Technology Adopters versus Non-Technology Adopters on the Sustainability of Agricultural Cooperatives: The Case of the East Kutai Regency Scale

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Article

Technology Adopters versus Non-Technology Adopters on the Sustainability of Agricultural Cooperatives: The Case of the East Kutai Regency Scale

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Abstract: In the current situation, the world is busy with technological advances, including Indonesia. Since its arrival, many business fields have competed with each other to take part as technology users. One business sector that cannot be separated from technological support is cooperatives. On the other hand, some cooperatives in the developing phase experience technological lag. At the same time, East Kutai Regency, which is the agricultural center in East Kalimantan Province, tends to rely on the cooperative sector to encourage small and medium-scale economies. This research aims to investigate the causality between access to computers (AC), internet networks (IN), digital administration skills (DAS), and financial literacy (FL) on profits (PFT). The objectivity of the study compares agricultural cooperatives that adopt technology with adopt non-technology. Using panel data regression from eighteen sub-districts in East Kutai, it is proven that technology adopting agricultural cooperatives were more prominent than non-technology adopting agricultural cooperatives during 2017–2022. However, there is a harmony in the statistical findings from both observations, where access to computers and financial literacy both have a significant effect on profits. Other analysis results show that internet networks and digital administration skills have an insignificant impact on profits. The study's implications provide valuable output for the future sustainability of agricultural cooperatives. The success of agricultural cooperatives depends greatly on the effectiveness of the application of technology.

Keywords: agricultural cooperatives; technology adopters; non-technology adopters; panel data regression

1. Introduction

1.1. Background

In the 21st century, technology plays a vital role in human routines, especially regarding the economic landscape (Ahmad et al., 2023; Haff, 2014). The focus of technology is not only limited to increasing economic added value but also functions as a channel of insight, developing productivity, building interaction, and integrating work that was previously classified as conventional into modern (Haleem et al., 2022; Hoehe and Thibaut, 2020; Tripathi, 2017). According to Arts et al. (2021), Diraco et al. (2023), Lind et al. (2019), and Rozstocki et al. (2019), with technological advances, humans receive greater utility than previous civilizations, where at that time technology was not so massive and was considered expensive.

Nowadays, with the advent of technological sophistication, humans are faced with choices (Kurniawan et al., 2023). First, the option to adapt and become an integral part. In this phase, humans

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start their daily activities by studying, correcting existing weaknesses, carrying out evaluations, and considering their position in the technological age. Thus, the decision-making process is identified and explored first based on a network of machines correlated with technology. Second, the option to fully accommodate all work equipment with technological facilities. In this stage, various information is filtered to design a work plan that is classified as essential. Third, a moderate situation where it does not always depend on technology, so technology is only emphasized in some professions and the rest still empowers human power in producing services or goods. For the third reason, humans are either subjects or are assumed to be objects of technology. In other words, humans can control technology and are not completely the target of a scenario that only cares about profits from technology without thinking about the fate of humans in the future. Fourth, the traditional cycle rejects the function of technology. Acceptance of technology is urgent. However, in the fourth pattern, technology is predicted by some people to only add new polemics. Interestingly, not all items of technology can replace humans. In several places, Kurt and Gök (2015), Liu (2022), and Nabela and Rianto (2020) reveal that the pillars of technology can actually damage traditions and culture, including shifts in human interactions, social relationships, communication, and individual morals and ethics.

When talking about economic competition, one of the advantages and competitiveness of business is reflected in its technological determination. Take the example of cooperatives as micro and medium-scale business clusters that have contributed to the economy across nations (Bharti, 2021; Mhembwe and Dube, 2017). Going back several decades, starting with Indonesia's independence reforms. The concept of cooperatives as a foundation in the people's economy, which was championed by one of the nation's founding figures, namely Mohammad Hatta, who was called the "Father of Cooperatives", initiated a type of business that allows all levels of the sector to move small production units in a sustainable direction (Halilintar, 2018; Maskur, 2016; Pulungan and Sardjono, 2021). At the moment when Indonesia was separated from Japanese colonial rule, trade was only controlled by the majority of big businessmen with a commercial sharing agreement with the Japanese government, but this only benefited some parties and was detrimental to the indigenous people. At that time, the expansive exploitation of natural resources without partnering with local businesses or employing Indonesian citizens spurred a new, more impressive understanding through the implementation of cooperatives. Although initially there were only two types of cooperatives, namely consumer cooperatives and producer cooperatives, at the beginning of their journey, currently they are increasingly developing along with the optimization of financial structures, such as service cooperatives, marketing cooperatives, multi-business cooperatives, and savings and loan cooperatives (Kusmiati et al., 2023).

In accordance with their names, the six cooperatives have different terminology. Consumer cooperatives are aimed at trading goods and services. In essence, consumer cooperatives are set up to provide goods and trade transactions. Institutionally, consumer cooperatives are implemented via business entities managed by cooperative members to sell various basic necessities to consumers. The vision of the producer cooperative is to compile a product from cooperative members at an affordable cost or below the average price from re-sellers for the members' needs. In principle, producer cooperatives focus on passing on local product wisdom from cooperative members to other cooperative members. In this perspective, producer cooperatives are built to provide services and distribute products to members to help household economic levels, making it easier and guaranteeing that they can create production inputs and market products efficiently.

Furthermore, service cooperatives are instructed to engage in service activities. It's the same as a consumer cooperative, but what this cooperative prioritizes is service for its members. Examples are insurance service cooperatives, transportation services, credit services, and so on. On the one hand, marketing cooperatives are prioritized to accommodate products produced by cooperative members and market them to consumers. Members act as product suppliers to marketing cooperatives. Another unique thing about multi-business cooperatives is that they operate in more than one unit or field, including product marketing, savings and loans, distribution of production facilities, and production operations. Then, the system in savings and loan cooperatives is centered

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on microfinance institutions that provide capital loans to cooperative members. Savings and loan cooperatives have the status of non-bank financial institutions whose business is supported by taking savings from all members and providing capital loans to cooperative members who need business investment. Apart from that, collecting funds in cooperatives with this concept takes the form of member contributions and savings, which are mandatory for each scheduled period. What the six cooperatives have in common is that the capital is sourced from the cooperative members or cooperative owners, involves all stakeholders involved in the cooperative to make policies, shares profits, and the main motive is rooted in the welfare of the members with a foundation of justice.

