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Identifying Institutions and Strategic Programs to Increase Sugarcane Production in Southeast Sulawesi, Indonesia

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Abstract

The decline in the productivity of the national sugarcane commodity has become an issue in the last ten years. When domestic demand for sugar is increasing, the decline in productivity indicates a crisis in sugarcane production. At the same time, the involved institutions and strategic programs to encourage sugarcane production have not been well identified. The research aims to determine the institutions that are expected to play a role and the strategic programs that are prioritized in increasing sugarcane production in Southeast Sulawesi, Indonesia. This study uses Interpretative Structural Modeling (ISM) to formulate complexity, hierarchy (levels) and classification among elements. The results showed that of the 14 sub-elements of the acting institutions studied, five institutions were key actors for increasing production, namely banking institutions; universities; agricultural, plantation and fisheries offices; industry, trade, cooperatives, & Small and Medium Enterprises (SMEs') offices; and private companies. Then, from the 13 sub-elements of the strategic programs, there are five strategic programs that also serve as the key programs, namely extension/assisting farmers; addition of plantation labor; providing access to capital; variations of profit-sharing and buying systems of sugarcane; and accuracy of time and adequacy of the supply of raw materials to the mills. This means that these institutions must play an important role, as well as strategic programs that must be carried out effectively to address the issue of sugarcane production in the country. Thus, researchers recommend involving all stakeholders in conducting strategic programs with the key actors as the leading driving institutions.

Keywords: institutions role; ISM; strategic program; sugarcane

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INTRODUCTION

Sugarcane is a commodity that has continued to experience global development in the past two decades (Bhatt, 2020). This commodity is grown on an area of 26 million ha in more than 90 countries around the world, and the plant itself and its by-product are considered essential to the food industry (Laga et al., 2019; Yuansah, 2019; Holkar et al., 2020). Although sugarcane is also a strategic commodity in Indonesia, the decline in productivity of the national sugarcane commodity has become an issue in the past ten years. Thus, developing this commodity is essential to absorb labor and meet the needs for sugar consumption and raw materials for the food and beverage industry. There are 62 sugar factories in Indonesia, 43 of which are state-owned enterprises, and the private sector owns the rest. However, even though Indonesia already has a national installed capacity of 316,950 tons of sugarcane per day

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(TCD), this amount still is required to meet domestic sugar consumption needs (Zainuddin and Wibowo, 2018).

In Indonesia, the islands of Java and Sumatra are the leading sugarcane producers. According to the Directorate General of Plantations (2021), the total production value recorded on the islands of Java and Sumatra is 1,334.3 and 929.9 thousand tons, respectively, with East Java as the national production center. However, the problem faced in the last decade is that sugarcane productivity keeps fluctuating when the demand for sugarcane by sugar mills continues to increase (Hani and Mustapit, 2016). To increase production, it is necessary to expand land and establish new production centers, and Southeast Sulawesi Province is one of them. Von Maltitz et al. (2019) also stated that it is required to select a suitable model of institutional arrangements that adequately enables farmers to promote sugarcane cultivation based on experiences in various Southern African nations. Then, from research conducted in Vietnam, Hoang et al. (2022) emphasized the requirement for research and development institutions to be prepared to conduct research, development and the transfer of sugarcane technology to increase output. The value of the combined product must be increased through the use of fresh concepts, increased capacity and technological transfer.

One of the largest privately owned sugar mills with a capacity of 12,000 TCD has been officially operating in this province since 2020. Therefore, it is necessary to extend land in the area in an effort to increase sugarcane production. One of the government's plans for developing sugarcane commodities is to target self-sufficiency in 2024 (Rohman et al., 2021). Some of the targets set include improving the performance of sugarcane fields, increasing the area planted and encouraging the production of white crystal sugar. Based on Statistics of Southeast Sulawesi Province (2022) data, the sugarcane harvested area in Southeast Sulawesi is 4.4 thousand ha, with a production yield of 18.8 thousand tons in 2021. To meet the capacity of sugar factories, it is necessary to carry out land extension accompanied by the recruitment of competent human resources.

The program to increase the production of a commodity in new areas certainly has several challenges. The readiness and ability of various institutions to work together, support and oversee strategic programs to increase sugarcane production are a few examples of issues that must be considered (Wardani et al., 2021). As a new commodity in the region, the first challenge is to open as much land as possible and obtain farmers willing to plant sugarcane. In contrast, the condition is that all agriculture-based companies compete to hire as much labor as possible. Not only that, it is still being determined whether this land extension will harm the sustainability of production, especially if the environmental implications of agricultural inputs and production methods are not carefully regulated. Therefore, applying appropriate farming management practices is one of the priorities for consolidating the potential for significant sugarcane production towards agricultural sustainability and reducing poverty (Allen et al., 1991; Bordonal et al., 2018; Yusuf et al., 2018; Wadghane, 2022). Moreover, the stakeholders face the problems of starting farming activities due to a lack of financial and social capital access. One of the obstacles is that institutions have no clear structure and role in running the commodities. Thus, researchers need to identify and formulate the position and structure of respected institutions that should give their contribution to increasing sugarcane production.

