Valid
W5	0.361	.666**	Valid	T5	0.361	.667**	Valid
W6	0.361	.678**	Valid	T6	0.361	.729**	Valid

* Correlation is significant at the 0.05 level (2-tailed), r-table = 0.361.
** Correlation is significant at the 0.01 level (2-tailed), r-tabel =0.306.

The analysis of data reliability using the Cronbach's Alpha model is shown in Table 3. From Table 3, it is evident that all internal variables (strengths and weaknesses) and external variables (opportunities and threats) have Cronbach's Alpha values of 0.841 > 0.60, indicating that the data obtained from the field is reliable.

Table 3 - Results of Data Reliability Analysis

Cronbach's Alpha	**Cronbach's Alpha Based on Standardized Items**	**N of Items**
0.841	0.854	24

With the valid and reliable data, we proceed to the analysis of the IFAS (Internal Factor Analysis Strategy) matrix and EFAS (External Factor Analysis Strategy) matrix. The results of the IFAS and EFAS matrix analysis are as follows:

a. IFAS Matrix (*Internal Factor Analysis Strategy*)

The IFAS matrix is a matrix used to identify strengths and weaknesses that influence farmers' interest in developing downstreaming of gamal leaf additive forage feed. The analysis of the IFAS matrix is conducted by calculating the multiplication of the average weight values and the average rating values for each internal strategic variable. The rating value in the IFAS matrix indicates the strengths and weaknesses of internal factors for the business unit, obtained from the multiplication of weights with ratings for each variable in each factor (Putri *et al*., 2020). Table 4 presents the results of the IFAS matrix analysis.

Table 4 - Internal Factors Analysis

INTERNAL FACTORS						
STRENGTHS					**Rating**	
Variable	**Description**	**Weight**	**Rating**	**Score**	**Min**	**Max**
S1	Leaf Chopper	0.09	3.60	0.31	3	4
S2	Response to downstreaming of gamal as a livestock feed additive	0.08	4.00	0.34	4	4
S3	Networking	0.09	4.00	0.36	4	4
S4	Knowledge of gamal tree	0.09	3.30	0.30	3	4
S5	Leadership of group chairman	0.09	4.00	0.38	4	4
S6	Durable product	0.09	3.70	0.34	3	4
	Total	0.54	22.60	2.03		
WEAKNESSES					**Rating**	
Variable	**Min**	**Min**	**Rating**	**Score**	**Min**	**Max**
W1	Knowledge of the formula between straw and gamal leaves	0.07	3.30	0.24	3	4
W2	Financial management	0.07	4.00	0.27	4	4
W3	Storage facilities for production results	0.07	3.50	0.26	3	4
W4	Member participation in group activities	0.08	3.80	0.31	3	4
W5	Optimization of product processing	0.08	3.60	0.31	3	4
W6	Business capital	0.08	3.30	0.27	3	4
	Total	**0.46**	**21.50**	**1.65**		
	TOTAL IFAS			**0.38**		

The explanation of these internal factors is as follows:

Strength

- Leaf chopper (S1): This leaf chopper helps accelerate farmers in cutting gamal leaves and branches into small pieces, making production more efficient, facilitating storage and packaging, and aiding in livestock digestion. Half (50%) of the respondents consider the leaf chopper essential for accelerating the production of gamal leaf additive forage feed. All livestock groups have one leaf chopper. The importance of grass/leaf/branch choppers for farmers to be more efficient, especially for large-scale farmers, has also been emphasized by (Amelia *et al.*, 2022). The leaf chopper variable scores 0.31.
- Response to downstreaming of gamal as livestock feed (S2): All respondents have a positive response to the acceleration activities of downstreaming gamal leaf additive forage feed. Fifty percent of respondents deem this acceleration activity highly important. The score for this response variable is 0.34, ranking third highest.
- Networking (S3): Networking refers to cooperation networks among farmers, both within and between groups, as well as with traders and even universities. All respondents have a good network with fellow livestock farmers. Sixty percent of respondents consider networking crucial for accelerating the downstreaming of gamal leaf additive forage feed. The networking variable scores 0.36, making it the second highest.
- Knowledge of gamal tree (S4): Respondents' knowledge of cultivating gamal trees and their understanding of the benefits of gamal trees as livestock feed has been established. Gamal trees grow easily on various types of soil, making them easy to cultivate and widely utilized as forage feed, albeit irregularly. Sixty percent of respondents deem knowledge of the gamal tree essential for accelerating the downstreaming of gamal leaf additive forage feed. The score for the knowledge of the gamal tree variable is 0.30.
- Leadership of group chairman (S5): The influence of the group chairman's leadership in organizational development is crucial. Seventy-seven percent of respondents believe that the leadership of the group chairman is highly important as an internal factor for accelerating the downstreaming of gamal leaf additive forage feed. Respondents also view the leadership of livestock groups as highly creative and innovative. The score for the leadership of the group chairman variable is 0.38, the highest score.
- Durable product (S6): Since gamal leaf additive forage feed is a dry product used to provide forage feed during the dry season, its durability allows it to last up to 2-3 years. Sixty percent of respondents emphasize the importance of a durable product as a determinant for accelerating the downstreaming of gamal leaf additive forage feed. The score for the durable product variable is 0.34.