1.2. Existing Situation

Apart from the role of small and medium enterprises (SMEs), history records that cooperatives were also the sector that was most resilient to the monetary crisis in 1997–1998 (Yuhertiana et al., 2022; Wulandhari et al., 2022). The rational reason behind the cooperative intensity of economic turbulence is independence (Darma et al., 2020). Trisniarti et al. (2022) explained that the existence of cooperatives until now is due to the fact that the majority of production raw materials and labor use local resources. Similar to SMEs, cooperative assets are also based on the micro, small, and medium scale, so external disturbances such as political shocks do not completely hit cooperatives. This is different from companies that employ many employees (in this case, including foreign workers) with large capital flows and are oriented towards high profits compared to the smaller number of administrators or investors in cooperatives with an even distribution of profits. The specific specialty of the two businesses above also lies in taxes. The tax factor is an important differentiator in mapping goals and values between cooperatives and companies.

In the case of Indonesia, cooperatives have saved the fate of several people by absorbing workers to be trained, coached, and educated, so they can manage cooperatives skillfully. Social capital in institutions binds cooperative members who, at any time, bear the burden of losses or profits collectively. Agricultural cooperatives are grouped into commodity cooperatives. Definitively, Candemir et al. (2021), Leite et al. (2021), Tortia et al. (2013), and Zhang et al. (2021) articulate agricultural cooperatives as a type of cooperative that explores natural resources directly without or with minimal extraction of natural resources. Agricultural cooperatives process primary natural resources, including plantation crops, livestock, fisheries, forestry, and food crops. The forms of agricultural cooperatives include consumer cooperatives, producer cooperatives, service cooperatives, marketing cooperatives, multi-business cooperatives, and savings and loan cooperatives, depending on their respective capacities. The presence of agricultural cooperatives cannot be separated from agricultural economic trends. Each agricultural cooperative has the autonomy granted by the competent authority to carry out organizational activities, opportunities, strategies, and missions according to the characteristics of each region. Basically, members are guided by the regulations prepared by the cooperative legal entity or established by individuals, with the separation of the members' assets as the main capital. In practice, Indonesian agricultural cooperatives have a dominant member composition consisting of the Association of Farmer Groups (GAPOKTAN) which are both mediated by farming institutions in rural areas to carry out entrepreneurship, including marketing of produce and processing units, providing production facilities, and channeling capital.

In the midst of a rapidly disruptive era, it is spurring many business elements to make changes. Often, understanding technology has a different narrative for realizing or resolving uncertainty in the field. This also happens to agricultural cooperatives. In reality, many agricultural cooperatives still have difficulty contextualizing technology when diagnosing new challenges (Anh, 2022; Jia et al., 2023; Liu et al., 2022; Luo et al., 2017; Moral and Uclés, 2022). This situation creates a dilemma. First, digitalization opens up a flow so fast that it requires improvements in supporting infrastructure. Inequality in the financial dimension has an impact on obstacles to network equality. Second, the cooperative data recording and storage system is not optimal, which is triggered by low literacy regarding applications and programs connected to one database. Third, classic conditions in internal cooperative management prepare human resources to find new breakthroughs in more

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transformative technology. Fourth, weak regulations that support business partnerships, including external supervision through computerization to ensure the security of cooperative data.

1.3. Research Motivation

Ideally, with Indonesian agricultural cooperatives entering their seventh decade, there should be no serious obstacles to the use of technology. This is considering that Indonesia is a developing market with bright prospects, including the government's initiative in providing technological infrastructure. At the same time, agricultural cooperatives are required to commit to increasing competence. One of them is technological acceleration. So far, among the latest topics that highlight the link between technology and non-technology adoption on the performance of agricultural cooperatives are discussed. According to the paper presented by Zhang et al. (2020) regarding the expansion of technology adoption in Sichuan (China), which is still unclear, the application of post-harvest and production technology causes a decline in the prosperity of agricultural cooperative members. Then, observations on household farmers in Ethiopia showed that cooperatives that prioritize agricultural technology through extension services have grown the experience, participation, and leadership of their members (Abebaw and Haile, 2013). The investigation of Yang et al. (2021) concluded that farmers who are members of agricultural cooperatives as technology adopters and non-adopters of technology to increase agricultural profits in China tend to be more dominated by farmers with low incomes than farmers with high incomes. On the other hand, small farmers in developing countries like Indonesia are determined by certain local conditions and needs. The low level of diversification in the Indonesian agricultural sector is caused by technology adoption, institutional structure, farmer characteristics, and business channels (Suprehatin, 2021). A recent study by Khan et al. (2022) estimates the quality of technology application in supporting agricultural cooperatives in Pakistan. The use of technology to increase agricultural income has exceeded expectations and is gradually being applied in Pakistan to reduce poverty. The final implication is that farmers with low incomes who are part of agricultural cooperatives by adopting technology actually have a better effect on agricultural income than farmers with high incomes who are non-technology adopters.

Reviewing the phenomena above, one of the keys to success in agricultural cooperatives is a technological approach. Therefore, this paper was created to dissect the sustainability of agricultural cooperatives through two lenses. First, the performance of agricultural cooperatives that rely on technology. Second, agricultural cooperatives are non-technology adopters. Thus, the research motivation is addressed not only to the management of agricultural cooperatives but also to stakeholders as a corridor for developing accurate policies to build a holistic cooperative business.

