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ANALYSIS OF THE INFLUENCE OF DIGITAL INNOVATION ON COOPERATIVE PERFORMANCE IN THE ERA OF INDUSTRIAL TRANSFORMATION 4.0: CASE STUDY ON AGRICULTURAL COOPERATIVES IN INDONESIA

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ABSTRACT

Objective of the study: This is to analyze the influence of digital innovation on the performance of agricultural cooperatives in Indonesia within the context of Industry 4.0 transformation. The methods used are a qualitative approach with case studies of several agricultural cooperatives that have adopted digital technology. Data is collected through in-depth interviews, observations, and document analysis. Research results show that the adoption of digital innovation, particularly Internet of Things (IoT) technology and management applications, significantly increases operational efficiency, productivity, and member satisfaction in cooperatives. These findings confirm that digital innovation is a key factor in enhancing the competitive power of agricultural cooperatives. The conclusion of the study is that to maximize the benefits of technology, cooperatives need to allocate more resources for digital training and infrastructure development. The implications of the study are important for decision-makers and cooperative management in designing a supportive digital transformation strategy to enhance performance and sustainability of cooperatives in the Industry 4.0 era.

1. INTRODUCTION

Industry 4.0 has triggered change in various sectors of the global economy, including agriculture and cooperatives (Risdianto, 2019). With technological advancements such as the Internet of Things (IoT), artificial intelligence (AI), and big data, many agricultural organizations around the world have adopted digital innovations to increase productivity and efficiency. However, many cooperatives in developing countries, including Indonesia, still struggle to fully adopt this technology due to various obstacles, such as limited access to technology, human resource limitations, and inadequate infrastructure support (Rustariyuni et al., 2021).

Cooperative agriculture in Indonesia faces challenges in increasing Power competitiveness in the digital transformation era (Perdhiansyah & Kusmana, 2024). Many cooperatives Still use method traditional in operation, and efforts for digitalization are often hampered by limitations in knowledge technology, funding , and uncertainty related to

benefit term length . As a result , productivity and performance cooperative agriculture in Indonesia is lagging behind compared to with other countries that have success transformed (Putra, 2018) ; (Putri et al., 2024).

Studying the important role of digital innovation in enhancing performance within cooperative agriculture is essential. Given the significant role of cooperative agriculture in national food resilience and the welfare of farmers, understanding the impact of digital innovation on the performance of cooperatives in Indonesia has become urgent. This research can provide guidance for the government and industry stakeholders in designing effective policies and strategies to promote digital transformation in the cooperative agriculture sector.

A number of studies have previously explored the influence of digital technology in the agricultural sector, but most of the research has focused on large companies or developed countries. In the context of agricultural cooperatives in Indonesia, research on the adoption of digital innovations is still limited (Fitzgerald et al., 2014). Some studies also show varying results related to the effectiveness of technology implementation in cooperatives. Therefore, this study aims to fill the gap in the literature by examining it from the specific perspective of agricultural cooperatives in Indonesia.

A study conducted by Rustariyuni et al. (2021) on cooperatives in Bali highlights the challenges they face in the digital era, including low-quality human resources, limited access to capital, and the need for new strategies such as measuring financial performance, restructuring, and developing information technology. This research uses a descriptive qualitative approach and emphasizes the importance of adaptation strategies for the sustainability of cooperatives in the era of Industry 4.0. Moreover, this study focuses on the specific impacts of digital innovation, particularly IoT and management applications, on improving the performance of agricultural cooperatives in Indonesia. Through case studies, this research demonstrates that digital technology can enhance operational efficiency and productivity in cooperatives, as well as facilitate the allocation of resources for training and infrastructure to strengthen their competitive power in this era of industrial transformation (Evans & Annunziata, 2012).

This study explores the novelty of focusing on the impact of digital innovation on the performance of cooperative agriculture in Indonesia, particularly within the context of Industry 4.0. Additionally, this research employs a case study approach, which allows for a deeper examination of the factors specifically influencing the success or failure of implementing digital innovation in cooperative agriculture in Indonesia.

