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INVESTIGATING THE ROLE OF AGRI-TECH STARTUPS IN SUPPORTING INCLUSIVE FINANCE FOR FARMERS IN INDONESIA

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ABSTRACT. Small-scale farmers are often financially excluded due to limited access to formal financial services. For decades, the Indonesian government has launched credit programs for farmers' financial inclusivity. However, it has yet to improve farmers' access to financial services significantly. The Indonesian government has encouraged financial technology providers to enhance credit financing for farmers. Besides fintech startups, agri-tech startup companies have helped provide digital financial services to the agricultural sector. This study aimed to analyze different types of agricultural startup businesses in supporting inclusive finance for farmers. This study uses a qualitative approach by conducting an online semi-structured interview as a data collection technique for four agri-tech startups and two experts. The data was analyzed by template analysis. The result showed that the presence of agri-tech startups could enhance farmers' opportunity to access new financial sources –either through crowdfunding or internal company financial resources - which is better than the existing financing schemes. However, several challenges arose regarding the existing culture that caused farmers to hesitate to join the agri-tech startups' program. Other challenges related to intermediaries' power in agricultural business that had strong ties with farmers' lives are the lack of infrastructure such as road and internet access and farmers' skill in using digital technology. Agri-tech startups have reduced those challenges by sending agriculture experts to the farmland, building intense communication with farmers, cooperating with intermediaries, and providing training for young farmers and farmer's children to optimize the use of smartphones in supplying agriculture knowledge and business.

Keywords: agriculture; agri-tech startup; farmer; financing; inclusive finance

INVESTIGASI PERAN PERUSAHAAN STARTUP TEKNOLOGI PERTANIAN DALAM MENDUKUNG KEUANGAN INKLUSIF BAGI PARA PETANI DI INDONESIA

ABSTRAK. Mayoritas petani Indonesia skala kecil, seringkali tereksklusi dalam mengakses layanan pembiayaan formal. Meski pemerintah telah meluncurkan program pembiayaan selama beberapa dekade, namun belum menunjukkan peningkatan akses layanan pembiayaan pada petani secara signifikan. Pemerintah Indonesia mendorong penyedia layanan pembiayaan digital untuk meningkatkan pemberian pinjaman kepada para petani. Di samping *startup fintech*, keberadaan perusahaan *startup* dibidang teknologi pertanian juga membantu menyediakan layanan pembiayaan digital di sektor pertanian. Studi ini bertujuan untuk menganalisis berbagai tipe bisnis perusahaan *agri-tech startup* dalam mendukung pembiayaan inklusif untuk petani. Dengan menggunakan pendekatan kualitatif, teknik pengumpulan data dilakukan melalui wawancara semi terstruktur secara online terhadap empat perusahaan *agri-tech startup* dan dua informan dari kalangan profesional. Data dianalisis dengan analisis template. Hasil studi ini menunjukkan hadirnya *agri-tech startup* meningkatkan peluang bagi petani untuk mengakses sumber pembiayaan baru, baik melalui *crowdfunding* atau sumber pembiayaan internal perusahaan, yang lebih baik dari skema pembiayaan yang ada. Namun, beberapa tantangan muncul dari sisi budaya yang ada, menyebabkan keengganan petani untuk mengikuti program *agri-tech startup*. Tantangan lainnya adalah adanya kuasa dari tengkulak yang memiliki ikatan kuat dengan kehidupan petani, kurangnya infrastruktur seperti jalan dan akses internet, dan kurangnya kemampuan petani dalam menggunakan teknologi digital. Tantangan tersebut dapat direduksi oleh *agri-tech startup* dengan cara mengirimkan tenaga ahli di bidang pertanian ke lahan pertanian, membangun komunikasi intensif dengan petani, bekerjasama dengan tengkulak, menyediakan pelatihan kepada petani muda dan anak dari para petani untuk mengoptimalkan penggunaan smartphone dalam meningkatkan pengetahuan dan bisnis pertanian.

Kata kunci: *agri-tech startup*; keuangan inklusif; pembiayaan; pertanian; petani

INTRODUCTION

Financial inclusion is believed to contribute to the achievement of the Sustainable Development Goals 2030, especially SDG 1 on eradicating poverty, SDG 2 on ending hunger, SDG 5 on achieving gender equality and economic empowerment of women, and SDG 8 on promoting economic growth and jobs (Kuada, 2019). Financial inclusion enables marginalized individuals and businesses to access a wide range of financial services, such

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as loans, savings, investments, and insurance, provided at reasonable costs by various reliable and sustainable institutions in a controlled environment (Olaniyi, 2017; Sanjaya & Nursechafia, 2016; Hasan et al., 2020, United Nations, n.d.). An inclusive financial system, combined with financial deepening (He et al., 2019) and human capital (Zhou et al., 2018), can lead to a wealthier and expansive economy and more improved economic growth (Hasan et al., 2020). More importantly, the development of inclusive finance contributes to poverty alleviation, thus narrowing the socio-economic gap between the rich and the poor (Jin, 2017). On a household level, inclusive finance allows underprivileged households to fulfil their basic needs for food, house, health care, and education (Chaddad et al., 2005).

