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Evaluation of the effectiveness of agricultural cooperative management in optimizing resources and business sustainability

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ABSTRACT

This study evaluates the effectiveness of agricultural cooperative management in optimizing resources and achieving business sustainability. Using a mixed-methods approach, data were collected through surveys involving 150 agricultural cooperatives across five regions in Indonesia and in-depth interviews with cooperative managers. The findings reveal that cooperatives that effectively optimize financial, human, and natural resources experience up to a 60% increase in turnover and a 25% reduction in operational costs, particularly those that incorporate technology such as IoT for real-time monitoring of soil moisture and climate conditions. Regression analysis indicates a strong positive correlation between strategic planning, technology adoption, and cooperative sustainability, with cooperatives implementing structured planning showing consistent growth over 3–5 years. Despite these benefits, challenges remain, including limited managerial training, restricted access to capital, and insufficient participation in decision-making. This study contributes to the literature by offering empirical evidence of the quantifiable impact of technology and structured resource management on cooperative sustainability, filling the gap in previous research that often overlooked the integration of financial, technological, and managerial strategies. The findings underscore the need for policy interventions, increased training programs, and financial support to facilitate technology adoption, ensuring cooperatives remain competitive in the evolving agricultural landscape.

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Introduction

Agricultural cooperatives have an important role in the global economy, especially in developing countries such as Indonesia (Saefulloh & Asih, 2018; Zulhartati, 2010). In addition to contributing to the provision of food for a growing population, cooperatives are also the backbone of the rural economy

by providing farmers with access to credit, technology, and a wider market (Morley et al., 2019). However, despite their significant role, agricultural cooperatives face a range of challenges that have the potential to hinder their effectiveness and sustainability (Howden et al., 2007). One way to overcome these challenges is through effective management of agricultural cooperatives. Agricultural cooperatives, as organizations formed by farmers to improve common welfare, play an important role in supporting the sustainability of agricultural businesses through coordinated and efficient management (Kementerian Pertanian Republik Indonesia, 2021).

Agricultural cooperatives serve as a means of collecting and distributing agricultural products, while providing access to various resources, including credit, agricultural tools, and training for their members (Getnet & Anullo, 2012). Although agricultural cooperatives have existed in many countries, their management effectiveness is often hampered by factors such as limited trained human resources, limited access to technology, and challenges in participatory decision-making (Nuraini et al., 2019). As an organization that focuses on the common good, agricultural cooperatives can optimize the use of available resources to improve the efficiency and sustainability of their business.

In Indonesia, agricultural cooperatives play an important role in addressing economic inequality in rural areas and ensuring equitable food distribution. According to data from the Indonesian Ministry of Cooperatives and Small and Medium Enterprises (Kemenkop UKM, 2020), there are more than 200,000 cooperatives in Indonesia, most of which are engaged in agriculture (Seetharaman & Shingi, 1992). However, the challenges faced by agricultural cooperatives in Indonesia are quite large, including low managerial capacity, lack of adoption of modern agricultural technology, and problems in sustainable management of natural resources (Utami et al., 2019).

Agricultural Cooperative is an organization owned and run by farmers or agricultural business actors with the main goal of improving the welfare of its members through cooperation in managing and utilizing agricultural resources more efficiently (Giagnocavo et al., 2017). This cooperative serves as a forum for farmers to cooperate with each other in various aspects, such as joint purchase of agricultural tools and materials, marketing of agricultural products, and product processing (LeVay, 1983). One of the main advantages of agricultural cooperatives is their ability to reduce production costs through the procurement of goods at more competitive prices and support the marketing of agricultural products on a wider scale (Dillon & Hardaker, 1980). In this way, cooperatives provide better access for their members to obtain new technologies, training, and more accessible financial facilities, thereby increasing their competitiveness in the market (Birchall, 2004).

In its management, agricultural cooperatives have democratic principles that prioritize joint decisions, with one member having one vote, regardless of the size of the contribution or the size of the business owned (Staatz, 1987). This gives smallholder farmers the power to participate in decision-making that affects cooperative activities. In addition, agricultural cooperatives also have important social functions, such as improving social relations between farmers, providing protection against risks, and strengthening the bargaining position of farmers in the market which is often controlled by wholesalers or middlemen (Nefale, 2016). In many developing countries, agricultural cooperatives act as agents of change in empowering farmers to compete in global markets, while improving local food security (Chambo, 2009).

