


## Article

# The Effect of Performance on the Sustainability of Coffee Farmers' Cooperatives in the Industrial Revolution 4.0 in West Java Indonesia

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**Abstract:** This research evaluates the effect the industrial revolution era 4.0 has had on the performance and sustainability of coffee farmer cooperatives, especially in the West Java region, considering that West Java is a coffee center area that is starting to be taken into account in Indonesia and the world in general, this is evidenced by the increasing number of farmer cooperatives coffee in the West Java region. One of the most monumental effects of the industrial revolution 1.0 was the birth of the British cooperative in Rochdale, the world's first modern cooperative. The industry continues to develop, cooperatives continue to adapt and try to continue to develop in accordance with technological advances, especially now that the industrial revolution 4.0 has entered, which emphasizes information technology, especially the use of the internet. However, there has been no previous research examining the use of information technology in coffee farmer cooperatives, especially in the era of the industrial revolution 4.0, even though this information technology is very important in the development of cooperatives today. Quantitative descriptive method with SEM analysis was used to identify the effect of cooperative capability on the performance and sustainability of cooperatives in several coffee cooperatives in West Java. The study's results found that the power of the cooperative did not significantly affect the performance of the Coffee Cooperative. Still, the capability of the cooperative had a positive and significant effect on the sustainability of the Coffee Cooperative. At the same time, the performance of the cooperative had a positive and significant impact on the sustainability of the coffee cooperative. The ability of cooperatives has a positive and significant effect on sustainability mediated by the performance of the Coffee Cooperative in the Industrial Revolution 4.0 era. This study recommends increasing the capabilities of cooperatives in membership, management, and business models to become sustainable cooperatives based on information technology to achieve added value from market-driven coffee products. The results of the study show that the respondents perceive that the cooperative's performance has a positive effect on their sustainability. Improving the performance of cooperatives in terms of (1) productivity, (2) effectiveness, (3) quality, and (4) achievement can be regarded as having a direct impact on the Coffee Cooperative's long-term viability. The industrial revolution in the agricultural sector is facing demographic challenges (ageing), so intelligent technology, artificial intelligence, big data, and augmented reality are strategic choices. The application of information technology has a direct or indirect positive impact on Indonesia's agricultural sector. Cooperatives in coffee agribusiness is also increasingly needed to respond to market demand by applying Information and Communication Technology (ICT).

**Keywords:** performance; sustainability; coffee farmer; cooperative



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## 1. Introduction

In Indonesia, coffee has a significant economic contribution. It contributes to the country's export, farmers' incomes, the production of industrial raw materials, job possibilities, and regional development [1]. One of the major coffee producers in Indonesia is the West Java province. Since 1911, coffee has been a big part of the West Java Province's economy. This is because the West Java Province is known for producing coffee (such as Preanger, a variety of Arabica coffee) with a unique taste and smell. The West Java government actively encourage and take the initiative to continuously expand the potential of West Java coffee. The creation of future markets for coffee goods is open to investors. With rising productivity and an expanding marketing, West Java's native coffee growing is still being performed today. Since the Dutch colonial era, West Java coffee has had its ups and downs, but it is now growing and helping to drive the economy along with the rising demand for coffee both domestic and abroad.

The West Java Provincial Government provides support to investors as outlined in their investment objectives and potential. Java Preanger Coffee is one of West Java's mainstay products. West Java remains the most attractive province for foreign and domestic investors, this is shown by it contributing 31% of total national investment [2]. Coffee ranks fourth among the nine most produced commodities in the West Java Province. Even though West Java is not one of the top ten coffee producers in the country right now, the provincial government of West Java is always working to improve coffee production in the West Java Province by supporting farmer groups and coffee cooperatives.

The majority of coffee in West Java is produced by smallholder plantations. Bandung Regency is one of the seventeen coffee plantation centers in West Java with the largest coffee plantation area. The area of smallholder Arabica and Robusta coffee plantations in West Java are 27,741 and 18,384 hectares, respectively. Arabica coffee output reached 11,253 tons, while robusta coffee production reached 9616 tons [3]. Coffee cooperatives are important in the accommodation of coffee producers maximizing the value chain and consequent output. Coffee cooperatives can play a role in providing services to their members so that it is easy for them to obtain production inputs and living necessities at affordable prices. This coffee cooperative also offers services so that the coffee grown by its members can be sold at a fair price and fits with the whole process of making coffee, from planting the seeds to roasting the beans. Cooperatives are business entities consisting of individuals or cooperative legal entities based on their economic activity, as well as a people's economic movement founded on the principle of kinship. In order to run effectively and efficiently, cooperatives that run businesses and organizations must put the interest of their members first. This is in line with cooperative and economic principles. If a cooperative can attract members, it can compete with other organizations in terms of membership, capital, services, and customers.