Weakness

- Knowledge of the formula between straw and gamal leaves (W1): Gamal leaf additive forage feed is a mixture of straw and gamal leaves. The nature of gamal leaves as a supplement means that the main raw material is straw, which contains a lot of coarse carbohydrate fiber. Due to this mixture, a balanced blend is necessary for optimal results. The best formula for the mixture of straw and gamal leaves is not widely known among respondents. Seventy percent (70%) of respondents consider knowledge of the formula for straw and gamal leaf mixture essential as a weakness factor in accelerating the downstreaming of gamal leaf additive forage feed. The variable W1 scores 0.24.
- Financial management (W2): (Frida, 2020) asserts that financial management determines the fate of a company because financial management activities involve acquiring funds, allocating, developing, and storing funds. The three groups of farmers in this study have not been given knowledge or skills in financial management, despite its importance. Sixty percent (60%) of respondents are neutral regarding financial management as a weakness factor among farmer groups. The variable W2 scores 0.27, the second highest score.
- Storage facilities for production results (W3): Storage facilities for production results are crucial, especially when producing on a large scale. Farmer groups have storage facilities in the form of tanks, but the number is limited, with an average of 4 large tanks per group. Fifty percent (50%) of respondents believe that storage facilities are a weakness factor in accelerating the downstreaming of gamal leaf additive forage feed. Variable W3 scores 0.26.
- Member participation in group activities (W4): Farmer groups have a minimum agenda of bi-weekly meetings to discuss farming or other urgent activities related to farming. It is expected that all members attend each meeting, but in reality, not everyone can attend. The level of member participation in group activities is low. Forty percent (40%) of respondents deem member participation as an important weakness factor in the downstreaming of gamal leaf additive forage feed. This variable scores 0.31, the highest score.
- Optimization of product processing (W5): Respondents feel that the processing of gamal leaf additive forage feed products is not yet optimal. This relates to the limited number of chopper machines and the lack of active participation by group members in the production process. Currently, the groups produce approximately 75 kg of gamal leaf additive forage feed per month, whereas this could potentially be increased to 125-150 kg per month. Seventy-seven percent (77%) of respondents state that optimizing product processing is highly important as a weakness factor. This variable also scores 0.31, the highest score, similar to variable W4.

- Business capital (W6): Business capital is a crucial aspect of any business. The size and scope of the business are determined by its capital. In business, capital is a facilitator. Respondents' business capital for gamal leaf additive forage feed business is relatively low, around 100 thousand per respondent, which hinders the development of livestock feed operations. For instance, this capital might be insufficient for packaging costs, transportation costs for straw, and other expenses. Fifty percent (50%) of respondents consider capital as an important weakness factor in the downstreaming of gamal leaf additive forage feed. This variable scores 0.27, the second highest score.

b. EFAS Matrix (*External Factor Analysis Strategy*)

The EFAS matrix is a matrix used to identify opportunities and threats that influence farmers' interest in downstreaming gamal leaf additive forage feed. The analysis of the EFAS matrix involves calculating weights and ratings for each external factor. The rating values in the EFAS matrix indicate the opportunities and threats of external factors for the research subject. These assessments are provided by each respondent, revealing the opportunities and threats. Below is the table of EFAS matrix analysis.