Financial inclusion also becomes a concern of the Indonesian government through the Government Regulation no. 114 of 2020 about the National Strategy of Inclusive Finance (NSIF). The NSIF is targeting groups of people who have limited or no access to formal financial services. These are low-income society, micro and small businesses, and cross-group society, such as women, migrants, people with special needs, elderly people, youths, citizens of underdeveloped areas and outer islands, and others. The government implemented several programs from 2013 to 2015 to achieve inclusive financing for all. These programs were the Prosperous Family Savings Program (PSKS) for underprivileged families affected by fuel price increase, the Smart Indonesia Program (KIP) for school age children and adolescents, and the Hopeful Family Program (PKH) for poor families with pregnant women and infants (Ministry of Finance Republic of Indonesia, 2019). Based on a survey conducted by the Financial Services Authority (OJK), Indonesia's financial inclusive index in 2019 reached 76.9%, increasing by 8.38% from 67.8% in 2016. Among those who were already inclusive in financial services, the majority of respondents used banking services (73.88%), followed by non-bank financial institution (14.56%), insurance (13.15%), pawnshop (12.38%), pension fund (6.18%), capital market (1.55%), and microfinance institution (0.72%). However, there were still marginalized groups of people who had limited access to formal financial services, particularly sources of credit (Sanjaya & Nursechafia, 2016). For example, small-scale farmers, who in majority had low income, and because of living in rural areas, they were often financially excluded (Yoko & Prayoga, 2019). As a part of the agricultural value chain, farmers need to have access to financial services to increase their wealth.

Financial inclusion of every actor in the agricultural value chain is a key prerequisite for agricultural productivity and growth (Kuada, 2019; Olaniyi, 2017). For this reason, half a century ago, the Indonesian government launched a special program for financing agricultural business. This financing program has evolved over time, from Pra-BIMAS credit program in 1945 to farmer business credit (KUR Petani) program in 2007, which remains popular today. The government financing program has brought benefits to some farmers. For example, farmers in Garut District can produce more potatoes after accessing a farmer business credit as one of the government financing programs (Wulandari et al., 2018). Research by Feryanto (2017) showed that farmers' income could increase through financing program and agricultural tool supporting programs, such as seed subsidy programs and fertilizer subsidy programs. However, the distribution of credit for farmer business remains suboptimal. The level of farmers' access to credit from formal financial institutions remains low (Indrawati, 2014; Mulyaqin & Haryani, 2013; Supanggih & Widodo, 2013). This might be due to several issues which could be divided into two factors: internal and external factors. Internal factors consist of low level of farmer's education, lack of information related to financial institutions, collateral asset constraints, i.e., farmers have uncertified farmland or limited farmland areas to become collateral asset (Supanggih & Widodo, 2013), less effort to process administrative documents, and preference to access capital loan from informal institutions such as middlemen (Astuti, 2019; Azizah, 2019; Imaniar & Brata, 2020; Supriatna, 2008). External factors consist of suboptimal role of agricultural extension agents in distributing information (Aminah et al., 2015; Supanggih & Widodo, 2013), complicated administration, large number of documents required by banks, monthly installment payment scheme not being suitable for farmers who only earn income during the harvest season (Supriatna, 2008), and banks' low interest in financing farmers due to high production risk and uncontrolled agricultural price (Herliana et al., 2018). To overcome the problems of limited access to financial services, the Indonesian government through the NISF regulation 2020 has encouraged digital financial

service providers to enhance credit financing for farmers, especially for those living in rural areas. Digital inclusive finance contributes to the enhancement of the financing landscape (Wang & Chen, 2023). In this digital era, the presence of agri-tech startup companies may help provide digital financial services to the Indonesian agricultural sector.

In Indonesia, there are 30 digital-based startups that specifically focus on agriculture, called agri-tech startups (Dwiartama, 2020). They provide digital technology not only for large companies in the agricultural sector, but also for small farmers. Most of them are driven by young entrepreneurs who seek to improve farmers' welfare with the motto of 'help farmer, save farming'. As one of their strategies is to improve farmers' welfare, agri-tech startups provide capital financing for Indonesian farmers through financial technology (fintech), for example peer to peer (P2P) lending business. In agricultural sector, P2P lending is a business model that in many cases allows investors to provide financing for farmers. The novelty of this business model is that the investment can be obtained from many different investors, ranging from individuals to institutions, and collected through a crowdfunding system. Crowdfunding is a financial innovation that refers to an alternative financing model that collects relatively small contributions from a relatively large number of individuals using the internet, without the need for standard financial intermediaries (GPFI, 2016). Through crowdfunding, agricultural fintech service companies can collect fund from public and distribute it to farmers. The maximum amount of the funding is equal to the value that the farmer generates with each harvest.

