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Rethinking maize development: linking production efficiency, value chains, and regional competitiveness

Yanti Saleh*, Siswatiana Rahim Taha, Robbyn Steven Mamengko, Dandi Hassan
Universitas Negeri Gorontalo, Gorontalo, Indonesia
*Correspondence author: yantisaleh@ung.ac.id
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ABSTRACT

Purpose: to synthesize existing empirical evidence on maize production efficiency, supply chain performance, value addition, and institutional arrangements in Gorontalo province, Indonesia.
Method: an integrative literature synthesis approach was used to review and analyze 20 selected journal articles on maize agribusiness in Gorontalo province and other regions of Indonesia. The literature was analyzed thematically across four dimensions: production efficiency, marketing and supply chain performance, value addition, and institutional capacity and regional competitiveness.
Findings: substantial variations in maize production efficiency across farming systems, alongside differences in marketing channel performance, supply chain coordination, and value distribution. Institutional factors, particularly farmer organizations, agricultural extension, and access to credit, play important roles in connecting production activities with downstream market opportunities. The synthesis highlights that regional maize competitiveness depends on integrating production efficiency, postharvest management, supply chain performance, and value addition, not production volume alone.
Implications: the findings emphasize the importance of integrated agribusiness strategies to improve farmers' income, value creation, and regional maize competitiveness.
Originality: this study offers an integrated agro-economic framework linking production efficiency, supply chain performance, value creation, and regional competitiveness in Gorontalo's maize agribusiness.

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Introduction

Maize plays a strategic role in Gorontalo province's agro-economic development in Indonesia (Faradilah et al., 2024), not only as a major agricultural commodity but also as a driver of interconnected economic activities, including input supply, farming,

trading, drying, storage, transportation, feed processing, and rural household livelihoods (Savary et al., 2020). Its importance is reflected in the province's substantial production performance (Geissmann & Zhang, 2018). According to Statistics Indonesia for Gorontalo province, the harvested area of shelled maize reached 130.52 thousand hectares in 2025, generating 653.29 thousand tons of dried shelled maize at 14% moisture content, representing a 4.36% increase from 625.97 thousand tons in 2024. These figures reinforce Gorontalo's position as one of Indonesia's major maize-producing regions (Rizzo et al., 2023). Nevertheless, increasing production does not necessarily translate into improved farmers' welfare or stronger regional economic competitiveness (Zaini & Abd., 2025). From a regional agro-economic perspective, agricultural performance should be assessed not only by production volume and land productivity but also by resource-allocation efficiency, farmers' income, marketing performance, price stability, value addition, and supply chains' capacity to generate and distribute economic value. Consequently, the central development challenge is not simply how to increase maize production, but how to transform production potential into an efficient, integrated, and competitive agribusiness system that generates sustainable economic benefits for regional stakeholders (Pilarski et al., 2025).

Despite its substantial production capacity, Gorontalo's maize sector still faces structural challenges linked to heterogeneous farm-level efficiency and coordination of downstream activities. Previous empirical findings reveal considerable variations in production performance across farming systems, technologies, and institutional environments. Fadwiwati et al. (2016), using stochastic frontier analysis involving 355 farm households in Boalemo, Pohuwato, and Gorontalo, identified differences in technical, allocative, and economic efficiency across maize varieties, while education, farmer group membership, credit access, and agricultural extension services were associated with variations in inefficiency. Similarly, Sumarno et al. (2015) demonstrated that integrated crop management (ICM) could improve productivity and technical, allocative, and economic efficiency. However, Sodiq & Haryanto (2021), using data envelopment analysis (DEA) on 441 maize farming units from the 2019 crop cutting survey, reported an average technical efficiency of only 56.7%. These findings indicate that substantial production potential remains unrealized, despite the availability of improved cultivation technologies and institutional support. On the marketing side, Ashari & Syamsir (2021) found that Gorontalo's maize market was integrated in the long run and that direct marketing channels to exporters generated lower marketing margins and higher farmer shares. Complementary evidence from Bone Bolango and Boliyohuto also indicates that certain marketing channels perform relatively efficiently in terms of marketing margins and farmer share (Anggowa et al., 2022; Rahim et al., 2023). This situation reveals an important agro-economic phenomenon: relatively favorable marketing performance can coexist with considerable inefficiencies at the farm level, suggesting that improvements in individual supply chain components do not necessarily guarantee optimal performance of the overall maize agribusiness system.

The existing literature provides valuable but predominantly fragmented insights into the development of Gorontalo's maize sector. Research on production has primarily examined technical, allocative, and economic efficiency, as well as the influence of cultivation practices, farmer characteristics, credit accessibility, and institutional support (Chandra et al., 2022; Chotimah et al., 2019; Fadwiwati et al., 2016; Haryanto, Wardana, Jamil, et al., 2023; Sumarno et al., 2015; Wardana et al., 2026). Meanwhile, marketing-oriented studies have focused on market integration, price transmission, marketing margins, and farmers' bargaining positions (Ashari & Syamsir, 2021;