Table 5 - EFAS Analysis

EXSTERNAL FACTORS						
OPPORTUNITIES					**Rating**	
Variable	**Description**	**Weight**	**Rating**	**Score**	**Min**	**Max**
O1	Availability of gamal trees	0.08	4.00	0.33	4	4
O2	Product price	0.09	4.00	0.35	4	4
O3	Soil topography	0.09	3.60	0.31	3	4
O4	Variety of chopper tools	0.08	4.10	0.34	4	5
O5	Supporting company	0.09	4.00	0.34	4	4
O6	Demand for additive feed	0.09	4.00	0.34	4	4
	Total	**0.51**	23.70	2.01		
THREATS						
Variable	**Description**	**Weight**	**Rating**	**Score**		
T1	Reforestation of gamal trees	0.08	2.00	0.17	2	2
T2	Habit of providing fresh feed	0.08	2.00	0.17	2	2
T3	Technological development	0.08	1.70	0.14	1	3
T4	Business capital assistance	0.07	1.40	0.10	1	2
T5	Development as a project	0.08	1.00	0.08	1	1
T6	Competitors of additive feed	0.09	1.60	0.14	1	2
	Total	**0.49**	9.70	0.80		
	TOTAL EFAS			**1.22**		

The explanation of the external factors is as follows:

Opportunities

- Availability of gamal trees (O1): Gamal trees grow easily in various types of soil, making them self-propagating, and many are intentionally cultivated as fence plants planted in front of houses or along roadsides (Khusnul & Prihatin, 2020). Under normal conditions, the availability of gamal leaves in the research area is assured. Forty percent (40%) of respondents consider the availability of gamal trees as an important opportunity factor in the downstream processing of gamal leaf additive forage feed. The variable O1 scores 0.33, the Third score among opportunity factors.
- Product price (O2): The price of gamal leaf additive forage feed sold by respondents is Rp. 3000 per kg, relatively cheaper compared to elephant grass which can reach Rp. 10,000 per kg. Sixty percent (60%) of respondents indicate it is important if product price is an opportunity factor in the downstream processing of gamal leaf additive forage feed. This variable has a score of 0.35, the highest score among opportunity factors.
- Regional topography (O3): The topography of the research area is steep and prone to landslides and floods (specific to the research location), making planting gamal trees beneficial for preventing landslides and floods. Gamal trees are not only planted in front of houses or along roadsides but also on hillsides to prevent erosion, demonstrating that the community has implemented environmentally conscious local wisdom. Sixty percent (60%) of respondents deem it important if regional topography is an opportunity factor in accelerating the downstreaming of gamal leaf additive forage feed. Variable O3 scores 0.31.
- Variety of chopper tools (O4): This variable refers to the variety of types of leaf/stem chopper tools available. The availability of various types of leaf/stem chopper machines allows farmers to choose according to their needs and available funds. These chopper tools can be purchased at agricultural stores, marketplaces, or online. Sixty percent (60%) of respondents state it is important if the variety of chopper tools is an opportunity factor in accelerating the downstreaming of gamal leaf additive forage feed. This variable scores 0.34, the second highest score.
- Supporting companies (O5): Universities (PT), represented by lecturers and students, transfer technology to the community, including farmer groups, through research and community service activities. Farmer groups or livestock groups become partners with universities, thereby enhancing technology transfer and knowledge dissemination. Fifty percent (50%) of respondents consider universities as an important opportunity factor in accelerating the downstreaming of gamal leaf additive forage feed. Variable O5 scores 0.34, the second highest score.

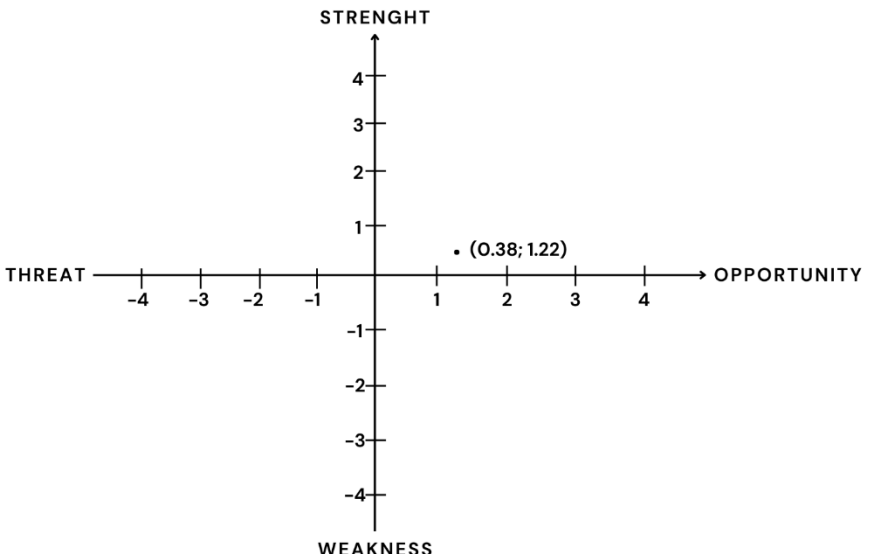
- Demand for additive feed (O6): The availability of various types of forage feed increases the demand for these products. This trend presents an opportunity for the gamal leaf additive forage feed business. Therefore, 70% of respondents find it important if demand for additive forage feed products is an opportunity factor. Variable O6 scores 0.34, the second highest score.