Cooperatives must be able to offer unique advantages that cannot be obtained from rival businesses. In other words, particular advantages in cooperatives cannot be obtained in other groups, and individuals may only obtain them by joining cooperatives. If they become members of the cooperative and use its services, they will get these benefits. Service quality is one of the enabling aspects for the longevity of commercial institutions, including cooperatives [4]. The sustainability of the cooperative, which is influenced by the degree of satisfaction of the cooperative's members, will be impacted by cooperatives that provide good service quality to their members. The cooperative will receive positive feedback from members who have experienced the high-quality service that it has offered. It may even have an effect by informing those who are not yet members of the institution in question to become members. Information technology application to cooperatives is one of the services in question. A coffee cooperative is one of the cooperatives currently seeing significant expansion, particularly in West Java, Indonesia. This is demonstrated by the existence of several well-managed coffee cooperatives in the West Java region. In the era of the industrial revolution 4.0, the benefits of information technology are increasingly felt in many sectors, including the agricultural sector, particularly in West

Java's coffee cooperatives. The Industrial Revolution 4.0 itself is a transformation effort towards improvement by integrating the world of technology such as the Internet of Things (IoT) and industrial production lines, where all production processes run with the help of intelligent technology as the main support. As the Fourth Industrial Revolution has begun, cooperatives have started to use technology that is changing quickly. This makes sure that any information learned is up-to-date and will help cooperative members improve their production and access to markets. Europe emerged as the leader in the agricultural sector in the industrial revolution 4.0. This is due to a demographic disaster (aging), which occurs when the population of producing age is smaller than the population of non-productive age, necessitating the replacement of population power with technology. In general, the presence of the Industrial Revolution 4.0 will have an impact on three aspects of human life, namely social, macroeconomic, microeconomic, and politics. For its own social impact, Industry 4.0 will take over the role that has been played by humans and be replaced by the use of sophisticated machines, technology, and computers. If not addressed properly, Industry 4.0 could cause the number of unemployed to increase dramatically. For economic impact, Industry 4.0 will clearly change business models in various fields. There are two impacts on the industrial revolution 4.0, namely positive impacts and negative impacts.

#### Positive impacts:

- Facilitates access to all information using devices that are connected to the internet or other technologies.
- Effectiveness in the field of production replaces human labor with machine technology, in addition to reducing production costs it can actually increase results.
- Increasing national income because it produces goods in a relatively short time, with good quality.
- Increasing opportunities for skilled workers, because using machines is not enough and you still have to use human experts to move them.

#### Negative impacts:

- Vulnerable to cyber-attacks because the production process uses technological machines, it is very important to have security.
- Requires a large investment in equipment and workers, because they have to spend quite a lot of money aside from conducting training.
- Urbanization, increasing the population of people in big cities and having an impact on the environment due to pollution, waste, and other negative things.

The 2018 Inter-Census Agricultural Survey (Sutas) data also show that there are 4.50 million farmers using the internet. The internet can be used as a productive medium (so far it tends to be consumptive as an entertainment medium) in reducing price volatility due to the disparity of information supply and demand. In the era of the industrial revolution 4.0, the development of information and communication technology is very rapid, it is hoped that it can be adopted as a strategy to improve the quality of product marketing. One of the efforts is to build an e-commerce-based trading system in agriculture. During the COVID-19 pandemic, which forced farmers to be literate in technology and able to take advantage of information technology, it was proven to be able to increase farmers' income where consumers could order food via the internet or better known as e-commerce. In the meantime, the industrial revolution 4.0 in Indonesia, particularly in the agricultural sector, has not been particularly effective.

Intelligent technologies included in the Industrial Revolution 4.0 include Augmented Reality (AR), the Internet of Things (IoT), artificial intelligence (AI), big data, and 3D printing. The use of information technology will affect the Indonesian agricultural industry, both directly and indirectly. However, all industries must adapt due to rapidly developing information technology, especially the agricultural industry. The current Industrial Revolution 4.0 focuses more on physical cyber systems, or the Internet of Things, rather than just tool automation. The agricultural industry in Indonesia needs to be prepared for the fourth

industrial revolution. The advancement of smart technology is expected to improve the performance of the agricultural industry.