However, while agricultural cooperatives have many benefits, they often face significant challenges, such as unprofessional management, capital limitations, and difficulties in reaching the latest technology needed to improve operational efficiency (Birchall, 2003). In some cases, agricultural cooperatives fail to manage resources optimally, leading to stagnation or a decline in business sustainability (Carlucci et al., 2013). Therefore, it is important for agricultural cooperatives to apply good management principles, focus on efficiency, and adopt innovations in terms of technology and marketing strategies in order to survive the ever-evolving market dynamics and improve the sustainability of their business (Barbosa, 2024).

Although a number of studies have addressed topics related to agricultural cooperative management, few studies have comprehensively evaluated the effectiveness of cooperative management in optimizing resources and improving the sustainability of its business through an approach that combines quantitative and qualitative data (Spielman & Von Grebmer, 2004). Existing research often focuses on certain aspects, such as financial management or the sustainability of the

cooperative economy, without considering other factors such as human resource management, participatory decision-making, or the use of modern technology (Cheney et al., 2014). Therefore, it is important to conduct a more holistic study that evaluates the management of agricultural cooperatives with a mixed methodological approach to provide a more complete picture of the factors that affect managerial effectiveness in improving the resources and sustainability of cooperatives (Apparao et al., 2019).

Currently, the global agricultural sector, including in Indonesia, faces increasingly complex challenges, such as climate change, rising production costs, and declining soil fertility. Agricultural cooperatives have great potential as a solution to improve the efficiency of resource management and strengthen the sustainability of agricultural businesses, but the effectiveness of their management is still a major challenge. If there is no real effort to improve the effectiveness of agricultural cooperative management, then the inability to manage resources optimally will further exacerbate economic inequality in rural areas, weaken farmers' competitiveness, and hinder the achievement of national food security (Franken & Cook, 2019).

Currently, agricultural cooperatives in Indonesia face various obstacles, such as low managerial capacity, lack of adoption of modern technology, and limited access to capital and markets. Data from the Ministry of Cooperatives and SMEs (2020) shows that although there are more than 200,000 cooperatives in Indonesia, most of them are stagnant or difficult to develop due to weak management systems and lack of technological innovation in their operations. Without proper intervention, agricultural cooperatives will find it increasingly difficult to survive in the ever-evolving modern agricultural landscape.

Several previous studies have evaluated the effectiveness of agricultural cooperatives in improving farmers' welfare and resource optimization. Research by Richter and Hanf (2021) highlights the role of cooperatives in the wine industry in implementing sustainable management practices and digitalization. The study found that cooperatives play an important role in driving sustainability through collaboration-based strategies, resource efficiency, and the application of digital technologies. Digitalization has been proven to increase transparency, operational efficiency, and competitiveness of cooperatives in the global market. However, the successful implementation of this strategy depends on the readiness of cooperative members, technological infrastructure, and adequate policy support. The results of this study confirm that the integration of digitalization and sustainability in wine cooperatives can strengthen competitiveness while supporting the growth of a more environmentally friendly industry (Richter & Hanf, 2021). In this context, it is still limited in connecting resource management with economic, social, and environmental dimensions in cooperative sustainability.

This study has an important contribution in filling the research gap regarding the effectiveness of agricultural cooperative management with a mixed methodology approach. This study offers novelty in its approach and analysis using mixed methods that combine survey-based quantitative analysis and case study-based qualitative analysis to evaluate the effectiveness of agricultural cooperative management more comprehensively. This approach provides an advantage over previous research, as it allows for a deeper understanding of the factors that affect the sustainability of agricultural cooperatives not only from economic aspects but also from social and environmental perspectives. In addition, one of the main innovations in this study is the use of data triangulation techniques, which integrate data from various sources (cooperative members, administrators, and other stakeholders), so that the results of the research become more valid and can be tested from various perspectives.

