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Innovation of Lease Model of Agricultural Machinery through Digitalization of Productive Waqf to Sustain Economic Resilience in East Java

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Abstract

East Java, as Indonesia's most populous province with the largest farming population, faces major agricultural productivity challenges due to limited access to machinery among smallholder and low-income farmers. This study aims to develop a lease-use model for agricultural machinery targeting farmers who live below the poverty line through the digitalization of productive waqf in order to enhance economic resilience. This research employs a descriptive qualitative approach using secondary data to formulate a model tailored to the needs of farmers. The findings reveal a lease-use mechanism for agricultural equipment that operates through several stages of waqf crowdfunding: (1) Al-Waqif (donors) register and contribute funds via a digital platform; (2) Al-Mauquf Alaihi (farmers) apply and borrow machinery under specified terms; and (3) the Indonesian Waqf Board and Sharia banks manage the system under regulatory supervision. The results indicate that this model has the potential to improve farmers' access to modern agricultural machinery, reduce production costs, and strengthen rural economic resilience through sustainable waqf-based financing. Furthermore, this study contributes to the literature by bridging the gap between Islamic social finance innovation and digital agricultural support systems and offers a sustainable and inclusive approach to agricultural development.

1. Introduction

Poverty remains a complex issue across various regions of Indonesia, including East Java Province. According to data released by the Badan Pusat Statistik, the poverty rate in East Java Province as of March 2024 was recorded at 9.56%, indicating a relatively high figure compared to several other provinces in Indonesia. For instance, Central Java reported a poverty rate of 9.58%, South Sumatra 10.97%, and South-east Sulawesi 11.21%, while provinces such as Jambi and Central Kalimantan recorded lower poverty rates, at 7.10% and 5.17% respectively. Although East Java is not the province with the highest poverty rate, these data underscore the need for sustained efforts to reduce poverty levels and improve community welfare, particularly among vulnerable groups such as farmers (Badan Pusat Statistik., 2024).

On the other hand, the agricultural sector plays a strategic role in national development, particularly in efforts to alleviate poverty. According to the Worldbank (2023), development in the agricultural sector has been proven to be two to four times more effective in increasing the income of the poor compared to other sectors. This sector contributes approximately 4% to global Gross Domestic Product (GDP) and accounts for more than 25% of GDP in several developing countries. Agriculture supports food security and serves as a livelihood for millions of poor households in rural

areas, including those in East Java. Unfortunately, this considerable potential has yet to be fully harnessed due to several structural barriers faced by smallholder farmers, one of which is limited access to agricultural tools and machinery (Worldbank, 2023).

This limitation is one of the primary factors contributing to the low productivity and income of farmers. This condition can be explained through the theory of the vicious cycle of poverty, which posits that low income leads to low savings, resulting in low investment. Consequently, productivity remains low, and the cycle of poverty persists. In the agricultural context, farmers' inability to purchase or rent agricultural machinery is a major obstacle to improving agricultural output. When farmers are unable to access modern agricultural technology, they are forced to rely on traditional farming methods, which are time-consuming, labor-intensive, inefficient, and highly susceptible to crop failure (Eldridge et al., 2022). Therefore, alternative solutions must be sought to enhance the competitiveness and efficiency of smallholder farmers in the production process.

In line with the poverty trap theory, limited capital and restricted access to productive assets often prevent smallholder farmers from adopting modern agricultural technologies that could significantly improve productivity and income. This structural constraint creates a reinforcing cycle in which farmers remain trapped in low-productivity agricultural systems. Therefore, innovative financing mechanisms are crucial for breaking this cycle and improving rural economic resilience by providing access to productive assets without imposing excessive financial burdens.

One potential solution offered within the framework of Islamic economics is waqf. Historically, waqf has played a significant role in supporting social and economic development in Muslim societies, including in the fields of education, healthcare, and social welfare. In contemporary practice, the concept of productive waqf has emerged, emphasizing the active management of waqf assets to generate sustainable economic benefits. Waqf is no longer limited to immovable assets such as land for mosques or schools but can also include movable assets such as cash, precious metals, and productive equipment. In Indonesia, the development of waqf is supported by a strong legal framework, particularly Undang-Undang No. 41 (2024) concerning Waqf, which allows waqf assets to be managed productively to support community well-being.

From an Islamic social finance perspective, productive waqf has increasingly been viewed as a sustainable instrument for poverty alleviation and economic empowerment. Unlike conventional charitable donations that are typically consumptive in nature, productive waqf enables the utilization of philanthropic assets for income-generating activities that can continuously benefit society (Ascarya et al., 2022). This characteristic makes productive waqf particularly suitable for supporting productive sectors such as agriculture, where access to capital and equipment remains a major challenge for smallholder farmers.

In the digital era, technological development has transformed the way philanthropic activities are conducted, including waqf. The rapid growth of digital platforms and financial technology has enabled the emergence of digital waqf systems that allow broader community participation. Indonesia has become one of the countries with the fastest-growing digital ecosystems, with thousands of technology-based startups and increasing adoption of digital financial services. This development has also encouraged the rise of online donation platforms and digital Islamic social finance instruments, including waqf crowdfunding mechanisms.