In addition, it is essential to formulate relevant strategic programs following the location of the sugar plantation and industry (Neupane et al., 2017). The importance of the clarity and priority of programs is to ensure that there are no overlapping programs or programs that decline others' progress to achieve the objectives. These programs can be based on government programs that are currently seeking to accelerate the increase in sugar productivity through three focus activities: on-farm, off-farm and institutional (Zhao and Li, 2015; Durroh, 2018). As alternatives, the programs can emerge from external institutions, such as non-government organizations or research institutions. The research uses Interpretive Structural Modeling (ISM) analysis tools to identify the complexity of institutional roles and program priorities in the development of sugarcane commodities, and this becomes the novelty of this study. The purpose of this study is to identify which institutions are expected to play a role in increasing sugarcane production and identify what strategic programs sugarcane stakeholders can implement to boost production.

MATERIALS AND METHOD

The data used in analyzing institutions that are expected to play a role and strategic programs to increase sugarcane production are the perceptions of experts who have knowledge and experience in the sugarcane plantations and the sugar industry in Southeast Sulawesi Province of Indonesia. In addition, institutional comprehension is needed in the region where the sugar plantation or industry operates. The first stage of data collection was determining the elements and sub-elements. The elements of the institution expected to play a role and strategic program were analyzed in this study. These two elements were determined based on: (1) research objectives and (2) results of discussions with experts in the field of sugarcane from several agencies/institutions.

ISM has nine choices of elements that can be assessed, but the ones most needed for this research are 'the agencies involved in the execution of the program' and 'the activities needed for the action plan'. Institutional elements are expected to play an essential role because of the urgency of the institutional arrangement model to support farmer empowerment and ease of access to capital. Furthermore, strategic program elements are needed to initiate the right strategy by the conditions of sugarcane farming in Southeast Sulawesi. By understanding the elaboration of these two elements, at least sugarcane farming actors already have clear descriptions of roles and programs to develop sustainable sugarcane farming. Thus, it becomes justified to select these elements.

The initial research results and discussions with various sugarcane stakeholders resulted in 13 institutional and 14 strategic program sub-elements, respectively. The next steps of this research were; (ii) preparing two series of questionnaires consisting of 78 and 91 questions, respectively, and (iii) determining samples of experts (Table 1). The experts referred to in this study were determined by purposive sampling technique based on the following characteristics according to the research objectives: (1) having experience in the field of sugarcane and the sugar industry, (2) having a reputation, position or authority in that field, (3) willing to participate in in-depth interviews, and (4) having strong influence and interest in the development of sugarcane commodities.

This study uses an ISM analysis tool, which functions to formulate a complex structure based on elements, formulate a hierarchy of relationships among sub-elements, and classify sub-elements into four quadrants (autonomous, dependent, linkage and independent). According to Waller (1980); Saxena et al. (1992), ISM analysis is carried out in the following stages: (1) identification of the set of elements; (2) determination of the contextual relationship between sub-elements; at this stage, data are collected through questionnaire interviews, in which experts determine contextual relationships between sub-elements based on their insights and experiences in sugarcane farming; (3) binary pairwise comparison (e.g., "Does sub-element one affect sub-element 2"); (4) development of a Structural Self-Interaction Matrix (SSIM)

Table 1. Data structure and properties

Data structure		
Data	Property	Function
Data on institutional actors and strategic programs	The level of importance of actors and strategic programs based on position: independent, linkage, dependent, autonomous	To identify and determine the level structure and hierarchy of institutional actors and strategic programs to increase sugarcane production
Elements		
Elements	Sub-elements and questions	Target
Institutions	13 sub-elements and 78 questions	Sub-elements as institutional variables that are expected to play a role in increasing sugarcane production
Strategic programs	14 sub-elements and 91 questions	Sub-elements as strategic program variables to increase sugarcane production

using the results of the experts' responses to the contextual relationships between sub-elements; (5) conversion of SSIM to Initial Reachability Matrix (IRM) by replacing symbols V, A, X, O in the questionnaire with numbers 1 and 0; (6) checking the matrix with the transitivity rule to get a matrix that complies with the transitivity rule, and (7) processing of the final matrix to get the Driver Power and Dependence (DP-D) values to produce a directional graph, which is a graph of related sub-elements directly and shows hierarchical levels and is classified into four quadrants.

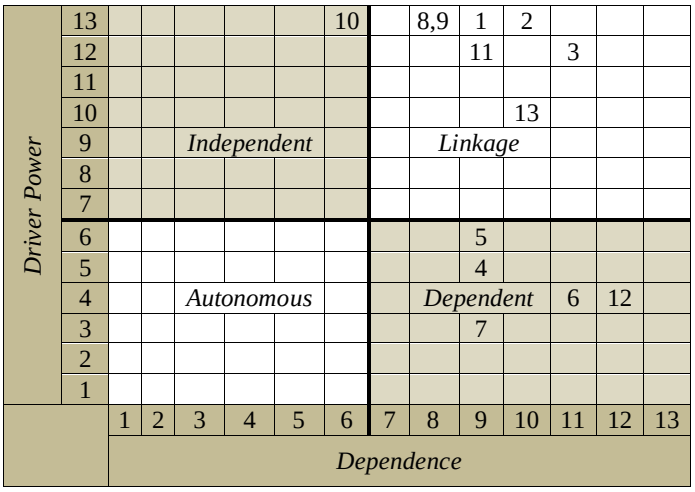
The four quadrants in question are as follows. The first quadrant is the weak driver-weak dependent variable (autonomous), in which the sub-elements contained in this quadrant are generally unrelated to the system or may have a little relationship. Sub-elements are considered in the autonomous sector if the DP value ≤ 0.5 and the D value ≤ 0.5. The second quadrant contains the weak driver-strong dependent variable (dependent), in which the sub-elements in this position are not independent, meaning that they are very reliant on the sub-elements above them. Sub-elements are included in this quadrant if the DP value ≤ 0.5 and the value D > 0.5. The third quadrant encompasses the strong driver-strong dependent variable (linkage), in which the sub-elements in this group need to be studied carefully because they have an unstable relationship between sub-elements. Sub-elements enter third quadrant if the DP value is > 0.5 and the D value is > 0.5. The four quadrant includes the strong driver-weak dependent variable (independent); the sub-elements in this quadrant are independent variables that have a significant influence on other sub-elements. Sub-elements include in the independent sector if the DP value is > 0.5 and the D value is $\leq$ 0.5. ISM analysis is made based on processing data and information from experts to obtain a consistent matrix using predetermined procedures.