Indrianti, 2020; Purwasih et al., 2018; Sari et al., 2021). Other studies have explored value chain structures, supply chain coordination, value addition, and marketing strategies at regional and national levels (Anggowa et al., 2022; Arifani & Mahfudz, 2024; Heryanto et al., 2025; Ilato & Bahua, 2024; Kango, 2018; Lihawa et al., 2021; Rahim et al., 2023; Sibuea et al., 2023; Wijanarko et al., 2021). Although these studies establish an important empirical foundation, their findings have generally addressed specific dimensions of agribusiness performance rather than explaining the interdependencies among production efficiency, supply chain coordination, marketing efficiency, value addition, and regional competitiveness. The principal research gap, therefore, lies not in the absence of empirical studies on Gorontalo's maize sector, but in the limited integration of their findings into a comprehensive regional agro-economic perspective. In particular, insufficient attention has been given to explaining how farm-level resource-use efficiency interacts with downstream supply chain performance and how these relationships ultimately influence farmers' economic benefits and the competitiveness of the regional maize industry. Addressing this gap advances the conceptual understanding by shifting the analytical perspective from isolated assessments of production or marketing performance to an integrated view of maize agribusiness as an interconnected economic system.

Against this background, this short communication synthesizes existing empirical evidence on maize production efficiency, marketing performance, value chain development, and institutional arrangements in Gorontalo province. It proposes an integrative framework for regional agro-economic development. Specifically, the study examines the relationships among three interconnected dimensions: (1) production efficiency, encompassing resource allocation, technological adoption, and farmers' institutional capacity; (2) supply chain and market efficiency, including marketing channels, price transmission, logistics, coordination, and the distribution of economic value; and (3) value creation and regional competitiveness, reflected in value addition, farmers' income, market access, and the capacity of regional agribusiness actors to compete within broader markets. Rather than reproducing individual research findings, this study connects the available evidence to identify complementary relationships, structural constraints, and potential pathways to improve the overall performance of the maize sector. The proposed framework also provides a basis for understanding why improvements in production or marketing at the individual level may not automatically generate proportional improvements in the economic performance of the entire agribusiness system.

This study's significance lies in its potential to broaden understanding of agricultural development from a production-oriented paradigm to an integrated value chain and regional competitiveness perspective. Increasing maize output alone cannot ensure inclusive agricultural growth when production inefficiencies, weak coordination among supply chain actors, unequal distribution of value added, and limited market integration continue to constrain economic benefits. By synthesizing existing evidence into a unified analytical framework, this study is expected to contribute theoretically to the regional agribusiness literature by clarifying the connections between farm-level efficiency, supply chain performance, and regional economic competitiveness. From a practical perspective, the findings may inform policymakers, agricultural institutions, farmer organizations, traders, and agroindustry stakeholders in designing more coordinated development strategies, including improvements in production technology, institutional capacity, postharvest infrastructure, market connectivity, financing mechanisms, and value-added processing. Ultimately, this study emphasizes that the

future development of Gorontalo's maize sector should be evaluated not simply by how much maize the region produces, but by how efficiently the entire agribusiness system creates, distributes, and retains economic value within the region.

Literature review

Agricultural systems theory and value chain theory

This study is primarily grounded in agricultural systems theory, which conceptualizes agriculture as an interconnected system involving input provision, production, postharvest handling, processing, distribution, marketing, and consumption (Garima et al., 2026). This perspective emphasizes that agricultural performance depends not only on the efficiency of individual activities but also on the coordination and integration among different actors and components within the agribusiness system (Singh et al., 2025). In the context of maize agribusiness in Gorontalo province, increased production does not necessarily translate into higher farmers' income or regional economic growth if downstream activities, such as storage, transportation, processing, and marketing, remain inefficient. Complementing this perspective, Porter's (1985) value chain theory explains how economic value is created, added, and distributed through interconnected business activities. The integration of these two perspectives provides a comprehensive foundation for understanding how production efficiency is connected to supply chain performance, value creation, and regional competitiveness (Ning & Yao, 2023). Thus, maize agribusiness development should be approached as an integrated economic system rather than a collection of independent agricultural activities (Rasyid et al., 2024).

Production efficiency theory

Production efficiency is based on neoclassical production theory and the concept of productive efficiency introduced by Farrell (1957). This theory explains the relationship between production inputs, such as land, labor, capital, seeds, fertilizers, and technology, and the resulting agricultural output. Production efficiency consists of three dimensions: technical efficiency, allocative efficiency, and economic efficiency. Technical efficiency refers to the ability to maximize output using available inputs, allocative efficiency concerns the optimal combination of inputs based on their relative prices, and economic efficiency represents achieving both forms of efficiency. In maize farming, these dimensions are shaped by cultivation practices, technology adoption, farmers' characteristics, credit access, and institutional support. Therefore, improving production efficiency is essential to optimizing agricultural resources and strengthening the economic performance of maize farming (Fadwiwati et al., 2016; Farrell, 1957; Sumarno et al., 2015).

Supply chain management theory

Supply chain management theory explains how product, information, and financial flows are coordinated among actors involved in production and distribution (Mentzer et al., 2001). In maize agribusiness, the supply chain encompasses farmers, input suppliers, collectors, wholesalers, processors, distributors, and final consumers. Its performance is determined by marketing channels, logistics costs, transportation, price information, market integration, and coordination among supply chain participants. Efficient supply chain management enables agricultural products to reach markets with lower transaction costs, better quality, and improved distribution performance. In

Gorontalo, this perspective is particularly relevant because the economic benefits of maize production depend on how effectively marketing and distribution systems connect farmers with domestic and industrial markets (Anggowa et al., 2022; Ashari & Syamsir, 2021; Rahim et al., 2023).