The integration of financial technology (fintech) with Islamic social finance instruments has created new opportunities for mobilizing social funds more efficiently and transparently (Alfian et al., 2025). Crowdfunding platforms, for instance, have been widely recognized as effective tools for pooling small contributions from large numbers of individuals to finance social or economic initiatives. When integrated with waqf mechanisms, crowdfunding can facilitate the collection of philanthropic funds that can be allocated toward productive assets, including agricultural machinery, thereby providing broader economic benefits for rural communities.

Recent studies have begun to examine the transformation of waqf in the digital era. For instance, the study Transformation of Waqf in the Digital Era: Qualitative Analysis of Waqf Crowdfunding Models and Cash Waqf Savings Products from the Perspective of Maqashid Syariah conducted by

Marpaung & Lubis (2024) highlights how digital platforms such as waqf crowdfunding and cash waqf savings products can expand community participation in philanthropic activities. Their findings indicate that digital waqf has the potential to mobilize social funds more effectively and align philanthropic activities with the objectives of Maqashid Syariah, particularly in protecting and developing economic resources (Hifdz al-Mal). However, the study also notes several challenges in implementing digital waqf, including regulatory uncertainty, limited public awareness, risks of mismanagement, and restricted investment opportunities.

Although these studies give valuable insights into the development of digital waqf, most existing research focuses primarily on fundraising mechanisms or institutional governance. The practical application of digital waqf to directly support productive sectors particularly agriculture remains relatively underexplored. Similarly, research on agricultural crowdfunding often focuses on financing farming activities but rarely integrates Islamic social finance instruments such as waqf within a comprehensive technological and institutional framework.

These limitations indicate a significant research gap. Although digital waqf, crowdfunding mechanisms, and agricultural development have been examined separately; however, there remains a deficiency of integrative models that amalgamate these components to tackle the structural challenges encountered by low-income farmers, especially regarding access to modern agricultural machinery. Table 1 presents a comparison of relevant previous studies to clarify this gap and highlight the novelty of the present study.

Table 1. Comparison of Previous Studies and Identification of Research Gap

Author(s)	Research Focus	Method/ Approach	Key Findings	Limitations	Contribution of This Study
Marpaung & Lubis (2024)	Digital waqf transformation through waqf crowdfunding and cash waqf savings	Qualitative analysis	Digital waqf platforms can expand community participation and support socio-economic development	Focuses mainly on fundraising mechanisms and institutional management; does not address sector-specific applications such as agriculture	Extends digital waqf utilization toward productive agricultural development through an agricultural machinery leasing model
Various Islamic crowdfunding studies	Islamic crowdfunding as an alternative financing mechanism	Financial technology models	Crowdfunding effectively mobilizes community funds for entrepreneurial activities	Mostly focuses on entrepreneurship and SME financing rather than agricultural productivity	Integrates crowdfunding mechanisms with productive waqf to support agricultural machinery access
Agricultural financing studies	Financial access for improving agricultural productivity	Agricultural economics approach	Improved access to finance increases farm productivity and income	Limited integration with Islamic social finance instruments such as waqf	Introduces waqf-based financing as an alternative mechanism for agricultural machinery provision
Innovation governance studies	Multi-stakeholder collaboration in innovation ecosystems	Penta Helix governance model	Collaboration among government, academia, industry, media, and society strengthens innovation systems	Uncommonly applied in Islamic social finance or agricultural financing contexts	Applies the Penta Helix framework to support governance of digital waqf-based agricultural machinery leasing
This Study	Digital productive waqf-based agricultural machinery leasing model	Qualitative conceptual modeling	Proposes an integrated framework combining digital waqf, crowdfunding, agricultural machinery leasing, and Penta Helix collaboration to improve	—	Provides theoretical and practical contributions to Islamic social finance and agricultural development

Author(s)	Research Focus	Method/ Approach	Key Findings	Limitations	Contribution of This Study
			farmers' access to technology		

If developed properly, digital *waqf*-based crowdfunding could be a useful way to connect the equipment needs of smallholder farmers with the *waqf* funds that are available from the community as a whole. Moreover, this digital approach is particularly well-suited to target the millennial generation, which is projected to comprise up to 70% of Indonesia's workforce by 2030 (Badan Pusat Statistik., 2018), a group known for its familiarity with technology and strong social awareness.

The development of a loan-for-use model for agricultural machinery based on the digitalization of productive waqf requires not only technological innovation but also cross-sector collaboration. In this context, the Penta Helix approach becomes highly relevant. The Penta Helix model of **Figure 1** emphasizes collaboration among five key stakeholders academia, industry, government, media, and society to foster innovation and sustainable development.