RESULTS AND DISCUSSION

Institutional hierarchy

One of the outputs of ISM is a directional graph (Figure 1), which divides 13 sub-elements, "institutions expected to play a role" in dividing sugarcane production into four quadrants. Among the thirteen sub-elements, all are divided into three quadrants (independent, linked and dependent), and no sub-elements are in the autonomous quadrant. This means that each institution is considered to have an interest and a role in trying to accelerate production. The differences are only in terms of driver power and dependence value. One sub-element is in the independent quadrant, namely banking institutions. This shows that banking institutions have more dominant influence and less dependency, while institutions in other quadrants synergize or help support these institutions.

Figure 1 depicts that there are seven sub-elements in the linkage quadrant. Institutions in this quadrant have an unstable relationship, which means that actions taken by sub-elements in this quadrant can affect sub-elements in their quadrant or other quadrants. The number of institutions in this quadrant suggests that at least 7 of the 13 inter-institution relationships require further investigation. Then there are five sub-elements in the dependent quadrant.



Notes:
1. Agricultural, Plantation, and Fisheries Office
2. Industry, Trade, Cooperative, and SMEs Office
3. Transmigration and Human Resource Office
4. Regional Development Agency
5. Agricultural Extension Center
6. Cooperatives
7. Research Institution/BPTP
8. Universities
9. Private Companies
10. Banking Institutions
11. Sugarcane Farmers Association (APTRI)
12. NGO
13. Farmers Group

Figure 1. Directional graph of institutions expected to play a role

According to the contextual relationship used in the analysis, these five institutions are not prioritized over others. However, institutions in this quadrant retain influence and can become institutions that support institutions above them.

The driver power and dependent values results indicate that seven levels of institutions are expected to play a role in increasing sugarcane production, where the institutions at the first level are the key actors. Interpretation of the institutional structure (Figure 2) was carried out to describe the roles and interrelationships among these institutions.

At the first level, there are five institutions, namely banking institutions; universities; agricultural, plantation, and fisheries offices; industry, trade, cooperatives & Small and Medium Enterprises (SMEs) offices; and private companies. These five institutions can be considered key actors in increasing the yield of sugarcane plantations because they have the highest values in driver power. Private companies have been identified as key actors because of their role in establishing sugar factories in Southeast Sulawesi as well as opening up plantation land around the sugar factories. As an initiator in efforts to achieve sugar self-sufficiency, the company is expected to continue to play a role in recruiting workers or establishing good partnerships with plasma farmers to ensure productivity growth (Susilowati et al., 2020).

Furthermore, there are banking institutions that are the only institutions that occupy in the independent quadrant. The expected role of this institution is to provide farmers with business credit assistance through partnership schemes or individual financing. Synergies between financial institutions and businesses, particularly as key actors, are highly anticipated if plantation yields and farmer incomes are to increase (Azmie et al., 2019). According to the informants, companies and farmers will find it easier to cultivate with capital assistance from financial institutions because the capital required in a sugarcane farming business is relatively large.

Universities, through their role in research and community service, are also expected to play a role in efforts to increase production. From the information obtained in the field, before the sugar factory was established, the company collaborated with two universities to assess the potential and feasibility of sugarcane farming in Southeast Sulawesi. After two years of planting, universities were asked to participate in research regarding the optimal fertilizer combination to increase production and yield. Therefore, universities play an important role in sugarcane development by conducting research on soil conditions, combined fertilization packages and institutional strengthening.