2. Literature Review

2.1. Agricultural Cooperative

Mirón-Sanguino et al. (2022), Ševarlić and Nikolić (2013), and Siregar et al. (2020) state that an agricultural cooperative is a legal entity established by an individual or a business that has legality by separating the assets of its members as the main capital to carry out business affairs that meet shared aspirations and needs in social, cultural, and economic aspects relevant to the principles and the value of cooperatives. Empowering and strengthening agricultural cooperatives is the mandate of Law of the Republic of Indonesia Number: 1 of 2013 concerning microfinance institutions, which was updated and emerged from Law of the Republic of Indonesia Number: 25 of 1992 concerning cooperatives (Wijaya et al., 2022). Substantively, agricultural cooperative financing depends on the Agribusiness Microfinance Institution (LKM-A) which is directly supervised by GAPOKTAN (Darma et al., 2020). Darwis et al. (2023) emphasize that in the agricultural institutional format, GAPOKTAN is also a recipient of grant funds from the government assistance scheme through Direct Community Assistance-Rural Agribusiness Development (BLM-PUAP). Figure 1 displays the organizational diagram of agricultural cooperatives in Indonesia.

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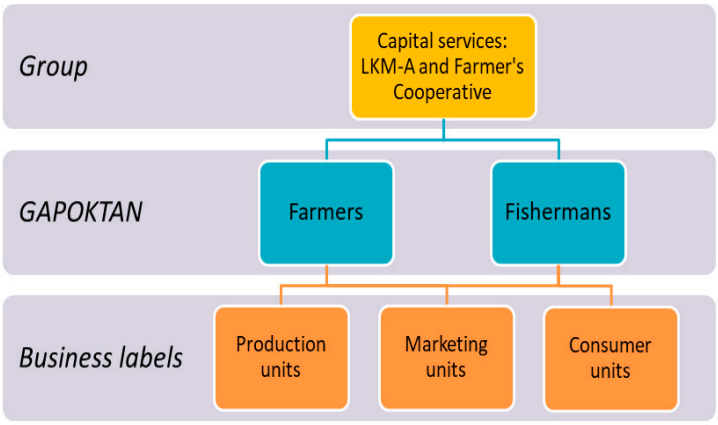

Figure 1. Institutional organization in agricultural cooperatives; *Source:* modified from da Silva et al. (2022).

As an illustration, agricultural cooperatives in Indonesia operate relatively in four positions: consumer cooperatives, service cooperatives, marketing cooperatives, and producer cooperatives. However, they are often mixed or in separate matters (Soetriono et al., 2019; Susilowati et al., 2014). In a business network, the circulation of a product is influenced by circulation or market segmentation, where there are industries that process and produce food purchased from raw materials. Generally, raw materials are sold by producers directly or by suppliers who collaborate to distribute semifinished products to companies. In this context, it allows the agricultural cooperative business to be in the producer, supplier, or consumer version. Meanwhile, in trade mobility, distributors deliver and connect the final product to consumers. Distributors also have contracts or exclusive rights with manufacturers. Apart from these traditional businesses, cooperatives can also deal with resellers and drop-shippers. Resellers are parties who buy goods from suppliers or other cooperatives and then sell them again to consumers. In contrast to resellers, the role of drop shippers is to market products from manufacturers, suppliers, or distributors without purchasing the product first. In modern market mechanisms, drop shippers do not have a stock of goods like resellers but concentrate on marketing via social media or e-commerce.

The requirements for establishing a cooperative include four procedures. First, the management of the agricultural cooperative, namely GAPOKTAN, Here, GAPOKTAN is a combination of professions or a group of people who work as fishermen and farmers, or those who depend on the agricultural sector for their livelihood or are owners of land for food crops, plantations, productive forests, livestock, and as fishermen, but does not include farmworkers who manage and help operate the five fields above with daily or monthly wages. Second, GAPOKTAN administrators were registered as BLM-PUAP recipients during the 2008–2015. Third, domicile in the village area, which is the identity of GAPOKTAN recipients of BLM-PUAP grants. Fourth, it is claimed to have inclusive financial capabilities, so that it can allocate funds as additional initial capital for establishing agricultural cooperatives.

Agricultural cooperative administrators are appointed and dismissed by the supervisory board. Several criteria for agricultural cooperative management include:

- Having the insight and manifestation to manage, develop, and establish agricultural cooperatives professionally;
- Never been convicted of committing a criminal act that harms other parties, especially those related to finances;
- Being fair and behaving wisely so that it can be accepted by members and local residents;
- Being honest, responsible, and able to protect all members' interests in encouraging agricultural businesses; and
- Each administrator is selected from former GAPOKTAN administrators. LKM-A supervisors are GAPOKTAN administrators who are appointed and dismissed by the Annual Member Meeting (RAT). The supervisor's specifications consist of three standards. First, supervisors are required to

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carry out their duties well and with full dedication for the interests of LKM-A and agricultural cooperatives. Second, supervisors are responsible for carrying out their duties toward members. Third, supervisors are prohibited from holding concurrent positions as administrators.

The instruments that GAPOKTAN, must comply with to develop and form LKM-A and agricultural cooperatives are:

- Recapitulate the Articles of Association-Bylaws (AD-ART) and other regulations;
- Tabulating the books and balance sheets of financial reports;
- Have verified members from the agribusiness sector;
- Office location or place of business with some equipment such as nameplates, stamps, symbols and official qualifications related to the organization; and
- If these four requirements have been met, the Agriculture Service at the City/Regency level can assign a registration code to agricultural cooperatives and LKM-A which is stated in the form of a Decree of the Head of the Agriculture Service. GAPOKTAN, which succeeds in building LKM-A, automatically has formal legality in the form of an agricultural cooperative legal entity with four categories of establishment. First, the meeting for the formation of agricultural cooperatives is held with a minimum of twenty members. Second, describe AD-ART transparently. Third, submit an application for ratification of the deed of establishment of the cooperative. Fourth, have a permanent domicile in the territory of Indonesia.

Overall, the financial service system at LKM-A and agricultural cooperatives uses conventional principles, namely providing loans (credit) and providing services that are closely related to members' primary needs based on interest rates. The financial service system of LKM-A and agricultural cooperatives is determined through deliberation between the management and members by selecting the best alternative that is easy to implement and can be understood by all members.