Threats

- Reforestation of gamal trees (T1): Although gamal trees are easy to cultivate, continuous harvesting without reforestation efforts will lead to a scarcity of gamal trees. Sixty percent (60%) of respondents find it important if reforestation is considered a threat factor in accelerating the downstreaming of gamal leaf additive forage feed. This variable scores 0.17.
- Habit of feeding fresh forage (T2): Generally, people prefer to feed fresh forage such as grass, straw, and wild plant leaves from forests. This forage is usually collected in the morning and during the day. Forty percent (40%) of respondents consider it important if the habit of feeding fresh forage is a threat factor. Variable T2 scores 0.17.
- Technological development (T3): Agricultural technology is constantly evolving in production, marketing, finance, and administration. If human resources cannot keep up and adapt to technological changes, they will be left behind. Technology in smallholder farming in Jember District is still relatively simple.This variable score 0.14.
- Business capital assistance (T4): Business capital is crucial for farmers, especially smallholder farmers who often lack access to financial assistance. Variable T4 scores 0.10.
- Coaching as a project (T5): Farmers appreciate partnerships with external entities, but they are concerned if these partnerships only last for a short period, such as 6 months to a maximum of 1 year. Sustainable development projects require longer-term commitment to ensure continuity and effectiveness. Forty percent (40%) of respondents deem it important if coaching as a project is a threat factor. This variable scores 0.08.
- Competitors in additive feed (T6): Besides gamal leaf additive forage feed, there are many other similar products in the market, posing competition to farmers focusing on gamal leaf additive forage feed. Therefore, variable T6 is important to include as a threat factor. This variable scores 0.14.
- Based on the total score of internal factors (Total IFAS score) and external factors (Total EFAS score) in Tables 4 and 5, namely Total IFAS score = 0.38 and total EFAS score = 1.22, it positions the environmentally-focused green fodder business of gamal leaf additive for livestock feed in specific locations in Jember in quadrant 1, indicating aggressive prospects (Figure 3). This position signifies favorable conditions for smallholder

farmers in Jember because internally, they possess strengths to capitalize on external business opportunities in gamal leaf additive for livestock feed. This aggressive strategy quadrant is characterized by high potential for growth and expansion due to the favorable alignment of internal strengths and external opportunities (Todorov & Akbar, 2018).

Figure 3 - The position of accelerating the downstream process of gamal leaf additive for livestock feed



Source: Primary data processed, 2023.

Strategy for Accelerating Downstream Processing of Forage with Gamal Leaf Additives

The strategy that should be implemented by the community of small-scale livestock farmers in Jember Regency to accelerate the downstreaming of environmentally aware FLF with specific location-based Gamal leaf additives at a potentially aggressive business position is to leverage the group's strengths to capitalize on existing opportunities. The aggressive strategies that can be implemented are listed in the Aggressive Strategy Matrix in Table 6.

Table 6 - Aggressive Strategy Matrix

STRENGHT / **OPPORTUNITY**	O1. Availability of Gamal trees
	O2. Product price
	O3. Topography of the area
	O4. Variation of chopping tools
	O5. Supporting company
	O6. Demand for additive feed
	AGGRESSIVE STRATEGY
S1. Chopping tool	1. S1 – O1 and O6
S2. Response to downstreaming of Gamal as livestock feed	2. S2 – O5 and O6
S3. Networking	3. S3 – O5
S4. Knowledge of Gamal trees	4. S4 – O2 and O3
S5. Leadership of the group chairman	5. S5 – O5
S6. Durable product	6. S6 – O5 and O6

The pairing of strengths (S) with opportunities (O) in the Table 6 was carefully determined by analyzing how each internal strength could be strategically leveraged to capitalize on specific external opportunities based on researcher's assessment and observation. For example, S1 (Chopping Tool) was paired with O1 (Availability of Gamal Trees) and O6 (Demand for Additive Feed) because the chopping tool enables efficient processing of Gamal leaves, ensuring a steady supply of raw materials to meet growing market demand. Similarly, S2 (Response to Downstreaming of Gamal as Livestock Feed) was linked to O5 (Supporting Company) and O6 (Demand for Additive Feed) to highlight how innovation in downstream processing can attract external support and address market needs. S3 (Networking) was paired with O5 (Supporting Company) to emphasize the role of strong stakeholder relationships in securing resources and partnerships.

