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# STRATEGY FOR STRENGTHENING ARABICA COFFEE AGRIBUSINESS INSTITUTIONS THROUGH AN INTERPRETATIVE STRUCTURAL MODELLING APPROACH IN SOUTH SULAWESI, INDONESIA

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## *ABSTRACT*

*Coffee exports are high, but productivity is low due to poor coordination, limited resources, and weak skills and infrastructure. The objectives of this research are to (1) explain the role of agribusiness institutions in enhancing the competitiveness of Arabica Coffee, (2) identify the obstacles that hinder the effectiveness of agribusiness institutions in enhancing Arabica Coffee production, (3) design strategic programs to improve Arabica coffee production. This research uses survey methods, interviews, and focus group discussions to obtain data by involving respondents or experts directly involved. The analysis used is Interpretative Structural Modeling to analyze institutional*

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*relationships and identify strategic points for policy intervention to increase Arabica coffee production. The results of the ISM analysis show that the Department of Food Crops, Horticulture, and Plantations of Enrekang Regency has a strategic role in increasing Arabica coffee production through coordinated strategic programs. The main obstacle is the lack of initial support for institutional involvement, which hinders inter-agency coordination. Strategic programs such as extension services focus on enhancing knowledge of farmers and skills to adopt sustainable technologies and practices.*

***Keyword:*** *arabica coffee productivity, coordination, institutional barriers, strategic program*

***Cite as*:**

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## INTRODUCTION

Research on strengthening Arabica coffee agribusiness in Enrekang Regency has been conducted previously. However, it tends to lack depth in identifying specific gaps related to institutional coordination, the effectiveness of farmer constraints, and the introduction of agricultural extension services. This study aims to fill these gaps by exploring how strengthening the institutional capacity of farmers can facilitate technology transfer, improve market access, and support the implementation of sustainable agronomic practices. Special emphasis is placed on the development of farmer institutions as catalysts for supply chain integration and the enhancement of Arabica coffee's competitiveness in the global market. By addressing this research gap, it is hoped that effective strategies can be designed to enhance the productivity and sustainability of Arabica coffee agribusiness in Enrekang Regency.

This concept is supported by the findings of Cooray and Özmen, who highlight the importance of institutional quality in managing environmental impacts, such as carbon emissions, where strong institutions can either mitigate or exacerbate emissions depending on their governance quality (Cooray & Özmen, 2024). Similarly, the study by Orlova and Shevchenko underscores the significance of sociocultural security within educational institutions, demonstrating that a secure and supportive environment can significantly reduce negative behaviours like drug abuse and delinquency, thereby enhancing the overall well-being and security of the educational environment (Orlova & Shevchenko, 2023).

Increasing farmer productivity, agricultural business efficiency, and competitiveness is a multifaceted challenge, particularly for smallholder farmers

facing numerous economic and social barriers. Developing agricultural institutions and enhancing farmer organization's capacity are crucial strategies to address these issues. For instance, participatory extension programs (PEPs) have been shown to support farmers by providing a platform for peer-to-peer learning, which helps them navigate the intertwined pressures of well-being, environmental sustainability, and profitability (Irmayani et al., 2024). The quality of institutions in Enrekang Regency still faces challenges, especially regarding coordination among farmer groups and strengthening Arabica coffee farmer cooperatives. Although some farmer groups have begun to develop networks to improve market access, poorly structured institutions hinder the optimal management and distribution of coffee yields. Additionally, the welfare of coffee farmers in Enrekang remains limited, with fluctuating incomes due to a lack of technical training and support to improve production quality and access to broader markets.

## RESEARCH METHOD

The research was conducted in Enrekang Regency, South Sulawesi Province, from December 2023 to February 2024 using purposive sampling, which is the deliberate selection of locations based on the specific qualities of the informants, referred to as farmers, local government officials, agricultural extension workers, community leaders, and academics, who are considered to have a direct relationship with the improvement of the Arabica coffee institution. This approach was chosen because it ensures the involvement of key actors, such as farmers, local government officials, agricultural extension workers, community leaders, and academics, who possess knowledge, experience, and direct roles in the coffee agribusiness system. The justification for using Purposive sampling is to obtain rich and contextual data, especially in studies that require a deep understanding of local institutional dynamics. However, this approach has limitations in terms of representativeness because the results cannot be generalized to a larger population. Therefore, although purposive sampling effectively uncovers specific information, this research acknowledges the importance of complementing the findings with other methods or considering additional variations to strengthen the external validity of the research results.