In agricultural sector, fintech becomes the overriding digital technology intended for financial inclusion (Trendov et al., 2019). It can provide access for farmers to affordable funding and insurance products to improve risk management. Agricultural startups as one of the emerging businesses in the digital era, have provided alternative financing for Indonesian farmers (Avisha et al., 2019; Prestama et al., 2019). Agricultural startups can help unbanked farmers access loans without collateral assets (Fitriani, 2018), supported by the collaboration with local communities to support capital financing and agricultural skill, especially for young people (Ramadhan, 2020).

Considering the advantages of agricultural fintech on P2P lending business in providing access to new financial sources for Indonesian farmers, it can be argued that agricultural startups have potential to support inclusive finance for unbanked Indonesian farmers. Previous studies on the development of inclusive finance through digital service for Indonesian farmers mostly focus on fintech startups, both sharia-compliant fintech (Bilal Khan et al., 2021) and conventional ones (Fitriani, 2018; Ramadhan, 2020) through a single case study (Avisha et al., 2019; Widiastuti et al., 2018). These studies also have narrow focus on fintech startups in crowdfunding and P2P lending business. Empirical study on multiple agri-tech startups is required to comprehensively analyze their role in pursuing inclusive financing through various financing schemes for Indonesian farmers. Therefore, this study aims to analyze different types of agricultural startup businesses in supporting inclusive finance for Indonesian farmers.

METHOD

This research used a qualitative approach. While previous literature only provided limited information about a phenomenon, qualitative approach encourages the researchers to focus on exploring this phenomenon from participants' point of view (Creswell & Creswell, 2018). The role of agri-tech startups in supporting inclusive finance for Indonesian farmers is the central phenomenon of this research that was explored through participants' view, perception and opinion. This research used online semi-structured interview as data collection technique. Because the study started during the COVID-19 pandemic, physical distancing measures prevented the researchers from conducting direct observation and interview with the farmers. Therefore, long-distance interviews with agri-tech startups and experts were conducted via conference call only. The semi-structured interviews involved seven interviewees, consisting of five key persons from agri-tech startups and two experts. Selection of participants was mainly based on their knowledge regarding companies' management, operation and development, and also their willingness to participate in the research. All participants of this research are given pseudo names to ensure the confidentiality of their identities. The profile of the participants in this research is shown in Table 1.

Table 1. Participant's profile

Participant's Domain	Position
Startup A	Founder, COO
Startup B	Founder, CEO

Startup C	VP Corporate Services, Head of National Commercial, Corporate Communication Lead
Startup D	Head of Subsidiary

Expert	Expertise
Expert 1	Startup business and digital ecosystem
Expert 2	Startup – farmers network/ relations

Source: developed by authors

The interviews were transcribed, interpreted, and analyzed using template analysis. Template analysis is usually used to analyze qualitative research data with any type of textual data, including interview transcripts, diary entries, or open-ended question responses on a written questionnaire (King & Brooks, 2016). Template analysis is one of the branches of thematic analysis. The difference is that template analysis offers an initial template before analyzing all transcribed data. However, the designed template is very flexible regarding the style and the format. King & Brooks (2016) argued that three features can influence a researcher's choice to use template analysis: the flexibility of the coding structure, the use of a priori themes, and the use of initial template. The flexibility of the coding structure means that template analysis does not require a fixed number of coding levels. Instead, this technique allows the researchers to develop broader themes from rich data related to their research questions. The use of a priori themes means that template analysis allows the researchers to define a limited number of some themes in advance that correspond to key concepts of the research. These themes are used tentatively and have the possibility to be redefined or discarded. The initial template is produced from a sub-set of data. Template analysis uses the initial template to analyze all the research data and it can be modified during the analysis process.

RESULTS AND DISCUSSION

Two main themes, followed by five sub-themes, were established after processing all the collected data using template analysis. All of the created themes were used to answer the role of agricultural startups in supporting inclusive finance for farmers in Indonesia. Table 2 shows the detail of the themes followed by their sub-themes from the results of the data analysis using a template analysis.

Table 2. Results of Template Analysis

Themes	Sub-Themes
Programs of agricultural startups in supporting inclusive finance for Indonesian farmers	Offering financing for farmers through crowdfunding
	Offering financing for farmers from company's internal financial sources
	Covering payment
Review of the program implementation	Challenge
	Solution

Source: developed by authors

Agricultural Startups' Programs to Support Inclusive Finance for Indonesian Farmers

Based on the results of the template analysis, there were three programs from agri-tech startups in supporting inclusive finance for Indonesian farmers. Table 3 shows different types of agri-tech startups and their programs in supporting inclusive finance for Indonesian farmers.