The availability of communication and information technologies may enhance the effectiveness and long-term viability of cooperatives and other agricultural institutions in rural areas. Ekpe et al. (2015) [5] defines organizational performance as the degree to which tasks are implemented inside an organization in an effort to meet the goals, objectives, mission, and vision of the organization and its business. The idea of organizational performance also shows how every public organization serves the community and how its performance can be assessed using current performance indicators to determine how well the organization's operations and work processes have been carried out as well as the success of its goals. It is important to be able to come up with new ideas, especially as we move into the 4.0 phase of the industrial revolution, in which technology is thought to be very good for the performance and sustainability of coffee cooperatives, helping them compete and stay in business in a time when competition is getting tougher.

## 2. Theoretical Background

Agricultural and rural institutions should deal with various aspects of rural life, such as social, economic, ecological, political, food, infrastructure, communication, poverty, and so on. Anwarudin and Dayat (2019) [6] consider agricultural and rural institutions as one of the supporting subsystems in the agribusiness system. Included in agribusiness supporting institutions are politics and government policies on agriculture, financial institutions, agricultural advisory institutions, educational and research institutions (including universities), Non-Governmental Organizations (NGOs), cooperatives, farmer groups, etc. Agricultural institutions in rural areas that are increasingly emerging are farmer cooperatives, including coffee farmer cooperatives. Cooperative is a business entity which consist of individuals or organizations. It carries out its activities based on economic principles and cooperation.

Cooperatives aim to improve the welfare of their members and create an advanced, just, and prosperous society [7]. This is aligned with the Indonesian's constitution. In developing and utilizing the resources available in the surrounding area, the cooperative is expected to have a positive impact on empowering residents who need the cooperative as a facilitator to support their activities. Business actors, particularly in remote areas, are facing several obstacles, such as the capital, marketing, and production techniques. Hence, in addition to providing capital assistance, cooperatives are also expected to advise on marketing and production strategies so that the products produced positively impact the business actors who run them.

Cooperative Sustainability is the ability of a Cooperative to maintain performance in its strategic environment through the ability to respond creatively to the dynamics of the surrounding strategic environment. Indicators of the sustainable development concept are multi-disciplinary because many development sectors must be considered. The considerations for sustainable development include the ecological, economic, socio-cultural, legal, and institutional sectors. Indicators are one way to evaluate and promote the sustainability of a production business. Indicators are also valuable variables that indicate the level of execution of dimensions. Before determining indicators, two things that must be done are understanding the concept of sustainable production and determining the conditions that must be met to achieve sustainability [8]. In general, cooperatives are said to be sustainable if they meet three criteria: (1) they are able to recover some costs or even become self-financing, (2) they provide a continuous flow of benefits, and (3) they survive over time [9].

Performance is a description of the achievement of organizational tasks to realize the goals, objectives, mission, and vision of the organization and its business. The performance of the cooperative describes the services provided to its members and the community/farmers as measured by using indicators to see the working mechanism of the organization and its business that has been carried out and to determine the achievement of the objectives obtained. Meanwhile, the ability to innovate is essential, especially the

use of ICT, which is deemed necessary to support the performance and sustainability of coffee cooperatives, so that cooperatives can compete, be stable, or survive in the era of increasing free competition.

Macharia (2019) [10] analyzed savings and loan cooperatives in Kenya. They found that cooperative performance greatly influences the income of its members. They collect data using surveys and analyze it with linear regression. This study does not consider the application of Industry 4.0 and how cooperative performance relates to sustainability.

Karyani and Kirana (2017) [11] researched coffee farmer cooperatives in Indonesia. They measured the difference in the income of cooperative members and farmers who are not members of the cooperative using linear regression. The cooperative, that is their sample, has not yet applied Industry 4.0 technology. They also did not discuss the sustainability of cooperatives.

Pedro et al. (2020) [12] examined Generation Z in cooperatives in the industrial revolution 4.0 era. Generation Z is people born in the range of 1995–2010. Generation Z has a fairly good basis for using technology compared to older people. They researched using ANOVA, this study did not emphasize farmer cooperatives and the performance and sustainability of these cooperatives.