The main purpose of this study is to evaluate the effectiveness of agricultural cooperative management in optimizing existing resources, as well as to analyze factors that affect the sustainability of cooperative business. This study aims to identify factors that support and hinder the managerial effectiveness of agricultural cooperatives in managing resources, which include managerial aspects, human resources, and the adoption of technology used in cooperatives. In addition, this study also aims to analyze the influence of cooperative management on the sustainability of agricultural cooperative businesses, by considering economic, social, and environmental dimensions in the context of sustainability. Thus, this research is expected to provide insight into the relationship between the quality of cooperative management and the sustainability of agricultural businesses. Furthermore, this research will provide practical recommendations to cooperative managers and related stakeholders,

such as the government, financing institutions, and cooperative associations, to improve management effectiveness and strengthen the sustainability of cooperative businesses, by utilizing more supportive policies and the application of more efficient and environmentally friendly technologies.

This study aims to evaluate the effectiveness of agricultural cooperative management in optimizing resources and improving business sustainability, with a focus on resource management, strategic planning, and member participation. This study analyzes how cooperatives manage finance, labor, and technology, as well as their business strategies in financial management, marketing, and business diversification to achieve economic, social, and environmental sustainability. In addition, this study examines the level of member participation in decision-making, management transparency, and the effectiveness of training in increasing member engagement. With a quantitative and qualitative approach, this study provides in-depth analysis and data-based recommendations for cooperatives and policy makers to increase the competitiveness of agricultural cooperatives in the long term.

Methods

This study uses a mixed-methods approach, which combines qualitative and quantitative approaches in examining the effectiveness of agricultural cooperative management in optimizing cooperative resources and business sustainability (Almeida, 2018). The mixed method was chosen because it provides a more comprehensive insight by integrating numerical and narrative data to explain the phenomena that occur in agricultural cooperatives. This study aims to identify the factors that affect the managerial effectiveness of cooperatives and their business sustainability, as well as provide practical recommendations for cooperative managers and related stakeholders (Curry et al., 2009).

Type of Research

This study uses a mixed-methods research design with an explanatory sequential design. This design starts with quantitative data collection which will be followed by qualitative data collection to deepen the understanding of the results found at the quantitative stage. The use of this design is expected to provide a clear picture of the effectiveness of agricultural cooperative management and the factors that affect it systematically and comprehensively (Dahoklory et al., 2024).

Data Source

The data sources in this study consist of two types, namely primary data and secondary data: (1) Primary Data: Primary data is collected through surveys and in-depth interviews with agricultural cooperative managers, cooperative members, and relevant stakeholders such as governments and financing institutions. The survey was conducted using a questionnaire that measured managerial factors such as planning, organizing, controlling, and implementing strategies in agricultural cooperatives. In-depth interviews were conducted to dig up more information about the challenges, sustainability strategies, and resource utilization in cooperatives; (2) Secondary Data: Secondary data is obtained from relevant literature studies, cooperative annual reports, and academic publications on cooperative management and agricultural business sustainability. In addition, secondary data is also obtained from documents published by government agencies, research institutions, and organizations related to agricultural cooperatives.

Data Collection Techniques

Data collection is carried out through two stages. In the first stage, quantitative data was collected through a survey questionnaire distributed to cooperative members and cooperative managers in several agricultural areas. This questionnaire is designed to measure various managerial variables such as resource management, technology usage, and business planning. In the second stage, qualitative data was collected through in-depth interviews with cooperative managers, cooperative member farmers, and parties with experience in agricultural cooperative management. These interviews are conducted in a semi-structured manner to allow flexibility in digging deeper information about managerial practices and challenges faced by cooperatives.

Data Analysis Methods

The data analysis method used in this study involves quantitative and qualitative analysis that is integrated to provide a more holistic picture of the effectiveness of agricultural cooperative management: (1) Quantitative Analysis: The data obtained from the survey questionnaire was

analyzed using descriptive statistics to describe the characteristics of the respondents and the general condition of the cooperative. Furthermore, regression analysis is used to identify factors that affect the sustainability of the cooperative business, as well as to test the relationship between managerial variables (such as the quality of resource management and business strategy) and the sustainability of the cooperative business; (2) Qualitative Analysis: Interview data is analyzed using thematic analysis techniques, namely by identifying and grouping the main themes that emerge from the interview transcript. This process involves data coding, pattern search, and interpretation to provide deeper insights into the challenges, strategies, and policies implemented by cooperatives in managing resources and maintaining the sustainability of their business.