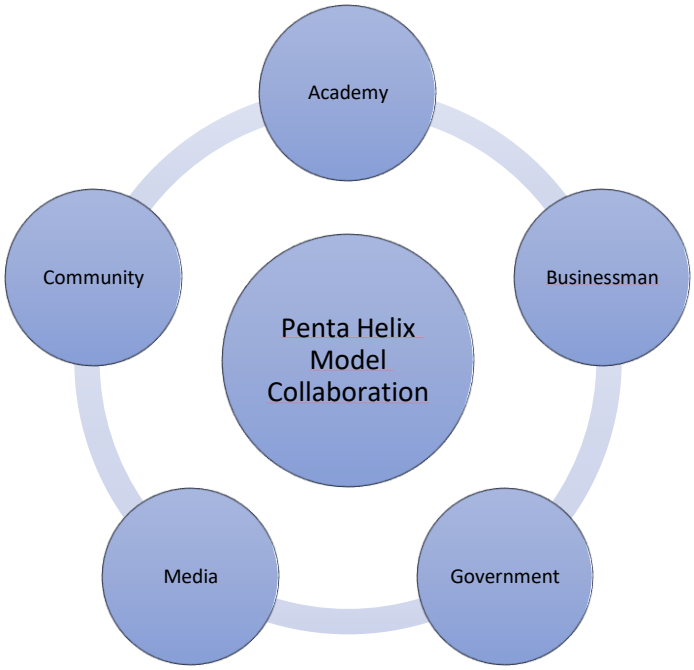

Figure 1. Model Penta Helix
Source: Khusniyah (2020)

This collaborative approach allows the government to function as a regulator and facilitator, industry as a technology and infrastructure provider, academia as a knowledge developer and evaluator, media as an information disseminator, and the community as the primary implementer. Compared with earlier innovation models such as the Triple Helix, the Penta Helix framework offers a more inclusive governance structure that incorporates broader societal participation.

The integration of the Penta Helix framework with digital productive waqf systems is particularly relevant in addressing complex socio-economic challenges that require multi-stakeholder coordination. Previous studies have shown that collaborative governance models can enhance the effectiveness of innovation ecosystems by combining institutional support, technological development, and community participation (Swandono, 2024). Therefore, applying the Penta Helix approach in managing digital waqf-based agricultural financing may strengthen transparency, accountability, and long-term sustainability.

Therefore, this study proposes an integrative model that combines digital productive waqf, crowdfunding mechanisms, and a loan-for-use system for agricultural machinery within a

collaborative Penta Helix framework. While previous studies have examined digital waqf platforms, crowdfunding mechanisms, and agricultural development separately, few have attempted to integrate these components into a comprehensive model aimed at improving farmers' access to agricultural technology.

The rationale for proposing this model lies in the urgent need to address structural barriers faced by smallholder farmers particularly limited access to productive assets while simultaneously utilizing the growing potential of digital Islamic social finance. By combining philanthropic funding mechanisms with digital technology and collaborative governance, the proposed model aims to create a sustainable system that enables farmers to access agricultural machinery without requiring large upfront capital investments.

From a theoretical perspective, this study contributes to the literature on Islamic social finance and agricultural development by proposing a conceptual framework that links philanthropic funding mechanisms with productive agricultural support systems through digital technology and multi-stakeholder collaboration. Practically, the model offers a potential institutional and policy framework that can facilitate farmers' access to agricultural machinery, reduce production costs, and increase productivity in rural areas with relatively high poverty rates.

Given the urgency of improving farmers' welfare and strengthening agricultural productivity, this study aims to design an innovative model for lending agricultural tools and machinery to smallholder farmers through the digitalization of productive waqf using a collaborative Penta Helix approach. The model is expected to contribute to strengthening economic resilience in East Java while promoting sustainable agricultural development through a digital Islamic social finance system.

2. Research Method

This study employs a descriptive qualitative approach with the objective of understanding and designing a loan-for-use model for agricultural machinery through the digitalization of productive waqf to support economic resilience in East Java. The data utilized in this research are secondary data obtained indirectly from various credible sources, such as literature related to agriculture, productive waqf, digitalization, Penta Helix collaboration, government policy documents, previous research reports, and statistical data from the Badan Pusat Statistik (BPS).

The secondary data used in this research were collected from several types of sources, including peer-reviewed journal articles, books, official government reports, institutional publications, and statistical databases related to agriculture, Islamic social finance, and digital economic development. Particular attention was given to recent studies discussing productive waqf, crowdfunding mechanisms, agricultural mechanization services, and collaborative governance models relevant to rural development. In addition, official reports from government institutions such as the Ministry of Agriculture, the Indonesian Waqf Board, and the Badan Pusat Statistik were utilized to provide empirical context regarding agricultural conditions and poverty levels in East Java.

The selection of data sources followed several criteria to ensure the relevance and credibility of the information. First, the data had to be directly related to the research topic, particularly literature discussing productive waqf, Islamic social finance, agricultural financing, or agricultural mechanization. Second, the credibility of the sources was considered, prioritizing peer-reviewed journal publications, official government documents, and reports from recognized institutions. Third, the selected data needed to reflect conditions that are comparable to the agricultural and socio-economic context of East Java. Through these criteria, the study ensured that the collected information could effectively support the formulation of the proposed model.

Data collection techniques include an in-depth literature review, documentation studies of official documents and previous research findings, as well as critical analysis by the author to generate a comprehensive understanding.

In analyzing the data, this study applies several qualitative analytical techniques. First, a thematic analysis was conducted to identify key themes emerging from the literature related to

productive waqf, crowdfunding mechanisms, agricultural mechanization, and multi-stakeholder collaboration. These themes were then categorized and synthesized to understand how existing concepts and empirical findings could be integrated into a coherent framework. Second, a content analysis approach was used to examine policy documents, institutional reports, and previous research findings to extract relevant information regarding agricultural challenges, financing mechanisms, and digital Islamic social finance initiatives.