Table 3. Business types of agri-tech startups in supporting inclusive finance for Indonesian farmers

Agri-tech Startup	Business type of agri-tech startups	Program in supporting inclusive finance for Indonesian farmers
Startup A	Agricultural fintech and e-commerce (B2B)	Offering financing for farmers through crowdfunding
Startup C	Agricultural ecosystem platform (e-commerce (B2B & B2C), fintech, supply chain management, and logistics)	
Startup B	Agricultural e-commerce (B2B)	Offering financing for farmers from company's internal financial sources
Startup D	Agricultural ecosystem platform (education, e-commerce (B2B, logistics, and data collection)	Covering payment

Source: developed by authors

Based on Table 3, three programs were offered by agri-tech startup businesses in supporting inclusive finance for Indonesian farmers: (1) offering financing for farmers through financial crowdfunding, (2) offering financing for farmers from the company's internal financial sources, and (3) covering payment. Despite the apparent focus of the main program on providing financial

services to farmers, the agri-tech startups also helped them with market access and agricultural skills and knowledge development.

Offering financing for farmers through financial crowdfunding

Two agri-tech startups in this research, startup A and startup C, improved Indonesian farmers' access to financial services by offering financial capital through public crowdfunding. Talking about this type of financing, two participants said:

> "We give loans to farmers for one-time harvesting, so it is based on the farmers' commodity and the area of their farmland. For example, a farmer group applies for a loan by proposing a budget plan, and then we will evaluate the accountability of the proposal. After the proposal is approved, we offer funding for the project to the public through a crowdfunding scheme." (Startup A)
>
> "When farmers apply for a loan or our marketing team finds farmers that we can support financially, then we send a technical team to do a feasibility study. After the feasibility study is completed and approved, we open this funding project to the public through a crowdfunding scheme." (Startup C)

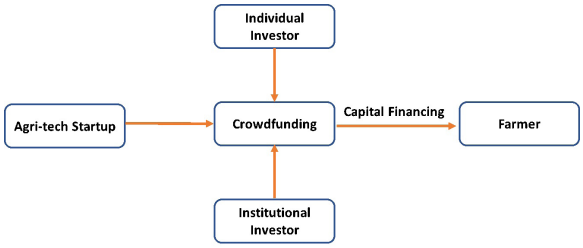

Figure 1. Capital financing through crowdfunding in agriculture business

Source: developed by authors

The new program that offered capital financing for farmers through crowdfunding helped them to access alternative non-banking financial services. This financing program may improve inclusive finance for Indonesian farmers. This financing program would also be beneficial for Indonesian farmers because financial access becomes one of the major problems for farmers in Indonesia, as some participants said:

> "So, if farmers are asked what they need, they don't need drones. And farmers don't need sophisticated sensors. The one planted on the ground or something. They don't need it. What matters is when something is produced, and when there are consumers who will buy it. The second is when farmers need some funds, and there are people to help them." (Startup C)
>
> "Small farmers or farmers with less than 2 hectares of land cannot meet the requirements of banks when they need capital financing." (Startup A)

The result of this research supports the findings of previous research by Mulyaqin & Haryani (2013), Supanggih & Widodo, 2013, and Supriatna (2008) which show farmers' problems in accessing financial services from formal institutions. Finance contributes significantly to agriculture by facilitating farmers in acquiring various agricultural tools and equipment (Pandey et al., 2018). Therefore, new alternative capital financing through crowdfunding has provided Indonesian farmers with advantages to develop their agricultural business. Furthermore, Startup A and Startup C did not only give capital financing for farmers but also improved farmers' agricultural skills and knowledge by sending agricultural experts to their fields. The purpose was to ensure that capital financing was spent effectively and to reduce the risk of crop failure. Since farmers are usually lack of financial literacy, it is important to supervise the financial spending. It is often found that farmers who receive financing from banks do not exclusively use their loans for their farming operations, but instead use them to pay living expenses or to buy some non-farm assets, as described by one participant:

> "Farmers who get capital financing from the bank allocate some of the money to pay for food, school fee and also buy a cow in case they experience agricultural failure. This is actually not right in the management of their finance. They should be able to make maximum use of the loans for the development of their farms." (Expert 1)

This shows that Indonesian farmers need to improve their financial literacy. When a farmer does not make an appropriate allocation from their loan, it can increase the risk of a non-performing loan. History has shown that the amount of non-performing loan in each agricultural credit program in Indonesia reached more than 50% during the period of 1945-1999 (Sayaka & Pasaribu, 2019). Farmers that possess financial literacy are more adept at protecting themselves from potential financial disruptions and developing financial resilience (Klapper &

Lusardi, 2020). According to (Das & Maji, 2023), cognitive capacity, education, land ownership, and risk tolerance are significant factors that can predict the level of financial literacy and debt literacy among farmers.