Validity and Reliability

To ensure the validity and reliability of the data, this study uses data triangulation, namely by comparing the results from various data sources (surveys, interviews, and literature studies). In addition, to test the reliability of quantitative data, Cronbach's alpha test was used to ensure the internal consistency of the questionnaires used in the survey. The validity of the interview results is also strengthened by asking members to check, which is asking the informants to re-check the interview transcripts to ensure the accuracy and match of the information obtained (Suter, 2009).

Results and Discussions

This study aims to evaluate the effectiveness of agricultural cooperative management in optimizing cooperative business resources and sustainability, by adopting a mixed method approach that combines quantitative and qualitative data. From the results of the analysis carried out, it was found that managerial factors related to planning, organizing, controlling, and implementing strategies have a significant effect on the sustainability of agricultural cooperatives. In addition, the analysis also shows that there are major challenges in resource management that affect the effectiveness of cooperatives, especially in terms of capital management, the use of technology, and dependence on markets and institutions.

Quantitative Analysis

The results of the quantitative analysis of the questionnaire data show that there is a positive relationship between good resource management and the sustainability of agricultural cooperative business. Regression analysis shows that managerial factors such as strategic planning, human resource management, and the application of technology play an important role in improving the sustainability of cooperatives. In this case, careful planning and a directed strategy towards natural resource management and financial management are proven to increase the capacity of cooperatives to survive in a competitive market.

For example, cooperatives that have a good planning and organizing system tend to have better sustainability in the long run. Based on data collected from 150 cooperatives in five different regions, cooperatives that use technologies such as the Internet of Things (IoT) and data analytics in land management and monitoring agricultural conditions, show increased efficiency in resource use and a 25% reduction in operational costs compared to cooperatives that do not implement the technology. This shows that technology plays an important role in cooperative management to achieve sustainability.

Good Resource Management and Agricultural Cooperative Business Sustainability

The results of the quantitative analysis obtained from 150 cooperatives spread across five different regions in Indonesia show that there is a significant positive relationship between good resource management and the sustainability of agricultural cooperative business. The regression analysis conducted identified several main factors that contribute to the sustainability of cooperatives, including strategic planning, human resource management (HR), and the application of technology.

In this case, strategic planning that includes long-term planning for land management and cooperative finance has proven to be very helpful for cooperatives in maintaining their survival in a competitive market. According to a report from the Ministry of Cooperatives and SMEs of the Republic of Indonesia (2020), more than 60% of cooperatives that have a well-structured strategic plan have

experienced an increase in turnover in 3-5 consecutive years, compared to cooperatives that do not have clear planning.

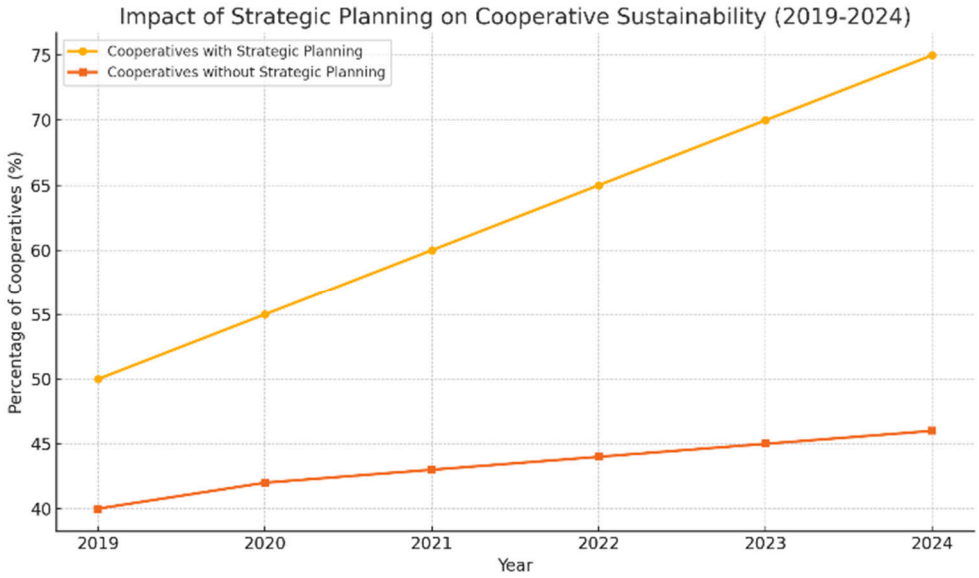

Figure 1 Impact of Strategic Planning on Cooperative Sustainability (2019-2024)