### Sampling Procedure and Data Collection

The sampling procedure using purposive sampling includes extension workers, coffee farmers, and academics selected as key informants due to their strategic roles in the Arabica coffee agribusiness. Extension workers provide data on the implementation of field programs, farmers convey constraints and opportunities at the production level, while academics contribute theoretical

analysis and strategic solutions. Data collection techniques through in-depth interviews and focused discussions ensure accurate and relevant information for designing effective institutional strengthening strategies.

Interpretative Structural Modeling (ISM) analysis systematically maps the hierarchical relationships between elements in a complex system. The ISM process begins with identifying key elements through discussions or interviews with experts and stakeholders. After identifying the main elements, the Structural Self-Interaction Matrix (SSIM) is developed by asking experts to evaluate the relationships between the elements based on criteria such as direct influence and dependence. These relationships are expressed in the form of symbols (V, A, X, O) that indicate the direction and existence of the relationships. SSIM is then transformed into a Reachability Matrix with a validation step to ensure logical consistency, which involves iterations until the hierarchical structure is divided into four quadrants: autonomous, independent, dependent, and linking. ISM analysis is more effective because it can systematically map hierarchical relationships and interdependencies between elements, thereby determining key elements and strategy priorities based on the interaction structure, which cannot be comprehensively achieved by other analyses such as SWOT and AHP. The MATLAB application is used to facilitate matrix analysis and structure visualization, making ISM an effective tool in designing institutional strengthening strategies based on a deep understanding of the relationships between elements and interrelations can be presented in Table 1.

Table 1. Elements and Sub-elements of Research on Institutional Strengthening of Arabica Coffee Agribusiness in Enrekang Regency, 2024

| Elements | Sub Elements |
|---|---|
| Institutions that play a role in increasing Arabica coffee production | 1. Enrekang Regency Food Crops, Horticulture and Plantation Service<br>2. Enrekang Regency Cooperative and SME Service<br>3. Enrekang Regency Regional Planning, Research and Development Agency<br>4. Agricultural Extension Center<br>5. Research Institutions/universities<br>6. Private companies<br>7. Coffee cooperative<br>8. Financial/banking institutions<br>9. Coffee organization<br>10. NGO<br>11. Farmer Group |
| Institutional obstacles in increasing Arabica coffee production | 1. Institutions were not involved from the start.<br>2. Weak institutional commitment<br>3. Lack of quality human resources<br>4. Limited human resource institutions |

| Elements | Sub Elements |
|---|---|
| | 5. There is no acting institution that functions as a coordinator<br>6. Limited budget for coordination<br>7. Limited facilities to support coordination<br>8. Lack of institutional understanding of their respective roles<br>9. Lack of program integration and synchronization<br>10. Farmer's attitudes are difficult to develop |
| Strategic program to increase Arabica coffee production | 1. Extension (upstream-downstream)<br>2. Production facilities assistance program<br>3. Increasing human resources for extension workers<br>4. Providing access to capital<br>5. Farmer institutional development program<br>6. Comparative study of institutions<br>7. Providing organic farming technology packages<br>8. Effective coordination between institutions<br>9. Extensification of plantation land<br>10. Establishment of farming business partnerships with companies<br>11. Establishment of a special research and development team for Arabica coffee |

Source: Primary Data based on the results of FGD with the Agriculture Office, Academics, Arabica Coffee Farmers, and Coffee Marketing Institutions (2024).

## RESULT AND DISCUSSION

The respondents in this study include five main groups: farmers, local government, agricultural extension workers, economic actors, and academics. Farmers were chosen because they are the main actors in the Arabica coffee agribusiness system and have direct experience in production challenges, land management, and market access. Local governments are involved in providing insights into local policies that support the development of the coffee sector and institutional strengthening. Agricultural extension workers are facilitators who bridge the transfer of technology and innovation from institutions to farmers. Economic actors, such as processors, exporters, and market players, provide perspectives on supply chain dynamics and competitive market needs. Academics contribute theory-based analysis and relevant strategic recommendations for institutional development. By involving various respondents, the research obtains rich and multidimensional data essential for designing holistic and adaptive institutional strategies in response to changing local and global conditions.

According to Figure 1, the eleven sub-elements are divided into three quadrants: independent, linkage, and dependent. No sub-elements are located in the autonomous quadrant.