The conventional financing scheme allows banks to provide only loans for farmers without guidance in financial management nor agricultural knowledge and skills. Therefore, Startup A and Startup C attempted to fill the gap by providing supervision to farmers on financial literacy and agricultural knowledge and skills, in addition to financing. Through this method, Startup A and Startup C could help reduce the risk of crop failure, which may also lower the risk of default on debt payment.

Because of farmers' low level of financial literacy, Startup A and Startup C did not disburse all the loan in cash to the farmers, but allocated some of it to purchase fertilizers, pesticides, and agricultural equipment. As two participants put it:

> "We also don't leave the farmer as they get our capital loan. We also assist in managing the purchase of fertilizers, pesticides and other agricultural products. Besides that, we also send a team of experts to live with them on their farmlands. For example, in Jonggol district, we placed one agricultural expert on the farmlands to support 131 farmers." (Startup A)
>
> "If we give cash in large amount, it will be like a challenge for them. We are worried if there are other necessities, when they see a lot of money, they will end up buying things that are not related to their operational needs. So, we give it gradually, while we share educational aspects with our agricultural expert on the farm. Besides that, we have started to directly facilitate their operational needs, such as fertilizers, seeds, and pesticides. So, rather than offering full cash, we give fertilizers, seeds and pesticides which are already good according to the advice of our agricultural expert." (Startup C)

The role of agricultural experts in the farmland was important for farmers to give them recommendation about the cultivation process and some advice related to agricultural business. Their presence had also improved the skills and knowledge of farmers in agricultural business, supported the implementation of good agricultural practices, and increased the quality and quantity of harvest. This result is in line with the result of previous research by Fadhilah, Eddy, & Siwi (2018) which highlighted the importance of farmers' skill and knowledge in implementing good agricultural practices and creating better agricultural production. Furthermore, farmers were also trained to make financial calculation and its management for good agricultural production. Using this method, farmers could implement good agricultural practices as recommended by the experts, and this could reduce the risk of crop failure. Agri-tech startups are an integral part in the entrepreneurial ecosystem and contribute to the absorption of financial resources (Bertucci Ramos & Pedroso, 2022).

Startup A and Startup C went beyond offering loans to help farmers; they improved financial literacy and assisted the cultivation process. Moreover, they also helped farmers open access to market. It is essential to ensure farmers could sell all their harvests to the right market, so they could generate income and successfully increase the rate of loan repayment. Startup A and Startup C opened the market for farmers in two ways. The first was by collecting all harvests and selling them to the agri-tech startup's consumers. The second was by helping farmers to sell only a portion of their crops to the agri-tech startup's consumer network. Commenting on ways of opening market access, two participants said:

> "So why is it important to help open market access to farmers? It is because farmers get money when their crops are bought. If it's using the old model, or if the farmers sell the crops themselves to the market, not all of them will be necessarily sold. Besides that, for example, if only 40-50% can be sold, the remaining 50% will be damaged. If we can support farmers by buying all of their crops, we are the off-takers, meaning that farmers will get money faster from selling their crops." (Startup C)
>
> "We are involved until the marketing chain to maximize sales and reduce the risk of failure in debt payment." (Startup A)

Startup A and Startup C offered a new alternative capital financing model for Indonesian farmers through a crowdfunding system. This type of financing increased farmers' opportunity to access financial services and support the development of inclusive finance for Indonesian farmers. Furthermore, Startup A and Startup C also helped farmers to improve their agricultural skills and knowledge, access new market, and develop financial literacy.

Offering financing for farmers from the company's internal financial sources

The second type of capital financing for farmers is offering financing from the company's internal financial sources. Through this method of capital financing, farmers could get a loan from agri-tech startups in the form of cash and agricultural supplies such as fertilizers, seeds, and pesticides. Farmers involved in this method of financing usually become the startup's partners through a cooperation agreement. Moreover, this method of financing is usually targeted only for farmer groups instead of individual farmers to facilitate coordination and achieve production target. Farmers who join farmer group could leverage the capital loan to achieve production target set by the agri-tech startup. On the other hand, individual farmers often cannot achieve the targeted production volume. Different from crowdfunding scheme, agri-tech startups which use internal financial sources do not send any agricultural experts to supervise and monitor the cultivation process. As harvest season approaches, agri-tech startup will collect and buy the entire crops and then sell them to their consumers. In this research, only Startup B had this type of financing model, as one participant commented:

> "We call the farmers who have collaborated with us as partner. And, we give loan in cash and agricultural supplies, such as seeds, fertilizers, and pesticides. When the harvest season is near, we buy the entire crops." (Startup B)

Figure 2. Capital financing from the company's internal financial sources in agricultural business
Source: developed by authors

Startup B offered a new alternative to capital financing model for Indonesian farmers. Through the company's internal financial sources, startup B offered capital financing for a group of farmers that was required to collaborate and become their partner. This type of financing increased farmers' opportunity to access financial services from formal institutions. This financing model has also supported the development of inclusive finance for Indonesian farmers.