Value creation and value added theory

Value creation and value-added theory explain how agricultural commodities generate additional economic value through processing, quality improvement, storage, distribution, and commercialization (Dahal et al., 2024). In maize agribusiness, value addition can be achieved through drying, grading, packaging, storage, and processing into animal feed and other derivative products. The Hayami et al. (1987) method provides an approach to measuring the economic value added through agricultural processing activities. However, value creation should also consider how economic benefits are distributed among farmers, traders, and processors. Unequal distribution of value added may limit farmers' income, even with improvements in downstream activities. Therefore, strengthening maize value chains requires not only increasing the total value generated but also improving the distribution of economic benefits among agribusiness participants (Arifani & Mahfudz, 2024; Ilato & Bahua, 2024; Lihawa et al., 2021).

Regional competitiveness theory

Regional competitiveness theory, particularly Porter's (1985) competitive advantage theory, explains a region's ability to use its resources, build productive capacity, and generate sustainable economic advantages. Porter's diamond model identifies four determinants of competitiveness: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry. Applied to maize agribusiness, regional competitiveness depends on agricultural resources, production technology, infrastructure, market demand, processing industries, and institutional coordination. Consequently, Gorontalo's competitiveness depends not only on maize production volume but also on its ability to develop an efficient, integrated, value-added agribusiness system. This perspective positions maize development as an important instrument for strengthening farmers' income, industrial linkages, and regional economic growth.

Method

This study adopts an integrative literature synthesis approach to examine the relationships among maize production efficiency, supply chain performance, value addition, institutional arrangements, and regional competitiveness in Gorontalo province, Indonesia. This approach integrates empirical findings from previous studies to develop a broader understanding of maize agribusiness performance from a regional agro-economic perspective. Rather than examining individual dimensions independently, the study synthesizes existing evidence to identify interrelationships, common patterns, and structural issues across different stages of the maize agribusiness system. Empirical studies from Gorontalo province are the primary analytical focus. In contrast, relevant studies from other regions of Indonesia are incorporated to provide comparative perspectives and strengthen the interpretation of broader agribusiness development issues.

The literature selection process yielded 20 journal articles based on four relevance and quality criteria. First, the articles directly addressed maize-related issues

associated with at least one of the following dimensions: production efficiency, marketing performance, supply chain management, value addition, institutional arrangements, or market integration. Second, each article had verifiable bibliographic information accessible through journal websites, DOIs, Garuda, Crossref, or institutional repositories. Third, the selected studies contained empirical or analytical findings that could be compared and synthesized across the identified research dimensions. Fourth, the articles demonstrated relevance to agricultural development, agribusiness performance, or regional economic competitiveness. Studies focusing on Gorontalo province were prioritized to maintain geographical relevance, whereas research from other Indonesian regions was included selectively to provide additional empirical comparisons and contextual insights.

The analytical process involved four interconnected stages. First, the selected articles were classified thematically into four principal analytical dimensions: (1) maize production efficiency, including technical, allocative, and economic efficiency; (2) marketing and supply chain performance, encompassing marketing channels, margins, farmer shares, price integration, logistics, and supply chain coordination; (3) value creation and value addition, particularly postharvest activities, processing, and the distribution of economic benefits; and (4) institutional arrangements and regional competitiveness, including farmers' organizations, credit accessibility, agricultural extension, market access, and supporting industries. Second, the selected studies' methodological approaches, analytical indicators, and principal findings were compared to identify differences in research perspectives and measurement outcomes. Third, patterns of convergence, contrasting findings, and potential explanations for variations in empirical results were examined by considering differences in research locations, observation periods, farming characteristics, and analytical methods. Finally, the findings were synthesized to establish conceptual relationships among production efficiency, supply chain integration, value creation, and regional competitiveness, providing the basis for an integrated framework for maize agro-economic development in Gorontalo.

Government statistical publications, particularly data from Statistics Indonesia for Gorontalo province, were used separately to provide updated information on harvested areas and maize production and to establish the study's regional economic context. These statistical sources were not included in the total of 20 journal articles because they served a descriptive contextual function rather than constituting part of the academic literature synthesis. Methodologically, this study is positioned as an integrative literature synthesis rather than a systematic literature review. It does not employ formal review registration, PRISMA procedures, meta-analysis, or other standardized systematic review protocols. Its primary contribution, therefore, lies in critically integrating and interpreting existing empirical evidence to develop a comprehensive understanding of the interconnections among production efficiency, value chains, and regional competitiveness in Gorontalo's maize agribusiness.

Results and discussion

Overview of the selected literature and research dimensions

The synthesis of 20 selected journal articles provides an empirical foundation for understanding the development of maize agribusiness in Gorontalo province and its broader agro-economic implications. The selected studies cover various geographical locations, research periods, analytical approaches, and dimensions of agribusiness

performance, ranging from farm-level production efficiency to marketing systems, supply chain management, value addition, institutional arrangements, and regional competitiveness. Most studies focus on Gorontalo province, providing context-specific evidence, while selected studies from other Indonesian regions offer comparative insights into broader agricultural and supply chain dynamics. The methodological approaches include stochastic frontier analysis (SFA), data envelopment analysis (DEA), econometric models, propensity score matching (PSM), marketing margin analysis, value chain analysis, and qualitative approaches. To provide a comprehensive overview of the literature, Table 1 presents each study's geographical coverage, data characteristics, analytical methods, principal findings, and contributions to the integrative synthesis.