S4 (Knowledge of Gamal Trees) was matched with O2 (Product Price) and O3 (Topography of the Area) to demonstrate how farmers' expertise can optimize production costs and adapt to environmental conditions, ensuring competitive pricing. S5 (Leadership of the Group Chairman) was connected to O5 (Supporting Company) to underscore the importance of effective leadership in negotiating and managing external support. Finally, S6 (Durable Product) was paired with O5 (Supporting Company) and O6 (Demand for Additive Feed) to highlight how product durability enhances market appeal

and aligns with external support. Overall, these pairings were designed to create synergies between internal capabilities and external opportunities, ensuring a strategic and competitive approach to business development. Simple detail as explained below:

1. The chopping tool owned by the group is used optimally to process the abundantly available Gamal leaves to meet market demand.
2. Maintaining a positive response to the acceleration of downstreaming FLF with Gamal leaves ensures continuous production of FLF with Gamal leaf additives and fosters networking with supporting institutions/universities to enter the market and meet market demand.
3. The strong network among livestock farmers can be used as a marketing medium to promote and sell FLF with Gamal leaf additives.
4. With farmers' knowledge of Gamal tree cultivation and the area's suitable topography for growing Gamal trees, reforestation can be carried out to prevent a shortage of Gamal, keeping product prices lower than other processed forage products and reducing landslide risks.
5. The inspirational group leader communicates and builds relationships with supporting institutions or universities to receive guidance and produce competitive FLF with Gamal leaf additives, both in price and product quality.

The durable FLF with Gamal leaf additives can be stored and well-packaged with training support from supporting institutions or universities.

Suggestion

This study highlights the potential of Gamal leaf additive forage as a sustainable solution to address feed scarcity and improve livestock productivity among small-scale ruminant farmers in Jember Regency. The findings demonstrate that Gamal, with its high nutritional value and adaptability to marginal soils, can significantly enhance feed quality, particularly during the dry season when traditional forage is scarce. The integration of Gamal into farming systems not only supports livestock health but also contributes to environmental sustainability by reducing overgrazing and improving soil health. Based on the total score of internal factors (Total IFAS score) and external factors (Total EFAS score) 3.63, which has positions in quadrant 1, indicating aggressive prospects. The proposed strategies are combination of strenght and oppurtunity components namely, optimize the use of chopping tool and downstream process, build strong network among livestock farmer, enhance farmer knowledge, build connection with supporting institutions and farmer's tarining support. However, the study has certain limitations. For instance, the research focused primarily on small-

scale farmers in Jember, which may limit the generalizability of the findings to other regions with different climatic, socio-economic, or agricultural conditions. Additionally, the study relied on self-reported data from farmers, which may introduce biases in the analysis. The applicability of Gamal leaf additive forage in other regions depends on several factors, including climatic suitability, availability of Gamal trees, and the existing livestock management practices. Regions with similar agro-ecological conditions and small-scale farming systems, such as parts of Southeast Asia, Sub-Saharan Africa, and Latin America, could potentially benefit from adopting this innovation. However, successful implementation would require tailored strategies to address local challenges, such as land tenure systems, access to resources, and farmer education.

One of the key findings of this study is the high level of migrant population in Jember, particularly in areas like Klungkung, Sukorambi District. This demographic dynamic makes it crucial to assess whether innovative business models, such as entrepreneurship-based production of Gamal-derived fertilizers or feed additives, are necessary and beneficial for the community. Such models could not only address feed scarcity but also create economic opportunities for both local and migrant populations, fostering inclusive growth and improving overall welfare. Future research can be focusing on comprehensive cost-benefit analysis should be conducted to evaluate the economic viability of Gamal leaf forage, including production costs, savings on traditional feed, and potential increases in farmer income.