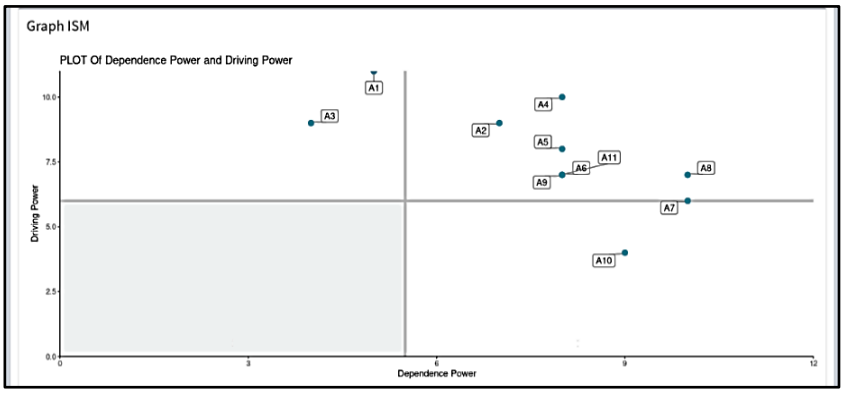


Figure 1.
Directional Graph (DP-D) of Institutions Playing a Role

The Enrekang Regency Food Crops, Horticulture and Plantation Service (A1) and the Regional Development Planning, Research and Development Agency (A3) are pivotal in enhancing Arabica coffee production in Enrekang Regency due to their high driver power and low dependence, indicating their significant influence and dominance over other sub-elements. This aligns with previous research highlighting the critical role of agricultural institutions in Indonesia**n** border regions (Santos-Rivera et al., 2024). However, the coffee agribusiness sector faces numerous challenges, including suboptimal cultivation practices, low productivity, and weak institutional structures for farmers. These issues are compounded by limited capital and the need for better adherence to good agricultural practice standards. The importance of institutional support is further underscored by studies showing that agribusiness institutions play a crucial role in strengthening food security and improving the welfare of small-scale farmers (Jänicke & Müller, 2024). Additionally, nutrient management in coffee-based agroforestry systems is essential for soil nitrogen cycling, with optimal strategies involving a combination of pruning and mixed fertilizer application to maintain soil nitrogen levels and microbial biomass (Kurniawan et al., 2024). The dynamic relationship between agricultural product circulation efficiency and the development level of the industry also highlights the need for modernized systems to support agricultural productivity in less-developed regions.

The dynamic relationship between the efficiency of agricultural product circulation and the development of the industry indicates the need for a modern system supporting agricultural productivity in the Enrekang Regency. Arabica coffee in Enrekang Regency has excellent potential due to its distinctive flavour.

However, it faces various challenges, such as limited access to post-harvest technology, low supply chain integration, and suboptimal institutional support. Applying modern technology and strengthening local institutions can help improve Arabica coffee's quality, traceability, and competitiveness in the Enrekang Regency. Moreover, supportive geographical conditions can ensure long-term productivity while maintaining environmental sustainability and sustainable agricultural practices. This strategy is expected to strengthen the position of Arabica coffee in both local and international markets and improve the welfare of farmers in the region.

**Establishment of a Structural Model of Institutional Strengthening Constraints**

The research results indicate that weak institutional commitment (A2), the only sub-element in the independent quadrant, is the most significant constraint and has a wide-ranging impact on other sub-elements. Policy implications emphasize the importance of strengthening institutional commitment by developing more targeted policies, such as establishing regulations that promote accountability and institutional transparency. From a practical standpoint, a collaborative approach between the government, farmer's associations, and extension workers can enhance coordination and strengthen relationships among the involved parties. To address constraint A2, strategic steps include enhancing managerial capacity through leadership training, performance-based incentives to encourage institutional accountability, and establishing effective oversight mechanisms. By addressing this weakness, other dependent or interrelated challenges can be managed more efficiently, supporting institutions' holistic and sustainable strengthening.