Table 1 synthesis matrix of 20 journal articles on maize agribusiness performance

No.	Author (year)	Location/data	Method	Key findings	Role in synthesis
1	Fadwiwati et al. (2016)	Boalemo, Pohuwato, Gorontalo; 355 HH	Cobb-Douglas SFA	TE, AE, and EE vary by variety; education, farmer groups, credit, and extension are linked to inefficiency.	Production efficiency
2	Sumarno et al. (2015)	Gorontalo Regency; 160 farmers	SFA + Dual cost frontier	Integrated Crop Management improves productivity and efficiency; human capital and institutions are crucial.	Technology and institutions
3	Sodiq & Haryanto (2021)	Gorontalo; 441 Ubinan units	DEA	Average maize technical efficiency is 56.7%.	Efficiency heterogeneity
4	Chandra et al. (2022)	Pulubala; 100 farmers	SFA-MLE	Labor, seed, and pesticide inputs are influential; average TE is 0.98.	Local efficiency
5	Chotimah et al. (2019)	Randangan, Pohuwato	Cobb-Douglas SFA	TE 0.75; AE 0.99; EE 0.73.	Regional comparison
6	Ashari & Syamsir (2021)	Gorontalo; 148 price weeks + 30 farmers	AECM, margin, farmer share	Long-run market integration; direct exporter channels are more profitable for farmers.	Marketing efficiency
7	Purwasih et al. (2018)	Gorontalo province	Price transmission	Examines maize price relationships across market levels.	Price transmission
8	Indrianti (2020)	Gorontalo regency	Margin + SWOT	Margin disparities; recommends credit and postharvest technology.	Marketing strategy
9	Kango (2018)	Gorontalo; 20 informants	Qualitative + SWOT	Marketing challenges include roads, inputs, credit, information, and institutions.	Marketing governance
10	Anggowa et al. (2022)	Kabila, Bone Bolango	Margin, farmer share, value added	Highest farmer share of 83.3%; two channels meet efficiency criteria.	Local supply chain
11	Rahim et al. (2023)	Boliyohuto; 30 farmers + supply chain actors	Margin, farmer share, Hayami	Three channels identified; Channels I and II are efficient.	Supply chain and value addition
12	Lihawa et al. (2021)	Taluditi, Pohuwato	Qualitative + quantitative	Farmers, traders, and corporations are major actors; value addition emerges along the chain.	Value chain
13	Ilato &	Gorontalo	Value chain +	Postharvest, transportation,	Regional

No.	Author (year)	Location/data	Method	Key findings	Role in synthesis
	Bahua (2024)	province	SWOT	bargaining position, industry integration, and institutional issues.	structural issues
14	Wardana et al. (2026)	10 provinces, including Gorontalo; 28,178 HH	PSM	Farmer group participation increases productivity by 0.095–0.195 t/ha.	Institutional effects
15	Haryanto et al. (2023)	Indonesia	SFA + PSM	FFS-ICM increases technical efficiency by approximately 1.48%.	Extension and human capital
16	Haryanto et al. (2023)	10 major provinces	PSM	Credit enhances productivity and technical efficiency; formal credit is more effective.	Capital and efficiency
17	Arifani & Mahfudz (2024)	Indonesia	Supply chain + Hayami	Processing enhances value addition, but disparities exist among actors.	Downstream development
18	Wijanarko et al. (2021)	East Java, South Sulawesi, NTT	Value chain + governance + marketing efficiency	Pandemic increased costs; price transmission was imperfect and chain performance varied.	National comparison
19	Sari et al. (2021)	Indonesia	VECM	Farmer, feed mill, and global markets are integrated in the long run, but short-run integration is limited.	Market integration
20	Heryanto et al. (2025)	East Java; 98 respondents	Logistics cost + margin + farmer share	Procurement costs dominate logistics; supply chain strategies must prioritize cost efficiency.	Logistics comparison

Source: synthesis of selected journal articles (2014–2026).

Table 1 shows that research on maize agribusiness has developed across several complementary analytical dimensions. Studies on production efficiency show substantial variation in technical, allocative, and economic performance, indicating that agricultural resource use remains a key determinant of maize productivity. Marketing and supply chain studies highlight differences in marketing channel efficiency, price integration, logistics costs, and farmers' shares. In contrast, value chain studies emphasize the importance of postharvest management, processing, and the distribution of value added. Furthermore, research on farmer organizations, agricultural extension, and credit accessibility demonstrates that institutional and human capital factors contribute to production and agribusiness performance. Collectively, these findings indicate that maize development cannot be adequately explained through production or marketing performance alone. Instead, the evidence supports an integrated analytical perspective in which production efficiency, supply chain coordination, value creation, and institutional capacity interact to determine the overall economic performance and competitiveness of the regional maize agribusiness system.