Covering payment

The last type of financing is different from the two above. In this type of financing, Startup D did not provide loans to farmers, but assisted them to manage the operation cash flow by covering payment for the sales of agricultural products purchased by modern market. In a common business in which Startup D did not participate, modern market customers usually bought products from farmers using consignment payment method. This method usually took several months until farmers could receive the payment. This hindered farmers' financial cash flow because they needed financial capital to grow new crops and to sustain themselves.

Figure 3. Common trade transaction
Source: developed by authors

Startup D acted as an intermediary between farmers and modern market by providing online application platform where trade transaction took place and allowing payments for the sales of agricultural products purchased by modern market. When consumers bought products on online platforms, Startup D covered payments to the farmers using its internal financial sources. Then, Startup D waited for the consumers to make the payment through consignment method. Through this method of financing, new cultivation could begin immediately without affecting the farmers' cash flow.

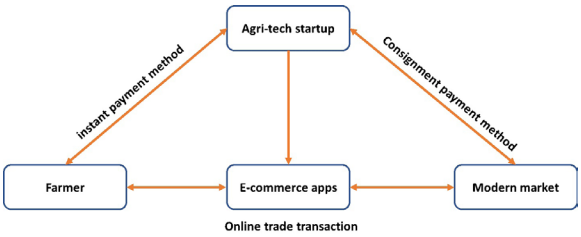

Figure 4. Startup E's involvement in trade transaction
Source: developed by authors

Our findings showed that Startup D had a type of financing model as seen in Figure 4, as one participant put it:

> "We do not only provide a platform for farmers and buyers to meet, but we also help cover payments from buyers to farmers. Because the buyers on our platform are modern market, and they usually pay purchase of crop products using consignment payment method over a period of three to six months. Delays in payments will become an obstacle for farmers to start cultivating crops and pay for their living cost." (Startup D)

Startup D offered Indonesian farmers a different way to access financial services. Through this cover payment, Startup D sought to support the operational cash flow of farmers' business.

This is a new alternative to the financing model offered by Startup D which could support the development of inclusive finance for Indonesian farmers.

Based on the explanation of the three programs above, agri-tech startups could support the government's financial inclusion improvement program as stipulated in Government Regulation no. 114 of 2020 on the National Strategy for Inclusive Finance (NSIF). Through these programs, agri-tech startups could help enhance financial inclusion, especially for Indonesian farmers who have difficulty accessing financial services from formal institutions.

The results of this study enriched the results of previous research from Fitriani (2018) and Ramadhan (2020), which discuss the role of agri-tech startups but only in the form of providing financial capital loans to farmers. This research examined the various roles of agri-tech startups in offering financial access for Indonesian farmers by not only offering hot cash but also supporting farmers' operational cash flow. Furthermore, agri-tech startups supported farmers with other activities such as improving farmers' agricultural skills and knowledge, opening new market access, and developing financial literacy. Through these supporting activities, agri-tech startups increased the opportunity for farmers' business and reduced the risk of debt-trap. This also supports the finding of Fitriani (2018) which showed that agricultural startup could help unbanked farmers access loans without collateral assets. Table 4 summarizes the advantages of each financial service program offered by agri-tech startups for Indonesian farmers.

Table 4. Summary of the advantages of agri-tech startup programs

Program in supporting inclusive finance for Indonesian farmers	Agri-tech Startup	Advantages
Offering financing for farmers through crowdfunding	Startup A Startup C	Offering financial capital Improving farmers' agricultural skills and knowledge Opening new market access by helping farmers selling their crops Providing guarantee to collect and buy all crops in every harvest season Improving financial literacy
Offering financing to farmers from company's internal financial resources	Startup B	Offering financial capital Providing guarantee to collect and buy all agricultural products in the harvest season Empowering farmers' family to work in warehouses and sorting centers
Covering payment	Startup D	Ensuring smooth operational cash flow Facilitating online trade transactions

Source: developed by authors

However, behind the benefits enjoyed by farmers, there were some challenges in the process of introducing programs from agri-tech startups to Indonesian farmers. The following section discusses some of the challenges and solutions of agri-tech startups in providing financial access to Indonesian farmers.

Challenges and solutions of agri-tech startups in providing financial access to Indonesian farmers

When introducing some programs to farmers, agri-tech startups faced some challenges, such as: (1) farmers hesitated over participating in the programs, (2) power of middlemen in agricultural sector, (3) lack of infrastructure around the farming area, and (4) farmers' skills in digital technology.