Based on the results of the thematic and content analyses, the study then employed a conceptual modelling approach to formulate a proposed model for the lease-use mechanism of agricultural machinery through digital productive waqf. This conceptual modeling process involved integrating insights from the literature with the Penta Helix collaboration framework in order to design a model that connects stakeholders such as government, academia, industry, community, and media in managing waqf-based agricultural equipment services.

To enhance the validity and credibility of the findings, this study implements data triangulation and source triangulation by comparing information from various documents and incorporating perspectives from academics, government agencies, waqf organizations, and stakeholders in the agricultural sector.

Data triangulation was conducted by comparing information obtained from different types of sources, including academic literature, policy documents, and statistical data, to ensure the consistency of findings across multiple references. The study further strengthened source triangulation by examining perspectives from various institutional contexts, including Islamic social finance institutions, agricultural policy reports, and innovation ecosystem studies. This comparative approach allows the researcher to validate the proposed conceptual model by ensuring that it is supported by multiple sources of evidence and relevant theoretical frameworks.

In addition, the conceptual framework developed in this study was cross-checked with existing literature in the fields of Islamic social finance, agricultural economics, and innovation ecosystem governance to ensure its theoretical consistency. This process serves as an indirect form of expert validation by aligning the proposed model with established academic discussions and empirical findings in related fields.

Through this approach, the study aims to develop an effective and applicable innovative model as a Sharia-based economic solution to improve the productivity and economic resilience of farmers in a sustainable manner. Furthermore, the descriptive qualitative approach enables the researcher to explore the underlying structural challenges faced by smallholder farmers particularly limited access to agricultural machinery and to translate insights from the literature into a practical conceptual model that addresses these challenges through the integration of digital productive waqf, crowdfunding mechanisms, and Penta Helix collaboration.

3. Results and Discussions

Based on thematic and content analysis of literature related to agricultural mechanization, Islamic social finance, and collaborative governance models, several key themes were identified. These themes represent the main structural issues and opportunities associated with the development of a digital productive waqf-based model for agricultural machinery leasing. The themes highlight the challenges faced by smallholder farmers in accessing agricultural equipment, the potential of digital waqf crowdfunding as an alternative financing mechanism, the importance of multi-stakeholder collaboration, and the conceptual development of a sustainable agricultural machinery service model. The results of the thematic analysis are summarized in Table 2.

The reviewed literature highlights several interconnected challenges and opportunities in agricultural development. First, smallholder farmers continue to face limited access to agricultural machinery due to high capital costs and unequal distribution of equipment. Second, financial constraints further restrict farmers' ability to invest in productive assets, as many are excluded from

formal financial institutions due to limited collateral and high sectoral risks. At the same time, the emergence of digital crowdfunding platforms and the growing interest in productive waqf present new opportunities for mobilizing philanthropic funds to support agricultural development. Previous studies also emphasize the importance of collaborative governance among multiple stakeholders to ensure effective implementation of innovative financing models. Furthermore, the digitalization of Islamic social finance enhances transparency, efficiency, and public participation in philanthropic initiatives. Based on these findings, this study proposes an integrated model that combines digital waqf crowdfunding, agricultural machinery leasing, and multi-stakeholder collaboration within the Penta Helix framework to improve smallholder farmers' access to agricultural technology.

Limited Access to Agricultural Machinery among Smallholder Farmers

Access to modern agricultural machinery remains a significant challenge for smallholder farmers in many developing countries. Agricultural mechanization plays an essential role in increasing farm productivity, reducing labor intensity, and improving operational efficiency. However, smallholder farmers often face structural barriers that limit their ability to adopt modern agricultural technologies. One of the main barriers is the high capital cost associated with purchasing agricultural machinery. Most small-scale farmers operate with limited financial resources and cannot afford expensive farm equipment such as tractors, harvesters, and irrigation technologies. In addition, limited access to formal credit and financial services further constrains farmers' capacity to invest in agricultural machinery.