Production efficiency and the utilization of agricultural resources

One of the most consistent findings across the literature is that high maize production does not necessarily reflect high production efficiency. Although Gorontalo province has demonstrated substantial production capacity, previous studies reveal considerable variations in technical, allocative, and economic efficiency across farming systems. Fadwiwati et al. (2016), using stochastic frontier analysis (SFA) involving 355

farming households in Boalemo, Pohuwato, and Gorontalo, found that production efficiency differed across maize varieties. Their findings also indicated that education, farmer group membership, credit accessibility, and agricultural extension were associated with variations in farming inefficiency. Similarly, Sumarno et al. (2015) demonstrated that Integrated crop management improved maize productivity and technical, allocative, and economic efficiency. However, Sodiq & Haryanto (2021), employing data envelopment analysis (DEA) on 441 maize farming units, reported an average technical efficiency of only 56.7%. At the local level, Chotimah et al. (2019) reported technical, allocative, and economic efficiency scores of 0.75, 0.99, and 0.73, respectively, in Randangan, Pohuwato. Meanwhile, Chandra et al. (2022) found a considerably higher average technical efficiency of 0.98 in Pulubala, with labor, seeds, and pesticides identified as influential production inputs.

These differences should be interpreted as evidence of structural heterogeneity rather than direct contradictions among studies. Variations in agroecological conditions, farming scales, production technologies, input combinations, managerial capabilities, observation periods, and sampling characteristics may generate different efficiency outcomes. Furthermore, SFA and DEA employ different analytical assumptions: SFA separates statistical noise from inefficiency, whereas conventional DEA evaluates relative efficiency against an empirical production frontier without explicitly separating random disturbances. Consequently, efficiency estimates from different methods and study settings should not be interpreted as directly equivalent. This interpretation is consistent with Farrell's (1957) production efficiency theory, which distinguishes technical, allocative, and economic efficiency as separate but interconnected dimensions. Technical efficiency concerns the ability to maximize output from available inputs, allocative efficiency concerns the optimal combination of inputs according to relative prices, and economic efficiency reflects the simultaneous achievement of both dimensions. The findings therefore suggest that increasing maize output through additional input utilization or harvested-area expansion may not necessarily improve economic performance if existing resources are not allocated optimally.

From an agricultural systems perspective, production efficiency is an initial, but not the only, determinant of agribusiness performance. Agricultural productivity is shaped by interactions among production resources, technological capabilities, farmers' knowledge, financial access, and institutional support. Haryanto et al. (2023) reinforce this argument by showing that farmer field school programs based on integrated crop management can improve technical efficiency. Their other study on credit accessibility also highlights the importance of financing sources in determining farm performance, with formal credit demonstrating stronger effects. Furthermore, Wardana et al. (2026) reported that farmer-group participation increased maize productivity by approximately 0.095–0.195 tons per hectare. These findings indicate that production efficiency is not merely a technical issue related to input-output relationships but also an institutional and managerial outcome. Therefore, policies for Gorontalo's maize sector should prioritize differentiated efficiency interventions based on farmers' characteristics, agroecological conditions, technological adoption, and institutional capacity rather than applying uniform production-enhancement programs.

Marketing performance and supply chain integration

Production efficiency alone cannot ensure that increased maize output generates higher economic returns for farmers. Turning agricultural production into economic benefits largely depends on the effectiveness of marketing channels, price transmission,

logistics, and coordination among supply chain participants. Previous studies in Gorontalo indicate that maize marketing performance varies according to the distribution channels and market structures involved. Ashari & Syamsir (2021) found that Gorontalo's maize market exhibited long-run market integration, while direct marketing channels to exporters generated relatively lower marketing margins and higher farmer shares. Similarly, Anggowa et al. (2022), in Bone Bolango, identified marketing channels with farmer shares reaching 83.3%, indicating that certain distribution arrangements provide relatively favorable economic benefits to producers. Rahim et al. (2023) also identified three maize marketing channels in Boliyohuto, with the first and second channels meeting the efficiency criteria applied in their study. These findings show that marketing efficiency varies across locations and distribution arrangements, and that marketing-channel selection can significantly affect the share of final market value farmers receive.

Supply chain management theory further explains the findings by emphasizing the coordination of product, information, and financial flows among interconnected supply chain actors (Mentzer et al., 2001). In agricultural systems, supply chain performance is influenced by transaction costs, transportation, storage, product quality, market information, and the bargaining positions of participating actors (Abula et al., 2022). For maize agribusiness, these factors are particularly important because the commodity requires appropriate postharvest handling, especially drying, moisture-content control, grading, and storage, before entering larger markets or industrial processing. Kango (2018) identified inadequate infrastructure, limited credit access, insufficient market information, and institutional weaknesses as constraints affecting Gorontalo's maize marketing strategies. Indrianti (2020) also identified differences in marketing margins and emphasized the importance of financing and postharvest technology. These findings suggest that marketing inefficiencies cannot be addressed exclusively by improving distribution channels; they also require improvements in infrastructure, institutional coordination, product quality, and access to market information.

Furthermore, the relationship between production and marketing performance should be understood through a systems perspective. Efficient production may generate larger marketable surpluses, but without adequate transportation, storage, and market connectivity, additional output may increase pressure on local markets and reduce farmers' bargaining positions. Conversely, efficient marketing channels cannot fully offset high production costs or low farm-level productivity. This relationship supports agricultural systems theory, which explains that an agricultural system's performance depends on the interaction and coordination of its constituent activities. It also reinforces value chain theory (Porter, 1985), which emphasizes that competitive advantage emerges through effective management of interconnected activities rather than optimizing a single production stage. Accordingly, the development of Gorontalo's maize agribusiness requires simultaneous improvements in farm-level efficiency and downstream marketing arrangements to ensure that production gains are effectively transmitted into higher economic returns.