Salgado, et al. (2021) [13] researched the potential of farmer cooperatives to convert coffee husks into biochar. This research examined the use of coffee waste in farmer cooperatives in Ecuador but does not discuss the performance and sustainability of these cooperatives.

Nguyen and Sarker (2017) [14] researched sustainable coffee supply chain management. This research has something in common, namely researching coffee, but does not discuss cooperatives and their performance and sustainability, nor does it discuss the industrial revolution 4.0

Shumetaa and D'Haese (2016) [15] examined the heterogeneous benefits and impacts of coffee cooperative membership in Southwest Ethiopia but the research did not consider the performance and sustainability of the cooperatives.

Yuliando, et al. (2015) [16] analyzed the factors of collaboration with other related agencies and the environment which play an important role for farmer cooperatives in order to improve the commercialization aspect of their products. This research was conducted at a tea farmer cooperative, but this research did not consider the industrial revolution and the sustainability of the cooperative.

Ortega (2019) [17] analyzed whether cooperatives in Rwanda are important institutions for building farmer capacity, promoting adoption of better technology and inputs, and increasing productivity. However, this research does not consider the performance and sustainability of the cooperative.

Of all the research above, none has examined the performance and sustainability of plantation cooperatives that apply industrial revolution technology 4.0, especially in emerging economy countries. In addition, it is also very rare for research to utilize Structural Equation Modeling (SEM). This is where the novelty of this research is, to see how big the influence of this information technology is on coffee farmer cooperatives (plantation commodities).

### 3. Materials and Methods

This study used a hybrid research design (mixed methods). Combining two types of quantitative and qualitative research is known as the “mixed technique” in research [18]. Sugiyono (2017) [19] says that combination research uses both quantitative and qualitative methods at the same time in a study to get more complete, reliable, objective, and valid results. This study used a questionnaire to collect data which were processed using a quantitative method, namely using SEM as a measuring tool. To process qualitative methods, the researcher collected data from Focus Group Discussions (FGDs) and conducted library research to complete the research data. SEM or Structural Equation Modeling is a combination of factor analysis and regression analysis which aims to examine the relation-

ship between variables in a research model. SEM model testing is divided into two main parts, namely, testing the validity of the measurement model and testing the validity of the structural model.

In this study, the Lisrel 8 software was used to perform SEM testing. The sampling method for this study was based on probability sampling; however, the sample of respondents was chosen by multistage random sampling, as the sampling process was undertaken in multiple phases (two, three, or more). Respondents were interviewed from the entire population of selected coffee cooperative members in West Java, respondents were selected among cooperative members, while the remainder were members of the management, and managers who provided additional information about cooperatives in the research area in terms of the variables' performance and sustainability. The Slovin formula was applied to a count in this investigation.  $n = 503/503 (0.05)^2 + 1 = 222$  since the expected error rate was 5 percent and the total population was 503. The questionnaire that was asked to respondents was based on indicators that could explain the variables and sub-variables of this research. The indicators, sub-variables, and variables can be seen in Table 1.

- Variable Operations

**Table 1.** Variable Operations.

Variable	Sub Variable	Indicator
Cooperative Performance "CP" [20]	Productivity	➤ The extra value cooperatives bring to their members
		➤ The increased productivity felt by members
		➤ The increased production of cooperative members
	Effectiveness	➤ The level of success achieved by the cooperative
		➤ The Conformity of results to objectives
	Quality	➤ Increasing the quality of cooperative productivity
		➤ Increased ability to utilize information technology
		➤ Signal quality that members can use
		➤ Opportunity to get training in understanding the application used
		➤ The the efficiency improvement of the cooperative
		➤ The Greater utilization improvement of information technology
		➤ Improved signal quality for members
		➤ The chance to receive training on the application being utilized
	Achievement	➤ Rewards earned by cooperative members
		➤ Rewards acquired by cooperatives
		➤ Acquiring co-op education
Cooperative Sustainability "CS" [21]	Social	➤ Interaction between members
		➤ Interaction between members and the coffee market
		➤ Conflict resolution between members
		➤ Conflict resolution between members and management
		➤ Conflict resolution between members and the market
	Economy	➤ Market ecosystem development
		➤ Member income level Enhancement of quality of life
		➤ Supply and Demand Matching
		➤ Member Well-Being
		➤ Continuity of Goods
	Ecology	➤ Cooperative concern for the cooperative environment and its members
		➤ Active environmental preservation efforts by cooperative members
Cooperatives Capability "CC" [22]	Membership	➤ A willingness to join the cooperative as a member;
		➤ A level of interest in joining a cooperative and volunteering to become a member of the cooperative



Table 1. Cont.