2.2. Utilization of Technology

Nowadays, technology adoption is one of the strategic steps in taking advantage of digital flows (Verhoef et al., 2021). Normally, technology adoption can be applied in various disciplines according to its actualization (Straub, 2009). One of the fields where this is implemented is cooperatives, or what is popularly called "e-cooperatives." It must be admitted that an innovation (such as technology) is not simply accepted by all groups. The main factor that hinders the adoption of an idea is individual doubt. Technology is defined as a model that requires humans to organize their lives according to the values brought by the technology itself (Sundberg, 2019). During this time, humans have had their own goals that have grown within the community. This then creates dynamics in the application of technology. The adoption process is important so that the technology is easy to implement (Miranda et al., 2016).

There are five analogies in the technology adoption process (see Figure 2). First, the knowledge stage is the phase where someone does not yet know the new technology. So that individuals know, the breakthrough needs to be conveyed via various technological channels, such as interpersonal communication, also known as word of mouth (WoM), print media, electronic media, and other channels depending on the level of activity, interests, and targets. Second is the persuasion stage, which explains the quality of potential users' thinking. Based on evaluation, discussion, and searching for sources that are considered sufficient, there is a tendency to start adopting or even rejecting technology. The presence of technology is a step to follow up on and react to in making decisions regarding technology adoption or vice versa. At this stage, individual beliefs have not fully responded to accepting technology, so the process is still stagnant. Third, decision-making. At this stage, individuals have the opportunity to make the final decision about whether to adopt or reject a technology. However, even though someone has made a decision, it is possible for a transition to occur in technology adoption. At this moment, at any time, individuals or groups of people can reject or accept technology. Fourth, the implementation stage. When someone begins to be touched by technology and learns more about it, it indicates dependence on technology. At this stage, someone continues to identify various other pieces of information to ensure the adoption of technology. Fifth, the confirmation stage is the final solution after implementation and acceptance of the technology. A

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person has made a decision through a series of justifications to justify the action taken. Individuals will be involved to consider whether the technology will be adopted again in the future or not. It also begins with evaluating the consequences of the decisions taken. It is very likely that someone will change the decision that was initially rejected and shift to accepting the technology. Considering that individual awareness begins to grow due to the impact of technology, its use will be limited in contemporary terms.

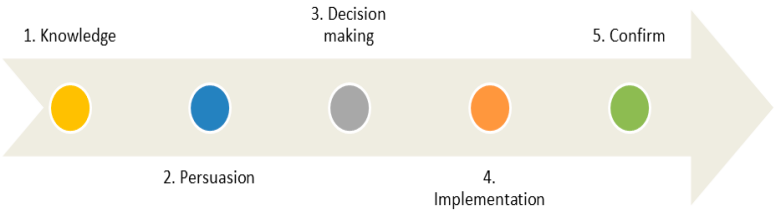

Figure 2. Five levels of technology acceptance; *Source:* Lin and Yu (2021), Sari (2022) and Ramadania et al. (2021).

Universally, in the Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM), the adoption rate is the relative speed that explains the innovation adopted by each member of the social system (Cheng, 2019). Technically, the measure of technology adoption is identical to the number of individuals who prioritize new ideas at a certain time, for example, in a certain year. In this case, the adoption rate is converted into a numerical indicator of the steepness of the adoption curve for a new cycle. As explained in the introduction, the root of the problem in agricultural cooperatives is crucial. The most fundamental polemic is that not all agricultural cooperatives in Indonesia incorporate technology into their work procedures. In operationalization, a combination of humans and technology is needed to improve productivity. There is a work ecosystem in agricultural cooperatives that must be improved, especially consistency in technology adoption. Even though the majority of technology has been successfully applied to many areas of work, some technologies that are suitable are actually contradictory to certain jobs (Purnomo, 2011).

2.3. Model Flow

Figure 3 below summarizes the flow of the research model. In synthesis, two variables are designed differently. First, explanatory variables. Explanatory variables function to predict the dependent variable. Explanatory variables are: (1) access to computers; (2) internet network; (3) digital administration skills; and (4) financial literacy. Second, the dependent variable. The dependent variable is calculated by four explanatory variables. The dependent variable is profit. The research assumption is built on the adoption of technology in agricultural cooperative management, which has an impact on business sustainability. On the one hand, agricultural cooperatives with the status of non-technology adopters are also able to realize business sustainability even though they are considered traditional.

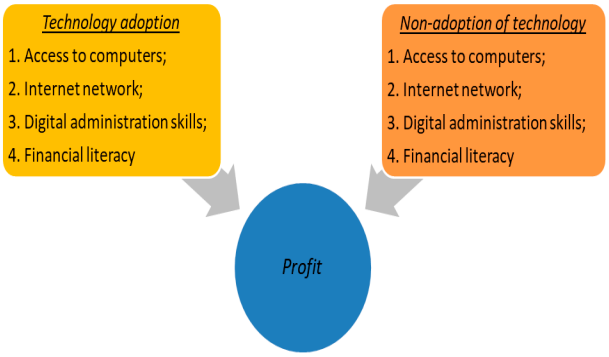

Figure 3. Theoretical framework.

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3. Materials and Methods

3.1. Core Data

This research compares the sustainability between cooperatives that adopt technology with cooperatives that adopt non-technology or developing cooperatives that operate traditionally. The data material is secondary. Data was collected from official publications released by the East Kutai Regency Cooperatives, SMEs, and Creative Economy Service for six periods (2017–2022). The data focuses on agricultural cooperatives with active status that are officially registered under the control and guidance of the regional government. The focus of the study is East Kutai Regency with the consideration that this region is one of the preferences for other regions at the national level that have succeeded in developing agricultural cooperatives. Apart from that, in the aggregate agricultural sector, East Kutai has the highest accumulated gross regional domestic product (GRDP) relative to the economic growth of East Kalimantan Province.