Value creation, value addition, and distribution of economic benefits

Beyond marketing efficiency, the economic performance of maize agribusiness is also determined by its capacity to generate additional value through postharvest management, processing, and industrial utilization. Value chain theory (Porter, 1985) provides a relevant explanation because it conceptualizes value creation as the outcome

of interconnected activities that enhance product quality, marketability, and economic usefulness. In maize agribusiness, value addition does not originate solely from primary cultivation; it also emerges through drying, cleaning, sorting, grading, storage, transportation, and processing into industrial products, particularly animal feed. Lihawa et al. (2021) identified farmers, traders, and corporations as key actors in the maize value chain and showed that economic value is generated across different stages of the chain. Similarly, Ilato & Bahua (2024) highlighted postharvest handling, transportation, bargaining positions, institutional capacity, and industrial integration as important structural issues influencing maize value chain development in Gorontalo. These findings demonstrate that regional maize development requires a broader understanding of value creation beyond the quantity of primary agricultural output.

Evidence from other Indonesian regions further reinforces the importance of downstream activities in strengthening agricultural value chains. Arifani & Mahfudz (2024) showed that processing activities generate additional economic value in Indonesia's maize agroindustry, although value added is distributed unevenly among supply chain actors. Rahim et al. (2023) also incorporated the Hayami method to examine value addition within local maize marketing and supply chain activities. Meanwhile, Heryanto et al. (2025) emphasized the importance of logistics cost structures in determining supply chain performance, particularly the contribution of procurement costs to overall logistics expenditure. These findings suggest that value addition should be evaluated not only by increases in product value but also by the costs required to generate that value. In other words, higher-value processing activities do not automatically result in higher profitability if production, procurement, transportation, and operational costs remain excessive.

An equally important issue is how economic benefits are distributed among actors in the value chain. Value added theory distinguishes between creating additional economic value and allocating that value among farmers, traders, processors, and other stakeholders. A maize value chain may generate substantial economic value downstream while farmers continue to receive a relatively small share of the final market value. Such disparities may arise from differences in bargaining power, access to processing facilities, market information, capital availability, and control over distribution channels. This condition aligns with Gereffi et al. (2005), who explain that governance structures within value chains shape how activities are coordinated and how economic benefits are distributed among participating actors. Therefore, developing Gorontalo's maize agribusiness should not focus exclusively on increasing processing capacity or downstream investment. It should also strengthen farmers' participation in value-adding activities through collective marketing, product standardization, improved storage facilities, and stronger linkages with processing industries. This approach can increase the share of economic value retained in the region while creating opportunities for more inclusive agribusiness development.

Institutional capacity and regional competitiveness

Institutional capacity represents a cross-cutting determinant that influences production efficiency, supply chain integration, and value creation. Empirical literature on Gorontalo repeatedly identifies farmer organizations, agricultural extension, credit access, and market information as key factors shaping maize agribusiness performance. Fadwiwati et al. (2016) and Sumarno et al. (2015) demonstrated the relevance of farmer characteristics and institutional support in explaining differences in production efficiency. Kango (2018) identified institutional weaknesses, inadequate infrastructure,

financing constraints, and limited market information as obstacles to developing maize marketing strategies. Ilato & Bahua (2024) also emphasized that weaknesses in farmer organizations and farmers' bargaining positions constrain the development of an integrated maize value chain. These findings indicate that institutions should not be viewed merely as support for social organizations but as mechanisms that facilitate coordination, reduce transaction costs, improve access to resources, and strengthen farmers' economic position within the agribusiness system.

More recent empirical evidence further supports the institutional dimension. Wardana et al. (2026) found that participation in farmer-based organizations increased maize productivity by an estimated 0.095–0.195 tons per hectare. Haryanto et al. (2023) showed that farmer field school participation improved technical efficiency by enhancing knowledge and adoption of improved cultivation practices. Their research on agricultural credit also showed that access to financing improves farm performance, with formal credit generating stronger effects than informal financing sources. These findings suggest that institutional support operates through several complementary mechanisms, including knowledge transfer, access to production capital, input procurement, production consolidation, market information, and collective bargaining. From an agricultural systems perspective, institutions connect different components of the agribusiness system and facilitate the flow of resources and information across production and marketing activities. Consequently, strengthening farmer organizations and other agricultural institutions is essential for improving not only farm-level performance but also the coordination and competitiveness of the entire maize value chain.

The relationship between institutional capacity and regional competitiveness can be further explained through Porter's (1985) competitive advantage theory, particularly the diamond model. The model emphasizes that regional or industrial competitiveness is shaped by factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry. In Gorontalo, factor conditions include agricultural land, labor, production technology, infrastructure, and financial resources. Related and supporting industries include seed suppliers, fertilizer providers, transportation services, storage facilities, and animal feed industries. Domestic and industrial demand reflects demand conditions, while the competitive environment is shaped by the capabilities of farmers, traders, processors, and other agribusiness enterprises. The availability of substantial maize production potential therefore provides an important foundation for regional competitiveness. However, realizing this potential depends on developing supporting infrastructure, institutional coordination, market connectivity, and downstream industrial capacity. Accordingly, regional competitiveness should be understood as the collective outcome of an integrated agribusiness system rather than a direct consequence of production volume alone.