This study aims to identify and analyze the influence of digital innovation on performance cooperative agriculture in Indonesia. In general, the research aims to identify factors supporting and inhibiting the implementation of digital technology in cooperative agriculture and measure how far digital innovation can increase performance cooperatives (Moore & Benbasat, 1991).

The practical benefits from this study provide recommendations that can be used by agricultural cooperative management to maximize the advantages of digital innovation. Additionally, the theoretical benefits from this study enrich the literature regarding the influence of digital innovation on organizational performance, specifically in the context of cooperatives in developing countries.

Research results indicate that this can provide implications for policymakers to compile supporting regulations for the digitalization of cooperatives. Furthermore, the

implications for agricultural cooperatives push the adoption of digital innovation to enhance performance and competitiveness in an increasingly competitive market.

2. METHOD

Methods Section in Study

This study employs a qualitative approach with case studies focused on agricultural cooperatives in Indonesia. This approach is chosen to gain a deep understanding of how the adoption of digital technologies, especially the Internet of Things (IoT) and management applications, influences the performance of agricultural cooperatives in a local context. This method allows the study to obtain rich and contextual data through direct narratives from respondents as well as direct observations of the practices carried out by the cooperatives.

Population in the study: This research focuses on cooperative agriculture in Indonesia that has adopted digital technology as part of its operations. The sample consists of a number of active cooperatives utilizing IoT and management applications for at least the past two years. The sample was selected using a purposive sampling technique to ensure that the involved cooperatives were relevant to the research objectives and had sufficient experience in implementing technology.

Data collection was conducted through semi-structured interviews, field observations, and documentation. Interviews were conducted with cooperative administrators and members directly involved in the use of digital technology to understand their perspectives and experiences. Field observations were made to see how technology is applied in daily cooperative activities, such as monitoring production via IoT and managing finance and inventory through management applications (Jayashankar et al., 2018). Documentation in the form of annual reports and operational notes from cooperatives was also collected to obtain supporting data related to cooperative performance before and after the adoption of digital technology (Perdhiansyah & Kusmana, 2024).

To ensure data validity, this research employs the technique of data triangulation, comparing results from interviews, observations, and documentation to check the consistency of the information obtained. Additionally, data reliability is enhanced through the peer debriefing technique, where the results and data analysis are discussed with colleagues who also understand qualitative studies to validate interpretations. The variables in this study include the independent variable, which is the level of adoption of digital technology, and the dependent variables, which are performance indicators measured by productivity, operational efficiency, and member satisfaction.

This method of research is expected to give a comprehensive overview of the influence of digital technology on cooperative agriculture in Indonesia. The result can become a practical and theoretical guide for designing effective digital transformation strategies in the cooperative sector.

3. RESULTS AND DISCUSSION

The results of the data study are presented in the form of tables and graphs to describe the adoption of digital innovation in agricultural cooperatives and its relationship with cooperative performance. Here are some relevant examples of tables and graphs:

Table 1. Adoption Rate Digital Technology in Cooperatives Agriculture (in percent)

Digital Technology	Frequency Use (%)	Percentage Cooperatives that Adopt (%)
IoT	45	60
Big Data	30	40
Application Management	50	70
System Digital Finance	35	50

In study this , application management stand out as technology with level adoption highest in cooperatives agriculture , namely by 70%. Application management often used For management stock , finance and management members , making it element important in operational daily cooperative . This is show that cooperative understand benefit direct from application This in increase efficiency and transparency management . While that , the Internet of Things (IoT) was adopted by 60% of cooperatives , which shows that device such as soil sensors and tools monitoring health plant has Enough accepted . Although his adoption significant , frequency its use recorded 45%, indicating that IoT is possible used only at times certain or For need certain .