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Evita Soliha Hani
Department of Agribusiness, Faculty of Agriculture, University of Jember, Indonesia
E-mail: ita_hani.faperta@unej.ac.id
Graduated from the doctoral program in 2006. Worked as a lecturer at the Faculty of Agriculture, Jember University, Indonesia from 1990 until now. My field of expertise is Human Resource Economics and Sustainable Agricultural Environment. Structural experience has been Secretary of the Department of Agricultural Socio-Economics, Head of the Department of Agricultural Socio-Economics, Head of the Agribusiness Study Program, Vice Dean for Academic Affairs, Vice Dean for Personnel and General Affairs and Head of the Laboratory of Agricultural Economic Development. Non-structural experience includes being an internal reviewer in Research and Community Service, Coordinator of Research Group on the Sustainable Bioindustry Agriculture and Centre of Research on Entrepreneurship and Agribusiness Management. Current research focuses on Human Resource Economics and Sustainable Agricultural Environment, with the topics of farmer welfare, farmer empowerment, farmer motivation, farmer economic business, and organic farming.

Wildan Muhlison
Department of Agrotechnology, Faculty of Agriculture, University of Jember, Indonesia Kalimantan street, Tegalboto No. 37
E-mail: wildan.muhlison@unej.ac.id
Wildan earned his Master's degree in 2016, specializing in Entomology and Integrated Pest Management. He began academic career as a lecturer in 2021, focusing his research on conservation-based Integrated Pest Management technology. Wildan;s professional experience includes serving as a Student Organization Advisor from 2019 to 2022, and currently hold the position of Head of the Agroecotechnology Laboratory, starting in 2025.

Tri Wahyu Saputra
Department of Agrotechnology, Faculty of Agriculture, University of Jember, Indonesia Kalimantan street, Tegalboto No. 37
E-mail: tw.saputra@unej.ac.id
He completed his undergraduate education in 2012 and his master's degree in 2016 at the Department of Agricultural Engineering, Faculty of Agricultural Technology, Universitas Gadjah Mada. He worked as a lecturer at the Department of Agricultural Engineering, Faculty of Agriculture, University of Lampung in the period 2017-2018 and then became a lecturer in the Agrotechnology study program, Faculty of Agriculture, University of Jember from 2019-now. The areas of expertise are modeling and simulation, especially Artificial Neural Networks, and urban farming, especially horticultural crop cultivation.

Roni Yulianto
Department of Animal Husbandry, Faculty of Agriculture, University of Jember, Indonesia Kalimantan street, Tegalboto No. 37
E-mail: roni.faperta@unej.ac.id
Graduated from Hiroshima University Japan in 2018, in the same years as a lecturer and researcher at the department of animal husbandry, Faculty of Agriculture, University of Jember. Expertise: agrostology, animal nutrient, and feed biotechnology. Experience: as editor, reviewer of the international/national journals and invited speaker. Some research was applied in the breeders to develop and increase human resources for breeders using biotechnology innovations and local resources to increase the nutrient quality of feed products and animal production in the future.

Laily Ilman Widuri
Master of Agronomy Study Program, Faculty of Agriculture, University of Jember, Indonesia Kalimantan street, Tegalboto No. 37
E-mail: laily-ilman@unej.ac.id
Over the past five years, I have been a lecturer at the University of Jember (2020-present). My bachelor's and doctoral research degrees have equipped me with a comprehensive understanding of laboratory and field experiences, especially expertise in tissue culture and plant ecophysiology and cultivation strategy in suboptimal land. My current research focuses on the development of mitigation crop cultivation strategies to mitigate climate change in saline soil.

Fariz Kustiawan Alfarisy
Management of Laboratory, Graduate School, State University of Surabaya, Indonesia Lidah Wetan Street, Surabaya (60213), East Java, Indonesia
E-mail: farizkustiawan@unesa.ac.id
My new affiliation at Management of Laboratory in State University of Surabaya. Lecturer have expertise in plant protection, toxicology environmental, emerging contaminant, and biological conservation. Until now as reviewer in some journal of scopus index, active as speaker in webinar online, and motivator. Now still on going PhD Student in Chung Yuan Christian University with major at Environmental Engineering.

Rizky Yanuarti
Department of Agribusiness, Faculty of Agriculture, University of Jember, Indonesia Kalimantan street, Tegalboto No. 37
E-mail: rizkyyanuarti@unej.ac.id0
Holds a Master's degree in Agribusiness (2019) and is currently a Researcher and Lecturer at the University of Jember, a position held since March 2022. With prior industry experience as an Auditor for Sustainable Certification of Agricultural Products. Rizky has developed expertise in sustainability standards, compliance, and best practices in agribusiness. Current research interests focus on the economics of sustainable agriculture, with specific topics including Certification impact assessments on smallholder farmers' livelihoods, Policy and market incentives for sustainable farming practices, Climate-smart agriculture or Circular economy in agribusiness.