Figure 4 displays the research area. Specifically, agricultural cooperatives active in East Kutai are spread across eighteen sub-districts, namely: Teluk Pandan, Telen, Sangkulirang, Sangatta Utara, Sangatta Selatan, Sandaran, Rantau Pulung, Muara Bengkal, Muara Wahau, Muara Ancalong, Long Mesangat, Kombeng, Kaubun, Karangan, Kaliorang, Busang, Bengalon, and Batu Ampar.

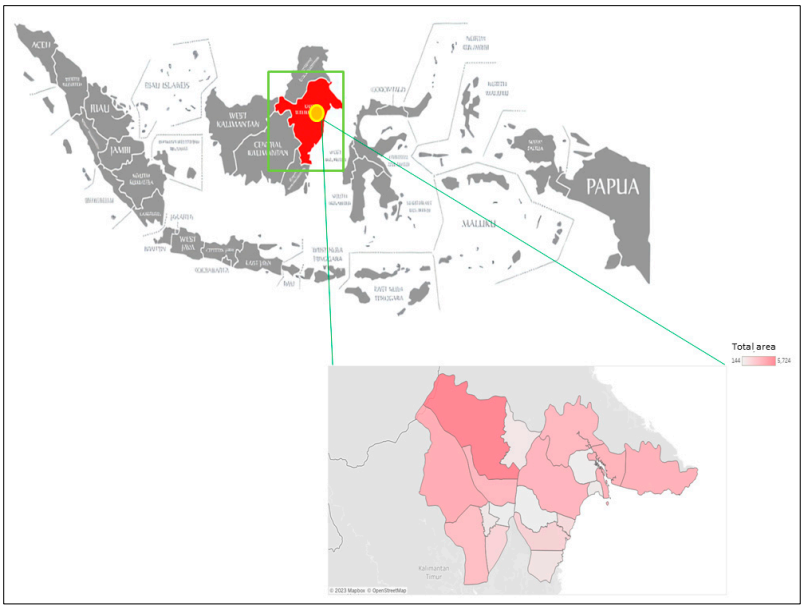

Figure 4. Study area; *Source:* Own.

3.2. Variables

The sustainability of agricultural cooperatives is reflected in their level of profit. Then, the mechanisms that influence cooperative profits are divided into four categories: access to computers, internet networks, digital administration skills, and financial literacy. Each variable has varying indicators. Table 1 summarizes the variable profiles based on parameters and codes, variable types, and units of measurement.

Table 1. Profile of variable.

Parameters (code)	Variable type	Measurement
Profit (PRT)	Dependent	Nominal (Rp.)
Access to computers (AC)	Explanatory	Percentage (%)
Internet network (IN)	Explanatory	Kilobyte per second (kbps)
Digital administration skills (DAS)	Explanatory	Operator in the administration division

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		(average units per cooperative)
Financial literacy (FL)	Explanatory	Length of time following financial education/training certification (years)

First, profit describes the financial benefits that are realized when the income generated from business activities exceeds the costs, fees, and taxes involved in supporting a business. Profit is the main benchmark for agricultural cooperatives. Implicitly, the realization of profit after income is reduced by all expenses or component costs, including the tax burden. Any profits are channeled back to the agricultural cooperative members, who choose to pocket the cash or invest it back into the business. Profit is calculated as total income minus expenses. Second, access to computers. Data on access to computers is elaborated based on the percentage of agricultural cooperative ownership of computers. Third, the internet network is detected by the network connection that appears in the status bar. The average internet network speed in Indonesia is between 250 kbps to 1 mbps every second. Fourth, digital administration skills are operator units in the administration division that control and carry out administration digitally. Fifth, financial literacy is defined as the level of basic knowledge of financial management identified by the average length of time following financial education or certification according to international standards.

3.3. Analysis Techniques

Data processing analysis uses a quantitative approach. In the quantitative scope, the panel regression method compares two objects, namely agricultural cooperatives that adopt technology vs. agricultural cooperatives that adopt non-technology. Conceptually, agricultural cooperatives that adopt non-technology are cooperatives whose majority still depend on conventional equipment. Because the data for each variable varies, it is proxies using logarithms. The basic statistical formulation is written below:

$$Y = \beta_0 + \beta_1 X + \ldots + \mu \quad (1)$$

After adjusting for variable composition, the equation function is then set as follows:

$$PFT_1 = \beta_0 + \beta_1 lnAC_{it} + \beta_2 lnIN_{it} + \beta_3 lnDAS_{it} + \beta_4 lnFL_{it} + \mu_1 \quad (2)$$

$$PFT_2 = \beta_0 + \beta_1 lnAC_{it} + \beta_2 lnIN_{it} + \beta_3 lnDAS_{it} + \beta_4 lnFL_{it} + \mu_2 \quad (3)$$

where: Y = dependent variable; β_0 = constant; $\beta_1,\ldots\beta_4$ = regression slope; ln = logarithm; X = explanatory variables; PFT_1 and PFT_2 = profit in agricultural cooperatives adopting technology and non-adopting technology; μ_1 and μ_2 = residuals; it = observation period.

Systematics in the panel regression model includes four things. First, descriptive statistics. Descriptive statistics facilitate large amounts of data for understandable interpretation, allowing, representing, and interpreting data more efficiently through various tabulation processes. Second, the correlation coefficient. Correlation coefficient to validate the reciprocal relationship between two variables. In its application, the research uses the product moment correlation score developed by Karl Pearson. Third, partial statistical testing, simultaneous statistical testing, and statistical testing of the coefficient of determination. Partial test to assess the individual influence of explanatory variables on the dependent variable. The simultaneous test projects collective causality between all explanatory variables on the dependent variable. Statistical test of the coefficient of determination to review the strength of the designed empirical.

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4. Results

In general, the five variables have diverse data. Table 2 concludes that all combined data sets of agricultural cooperatives that adopt technology and non-technology adopters are quite varied. The maximum profit value reaches Rp. 115,700,500 and the minimum profit is Rp. 62,050,450, resulting in a mean of Rp. 88,875,475. In terms of access to computers, the maximum achievement was 98.39% and the minimum value reached 41.8%, while the mean was 70.1%.