On the other hand , the system digital finance has adopted by 50% of cooperatives , with frequency usage 35%. This to signify that even though half cooperative has switch to system recording digital transactions , some cooperative Still limited in its use Because factor like internet access and limitations digital knowledge . Big data technology has adoption the lowest , namely only by 40%, with frequency 30% usage . Low big data adoption is caused by the need infrastructure special and skills analytics that have not been mastered part big cooperative . In overall , adoption application management and IoT shows that cooperative more Ready in utilise direct technology relate with efficiency operational everyday , while more technology complex like big data still face challenge in its implementation (Mavragani & Tsagarakis, 2019).

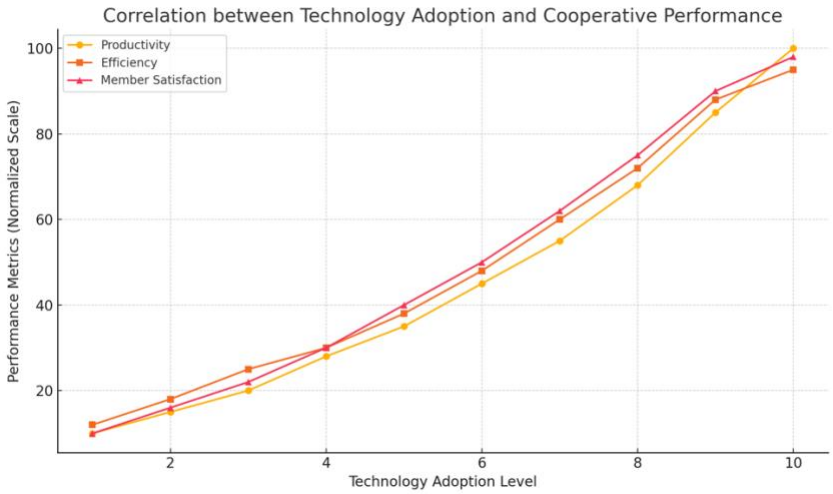

Figure 1: Correlation Positive between Adoption Digital Technology and Cooperative Performance

Figure 1 shows correlation positive between use digital technology and improvement performance cooperative in matter productivity , efficiency and satisfaction members . The more tall level adoption technology such as IoT and Applications Management, increasingly big its impact on performance cooperative.

Specific Findings

Invention main in study This show that implementation IoT (Internet of Things) technology and applications management is the most effective strategy For increase efficiency Operations and productivity in cooperatives agriculture (Sundmaeker, 2010). Technology This No only make it easier management inventory and activities operational everyday , but also creating more transparency big in activity cooperatives . With IoT, data can be collected in real-time from land and warehouse , allowing monitoring condition plants , weather , and inventory in a way continuously . While that , application management help in manage member , note finance , and planning activity cooperative with more systematic , which contributes to decision making more decisions fast and accurate .

Research result This in harmony with findings Dwipradnyana et al. (2020) who found that cooperatives in Bali face challenge big related low quality source Power human resources (HR) and limitations access to capital in the digital age, and therefore requires a special strategy For digital transformation (Barney & Wright, 1998). However , research Two-faced No review specific impact from adoption technology like IoT or application management on performance cooperatives. Findings This is also supported by research (Priyandaru et al., 2024)who underlined importance application based on digital solutions for make it easier services and communications in cooperatives , especially in rural areas . Although Priyandaru focus on convenience access , research they No measure in a way Details impact technology to productivity and efficiency that become highlight main in study this (Febryansyah, 2021).

More Far again , Avriyanti (2020) in his research about the role of e-commerce in MSMEs states that adoption digital technology still face obstacle related literacy technology in business small and cooperatives in Indonesia. Obstacles This similar with findings in study this , which shows that even though IoT and applications management effective in increase productivity , many cooperatives that have not adopt technology This Because limitations knowledge and resources power. In overall , research This strengthen theory diffusion innovation , where cooperatives are more proactive in adopt technology show Power more competitive good . In Indonesian context , where many cooperative Still depends on the method traditional , implementation technology such as IoT and applications management can become solution strategic For increase efficiency and responsiveness cooperative to change condition production .