Farmers hesitated over participating in the program

When the agri-tech startups first introduced their programs to farmers, only a few farmers were willing to participate. Many farmers hesitated and refused to work with agri-tech startups because the power of existing culture made them cautious about new entities entering the agricultural business. Moreover, farming techniques that have been taught for generations resulted in many farmers refusing to follow the farming methods proposed by agricultural experts from agri-tech startups. The comments below illustrate this situation:

> "The more remote the area, the more difficult it is for the farmers to change the system, especially to change their culture." (Startup B)
>
> "Most of the farmers have cultivation technique that has been passed down from generation to generation, so it's difficult if we directly order them to change that technique; we might face significant resistance from the farmers." (Startup C)

These challenges did not stop agri-tech startups from introducing programs to Indonesian farmers. Agri-tech startups had to make enormous efforts to gain farmers' trust, such as by living with farmers and communicating intensively within weeks or even months. They reached out to key opinion leaders, both farmers and community leaders. They also worked with key farmers to initiate new cultivation procedures as recommended by agricultural experts, and then showed them that crop yields were better than those from traditional techniques. Some participants said:

> "At first, the farmers rebuffed. They even firmly refused. But since our team lived with the farmers and built intensive communication with them, they finally liked us." (Startup A)
>
> "Usually, we approach one key farmer in the area. Then, for example, if they have one hectare, we ask for a few areas as an example to be planted according to the techniques recommended by our agricultural experts. When the harvest of our method is better, and the farmer is happy with the increasing omzet, the key farmers will talk over coffee or chat with other farmers. Eventually, other farmers came to us by themselves to ask for help." (Startup C)

Middlemen power in agricultural environment

Middlemen have been present for a long time and often lead the supply-chain in agricultural business. A middleman plays many roles in agricultural business activities, from offering capital financing to collecting and distributing crops during harvest season. Two participants commented as follows:

> "The location and transportation constraints have left farmers dependent on middlemen to market their crops. Moreover, when farmers obtain loans from a middleman, the selling price can be further reduced." (Expert 1)
>
> "Our founders see that farmers have a lot of difficulties when they want to sell their agricultural products. Therefore, farmers rely on middlemen to sell their crops." (Startup C)

This result is consistent with those of Imaniar & Brata (2020) and Azizah (2019) which showed that middlemen existed in the agricultural business and helped farmer to access market. Middlemen give loans to farmers, collect and buy agricultural products from farmers, and then sell them to consumers in the market. However, farmers could be at a disadvantage as some middlemen set very low purchasing price to farmers (Astuti, 2019).

The role of middlemen in farmers' life is not only within the farm, but also outside the trade. Middlemen can lend money (often at high interest rates) to farmers to cover basic needs such as children's school fees, medical expenses, food, and other daily needs. This could give middlemen a powerful position in agricultural sector. Therefore, the strong power of middlemen posed a challenge for agri-tech startups to introduce new alternative financing programs to farmers. Farmers have long been heavily dependent upon middlemen, making access to other financial services extremely difficult. Replacing such a strong entity like middlemen is almost impossible. Instead of competing with middlemen, agri-tech startups chose to cooperate with middlemen, especially in marketing and distributing the crops.

Lack of infrastructure around the farming area

The infrastructure around the farmland became another challenge for agri-tech startups to help farmers to access financial services and implement other supported programs. Lack of stable internet access and adequate road conditions were the major problems around the farmland, mostly located in rural areas. These conditions had an impact on how agri-tech startups implemented programs for farmers. Poor road conditions posed a challenge for agri-tech startups when collecting harvested crops. Trucks for distributing the crops could not reach the fields because the roads were too narrow and bumpy. As a result, farmers and workers of agri-tech startup had to bring the crops by foot to the truck in the parking area. In addition, the lack of stable internet access could affect internet communication and delay the input of cultivation data to the smartphone application. To overcome this problem, the startup staff often had to record the cultivation data manually and then entered the data when the internet access was good. An obstacle to the adoption of technology is the effect of the lack of well-organized supply chain due to inadequate infrastructure (Kaushik et al., 2023).

Farmers' skill in digital technology

Lack of skills in digital technology posed another challenge for agri-tech startups to introduce financing programs which utilized digital technology platforms. This is because 64.20% of Indonesian farmers were over 45

years old, and only around 13.44% of Indonesian farmers had experience in accessing the internet (Badan Pusat Statistik, 2018). Indonesian farmers' lack of digital technology skills, such as operating smartphones and using online applications, could inhibit the implementation of agri-tech startup programs.

To overcome these problems, agri-tech startups hired an agricultural expert to help farmers not only by giving recommendations about agricultural techniques, but also inputting the cultivation data into the online application. Agri-tech startups also trained the farmers' children to optimize their smartphone use not only for communication or accessing social media, but also for learning and business.