Furthermore, agricultural cooperatives have a maximum internet network of 850 kbps, while the minimum internet network is 300 kbps and the mean internet network reaches 575 kbps. On average, agricultural cooperatives have operators with a maximum digital administration skill of 16 units; the lowest is 5 units, and the mean reaches 10.5 units. Agricultural cooperative managers spend a maximum of 6.5 years attending education or training to obtain financial certification, while the minimum training time is 2 years, with the average duration of financial training reaching 4.25 years. The standard deviation (S.D.) scores for the five variables are shown below: profit (37,936,314.17), access to computers (40.02), internet network (388.91), digital administration skills (7.78), and literacy finance (3.18).

Table 2. Descriptive statistics matrix.

Variables	Mean	S.D	Max.	Min.
Profit	88,875,475	37,936,314.17	115,700,500	62,050,450
Access to computers	70.1	40.02	98.39	41.8
Internet network	575	388.91	850	300
Digital administration skills	10.5	7.78	16	5
Financial literacy	4.25	3.18	6.5	2

With the SPSS version 29 tools, the criteria for assessing correlation range from -1 to 1. Obilor and Amadi (2018) and Ratner (2009) explain that if the correlation coefficient is close to -1 or 1, then the two variables have a strong correlation. Conversely, if the correlation score is close to 0, then the two variables tend to have a weak or even no correlation. In product-moment correlation testing, it is possible to direct the correlation between variables negatively or positively. From Table 3, there is not a single relationship between variables that is negatively correlated. However, based on the degree of probability, a significant relationship was found. The five significant causalities between IN and PRT ($\rho = 0.000$), FL and PRT ($\rho = 0.000$), DAS and AC ($\rho = 0.045$), FL and AC ($\rho = 0.023$), and FL and DAS ($\rho = 0.006$).

Table 3. Pearson correlation.

	PRT	AC	IN	DAS	FL
PRT	1	.362	.783**	.411	.887**
		(.117)	(.000)	(.072)	(.000)
AC	.362	1	.409	.454*	.507*
	(.117)		(.080)	(.045)	(.023)
IN	.783**	.409	1	.255	.273
	(.000)	(.080)		(.279)	(.244)
DAS	.411	.454*	.255	1	.700**
	(.072)	(.045)	(.279)		(.006)
FL	.887**	.507*	.273	.700**	1
	(.000)	(.023)	(.244)	(.006)	

Abbreviations: PRT = profit, AC = access to computers, IN = internet network, DAS = digital administration skills, and FL = financial literacy; *Degrees of probability*: *) ρ <0.05 and **) ρ <0.01.

In this session, reveal the interrelationships in partial and simultaneous variable relationships as well as the determination of the study model (see Table 4). As a result, it was noted that under constant conditions, the four explanatory variables, namely AC, IN, DAS, and FL, had a positive ($\beta = 2.739$) and significant ($\rho = 0.040$) impact on PFT_1 in technology-adopting cooperatives. In contrast to

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the case of non-technology adopter cooperatives, where AC, IN, DAS, and FL actually have a negative influence (β = *-0.094*) and are not significant on PFT_2 (ρ = *0.848*). In partial causality, there are two positive paths with significant effects between AC (β = *2.839*; ρ = *0.002*) and FL (β = *2.761*; ρ = *0.029*) on PFT_1 of agricultural cooperatives adopting technology. Although the two explanatory variables (IN and DAS) have no significant impact, the relationship is positive. Another statistical interpretation presents that, for the case of agricultural cooperatives that are non-adopters of agricultural technology, FL is the only variable that is on the positive path (β = *0.071*) with a significant effect (ρ = *0.039*) on PFT_2. The opposite thing in the non-adopter regression is that although the three explanatory variables (AC, IN, and DAS) were found on a negative path (β = *-0.141*; β = *-0.043*; β = *-0.003*), only AC had a significant impact (ρ = *0.032*) and the remaining two variables actually had an insignificant impact on PFT_2 (ρ = *0.100*; ρ = *0.726*).

Table 4. Summary of tests, dependent variable: profit.

Items	Adopters	Non-adopters
Constant	2.739*	-.094
	(.040)	(.848)
S.E	1.336	.490
Access to computers	2.839**	-.141*
	(.002)	(.032)
Internet network	.100	-.043
	(.399)	(.100)
Digital administration skills	.411	-.003
	(.730)	(.726)
Financial literacy	2.761*	.071*
	(.029)	(.039)
F-statistic	31.077**	1.649
	(.000)	(.195)
R^2	.853	.408
N	108	108

Degrees of probability: *) ρ <0.05 and **) ρ <0.01.

When compared using the F-statistical test, agricultural cooperatives that adopt technology are better than agricultural cooperatives that are not adopters of technology. The score on the F-statistic implies that the four explanatory variables have a significant simultaneous relationship to PFT_1 (ρ = *0.000*). On the one hand, AC, IN, DAS, and FL have an insignificant simultaneous effect on PFT_2 (ρ = *0.195*). Based on the coefficient of determination (R^2), the study model for agricultural cooperatives adopting technology is more dominant than agricultural cooperatives not adopting technology. The R^2 scores of the two show a striking two-fold difference. The study model with a very close relationship between the four explanatory variables on PFT_1 reached 85.3%, and the rest is beyond discussion. Interestingly, in the non-technology adopter agricultural cooperative model, AC, IN, DAS, and FL, there is a close relationship with PFT_2 of 40.8%, and there are still many attributes outside the model that need to be highlighted.

5. Discussion

Table 5 attaches data regarding cooperative units for agricultural commodities (including technology adopters and non-technology adopters). At the regional level, East Kutai agricultural cooperatives account for half of the total number of East Kalimantan agricultural cooperatives. Throughout the six periods, the average agricultural cooperative with active status was 667.3 units, with a growth of 0.45%, while the average agricultural cooperative in East Kalimantan reached 1,333.5 units, or a growth of around 0.34%, and the average agricultural cooperatives in Indonesia were 38,644 units (0.28%). Especially in 2020–2021, the number of agricultural cooperatives and their growth trend experienced a drastic decline. This is caused by the COVID-19 phenomenon, which

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disrupts human mobility, including work routines. The pandemic outbreak has also triggered economic turmoil in various multi-sectors, such as agricultural cooperative businesses.