Variable	Sub Variable	Indicator
	Management	<ul style="list-style-type: none"> <li>➤ Openness to managing cooperatives</li> <li>➤ Possibility of receiving information from outside the organization</li> <li>➤ Possibility of receiving training in the use of information technology</li> <li>➤ Possibility of taking part in the creation of cooperatives</li> </ul>
	Enterprise	<ul style="list-style-type: none"> <li>➤ Gain access to effective and efficient management,</li> <li>➤ The chance to use information technology to access business services,</li> <li>➤ The chance to look for and seize business prospects, and</li> <li>➤ The chance to sell cooperative products using technology.</li> </ul>

- Structural Equation Model (SEM)

Utilizing the Structural Equation Model, research on the performance and sustainability of coffee cooperatives in the 4.0 industrial revolution era in West Java was evaluated (SEM). According to [23], SEM is a multivariate approach used to test hypotheses on the simultaneous relationships between several variables. SEM can explain the causal relationship between independent and dependent variables. The relationship between the variables used in this study can be seen in Figure 1.

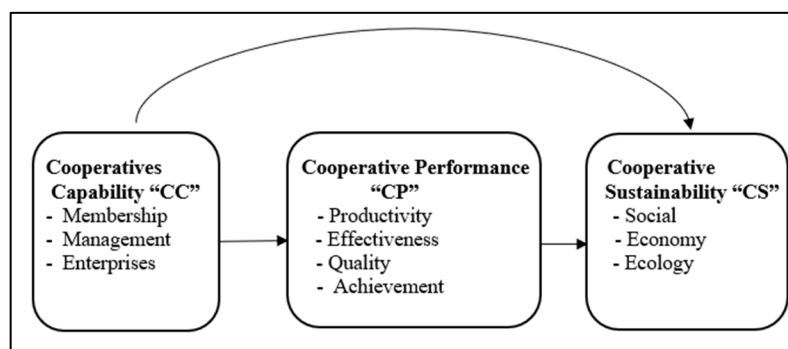


Figure 1. Variables Relationship Framework.

#### 4. Results

The following findings of testing hypotheses are shown in the table below.

**Hypothesis 1 (H1).** Cooperative capabilities have a positive and substantial influence on cooperative performance.

Based on the results of Table 2, it is known that the value of t count to determine the effect of cooperative capability variables on cooperative performance variables was 2.30 which was greater than the requirement of 1.96. So, it can be concluded that the capability of the cooperative had a significant effect on the performance of the cooperative. Then, H1 is accepted.

Table 2. Path Coefficient and T-Statistics.

			Estimate	S.E.	T Count	Label
CP	<—	CC	0.210	0.089	2.30	Accepted
CS	<—	CP	0.48	0.07	6.89	Accepted
CS	<—	CC	0.270	0.069	3.88	Accepted
CP	<—	CS	0.270	0.081	2.34	Accepted

**Hypothesis 2 (H2).** Cooperative sustainability is positively and significantly impacted by cooperative performance.

Based on the results of Table 2, it is known that the t count value to determine the effect of cooperative performance variables on cooperative sustainability variables was 6.89 which is greater than the requirement, which was 1.96. So, it can be concluded that the performance of cooperatives had a positive and significant effect on the sustainability of cooperatives. Then, H2 is accepted.

**Hypothesis 3 (H3).** *Cooperative sustainability is significantly and favorably impacted by cooperative capabilities.*

Based on the results of Table 2, it is known that the t count value to determine the effect of the cooperative capability variable on the cooperative sustainability variable was 3.88 which is greater than the requirement of 1.96. So, it can be concluded that the capability of cooperatives had a significant effect on the sustainability of cooperatives. Then, H3 is accepted.

**Hypothesis 4 (H4).** *Cooperative Performance has a favorable and considerable influence on the sustainability of cooperatives, mediated by cooperative performance.*

Based on the results of Table 2, it is known that the value of t count to determine the effect of cooperative capability variables on cooperative sustainability variables mediated by cooperative performance was 2.34 greater than the requirement of 1.96. So, it can be concluded that the capability of cooperatives had a significant effect on the sustainability of cooperatives mediated by cooperative performance. Then, H4 Accepted.