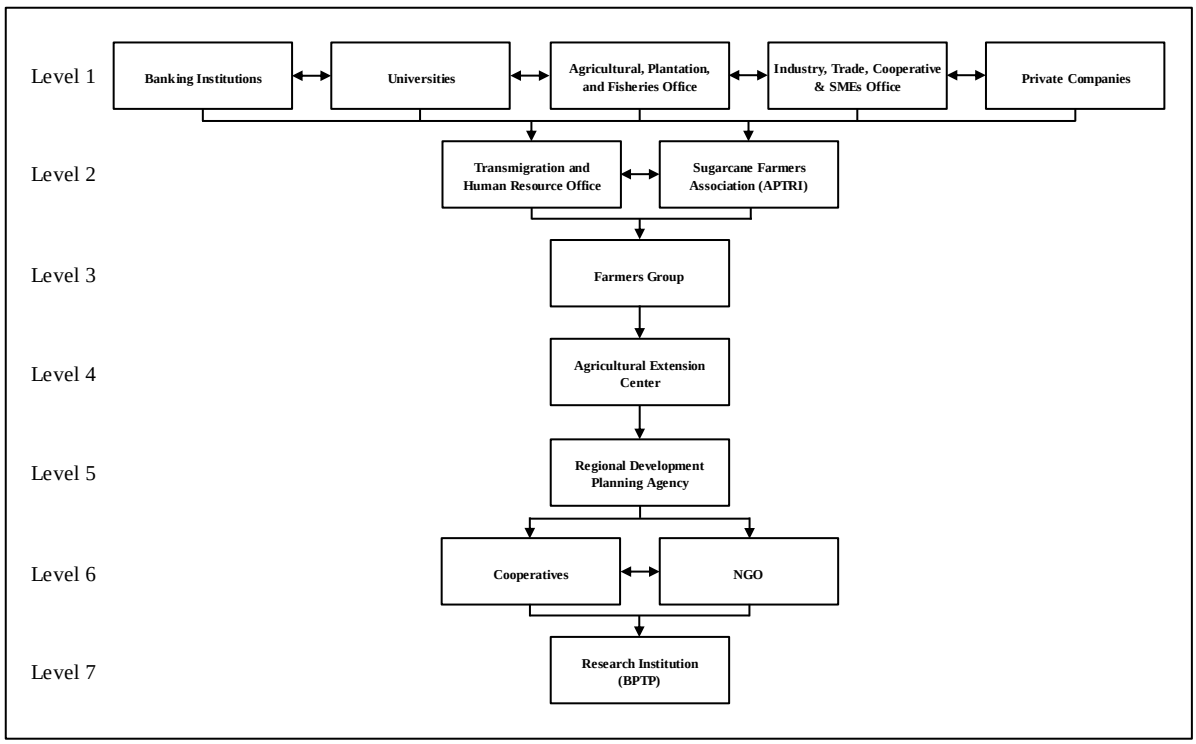


Figure 2. Institutional structure

Furthermore, there are agriculture, plantation and fisheries offices as well as industry, trade, cooperatives and SMEs offices that are government organizations. Both organizations are key actors because they are responsible for sugarcane problems. Furthermore, the plantation sub-sector must strive to increase sugarcane commodity productivity by formulating, implementing, and monitoring policies or programs. The office of industry, trade, cooperatives, and SMEs believes that this institution has no direct influence on increasing sugarcane production. Nonetheless, it is expected that this institution will play a role in ensuring trade policy and market availability for sugarcane products, encouraging more farmers to cultivate the commodity. Moreover, this institution can play a role in coordinating and consulting between government and non-government organizations in developing strategic and work plans to support one another.

At the second level, there are two institutions: transmigration and human resource office and sugarcane farmer association (APTRI). In general, this office is responsible for developing technical policy materials, strategic planning, guidance, assessment, analysis, and evaluation of employment-related issues. This institution can play a role by ensuring the development of society's working competence through training and then ensuring their placement in various jobs, including those in the sugar industry. Furthermore, APTRI is an institution that is expected to play a role because of the need for this association in Southeast Sulawesi. APTRI is a farm-level institution that is expected to benefit the interests of sugarcane farmers by increasing farmer productivity and income while also positively impacting the development of sugarcane areas. The results of this study are supported by Yunitasari et al. (2020), which show that increasing the role of APTRI has been proven to increase the production and income of sugarcane farmers in East Java. Therefore, farmers or the government must request the establishment of APTRI in Southeast Sulawesi.

From level three to five, there is only one institution each, namely farmer groups, agricultural extension center, and regional development planning agency, respectively. Farmer groups are the main subjects or actors in sugarcane production because they work from preparing the land to harvesting. Farmer groups are also the institutions that have the most interactions with other institutions. Meanwhile, because there were no farmers forming groups in Southeast Sulawesi, it was still difficult to establish partnerships, provide assistance, and develop institutions for farmers through programs only targeting farmer groups. This necessitates the establishment of this institution, which aims to improve farming management in order to increase sugarcane production (Magfiroh and Wibowo, 2019).

Furthermore, agricultural extension centers are critical in providing farmers with counseling and assistance. Although agricultural extension workers generally focus on assisting major food crops such as rice, they must also pay attention to and provide counseling to sugarcane farmers because the projected number of land and farmers will continue to increase, making it one of the production centers in Indonesia. Then, regional development planning agencies can control the assistance and programs provided by regional development work units. As a regional planning institution, this institution is expected to be able to develop short-term and medium-term plans to make Southeast Sulawesi a center and model for sugarcane production in Indonesia.

Furthermore, at the sixth level, there are two institutions, namely cooperatives and non-governmental organizations (NGOs). There are currently no NGOs in Southeast Sulawesi that advocate for the interests of sugarcane farmers or provide assistance and community development. However, the existence of this organization is undeniably beneficial in terms of empowering and strengthening communities, as well as increasing farmer production and income. Furthermore, there is a cooperative known as the people's sugarcane farmers' cooperative (KPTR), which is a necessary institution for sugarcane farmers in terms of access to business capital, the availability of production inputs (fertilizers and medicines), and product distribution (Masrukhin et al., 2019). To run sugarcane plantations for a year, both farmers and companies require significant capital. This capital can be obtained from cooperatives through credit or through specific schemes arranged with its members. In terms of production facilities, cooperatives are the institutions through which farmers can obtain production facilities with payments made after harvest. At the highest level, there is only one institution: research institute/BPTP. In the dependent quadrant, BPTP has the lowest driver power value. However, this institution is still expected to play a role

in increasing sugarcane production in Southeast Sulawesi through training, research and the application of technology in sugarcane farming.