Toward an integrated framework for maize agro-economic development

The selected literature reveals that previous studies have generated substantial empirical evidence on maize production efficiency, marketing performance, supply chain structures, value addition, and institutional arrangements. However, these findings have generally been examined through separate analytical perspectives. Production-oriented studies focus primarily on input utilization and productivity; marketing studies examine margins and farmer shares; value chain research evaluates economic activities and value addition; and institutional studies investigate the role of farmer organizations, financing, and agricultural extension. Although each perspective

provides important insights, their fragmented treatment limits a comprehensive understanding of how improvements in one dimension influence the performance of other components within the regional agribusiness system. Therefore, the principal research gap is not the absence of empirical studies on Gorontalo's maize sector but the limited integration of existing findings into a unified regional agro-economic framework.

To address this gap, the present study proposes an integrative framework grounded in agricultural systems theory and value chain theory. The framework conceptualizes regional maize development as a sequence of interconnected processes beginning with the utilization of regional resources, followed by production efficiency, postharvest performance, supply chain efficiency, market integration, and value creation, ultimately contributing to farmers' income, commodity competitiveness, and regional agro-economic performance. Within this framework, production efficiency determines farmers' capacity to transform available resources into agricultural output, while postharvest efficiency ensures product quality and marketability are maintained after harvesting. Supply chain efficiency then facilitates moving products from production centers to markets and processing industries, while market integration and value addition determine opportunities to increase and distribute economic benefits. Together, these dimensions improve farmers' income and the regional maize agribusiness system's competitive performance.

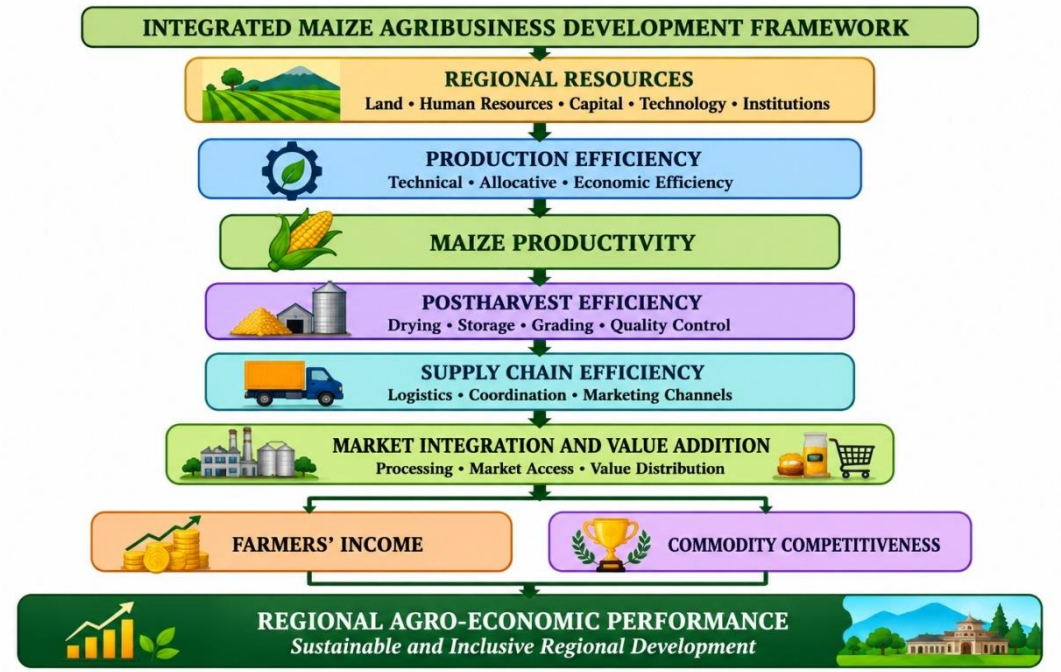


Figure 1 integrative framework for regional agro-economic development

The relationships among these interconnected dimensions are illustrated in Figure 1, which presents the proposed integrated maize agribusiness development framework. The framework demonstrates how the utilization of regional resources influences production efficiency and maize productivity, which are subsequently connected to postharvest efficiency, supply chain integration, and market integration and value addition. These interconnected processes are expected to increase farmers' income, strengthen commodity competitiveness, and ultimately improve regional agro-economic performance through sustainable and inclusive agricultural development.

A key feature of the proposed framework is positioning institutions as a cross-stage connecting mechanism rather than an isolated component. Farmer groups, cooperatives, and other farmers' economic organizations can facilitate access to agricultural inputs, extension services, credit, production technologies, postharvest facilities, market information, and collective marketing arrangements. Their functions extend across the entire agribusiness chain, allowing institutions to connect upstream production activities with downstream market requirements. This conceptualization aligns with empirical findings from Fadwiwati et al. (2016); Sumarno et al. (2015); Haryanto et al. (2023); and Wardana et al. (2026), which show the importance of institutional participation, knowledge, and financing in improving agricultural performance.

The proposed framework also emphasizes the complementary relationship between upstream and downstream development. Increasing maize production without adequate drying, storage, transportation, and market access may create additional logistical pressure, worsen quality, and weaken bargaining positions. Conversely, developing processing facilities and marketing infrastructure without improving farm-level production efficiency may raise procurement costs and reduce the competitiveness of raw material supplies. Therefore, improvements in production capacity, postharvest infrastructure, market connectivity, and processing activities must be designed as complementary interventions. This argument is the study's central conceptual contribution: regional maize competitiveness emerges not from optimizing individual agribusiness activities independently, but from strengthening integration and coordination across the entire agricultural value chain.