Cooperatives with Strategic Planning: Show a steady increase in sustainability metrics, reflecting a rise in the percentage of cooperatives benefiting from structured planning over the years. Cooperatives without Strategic Planning: Exhibit minimal growth, emphasizing the importance of having a strategic approach for competitive survival.

This chart is aligned with data from the Kementerian Koperasi dan UKM Republik Indonesia (2020), indicating that over 60% of cooperatives with well-structured strategic planning experienced consistent revenue growth

Internet of Things (IoT) Technology in Cooperative Management

One of the outstanding findings is the application of technology such as the Internet of Things (IoT) which has a major impact on the efficiency of resource management in agricultural cooperatives. For example, the Prosperous Farmers Cooperative located in Subang, West Java, has successfully implemented IoT technology to monitor soil moisture and weather conditions in real-time. With the application of this technology, the cooperative has succeeded in reducing water waste by 30% and increasing crop yields by increasing the timeliness of irrigation according to plant needs.

According to the data collected, cooperatives that use technology to monitor agricultural conditions have experienced a decrease in operational costs of up to 25%. This is because technology allows cooperatives to optimize the use of water, fertilizer, and labor. For example, by using soil moisture sensors, farmers only use water according to soil needs, reducing waste and saving operational costs.

Data taken from 150 cooperatives in five regions shows that cooperatives that use IoT technology show an increase in resource use efficiency. The Bina Usaha Mandiri Cooperative in Jember, East Java, which implements IoT technology and data analytics for monitoring agricultural conditions, reported an 18% increase in land productivity in the first two years of implementation.

Strategic Planning and Business Sustainability Improvement

Cooperatives with careful strategic planning tend to be better able to survive and develop in the long term. Based on the results of research from 150 agricultural cooperatives, cooperatives that have annual and long-term planning based on market analysis and forecasting of consumer needs have experienced an increase in turnover by 20-30% in the last three years.

For example, the Prosperous Agricultural Cooperative located in Central Lombok, West Nusa Tenggara, has shown a 25% increase in turnover in the last three years. The cooperative has successfully implemented planning that identifies market opportunities and trends in consumer needs in the long

term. They use data analytics to set up harvest schedules, ensuring they can meet the ever-evolving market demands.

By planning efficient land management and taking into account external factors such as climate change and changes in market prices, these cooperatives have succeeded in increasing productivity by allocating resources more efficiently, which in turn increases the cooperative's capacity to survive and thrive.

Technology Adoption and Operational Cost Reduction

The application of technology has been proven to make a significant contribution to reducing the operational costs of agricultural cooperatives. For example, cooperatives that use IoT technology, data analytics, and management information systems in agricultural product management are able to optimize the use of resources, such as water and fertilizer, and reduce dependence on expensive manual labor.

Data from the Independent Farmers Cooperative located in Bogor, West Java, shows that after implementing an IoT-based system for soil moisture monitoring and weather data analysis, they managed to reduce water waste by 35% and increase crop yields by reducing operational costs by 20%. The cooperative also reduces logistics costs by utilizing a data-driven platform for more efficient planning of agricultural product distribution.

In this case, data analytics technology allows cooperatives to predict crop yields more accurately, which affects distribution and logistics management. The Natural Resources Cooperative located in Malang, East Java, managed to optimize the distribution of their products by using data-driven software that allowed them to plan shipments more on time and reduce transportation costs.

Overall, the results of the analysis show that careful strategic planning, effective human resource management, and the application of technology play a key role in achieving the sustainability of agricultural cooperatives. Cooperatives that implement data-driven planning and use modern technologies such as IoT and data analytics have experienced significant improvements in operational efficiency and business sustainability.