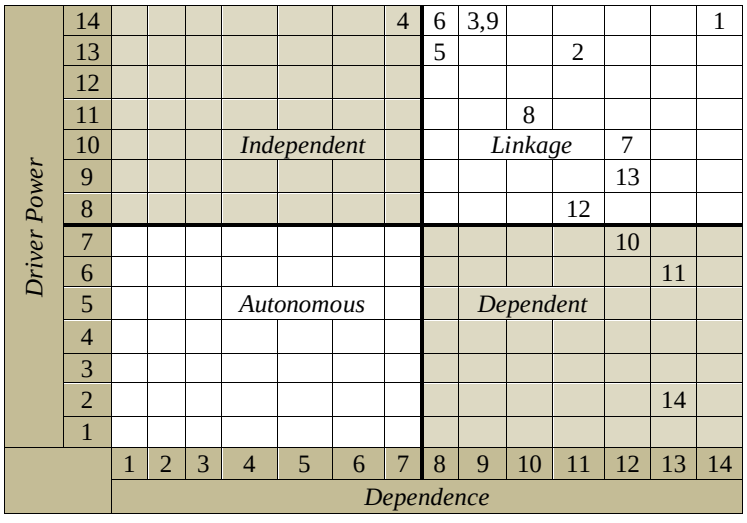
Strategic programs

The directional graph (Figure 3) is one of the outputs from ISM, which divides 14 sub-elements of the strategic program to increase sugarcane production into four quadrants. The sub-elements are divided into three quadrants (independent, linkage and dependent). There are no sub-elements in the autonomous quadrant in strategic program evaluation. Each program appears to be capable of resolving the sugarcane production crisis. These programs are only distinguished by their priority. There is only one sub-element in the independent quadrant, namely 'providing access to capital'. This program places a strong emphasis on increasing sugarcane production, while programs in other quadrants assist in support of independent programs. Furthermore, four sub-elements in the linkage quadrant are priority programs that must be prioritized by various stakeholders in order to increase the quantity of sugarcane production.

There are ten sub-elements in the linkage quadrant. The programs in this quadrant have an unstable relationship, meaning that the actions of the sub-elements in this quadrant can affect the sub-elements in their quadrant and those in other quadrants. In other words, this program will have a significant impact on whether sugarcane production increases or decreases. This quadrant also includes four key programs: accuracy of time and adequacy of sugarcane supply to mills; variation of profit-sharing and sugarcane buying system; addition of plantation human resources; and extension/assisting farmers.

There are three sub-elements in the dependent quadrant: formation of sugarcane research and development team; socialization and pilot project of sugarcane plantation; and benchmarking with advanced sugarcane plantations. These three programs are not given higher priority than others. However, the programs are still required to support top-level programs or to become new programs if the prioritized programs are completed. The institutional benchmarking program is in the lowest position or level in this quadrant because it has the least amount of driver power, which means that it has no more significant influence than the program at the higher level. However, this program is expected to motivate farmers after visiting institutions or examples of successful plantations in sugarcane cultivation.

The results of this study indicate that there are nine levels of strategic programs for increasing sugarcane production, where programs at level one are considered as the main programs. Structural-level interpretation of the programs (Figure 4) was carried out to describe the programs.



Notes:
1. Extension/Assisting Farmers
2. Production facilities assistance program
3. Addition of plantation human resources
4. Provision of access to capital
5. Increased interest of local farmers to work in sugarcane plantations
6. Accuracy of time and adequacy of sugarcane supply to the mills
7. Farmers institutions development program
8. Formation with farmer partnerships with companies/industry
9. Variation of profit-sharing and buying system of sugarcane
10. Formation of sugarcane research and development team
11. Socialization and pilot project of sugarcane plantation
12. Extensification of plantation land
13. Effectiveness of inter-institutions coordination
14. Benchmarking with advanced sugarcane plantations