Table 5. Total agricultural cooperatives and their growth in East Kutai, East Kalimantan and Indonesia.

Year	East Kutai	East Kalimantan	Indonesia	% of East Kutai	% of East Kalimantan	% of Indonesia
2017	638	1,273	37,144	–	–	–
2018	724	1,468	41,693	13.48%	15.32%	12.25%
2019	845	1,501	45,489	16.71%	2.25%	9.1%
2020	600	1,252	35,761	-28.99%	-16.59%	-21.39%
2021	591	1,246	35,502	-1.5%	-0.48%	-0.72%
2022	606	1,261	36,275	2.54%	1.2%	2.18%

Source: BPS of Indonesia (2023), BPS of East Kalimantan (2023), and BPS of East Kutai (2023).

In the midst of the sharp increase in the spread of COVID-19 in Indonesia throughout 2020–2021, both in East Kutai, East Kalimantan, and Indonesia, the number and growth of agricultural cooperatives are in a downward trend, which also has an impact on many commodities. What's worse, from 2019 to 2021, cooperative units at the three scales are decreasing. For example, in East Kutai, agricultural cooperatives shrank by 254 units (-30.49%), while agricultural cooperatives in East Kalimantan shrank by 255 units (-17.07%), and agricultural cooperatives in Indonesia shrank by 9,987 units (-22.11%). Moreover, with the average length of business being 2–2.5 decades or established since the early 1998s, the existence of agricultural cooperatives in East Kutai, East Kalimantan, and Indonesia is relatively positive. This can be seen from the impressive pattern since 2017–2019, where East Kutai agricultural cooperatives increased by 254 units (30.19%). Also, there was a conducive transformation in East Kalimantan agricultural cooperatives, reaching 255 units (17.57%), and in Indonesia it reached 9,987 units (21.35%).

All of the above achievements cannot be separated from the investment climate and government policies supporting agricultural cooperatives. With the synergy of the two, the agricultural sector continues to grow from time to time. Despite the threat of lockdown, agricultural cooperatives have proven to be resilient compared to other business characteristics (e.g., Aminulloh et al., 2021; Khasanah et al., 2022; Pratikno and Pattinussa, 2022; Yuhertiana et al., 2022). The recovery of the agricultural sector was faster, while other economic sectors such as manufacturing, services, construction, and trade were slower. Only agriculture, electricity, and clean water are essential sectors that are crucial in supporting human life, even though they are slightly isolated by regional quarantine. From a macroeconomic perspective, farmers who are connected as members of cooperatives (GAPOKTAN) play an important role in the agricultural economy in Indonesia, East Kalimantan, and East Kutai. Although the growth of the agricultural sector in the three objects appears to be fluctuating, the trend remains positive. The average agricultural GRDP growth in East Kalimantan is slightly superior to that in East Kutai. The growth percentage achieved was 8.03%, compared to 7.72%. At the national level, the average growth was 12.98%.

In reality, Figure 5 also explains the GDP growth performance of the agricultural sector in East Kutai, East Kalimantan, and Indonesia during 2018–2022. Specifically, there are striking similarities between the three objects. The latest data shows that the most dominant agricultural GDP growth for the three was in 2020, followed by East Kutai (9.12%), East Kalimantan (8.8%), and Indonesia (13.7%). The lowest will be in 2022, with the following respective percentages: East Kutai (5.9%), East Kalimantan (7.04%), and Indonesia (12.4%). This fact signals that when COVID-19 surged, especially in 2020–2022, economic growth in the agricultural sector at the domestic, provincial, and regional scales was relatively stable. However, agricultural GDP growth is starting to shrink in the new normal, or post-pandemic era. One of the reasons for the drastic decline in agricultural economic growth is productivity. The shift in economic structure from the primary sector to the tertiary sector during COVID-19 has pushed the majority of Indonesia's population involved in agriculture to shift

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to the service sector. The transition of the two sectors causes unbalanced economic circulation. The labor market in the agricultural industry, with a decreasing share, is also reducing the agricultural value chain.

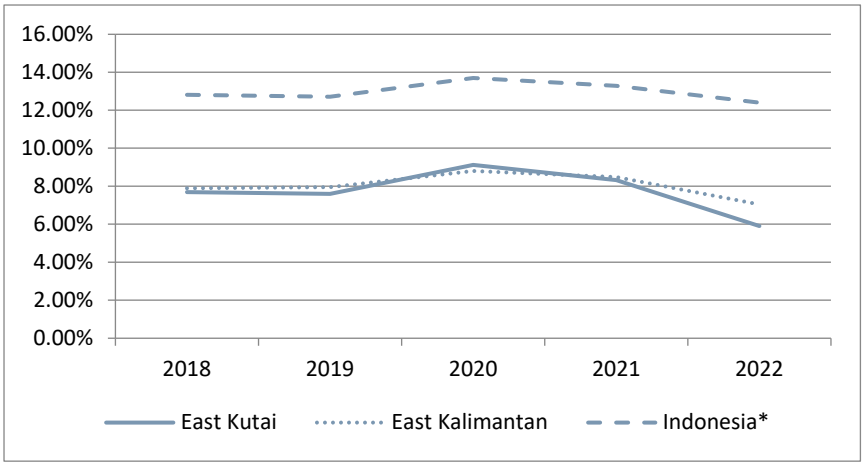

Figure 5. Agricultural economic contribution to GRDP and GDP; *Source*: BPS of Indonesia (2023), BPS of East Kalimantan (2023), and BPS of East Kutai (2023); *Noted:* *) GDP = gross domestic product.