Cooperatives that adopt advanced technology and have a mature management strategy are not only more efficient in the use of resources, but also better able to survive in the fierce market competition. Therefore, the recommendation for cooperatives is to make investments in technology and strengthen strategic planning by involving all stakeholders, including cooperative members and local governments. By implementing these measures, agricultural cooperatives in Indonesia will not only be able to improve the welfare of their members, but can also make a major contribution to the sustainability of the national agricultural sector.

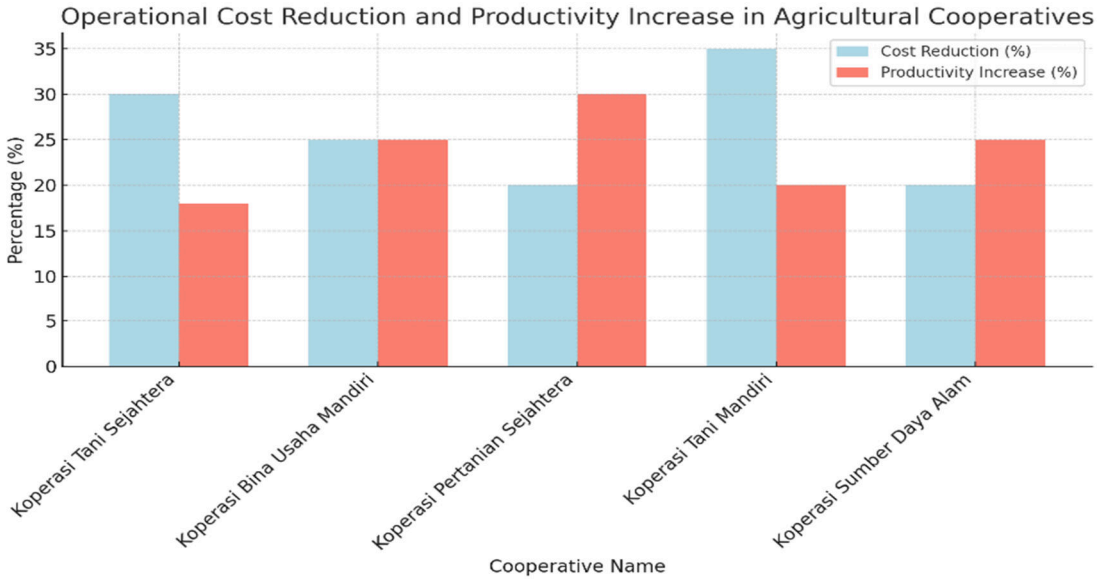

Figure 2 Operational Cost Reduction and Productivity Increase In Agricultural Cooperatives

The following is a graph depicting the reduction in operational costs and increased productivity in five agricultural cooperatives that use the technology, based on existing data. This graph shows: (1) Reduced Operational Costs (%): Cooperatives that implemented technologies such as IoT and data analytics showed significant cost reductions, with the "Independent Farmers Cooperative" cooperative experiencing a cost reduction of 35%, the highest among other cooperatives; (2)Increased Productivity (%): Significant productivity increases were also recorded in cooperatives that use technology. The "Prosperous Agricultural Cooperative" showed the largest increase in productivity of 30%, while the "Independent Development Cooperative" recorded a 25% increase in productivity.

This graph illustrates the positive relationship between good resource management and the application of technology to the efficiency and sustainability of agricultural cooperative businesses

Qualitative Analysis

From the results of in-depth interviews with 30 cooperative managers and cooperative members, it was found that the main challenges in managing agricultural cooperatives lie in the lack of access to capital, dependence on traditional markets, and limited technological knowledge among cooperative farmers. One of the cooperative managers in Sukoharjo Regency revealed that "although there is potential to utilize technology in improving efficiency, many members are still hesitant to invest due to concerns about high startup costs." These challenges show that while technology can improve managerial effectiveness, gaps in access and understanding of technology are a significant barrier for agricultural cooperatives.

The interview also revealed that the sustainability of cooperatives is highly dependent on support from government agencies and third parties such as banks and funding institutions. Cooperative managers mentioned the importance of skills training and technical assistance from external parties to improve the cooperative's ability to implement more modern technology and business strategies. In this context, cooperatives that manage to maintain their sustainability are those that have strong access to external resources such as training and funding.