Figure 3. Strategic program digraph

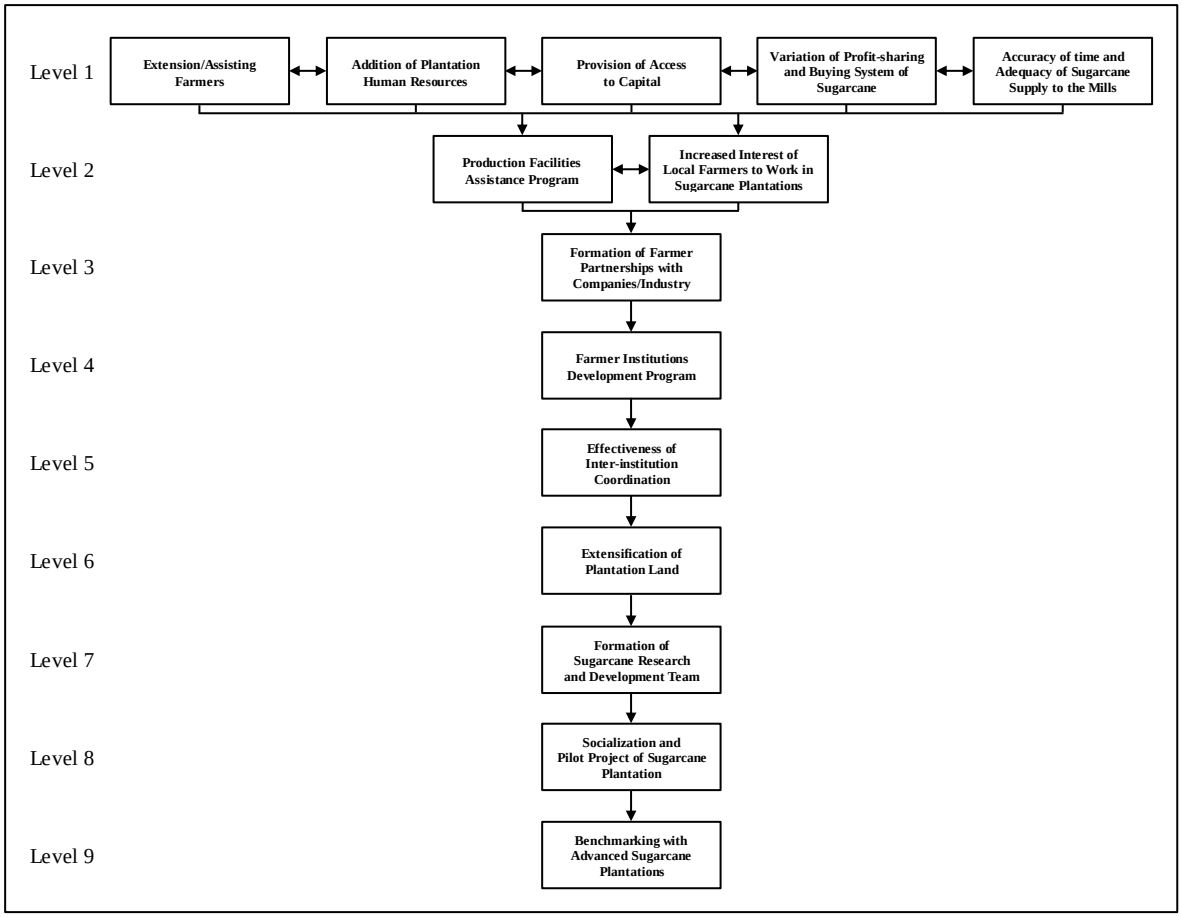


Figure 4. Structure of strategic programs

The extension program is critical because farmers' primary need is assistance in sugarcane cultivation to achieve production and yield levels that meet factory needs. In addition, the importance of this program is also indicated by the highest driver power and dependence values in the quadrant, which shows the strong influence and dependence of this program with all the programs analyzed. Based on information from sugarcane plantation managers, most people in Southeast Sulawesi province are still relatively new to cultivating sugarcane because this plant has only been introduced since the establishment of one of the largest sugar mills in Indonesia in 2019. Sugarcane planting has only been done for two years, beginning in 2020, with a workforce that is still lacking in quantity and experience in sugarcane cultivation. As a result, extension workers from the government, businesses, or non-governmental organizations are required as external factors that encourage and assist farmers in increasing the productivity of their land (Arbiyansah et al., 2019; Rokhani et al., 2021).

Among the forms of extension and assistance that can be given to farmers are land preparation, planting and fertilizing in the first four months, treatment and protection from pests, and harvesting. According to sugarcane supply partners, the harvesting season is the most critical time to receive intensive assistance. This is because even a minor delay in harvesting can significantly reduce sugarcane yields. Then, lower yield contributes to less sugar production, which automatically results in low-profit sharing between the company and partner farmer. However, because sugarcane farmers continue to lack knowledge and practice, all stages are equally important to receive intensive extension (Lestari et al., 2021).

The next main strategic program is the addition of plantation human resources because sugarcane farmers are still lacking. In the case of sugarcane plantations in Bombana Regency, Southeast Sulawesi, in 2022, only 6,000 ha of land will be worked on out of a total of 28,000 ha of land that is ready for clearing. Meanwhile, the sugar factory at that location has an optimal production capacity

of 4,600 TCD and a maximum capacity of 12,000 TCD. In addition, sugarcane/plasma farmers have yet to be able to fulfill half of this production capacity. This causes the factory to only operate once every ten days, which is extremely detrimental to the company and plasma farmers, owing to the enormous operational costs required to activate factory machines. Due to the high production capacity that needs to be met and the vast area of plantation land that has not been worked on, this program has become one of the core programs in increasing sugarcane production.

Then, capital issues became the main obstacle for new commodities such as sugarcane in Southeast Sulawesi. The experts interviewed said that the price of production inputs was very high and, at the same time, difficult to bear for the farmers. Meanwhile, it is also impossible for the company to provide all the means of production for farmers. Therefore, one solution is to provide farmers with access to capital through partnership schemes with companies, banking institutions or NGOs. The research by Mayangsari (2022) also found that partnerships in the food and energy security credit programs (KKPE) and sugarcane cultivation assistance programs between sugar factories and farmers can run effectively and contribute to the welfare of farmers. The action of this program is that stakeholders who have strong influence can open up access to capital for farmers or teach farmers to seek access to get capital in every planting season.