Table 2. Key Themes Identified from Literature Analysis

Theme	Key Issues Identified	Implications for the Proposed Model	Selected References
Limited Access to Agricultural Machinery	Smallholder farmers often face limited access to modern agricultural machinery due to high purchase costs, limited financing options, and uneven distribution of agricultural equipment.	A shared-access or leasing system is needed to enable farmers to use agricultural machinery without large capital investment.	(Chen et al., 2025; Daum, 2022; Mohammed et al., 2023; Qiu et al., 2023; Rojas, 2024; Wei & Lu, 2024)
Potential of Waqf Crowdfunding	Digital crowdfunding platforms facilitate collective funding from numerous donors, while productive waqf allows philanthropic funds to invest in income-generating assets.	Integration of crowdfunding with productive waqf can mobilize social funds to finance agricultural machinery.	(Fahmi et al., 2025; Lahuri & Lutfiah, 2024; Mansyur & Isman, 2024; Marpaung & Lubis, 2024; Nita et al., 2025; Sayuti et al., 2023)
Agricultural Financing Constraints	Farmers often face limited access to formal financial institutions due to lack of collateral and high financial risks in agriculture.	Islamic social finance instruments such as waqf can provide alternative and inclusive financing mechanisms.	(Al-Tulaibawi et al., 2024; Fahlevi et al., 2026; Hardana et al., 2025; Majid, 2022; Majid & Sukmana, 2023; Napitupulu et al., 2025)
Multi-Stakeholder Collaboration	Agricultural innovation requires collaboration among government, academia, industry, community, and media.	The Penta Helix framework can support coordinated governance in implementing digital waqf-based agricultural programs.	(Heryadi et al., 2022; Larasati et al., 2024; Nurhaida et al., 2024; Shkarupeta & Babkin, 2024; Sundari & Mawardi, 2024; Suryana et al., 2025)
Digitalization of Islamic Social Finance	Digital technology enhances transparency, efficiency, and accessibility in managing Islamic social finance.	Digital platforms enable broader public participation in waqf crowdfunding initiatives.	(Haidar et al., 2024; Haji-Othman et al., 2025; Junarti et al., 2024; Matla'il Fajar et al., 2024; Sarif & Ariyanti, 2025; Taqiyyah & Anggraeni, 2025)

Another important issue is the uneven distribution of agricultural equipment, which often favors large agricultural enterprises rather than smallholder farmers. As a result, many farmers continue to

rely on traditional farming methods, which limits productivity and increases production inefficiencies. These challenges indicate the need for alternative mechanisms that enable farmers to access agricultural machinery without requiring large capital investments. One potential solution is the development of shared-access systems, such as agricultural machinery leasing or service-based mechanization models, which allow farmers to utilize equipment through collective or rental arrangements rather than individual ownership.

Agricultural Financing Constraints in Smallholder Farming

In addition to limited access to machinery, smallholder farmers also face significant constraints in accessing formal agricultural financing. Conventional financial institutions often perceive agriculture as a high-risk sector due to uncertainties related to climate variability, fluctuating market prices, and production risks. Furthermore, many farmers lack the collateral required by banks and financial institutions to obtain loans. As a result, smallholder farmers are frequently excluded from formal financial systems and must rely on informal financing sources, which are often limited and expensive.

These financial constraints create a structural barrier that prevents farmers from investing in productive assets such as agricultural machinery, improved seeds, and modern farming technologies. Therefore, alternative financing mechanisms are needed to provide more inclusive financial access for smallholder farmers. Islamic social finance instruments, particularly waqf, offer a promising alternative financing model. Productive waqf allows philanthropic funds to be invested in income-generating assets that benefit communities over the long term. By allocating waqf funds to agricultural development initiatives, it becomes possible to support farmers who are excluded from conventional financial systems.

The Potential of Digital Waqf Crowdfunding for Agricultural Development

Recent developments in financial technology have enabled the emergence of digital crowdfunding platforms that facilitate collective fundraising from a large number of individuals through online systems. Crowdfunding has increasingly become an effective mechanism for mobilizing financial resources for social, economic, and development projects. When integrated with Islamic social finance instruments such as waqf, crowdfunding platforms can significantly enhance the capacity to mobilize philanthropic funds.

Digital waqf crowdfunding allows individuals to contribute small amounts of money through digital platforms, which collectively can generate substantial funding for productive investments. Productive waqf ensures that donated funds are not only distributed for charitable purposes but are also invested in income-generating assets that provide sustainable benefits for society. In the context of agricultural development, this mechanism can be used to finance agricultural machinery that supports smallholder farmers. Through digital waqf crowdfunding, community members can participate in supporting agricultural development while waqf institutions manage the collected funds to acquire productive assets. This model combines philanthropic financing with productive asset management, creating a sustainable financial mechanism for rural economic development.

Multi-Stakeholder Collaboration through the Penta Helix Framework

The implementation of innovative financing models for agricultural development requires collaboration among multiple stakeholders. Coordinated action across different sectors is essential for achieving agricultural innovation and rural economic development, as no single institution can accomplish this. The Penta Helix framework provides a collaborative governance model that integrates five key stakeholders: government, academia, industry, community, and media. Government institutions play a crucial role in providing policy support, regulatory frameworks, and institutional coordination that facilitate the development of agricultural innovation and Islamic social finance initiatives.

Academic institutions help by conducting research, creating knowledge, and offering policy suggestions based on evidence to help design sustainable financing models. The private sector and financial technology companies provide digital infrastructure that enables the operation of crowdfunding platforms and financial technology solutions. Waqf institutions and community organizations act as implementers responsible for managing waqf funds and ensuring that the benefits reach targeted beneficiaries. Meanwhile, the media plays an important role in increasing public awareness, promoting transparency, and encouraging community participation in waqf crowdfunding initiatives. Through the Penta Helix collaboration framework, stakeholders can jointly support the implementation of innovative agricultural financing mechanisms.

Conceptual Model of Agricultural Machinery Leasing through Digital Productive Waqf

Based on the identified challenges and opportunities, this study proposes a conceptual model that integrates digital productive waqf crowdfunding with an agricultural machinery leasing system. The model aims to provide smallholder farmers with affordable access to agricultural machinery while ensuring the sustainable management of waqf assets. The conceptual model consists of three main stages. The first stage involves institutional collaboration within the Penta Helix framework. In this stage, government institutions, waqf organizations, academic institutions, fintech platforms, and community stakeholders collaborate to establish the governance structure and digital infrastructure required for the waqf crowdfunding system.