Some past papers highlight the role of computers in optimizing cooperative profits. The globalization revolution stimulated the Gulf Cooperation Council (GCC) to consider technological advances in the development of the financial system. Through electronic-based financial technology, the percentage of the money supply and GDP are increasing. By collaborating computer domains, it becomes easier to collaborate and coordinate in various work environments (Alshubiri et al., 2019; Bullinger-Hoffmann et al., 2021). For example, multi-agent-based supply chain cooperatives in China, cooperative businesses in the United States, microbanking in China, and cooperative communities in the United States. Studies from Cook (2018), Deller et al. (2009), Lv et al. (2022), Majee and Hoyt (2011), and Zhang and Geng (2012) stated that the use of technology in two simulations, namely the average individual income, enthusiasm, and cooperation in cooperatives, had a lower ratio of profit distribution to changes in knowledge spillovers. Extrapolation from the entire population is projected to have a larger impact on cooperative revenues. For a long period of time, cooperative regeneration was determined by a process of technological adaptation embedded in strategic planning. Developments such as financial technology (FinTech) in the financial services industry bring gradual profit opportunities.

The experiments in the previous edition debated the findings in several cases regarding the relevance of internet networks to profits in banking, agribusiness, business model innovation, organizational capabilities, and entrepreneurship. The external effect of internet financing allocation will reduce commercial bank profits, but internet financing allocation actually has a positive impact on traditional bank profits in China (Yang et al., 2023). In Shandong–China, spectacular internet technology for modern agricultural patterns in maximizing apple farmers' income is the right policy (Zhang et al., 2021). Digitalization, such as internet provision, has explored new business opportunities to create value networks in automotive and media companies in Germany (Rachinger et al., 2019). According to Brous et al. (2020), the internet of things (IoT) has a dual effect, i.e risks and benefits. In the case of a few companies in the Netherlands, IoT is certain to have a comprehensive impact on asset management, but at the same time, it generates unexpected social changes in the organization. Langley et al. (2021) argue that business sketches at the macro, medium, and micro levels contained in the technological intelligence framework clearly understand the service ecosystem.

The connection between digital administration skills and profits is revealed in several manuscripts (Ciruela-Lorenzo et al., 2020; Feyen et al., 2021; Hasbullah and Bareduan, 2021; Jorge-Vázquez et al., 2021; Wijaya et al., 2023; Xie et al., 2016). Digital financial services programs have

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implications for public policy. Technology providers enhance the asymmetric exchange of information and enable economic forces to bring major advances to the global market structure. Reducing transaction costs in market structures accommodates more innovative improvements in the production of financial services, including the acquisition of trust capital, data, compliance activities, funding, and customers. In the context of smart agriculture, the digitalization of agricultural cooperatives in Spain is characterized by intensive information technology at various stages of the economic value chain. To preserve better understanding, decision-makers in agricultural cooperatives need a technology adoption process. One of the determining factors for improving digital technology is offering, embracing, and evaluating new technologies that offer the potential of electronic commerce. As an illustration of agri-food cooperatives in Europe, where wealth measures are influenced by heterogeneous performance, integration, skills training, and digital connectivity. In the scope of the Chinese market, co-creation of value between customers and enterprises relies heavily on understanding technological resources. In this way, alternative competitive strategies push company assets in a transformative direction. This is different from the evidence for several traditional cooperatives at the private campus level in Indonesia. The digital cooperative framework model is running slowly due to conventional membership administration, traditional logistics models, limited time, and manual transactions.

The relationship between financial literacy and profile level was tested through a study approach. For example, an investigation from HC and Gusaptono (2020) analyzed the causality between financial literacy and investment decisions. Financial attitudes, financial awareness, financial behavior, and good financial knowledge encourage customers' decisions to take credit and save at sharia banking in Yogyakarta (Indonesia). In many agro-rural cooperatives in Nepal, cooperative sustainability is influenced by the strength of financial literacy (Nirmal and Bikram, 2015). Technically, investment and saving decisions are assisted by non-profit organizations. By maintaining, designing, and assisting local institutions that focus on basic financial knowledge and technology transfer, it will be useful towards achieving better finances. The financial management behavior of state employee cooperative administrators in Bandar Lampung-Indonesia is reflected in their level of insight. Ermawati et al. (2019) explained that basic knowledge of cooperative management resources is considered to have a significant relationship with financial literacy. The relationship between financial literacy and the financial performance of SMEs in Malaysia with manager control and SME characteristics as moderating variables was tested (Yakob et al., 2021). The validation results explain that financial literacy has a significant impact on SME performance. Through financial literacy skills and professional managerial concepts, sustainable business performance can be guaranteed. Also, business classes in construction, mining and quarrying, agriculture, manufacturing, and service units carried out consistently will expand economic benefits.

6. Conclusions

The target of this research is to compare the sustainability of agricultural cooperatives that adopt technology versus those that adopt non-technology. The data sample focuses on agricultural cooperatives affiliated with the East Kutai Regency government. Through a series of tests, two main things were found. First, access to computers, internet networks, digital administration skills, and financial literacy have a positive effect on the profits of agricultural cooperatives adopting technology. Second, access to computers, internet networks, digital administration skills, and financial literacy have a negative impact on the profits of agricultural cooperatives that are not technology adopters. Third, partial testing found that access to computers, internet networks, digital administration skills, and financial literacy had positive implications for profits in agricultural cooperatives adopting technology, but not in the case of non-technology adopting cooperatives, where only financial literacy has a positive impact on profits.

The academic implications of studying technology are pioneering and best practices for cooperative sustainability. By prioritizing technological elements, it will create creativity for agricultural cooperatives. Agricultural cooperative managers carry out adaptive initiatives to involve all members in an integrated manner. In operations, agricultural cooperative management can bridge

technological innovation, for example, by encouraging technological space that makes payment transactions easier through digital applications that are tracked by a system.

Policy actors are expected to promote, socialize, and transfer knowledge related to technology use skills. Current regulations are still weak, where the government's limitations in dividing supervisory duties often overlap, so they need to be modified. Practical recommendations for non-technology-adopting cooperatives must be resolved through long-term schemes to pay more attention to internet networks and digital administration skills without ignoring the potential of local wisdom. The weakness of the study lies in the observation period. Therefore, future scientific work proposes a constructive methodological design.

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