The partnership pattern between farmers and companies currently in effect is a profit-sharing system. However, according to some farmers, this system is not profitable due to the slow receipt of profit sharing because they have to wait until the sugar is sold. This problem was also found in research on partnership patterns at sugar factories in Java which showed that the profit-sharing system was not populist among farmers (Azmie et al., 2019; Yunitasari et al., 2020). Variations of production sharing and sugarcane purchase system can be implemented to overcome this problem of the partnership pattern. If the stop-buy system is implemented while farmers are still unable to meet the factory's daily needs due to a lack of quantity, they can still earn a decent income (BEP) based on the yield when the sugarcane is harvested. The speed of circulation of money through the buy-out system allows farmers to quickly roll back their money to prepare for the next planting season. This scheme will enable farmers to continue working on sugarcane farming and can invite other workers to join this sector because the rewards are quickly received. Finally, when farmers have reached their maximum production capacity, variations of the partnership system for production sharing and buying and selling can be implemented, benefiting both companies and farmers.

Furthermore, there is a program called accuracy of time and adequate supply of sugarcane to the mills to increase sugarcane production. This program is more related to improving the yield of sugarcane. Stakeholders can think of programs to ensure partners or smallholders can meet targets. Sugarcane that is harvested and supplied on time can get the ideal yield and avoid problems in logistics (Junqueira and Morabito, 2019). For example, sugarcane that is supplied on time and directly milled on the day of harvest from plasma farmers in South Konawe Regency can get a yield of seven from the factory. However, if it is not timely, it is milled two weeks after it is harvested, then its value can decrease to 4-5 yields. This decrease in yields will have an impact on the company's and farmers' low income so that they have difficulty in buying relatively expensive production facilities, and ultimately affect their loss of motivation to continue sugarcane cultivation activities. Thuankaewsing et al. (2015), who researched harvest scheduling, explained one of the problems, namely inefficient harvest scheduling causing conflict between farmers and companies. In comparison, Australia uses metaheuristic techniques and programming constraints combined as an efficient solution for very complex sugarcane-to-mill transport systems. Thus, a better cane transportation scheduling system is achieved to maximize transportation (Masoud et al., 2016; Sierra et al., 2022). Therefore, stakeholders can formulate an efficient schedule in addition to farmer groups or plasma farmers that must consistently supply sugarcane to factories according to schedule.

At the second level, there are two strategic programs, namely the production facilities assistance program and increasing the interest of local farmers to work in sugarcane plantations. Many parties, including agricultural services, companies, banking institutions, and NGOs, can carry out production facilities assistance programs. For example, government support

through the agricultural service to sugarcane farmers as a whole in the context of providing routine assistance is very much needed, especially when they have one of the largest sugar factories in Indonesia operating in their area. One of the steps taken is to start allocating input assistance budgets to sugarcane commodities, which can significantly contribute to locally-generated revenue (PAD). If related agencies, companies, or other institutions can assist with the right quality, target, and time for farmers, increased production can occur sustainably (Pratiwi et al., 2018; Sunarti, 2021).

Furthermore, the program to increase the interest of local farmers occupies a high position because it greatly influences employment in this sector. Since the factory was almost operational in 2019, the company has also conducted outreach to the community about planting sugarcane in the hope that once the factory is operating, the sugarcane will also be available to be processed into sugar. However, because farmers are unfamiliar with these plants and the competition between commodities to recruit workers is high, the number of sugarcane farmers is still relatively small. This issue of interest is also not limited to whether farmers decide to try sugarcane farming or not but also how they still desire to continue cultivating sugarcane. If stakeholders can continue to arouse interest, attract new farmers, and persuade them to continue working on sugarcane farms. This will encourage increased sugarcane production, and the factory's needs can be fulfilled. Therefore, the government (agriculture or labor department) and companies need to consider about strategic steps to make farmers choose sugarcane cultivation as their livelihood.

At levels three and four, there is one program each, namely establishing farmer partnerships with companies/industry and farmer institutional development program, respectively. Forming partnerships is an essential and interrelated program because there are companies and plantations in the same area, so partnerships are indeed a strategy implemented by companies to ensure their sugarcane needs are met. On the other hand, the partnership will also provide farmers with several benefits, such as mentoring, input assistance, and bonuses from the company. Kumalasari et al. (2019) found differences in production and income between sugarcane farmers who establish partnerships with non-partnered farmers. As a result, partnered farmers have slightly more production with higher income per hectare per year. Through these benefits, farmers can maximize the potential of their land so that their yields can increase compared to when they only try to farm themselves. The same condition applies to the partnership scheme between companies and smallholders in Hippo Valley, Zimbabwe. The adequacy of inputs affects the capacity of farmers to achieve quality criteria, which are often targeted by plantations, and ultimately determines the net income of farmers (Mazwi, 2020). Even though it does not provide significant additional profits, the partnership scheme can make it easier for farmers to carry out their farming activities and guarantee market certainty.