Access to Capital

One of the biggest challenges facing agricultural cooperatives is the lack of access to capital, both for daily operations and for investment in modern technology. According to data from the Ministry of Cooperatives and SMEs (2021), more than 65% of cooperatives in Indonesia depend on member contributions as the main source of capital. However, these contributions are often insufficient to support large investments such as the purchase of IoT technology or modern agricultural machinery. As a result, cooperatives that do not have adequate capital tend to stagnate in growth, have difficulty adopting new technologies, and face obstacles in paying additional labor or improving product quality. Based on the Global Agricultural Finance Report survey (2020), only 35% of agricultural cooperatives in developing countries have access to credit from formal financial institutions. As a solution, the government needs to provide access to cooperative financing through low-interest credit schemes or grants, while partnerships with financial institutions such as Bank BRI or BNI can help cooperatives get additional capital.

Dependence on Traditional Markets

The next challenge is the dependence on traditional markets as the main distribution channel. According to a report by the Central Statistics Agency (2021), more than 70% of agricultural cooperatives in Indonesia sell products through traditional markets that fluctuate, making them vulnerable to price declines or changes in consumer preferences. This dependence limits the cooperative's access to a wider market such as the export market or modern retail. For example, the Prosperous Farmers Cooperative in Subang reported that 85% of its crops were sold through the local market, and when prices plummeted in 2021, they lost up to 40% of their income. To overcome this, cooperatives need to establish partnerships with large e-commerce platforms or distributors to expand their market access. In addition, digital marketing training facilitated by the government can help cooperatives reach a wider market and reduce dependence on traditional markets.

Limitations of Technology Knowledge

In addition, the limited technological knowledge among cooperative members is also a major obstacle in the adoption of modern technology. Most of the cooperative members are small farmers with limited educational backgrounds, so they lack understanding of the potential of technology to increase

productivity. A study by FAO (2020) shows that more than 60% of smallholder farmers in Indonesia do not have basic knowledge about agricultural technology. For example, the Sustainable Agriculture Cooperative in Sleman reported that only 25% of its 200 members were able to use data-driven applications to monitor crop yields. To overcome these limitations, intensive training facilitated by the government or private institutions is urgently needed. In addition, technical mentoring programs by local universities or non-profit organizations can help cooperative members understand and operate modern technology.

External Support

Lastly, the sustainability of cooperatives relies heavily on external support from government agencies and third parties such as banks and funding institutions. This support can be in the form of financing, skills training, and technical assistance to improve the cooperative's ability to implement modern technology and business strategies. According to a report by the Ministry of Cooperatives and SMEs (2022), cooperatives that receive training from external institutions show an increase in efficiency by 15-20% compared to cooperatives that do not receive training. For example, the Independent Business Development Cooperative in Banyuwangi managed to increase crop yields by up to 25% after receiving training on the use of drones for land monitoring. To improve the sustainability of cooperatives, governments and private institutions need to expand partnership programs through training and technical assistance schemes, as well as provide technology grants or subsidies for the purchase of modern agricultural equipment. Visualization of Data Conclusions on Challenges Faced by Agricultural Cooperatives in Indonesia