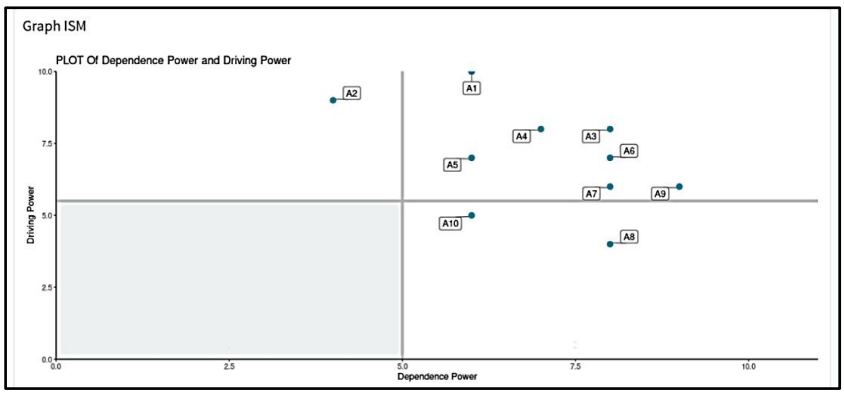


Figure 2.
Directional Graph (DP-D) Barriers Causing Weak Coordination

Some sub-elements in this quadrant require special attention because changes in one element can trigger changes in other elements, either directly or indirectly. This emphasizes the importance of a systemic approach in addressing coordination challenges in the institutional coffee agribusiness sector, as shown in Figure 2. It shows a quadrant map that maps the relationship between driving power and dependence power of various sub-elements in the Arabica coffee agribusiness coordination system. The linkage quadrant displays seven main sub-elements: A1 (delayed institutional participation), A3 (lack of quality human resources), A4 (limited institutional personnel), A5 (lack of effective coordinators), A6 (limited budget for coordination), A7 (limited infrastructure to support coordination), and A9 (lack of program integration and synchronization). These sub-elements have high driving and dependency power, indicating that other elements influence them and significantly impact other elements. For example, lack of quality human resources (A3) and limited budget for coordination (A6) are interdependent challenges that can affect the overall effectiveness of coordination. However, the explanation of weak coordination and lack of human resources needs to be adjusted to the context of South Sulawesi. The dynamics in this region indicate that coordination issues are more related to institutional fragmentation and the lack of synergy among stakeholders rather than just a shortage of human resources. For example, although the number of personnel in the Food Crops, Horticulture, and Plantation Service of Enrekang Regency is limited, the main issue lies in the uneven distribution of tasks and priorities among the related institutions. Additionally, weak coordination is often caused by the lack of effective communication mechanisms between institutions and the minimal shared understanding of the strategic goals of Arabica coffee agribusiness. Therefore, relevant solutions include strengthening multi-stakeholder governance mechanisms and enhancing institutional capacity to create more integrated collaboration rather than just focusing on increasing the number of human resources.

An integrative strategy considering institutional involvement and sustainable resource management is needed to increase Arabica coffee production in Enrekang Regency. In order to increase product competitiveness, strengthening agricultural institutions includes improving human resource competencies, ensuring sufficient infrastructure is available, and creating effective marketing strategies. Establishing cooperative governance among farmers, business people, and local governments is also critical to guarantee the sustainability of economic and ecologically sustainable coffee production. The development of the Arabica coffee industry in the area will largely depend on local government support in the form of laws that encourage training, research, and agricultural extension (Paloma, 2022). Maintaining the sustainability of

Arabica coffee commodities can be strengthened by the involvement of local entities in their management.

With the increase in Arabica coffee productivity in Enrekang Regency, some recommended strategies that can be adopted include applying research-based agricultural techniques and technology, as implemented in Aceh Gayo Regency, which successfully improved production yields through superior seed breeding and integrated pest management. In addition, developing partnerships between farmer's research institutions and the private sector for technology transfer can enhance production efficiency. Additionally, Enrekang Regency, which borders Tana Toraja, can collaborate in coffee management where the application of agroforestry techniques and sustainable soil quality maintenance have improved the quality and quantity of coffee production, which is also influenced by the promotion of coffee with geographical indications and strong local branding. Thus, post-harvest actions, including developing speciality coffee and organic certification, have proven to add value and competitiveness to Arabica coffee, as implemented in the Kona region of Hawai. Collectively, these insights underscore the need for integrated policies that address coffee farmer's specific challenges, promote technological innovation, and ensure sustainable agricultural practices to improve the income and welfare of farmers globally.

**Strategic Programs to Crease Arabica Coffee Production in the Enrekang Regency**

The strategic program to increase Arabica coffee production in Enrekang Regency, as analyzed using the Interpretative Structural Modeling (ISM) tool, highlights the importance of three key sub-elements: upstream-downstream extension (A1), increasing human resources for extension workers (A3), and farmer institutional development program (A5). These sub-elements, categorized in the independent quadrant, are pivotal in enhancing coffee production due to their significant influence. The upstream-downstream extension program (A1) is crucial as it ensures a seamless flow of knowledge and resources from the initial stages of production to the final stages of marketing and distribution, similar to the comprehensive approach seen in the genetic diversity study of black pepper in Sri Lanka, which emphasized the need for a broad genetic base to enhance crop resilience. Increasing human resources for extension workers (A3) is akin to the rapid breeding methods used in wheat cultivation, where extending the light period and breaking dormancy in early harvested seeds were key to accelerating breeding cycles and improving crop traits (Aydın et al., 2024). The farmer institutional development program (A5) aligns with the findings from the silvopastoral systems (SPS) study, which emphasized the role of gender, resources, and knowledge in adopting sustainable practices, highlighting the importance of institutional support and training programs (Castro-Nunez et al., 2024).