In general, whenever agri-tech startups introduced new financing programs for Indonesian farmers, there were always some challenges and resistance from farmers. Table 5 shows the challenges and solutions in each startup's program.

Table 5. Challenges and solutions in each startup's program

Program in supporting inclusive finance for Indonesian farmers	Agri-tech Startup	Challenges	Solutions
Offering financing for farmer through crowdfunding	Startup A Startup C	Farmers' hesitation to participate in the program	Living with farmer and building intensive communication with them Reaching out key farmers and community leaders Working with key farmers to implement cultivation procedures recommended by agricultural experts Showing real examples of crop yields from new cultivation techniques
		Power of middleman	Working with middlemen in marketing and distributing the crops
		Lack of internet infrastructure around the farming area	Recording cultivation data manually in notes when working in areas without internet access
		Lack of road infrastructure around the farming area	Carrying the crops to the parking area
		Lack of farmers' skills in digital technology	Assisting farmers inputting cultivation data into smartphone applications Training the farmers' children to optimize the use of smartphones to improve knowledge and business
Offering financing for farmers from company's internal financial sources	Startup B	Farmers' hesitation to participate in the program	Living with farmer and building intensive communication with them Reaching out key farmers and community leaders
		Power of middleman	Working with middlemen in marketing and distributing the crops
Helping the operational financial cashflow of farmers' business	Startup D	Lack of farmers' skills in digital technology	Training the farmers' children to optimize the use of smartphones to improve knowledge and business

Source: developed by authors

As discussed earlier, the success of the agri-tech startups' financing programs was supported by the collaboration with local communities. Consistent with Ramadhan (2020), this research found that agri-tech startups did not only improve farmers' agricultural skills, but also their digital literacy, either directly or indirectly. Direct support was usually intended for young farmers, while indirect support was in the form of training for young people who were related to the farmers.

In regard to the advantages of agri-tech startups in providing access to new financial sources for Indonesian farmers and considering their activities which were not exclusive to

financing only, the agri-tech startups could be categorized as non-fintech startups. This corroborates the findings of previous studies on the development of inclusive finance through digital financial services for Indonesian farmers which mostly focus on fintech startups (Bilal Khan et al., 2021).

Since farmers usually prefer to access capital loans from informal institutions such as middlemen (Supriatna, 2008), this research found that the presence of agri-tech startups in the agricultural sector could also reduce the power of middlemen over farmers. In relation to this, the agri-tech startups tried to build intensive communication with the farmers, which usually required an approach to key farmers and/or community leaders and was given precedence. Furthermore, the agri-tech startups also built mutual cooperation with the middlemen to decrease or to eliminate rivalry in business relations with the farmers.

CONCLUSION

This study has shown the role of agri-tech startups in supporting inclusive finance for farmers in Indonesia. The presence of agri-tech startups could increase farmers' opportunity to access new financial sources, either through crowdfunding or internal financial resources, which were better than the existing financial sources. Existing financing program known as farmers' credit could not be utilized optimally by farmers. As a source of financing, banks often had little interest in financing farmers who had high uncertainty in repaying the credit, including loans. In this context, agri-tech startups could help farmers increase their chances of loan repayment by being involved in the cultivation process and providing the farmers with new market access for their crops. These could support farmers' operational cash flow. However, several issues arose when agri-tech startups introduced their programs to farmers. The first issue was the existing farming culture that caused hesitation from farmers to participate in the agri-tech startups' programs. Other challenges include the power of middlemen in agricultural business that had strong ties with farmers' life, lack of infrastructure such as road and internet access, and lack of farmers' skills in using digital technology. Agri-tech startups had overcome these challenges by sending agricultural experts to the farmland, building intensive communication with farmers, cooperating with middlemen, and providing training for young farmers and farmers' children to optimize the use of smartphones to improve knowledge and business.

This study contributes to the academic discussion on how agri-tech startups can act as alternative financing sources for farmers. It also provides information for agricultural extension on how they can work with agri-tech startups to support farmers. This study is also expected to aspire collaboration between banking institutions and agri-tech startups, where banks act as investors and agri-tech startups as funding managers and distributors. This collaboration may reduce the probability of non-performing loans that often occurs in conventional credit schemes.

This study has several limitations. First, we only gathered information and analysis from startups' perspectives without balancing them with farmers' standpoint. Second, the case study might not represent the condition of agri-tech startups at the national level. Therefore, future research is needed to enrich the discussion about the role of agri-tech startups in inclusive finance for farmers. A survey at a national level on financing activity of agri-tech startups may provide comprehensive insights into the critical role of agri-tech startups in financial inclusion. Moreover, quantitative and qualitative analyses of the impact of financing provided by agri-tech startups on company's profitability and farmers' welfare could provide more convincing evidence on the significant role of agri-tech startups.

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