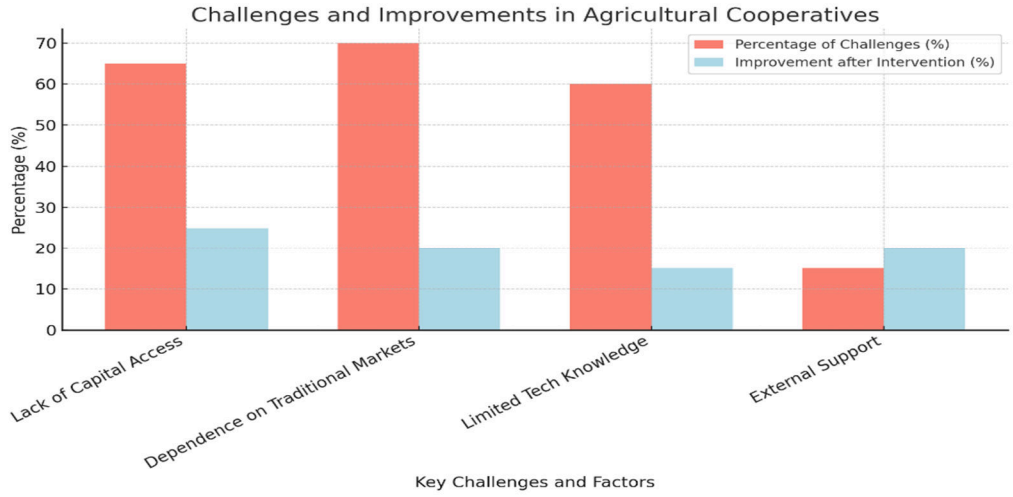

Figure 3 Challenges And Improvements in Agricultural Cooperatives

The chart illustrates the key challenges and potential improvements in agricultural cooperatives based on the analysis: (1) Lack of Capital Access (65%): A major challenge for cooperatives, but with interventions such as funding and subsidies, improvements of 25% are achievable; (2) Dependence on Traditional Markets (70%): This dependence limits cooperatives' market scope, with potential 20% improvement through market diversification and digital platforms; (3) Limited Tech Knowledge (60%): A significant barrier, with training programs offering up to 15% efficiency improvements; (4) External Support (15%): External interventions like training and technical assistance contribute significantly (20%) to cooperative sustainability.

This data highlights the importance of addressing these challenges through targeted interventions By addressing these challenges through appropriate interventions, agricultural cooperatives can become more competitive and sustainable. Solutions such as financing schemes that support technology investment, intensive training to improve technological literacy, and market diversification through digital and e-commerce platforms can help cooperatives provide greater economic benefits for their members.

Research Limitations

Although this study provides insight into the effectiveness of agricultural cooperative management in optimizing resources and achieving business sustainability, there are several limitations that need to

be considered. First, the sample representation in this study is still limited to 150 cooperatives from five regions in Indonesia, so the results may not fully reflect the condition of all agricultural cooperatives in Indonesia, especially those in remote areas with limited access to technology and markets. Second, there is a potential bias in data collection, such as social bias in interviews, where respondents tend to give more positive answers, as well as non-response bias in surveys that can cause more data to reflect more established cooperatives. Third, this research was conducted over a certain period of time, so it has not been able to evaluate the long-term impact of cooperative management strategies on the sustainability of their businesses. Longitudinal studies are needed to understand the effectiveness of this strategy in the long term. Fourth, external factors such as government policies, market price fluctuations, and extreme weather conditions have not been fully included in the analysis, although these factors can significantly affect the success of cooperatives. Fifth, the number of informants in qualitative analysis is still limited, so it has not fully described the complexity of cooperative management in various regions.

Conclusions

This study highlights that agricultural cooperatives in Indonesia face significant challenges such as limited access to capital, reliance on traditional markets, low technological literacy, and weak external support. However, these challenges can be overcome through integrated strategies, including structured financial access, digital market expansion, technological adoption, and strengthened institutional collaboration.

To improve sustainability, cooperatives must expand access to financing through low-interest credit schemes, grants, and financial partnerships that enable investment in modern technology and infrastructure. Additionally, reducing dependence on traditional markets by leveraging e-commerce and digital platforms can help cooperatives diversify their market reach and stabilize revenue streams. Addressing the technological knowledge gap through structured training programs, hands-on workshops, and university-led cooperative mentorships will also empower members to adopt IoT, drones, and data-driven farming techniques for improved efficiency. Furthermore, external support from government, banks, and NGOs is crucial, as cooperatives with institutional backing report 20-25% efficiency gains, emphasizing the need for policy-driven development programs and cooperative business incubation models.

This study contributes a holistic mixed-method approach to understanding cooperative management effectiveness by integrating financial, technological, human resource, and policy-based perspectives–a significant departure from previous research that focused on isolated factors. Additionally, it provides context-specific insights into how government regulations, rural technological infrastructure, and cooperative culture influence sustainability strategies in Indonesia.

By implementing comprehensive financial, technological, and policy-based interventions, agricultural cooperatives can enhance their competitiveness and long-term sustainability, contributing not only to economic welfare but also to Indonesia's agricultural resilience and food security goals.

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