The second stage focuses on the mobilization of waqf funds through digital crowdfunding platforms. Donors contribute funds through online systems that provide transparency, accessibility, and efficiency in fundraising processes. The collected funds are then managed by authorized waqf institutions to acquire agricultural machinery as productive assets. The third stage involves the operational utilization of the agricultural machinery through a leasing or shared-access mechanism for farmers. Instead of purchasing machinery individually, farmers can access equipment through affordable leasing arrangements. The revenue generated from this leasing system can be used to cover maintenance costs, operational expenses, and the expansion of agricultural services to other farming communities.

Crowdfunding Wakaf

Crowdfunding is defined as the practice of funding a project or venture by raising small amounts of money from a large number of people, typically via the internet (Azganin et al., 2021). The application of crowdfunding as a solution in the context of waqf remains underutilized. Several studies have found that crowdfunding platforms can address liquidity issues, particularly in the context of waqf, as highlighted by Azganin et al. The author selected a sample of 101 participants and conducted interviews with financial technology and waqf experts to assess the potential benefits of crowdfunding and blockchain in addressing challenges faced by waqf land in Malaysia. The findings indicate that adopting such technologies can enhance transparency and overcome financial constraints faced by waqf institutions in Malaysia. Most business crowdfunding platforms in Western countries are interest-based, which points out the urgent need for Sharia-compliant crowdfunding platforms.

Anshari et al,. (2019) emphasize that, in many cases, farmers own land but lack access to financial means to cover their operational costs, even when they approach banks or investors to purchase materials and machinery. Therefore, access to financing remains one of the major challenges faced by farmers, particularly those operating small-scale farms or lacking access to formal banking services.

From a humanitarian and risk-sharing perspective, crowdfunding platforms enable risk-sharing practices between project developers and crowd-investors, focusing on generating social impact (Pratono et al., 2020). Similarly, Thaker & Pitchay (2018) proposed a waqf crowdfunding model to develop waqf land in Malaysia. Their study found that this model could assist waqf institutions in overcoming liquidity challenges and identifying alternative funding sources through online

crowdfunding platforms, ultimately financing various waqf land development projects. The proposed model is unique in that it introduces the concept of cash waqf as a key feature of the platform, where collected waqf funds are converted into illiquid assets such as hospitals and buildings. An illustration of the waqf crowdfunding model can be seen in Figures 2 and 3 below.

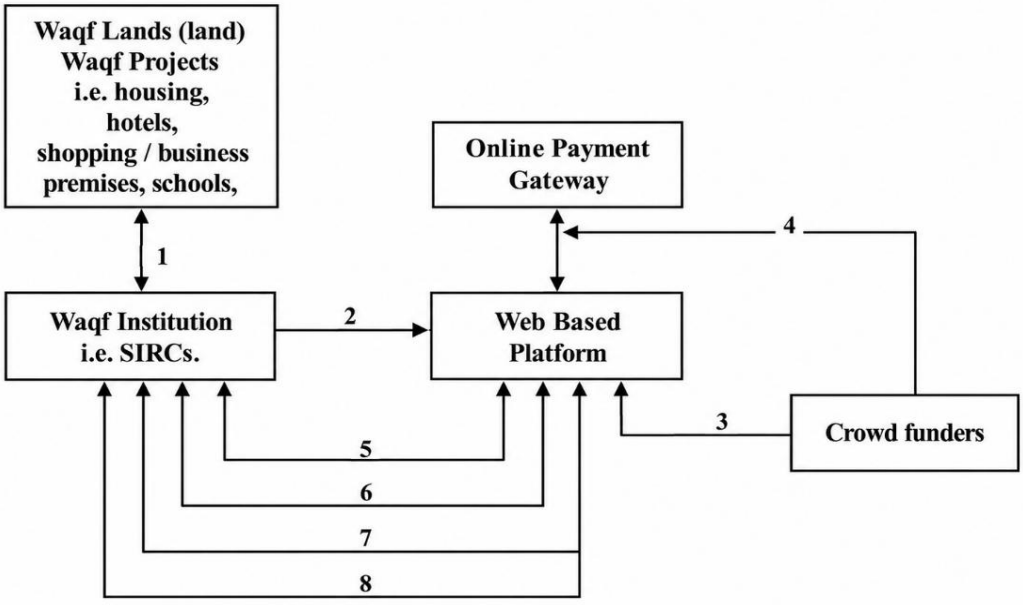

Figure 2. Model Crowdfounding Wakaf (Thaker & Pitchay, 2018)