Additionally, integrating Trichoderma spp. in peanut cultivation, which improved plant growth and disease resistance, underscores the potential benefits of biocontrol and sustainable agricultural practices that could be incorporated into coffee production strategies. Lastly, the intensified cereal systems with mung bean in the Eastern Gangetic Plains demonstrated the importance of diversified cropping systems for increased profitability and resource efficiency, which could be a valuable consideration for coffee production systems. Thus, the strategic focus on these three sub-elements, supported by agribusiness institutions, is essential for achieving significant improvements in Arabica coffee production in the Enrekang Regency.

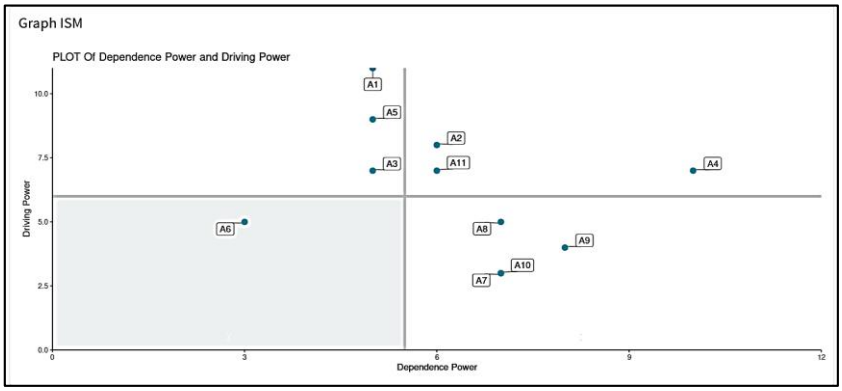


Figure 3.
Directional Graph (DP-D) Strategic Program to Increase Arabica Coffee Production

The linkage quadrant's sub-elements, such as the production facilities assistance program (A2), providing access to capital (A4), and the formation of a unique team for Arabica coffee research and development (A11), play a crucial role in enhancing Arabica coffee production. These programs are interdependent and can influence each other and other quadrants. For instance, providing access to capital (A4) is essential for implementing organic agricultural technology packages (A7) and forming farming business partnerships (A10), which are in the dependent quadrant. The effectiveness of these programs can be seen in various agricultural contexts. For example, the adoption of silvopastoral systems (SPS) in livestock farming, which integrates trees, forages, and livestock, has shown that access to financial resources and gender roles significantly impact adoption rates and environmental conservation efforts (Castro-Nunez et al., 2024). Similarly, the provision of organic agricultural technology packages (A7) can be linked to the increased coexistence of antibiotic and metal resistance genes in organically fertilized soils, highlighting the need for careful management to safeguard public health. The formation of a unique team for Arabica coffee research (A11) can draw parallels with the study on Trichoderma spp., which

demonstrated the benefits of microbial inoculation in enhancing plant growth and disease resistance, suggesting that focused research can lead to significant agricultural advancements.

Additionally, the comparative study of institutions (A6) in the autonomous quadrant, though having low driver-power, can still motivate farmers by showcasing successful cultivation practices, similar to how Yemeni coffee farmers could benefit from improved traceability and sustainability practices using Near Infrared Spectroscopy (Santos-Rivera et al., 2024). Lastly, the extensification of Arabica coffee plantation land (A9) and the formation of farming business partnerships (A10) can be informed by the successful breeding programs for acid-tolerant maize in Angola, which improved productivity under various soil conditions. These interconnected programs collectively contribute to a robust strategy for enhancing Arabica coffee production.

## CONCLUSION AND SUGGESTION

### Conclusion

The Department of Food Crops, Horticulture, and Plantations of Enrekang Regency is involved in strengthening the coffee institution. These institutions play a role in achieving production increases, environmental sustainability, and socio-economic welfare. Coordination between institutions has become an obstacle that must be addressed early on so that coordination runs effectively in the long term. Socially and economically, strengthening institutional capacity through technical training, participatory extension, and integration of farmer skill enhancement programs can improve product quality and market access.

### Suggestion

The Enrekang Regency Government should establish an inter-agency coordination forum involving the Agriculture Office, farmer's cooperatives, research institutions, and the private sector to align work programs and ensure synergy in policy implementation. The introduction of a digital platform for sharing data and information in real-time to enhance the competitiveness of Enrekang Arabica coffee in the global market.

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