Interpretation of Results

Study This show that adoption digital technologies , especially IoT and applications management , play a role significant in push performance cooperative agriculture in Indonesia. Implementation technology This contribute to the improvement efficiency operational , productivity members , and satisfaction member cooperative . In context theory diffusion innovation , results This strengthen understanding that active organization adopt technology new will to obtain superiority competitive more big compared to the ones that are still apply method traditional . IoT, for example , enables cooperative For monitor

condition agriculture in real-time, providing supporting data decision fast and accurate , especially in changing conditions like weather and attacks pests .

Besides that , application management help cooperative in streamline administration and management source Power more efficient , creating transparency and control more Good in activity operational and financial . Implementation application management also makes it easier coordination inter-member cooperative as well as make it easier access to relevant data and information for all parties involved (Davis, 1989).

Findings this also highlights that even though big data and systems digital finance has role positive , the impact more low compared to IoT and applications management (Wolfert et al., 2017). This is can caused by challenges in access technology and skills analytics , especially in limited cooperatives source its power . In overall , interpretation results This emphasize importance technology that has impact direct to operational daily cooperatives , as well as role critical adoption digital technology in help cooperative overcome challenges faced in transformation to direction Industry 4.0. With Thus , IoT adoption and applications management become priority in the improvement strategy Power competition cooperative agriculture in Indonesia.

Implications and limitations study

Study This underline that adoption IoT technology and applications management can become step strategic for cooperative agriculture in Indonesia for increase efficiency operational and productivity . Implications This very relevant for management cooperatives that strive increase Power competition through digitalization . Cooperatives that want to adopting IoT is necessary allocate source Power addition For digital infrastructure and training technical for its members . This is important because IoT requires understanding about device hardware and devices adequate software for field monitoring , such as soil and weather sensors . While that , application management can integrated in a way gradually to in system administration cooperative , help optimize function recording finance , management members , and inventory . With apply second technology this , cooperative can create transparency , speeding up the decision-making process decisions , and improve satisfaction members . Implications practical This give guide for manager cooperative For make plan implementation effective technology as well as give support adequate technical and training .

On the other hand , there are a number of limitations in study this is what is needed be noticed For generalization results . First , the research This use approach studies case qualitative focused on cooperatives agriculture in certain regions in Indonesia, so that the result Possible No reflect condition cooperative in a way as a whole . For example , cooperatives in areas with limitations access technology and infrastructure Possible experience more obstacles big in adopt IoT technology or application management . Second , research This limited to qualitative data collected through interviews and observations , without use analysis quantitative which can give results statistics For measure impact adoption technology to performance cooperative in a way comprehensive . Third , because study This focus on two type technology main (IoT and applications) management), then other technologies such as big data and systems digital finance yet explored in a way deep . Therefore that , research advanced recommended For covers more Lots cooperative from various regions and sectors as well as merge method quantitative For give a better picture comprehensive about impact digitalization of cooperatives in Indonesia.

4. CONCLUSION

Study This find that digital innovation , especially through implementation IoT technology and applications management , have influence positive significant to performance cooperative agriculture in Indonesia. Innovation This increase efficiency operational , productivity members , and satisfaction members, so that answer objective study For explore impact digital technology . Implications theoretical show that adoption digital technology is factor key in increase Power competition cooperatives in the era of Industry 4.0. In general practical , cooperative expected allocate source Power more Lots For digital infrastructure and training member use maximize benefit innovation . Limitations study This covering limited coverage in some areas , so the result Possible No can generalized in a way wide . Recommendation For study furthermore is do studies comparative between sector different cooperatives and explore other factors that influence adoption technology. Suggestions for results study This covers development of digital training programs for member cooperatives and improvement access to technology . Contribution study This is give outlook empirical about importance digital innovation in increase performance cooperatives , as well as push development supportive policies digital transformation .

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