## 5. Discussion

### Research Finding

We may develop a matrix of study findings using the results of the SEM test, as shown in Table 3 below. Based on the results of the SEM test, we can make the research matrix in Table 3.

**Table 3.** The hypothesis test.

Hyphothesis	Result	SEM Analysis Result
H1	Validated and significant	t count value = 2.30 Accepted
H2	Validated and significant	t count value = 6.89 Accepted
H3	Validated and significant	t count value = 3.88 Accepted
H4	Validated and significant	t count value = 2.34 Accepted

In the era of the Industrial Revolution 4.0, cooperative capability has discernible impact on coffee cooperative performance.

The t-value of 2.30 indicated from the data that the cooperative capability variable did significantly affect the success of the Coffee Cooperative during the 4th Industrial Revolution. It may be inferred that improving cooperatives' capacity in terms of (1) membership, (2) management, and (3) business will have a significant impact on how well the coffee cooperative performs during the Fourth Industrial Revolution.

According to research conducted by Macharia (2019) [10], the performance of coffee cooperatives in Kiambu County, Kenya is strongly influenced by the role of management or administrators, as well as the participation of farmers, income levels, and determining the effect of intermediary interventions on coffee cooperative performance.

Meanwhile, in this study, we found that cooperative capabilities also significantly influence the performance of coffee cooperatives. This can be shown based on the research



results in Table 2. Therefore, cooperative management needs to pay attention to the capabilities of all members of the cooperative, especially capabilities related to the use of technology. It is hoped that all members of coffee cooperatives will have the capability to utilize technology, so that it will improve the performance of cooperatives in the era of the Industrial Revolution 4.0.

In the meantime, Dyahrini (2019) [24] research indicates that organizational culture affects performance via cooperatives' competitive advantage. This conclusion suggests that if the organizational culture is robust, the competitive advantage will be stronger, which will have a beneficial effect on the performance of cooperatives in the province of West Java. In the era of the Fourth Industrial Revolution, cooperative performance has a positive and significant impact on the sustainability of coffee cooperatives.

The results of this research demonstrated, as indicated by the t-value of 6.89, that the cooperative performance variable had a favorable and significant impact on the sustainability of the Coffee Cooperative in the Industrial Revolution 4.0 age. In the context of the Fourth Industrial Revolution, it can be said that improving cooperative performance in terms of (1) productivity, (2) effectiveness, (3) quality, and (4) achievement will have a direct impact on the sustainability of coffee cooperatives.

In the era of the 4.0 Industrial Revolution, cooperative capabilities have a positive and substantial effect on the sustainability of coffee cooperatives. The t-value of 3.88 indicates that the cooperative competency variable did have a significant effect on the coffee cooperative's sustainability in the era of the Fourth Industrial Revolution. Increasing the capacity of cooperatives in terms of (1) membership, (2) management, and (3) business will not have a direct impact on the sustainability of coffee cooperatives in the period of the 4.0 Industrial Revolution.

Cooperative Capabilities Have a Positive and Substantial Impact on Sustainability, Mediated by Coffee Cooperative Performance in the Fourth Industrial Revolution. The results indicated that the cooperative capability variable had significant effect on the performance of the Coffee Cooperative mediated Sustainability in the era of the Industrial Revolution 4.0, as indicated by the tally value of 2.34. Increasing the capabilities of cooperatives in terms of (1) membership, (2) management, and (3) business seems to have a direct effect on sustainability as mediated by the success of the Coffee Cooperative during the Industrial Revolution.

## 6. Conclusions

The study's findings, based on these findings lead to the following conclusions: testing the first hypothesis does show that cooperative capabilities have a positive effect on the performance of coffee cooperatives in West Java during the Industrial Revolution 4.0; testing the second hypothesis shows that motivation has a positive effect on the performance of coffee cooperatives in West Java; testing the third hypothesis shows that cooperative capabilities have a positive effect on the sustainability of coffee cooperatives in West Java during the Industrial Revolution 4.0., and testing the fourth hypothesis shows that cooperative capabilities have a positive effect on cooperative sustainability mediated by the performance of coffee farmer cooperatives in West Java during the Industrial Revolution 4.0.

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