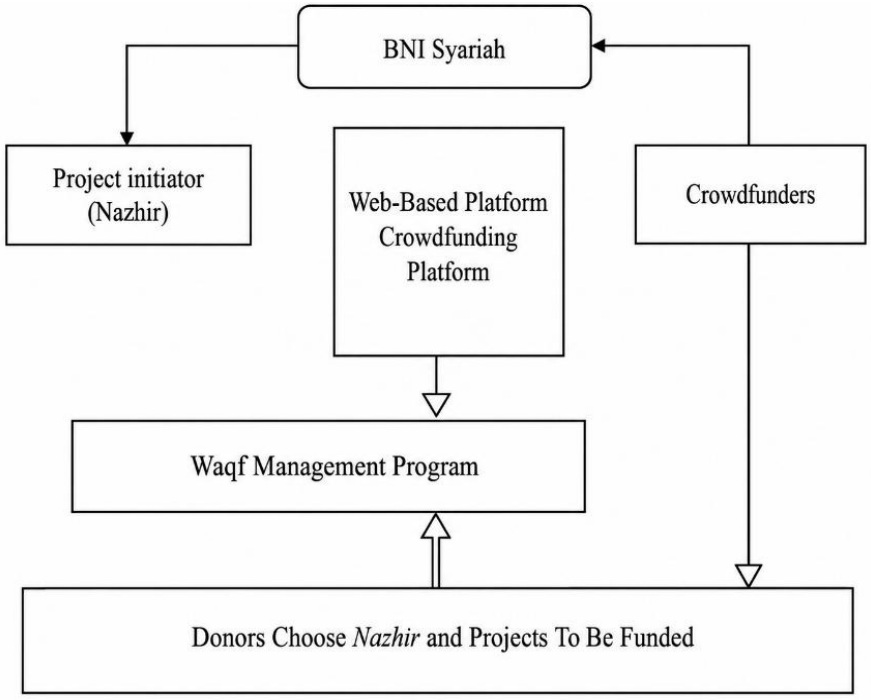

Figure 3. Model Crowdfounding Wakaf (Nasution & Medias, 2020)

Innovation Model of Agricultural Equipment Lending through Productive Waqf Crowdfunding

Based on the preceding analysis, the researcher proposes an innovative model for lending agricultural equipment through productive waqf crowdfunding by utilizing a fintech platform. This innovation is expected to provide a practical solution for smallholder farmers who lack the financial means to purchase agricultural tools and machinery, thereby enabling them to carry out their production processes more effectively and efficiently. Moreover, this program has the potential to enhance the transparency and accountability of the waqf system. The basic framework of the agricultural equipment lending model through productive waqf crowdfunding is presented in Figure 4.