The farmer institutional development program can increase sugarcane production because strong institutions, in the sense that there are active groups, can attract agencies to assist, companies to partner with, and NGOs to empower farming communities (Nisar et al., 2021). However, what needs to be considered is building and maintaining groups based on social capital and organizational skills. For small-scale farmers, farmer groups are valuable forums for interaction, learning, and solving problems. However, if a group structure based solely on kinship transcends ability and appropriateness, this can undermine group unity and jeopardize farm management, as found in farmers' associations in Swaziland (Mhlanga-Ndlovu and Nhamo, 2017). This is supported by Diarto (2022), which states that to get credit assistance, farmers must create an active group. In addition, strong institutions can also open access to various institutions, provide strong selling power, and improve farmers' welfare (Yuniati et al., 2017; Puspita, 2020).

Furthermore, at levels five and six, there are programs for effectiveness of inter-agency coordination and extensification of plantation land. The many parties involved in developing sugarcane plantations can cause coordination problems. One possibility is that the assistance programs are not synchronized and even overlap, resulting in inefficient aid distribution. Therefore, coordination between institutions can boost production by maximizing the effectiveness of programs, such as counseling and input assistance, from each institution to increase sugarcane production. Furthermore, the land

extension program will undoubtedly increase output, provided the number of workers is fulfilled (Sawaengsak and Gheewala, 2017). This program requires good execution of programs at the top level, especially the fulfillment of plantation human resources. Companies and plasma smallholders cannot expand their planting areas if continue to struggle with land management. The same lesson can be learned from Brazil, productivity gains are based on extending licenses, but these rights are not sustainable in the long term. The sugarcane industry should invest in more modern manufacturing equipment, increase land productivity, and strengthen inter-agency collaboration because the potential benefits of relying solely on land expansion are small and unsustainable (Gonçalves et al., 2021).

At the last three levels (7 to 9), there is one program each, namely forming a special team for research and development of sugarcane, socialization and pilot project of sugarcane plantation, and comparative study to more advanced sugarcane plantations. One of the obstacles that the farmers face through the results of interviews is the lack of information regarding applying the right combination of fertilizers to sugarcane fields in Southeast Sulawesi. The logical consequence is that a particular team is needed to examine soil conditions and the combination of production inputs to optimize plantation production. Relevant research was done by Diana et al. (2016) and Putri et al. (2020), comparing fertilizer combinations to find the ideal formula to support increased production. Furthermore, for the past two decades, Philippine institutions (government, universities, and private institutions) have been working on initiatives to improve sugarcane genetics (Luzaran et al., 2022). This emphasizes the significance of forming a research team/institution comprised of sugarcane experts from agricultural research institutes and universities to produce the best varieties and analyze the most optimal combination of production factors to produce the best varieties and analyze the most optimal combination of production factors to increase sugarcane production.

Socialization and pilot projects occupy the eighth level and are in the dependent quadrant, indicating that this program supports or complements the programs above it. The socialization was already carried out before the sugar factory started operating. More efforts, however, are required for this socialization to produce results in the form of new workers in sugarcane plantations. The pilot project is required in order to convince farmers/ communities, who will only join after seeing promising results, to participate as partners or become part of the company's sugarcane plantations. With the implementation of these two programs, it will support programs to increase farmer interest and programs to improve plantation human resources. Sugarcane farming in Colombia can be an example in preparing for this pilot project. Researchers seek to understand and develop models for important factors such as weather uncertainties, equipment capacities, and planning of sowing and harvesting operations to maximize agricultural productivity while accounting for uncertainties. Continuous application and evaluation on demonstration land can ensure abundant and sustainable sugarcane yields (Carvajal et al., 2019).

The last program is benchmarking to advanced sugarcane plantations. Learning from other farmers' farming experiences enriches their knowledge and ability to handle specific cultivation cases. By benchmarking with sugarcane plantations, farmers can learn how to cultivate better than before (Imran et al., 2019). If the experience and practical knowledge gained can be appropriately applied in Southeast Sulawesi, farmers can increase the level of productivity of their land.

The following policy recommendations for institutional development to increase sugarcane production in Southeast Sulawesi of Indonesia are based on the findings of research and comparative studies of sugarcane cultivation in other countries. In the area of sugarcane plantations, policies are required to ensure the hiring of the qualified extension agent. Moreover, researchers and NGOs should focus on R&D while also being committed to empowering sugarcane institutions. The government, through the plantation agency, can offer initial assistance to farmers as an incentive for them to try sugarcane cultivation in circumstances where all farmers are now unable to join the partnership scheme since the bank prioritizes funding for pilot groups. Finally, to comprehend each stakeholder's function and the strategic programs implemented in the field, it is essential to involve all stakeholders in conducting strategic programs, with the key actors as the main-driving institutions.

CONCLUSIONS

This research provides a model of institutions and strategic programs for increasing sugarcane production in Southeast Sulawesi, Indonesia. Five institutions are regarded as key actors in increasing sugarcane production, including banking institutions; universities; agricultural, plantation, and fisheries offices; industry, trade, cooperatives and SMEs offices; and private companies. Four key programs are also considered crucial in enhancing sugarcane production. They are accuracy of time and adequacy of sugarcane supply to the mills, variation of profit-sharing and buying system of sugarcane, addition of plantation human resources, and extension/assisting farmers. Thus, we recommend involving all stakeholders in conducting strategic programs with the key actors as the leading driving institutions. This study also compared sugarcane farming in many countries, which can be considered to adopt (harvesting schedule, transportation system, and R&D). Future studies are needed to construct an effective institutional coordination model in a complex system. In addition, there is potential for research in the implementation of partnership models that can support farmers' welfare and sustainable agriculture.

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