Policy implications for regional maize agribusiness development

The integrated framework provides several important policy implications for strengthening Gorontalo's maize agribusiness. First, production policies should shift from an output-oriented approach toward resource-use efficiency and productivity improvement. Given the variations in technical, allocative, and economic efficiency identified in previous studies, interventions should be differentiated by agroecological conditions, farming characteristics, technology adoption, and farmers' managerial capabilities. Prioritize improving access to quality seeds, balanced fertilizer use, appropriate cultivation technologies, and agricultural extension services to optimize production resources rather than merely expand harvested areas. This approach aligns with Production Efficiency Theory, which emphasizes optimizing input combinations to achieve economically efficient production outcomes.

Second, postharvest management and supply chain infrastructure should become integral components of regional maize development strategies. Investments in drying facilities, warehouses, grading systems, transportation infrastructure, and product quality standardization can reduce postharvest losses, maintain product quality, and improve access to larger markets. Third, strengthening farmer organizations and collective marketing arrangements is necessary to improve production consolidation, bargaining positions, and access to institutional buyers, exporters, and processing industries. These measures matter because individual farmers often struggle to meet large-volume procurement requirements and consistent quality standards. Fourth, agricultural financing and extension services should be developed as complementary institutional interventions. Credit accessibility enables farmers to obtain production inputs and adopt improved technologies, while extension services strengthen their capacity to utilize resources efficiently. Integrating these interventions can generate

greater benefits than implementing financing, technology, and institutional programs independently.

Fifth, downstream development should be directed toward increasing the economic value retained within Gorontalo province. Strengthening local drying, storage, processing, and animal feed industries can create additional economic activity, expand employment opportunities, and strengthen linkages between agricultural producers and regional industries. However, downstream investment should also consider how value is distributed to ensure farmers participate more actively in the economic benefits generated along the value chain. Finally, evaluating regional maize development programs should use multidimensional performance indicators rather than relying exclusively on harvested areas and production volumes. These indicators should include technical, allocative, and economic efficiency; postharvest losses; marketing margins; farmer shares; logistics costs; market integration; value addition; farmers' income; and regional competitiveness. This evaluation framework aligns more closely with agricultural systems theory because it assesses the performance of interconnected agribusiness components rather than individual activities in isolation. Ultimately, these policy directions emphasize the importance of coordinated interventions that connect production improvement, institutional strengthening, supply chain integration, and downstream industrial development to achieve more inclusive and sustainable regional agro-economic growth.

Conclusions

This study concludes that maize agribusiness development in Gorontalo province cannot be evaluated solely by production volume; it must be understood through the integration of production efficiency, postharvest management, supply chain performance, market integration, value addition, and institutional capacity. The synthesis of 20 journal articles reveals substantial variations in production efficiency across farming locations, technologies, and analytical methods, indicating that increased productivity does not automatically translate into higher economic returns. Furthermore, although several marketing channels demonstrate relatively favorable performance in terms of marketing margins and farmer shares, challenges remain in logistics, postharvest handling, price transmission, and the distribution of value added. Institutional factors, particularly farmer organizations, agricultural extension, and credit accessibility, emerge as cross-cutting determinants connecting production activities with downstream market opportunities. These findings reinforce the argument that regional competitiveness is determined by the overall integration and coordination of the maize agribusiness system rather than the performance of individual components.

This study's main contribution is an integrative conceptual framework that links production efficiency, supply chain integration, value creation, and regional competitiveness from a regional agro-economic perspective. By synthesizing previously fragmented empirical findings, this study extends the application of agricultural systems theory and value chain theory in explaining how agricultural resources are transformed into economic value and regional development outcomes. The framework also provides practical implications for policymakers by emphasizing complementary interventions in production technology, postharvest infrastructure, collective marketing, institutional strengthening, financing, and downstream industrial development. Nevertheless, this study has limitations because it relies on a synthesis of 20 selected journal articles with differences in geographical coverage, observation periods, sample characteristics, and analytical methods. Furthermore, the proposed framework is conceptual and has not

been empirically tested to establish the magnitude and causal relationships among its components. Therefore, its findings should be interpreted as an integrated analytical perspective rather than definitive evidence of causal relationships within Gorontalo's maize agribusiness system.

Future research should empirically examine the proposed framework using integrated farm-level and supply chain data covering farmers, traders, processors, and other relevant agribusiness actors in Gorontalo province. Quantitative approaches, including structural equation modeling (SEM), econometric modeling, or network-based supply chain analysis, could investigate the direct and indirect relationships among production efficiency, institutional capacity, supply chain performance, value addition, farmers' income, and regional competitiveness. Further studies should also incorporate comparative analyses across districts, production seasons, and marketing channels to identify variations in agribusiness performance and the effectiveness of different institutional arrangements. In addition, future research could evaluate the economic impacts of postharvest infrastructure, collective marketing, formal credit, and local processing industries on farmers' income and regional value retention. Such empirical investigations would strengthen the proposed framework and provide a more robust evidence base for designing integrated, inclusive, and sustainable maize agribusiness development strategies in Gorontalo province.

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