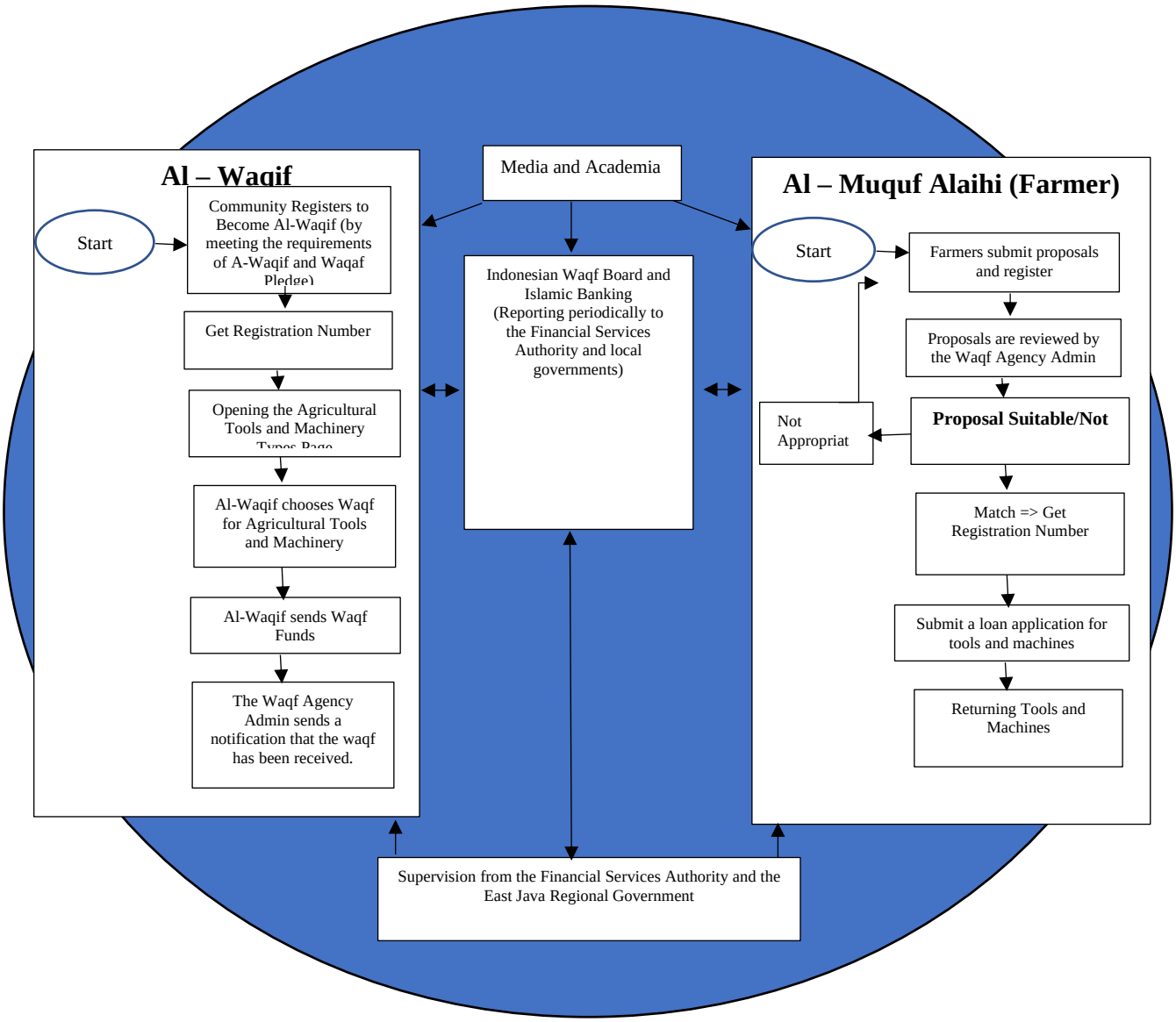

Figure 4. Innovation Model of Agricultural Machinery Lending through the Digitalization of Productive Waqf Based on Crowdfunding
(Source: data processed, 2025)

Stage 1. begins with a collaborative effort among the Indonesian Waqf Board, Islamic banks, the East Java regional government, the Otoritas Jasa Keuangan (OJK), and academics to develop a digital waqf system based on crowdfunding. The Indonesian Waqf Board and Islamic banks function as intermediaries and facilitators of the waqf activities, responsible for reporting to the Otoritas Jasa Keuangan (OJK) and the East Java regional government. The OJK and East Java government act as supervisory bodies, while academics contribute to the development of the digital waqf system model based on crowdfunding. Once the program is launched, media outlets play a role in disseminating information to the broader public.

Stage 2. outlines the process for Al-Waqif (the donor) to independently register and donate via the fintech platform. The sequence is as follows:

a) individuals access the platform to register, fulfill the requirements to become Al-Waqif, and complete the waqf pledge;
b) a registration number is issued;
c) they access the agricultural machinery selection page;
d) Al-Waqif selects the type of machinery to be donated through waqf;
e) the waqf funds are transferred;
f) the Waqf Board admin sends a notification confirming the waqf has been received.

Stage 3. pertains to Al-Mauquf ‘Alaih (the waqf beneficiaries/farmers). Farmers independently register and receive the machinery loan via the fintech platform. The process includes:

a) the farmer submits a proposal and registration form;
b) the proposal is reviewed by the Waqf Board admin;
c) if approved, the farmer receives a registration number; if not, revisions are required;
d) the farmer applies for the equipment loan;
e) after use, the machinery is returned.

A more detailed depiction of the development of the innovation model for agricultural machinery lending through the digitalization of productive waqf based on crowdfunding can be found in Figures 5, 6, and 7 below.

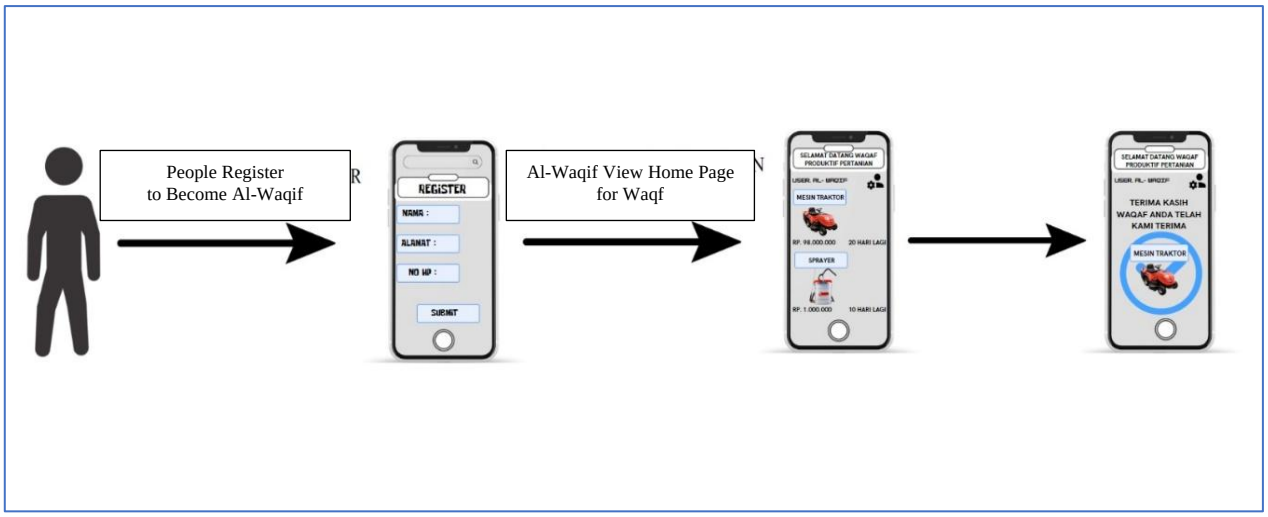

Figure 5. Process Flow of the Agricultural Machinery Lending Model through the Digitalization of Productive Waqf Based on Crowdfunding for Al-Waqif
(Source: data processed, 2025)

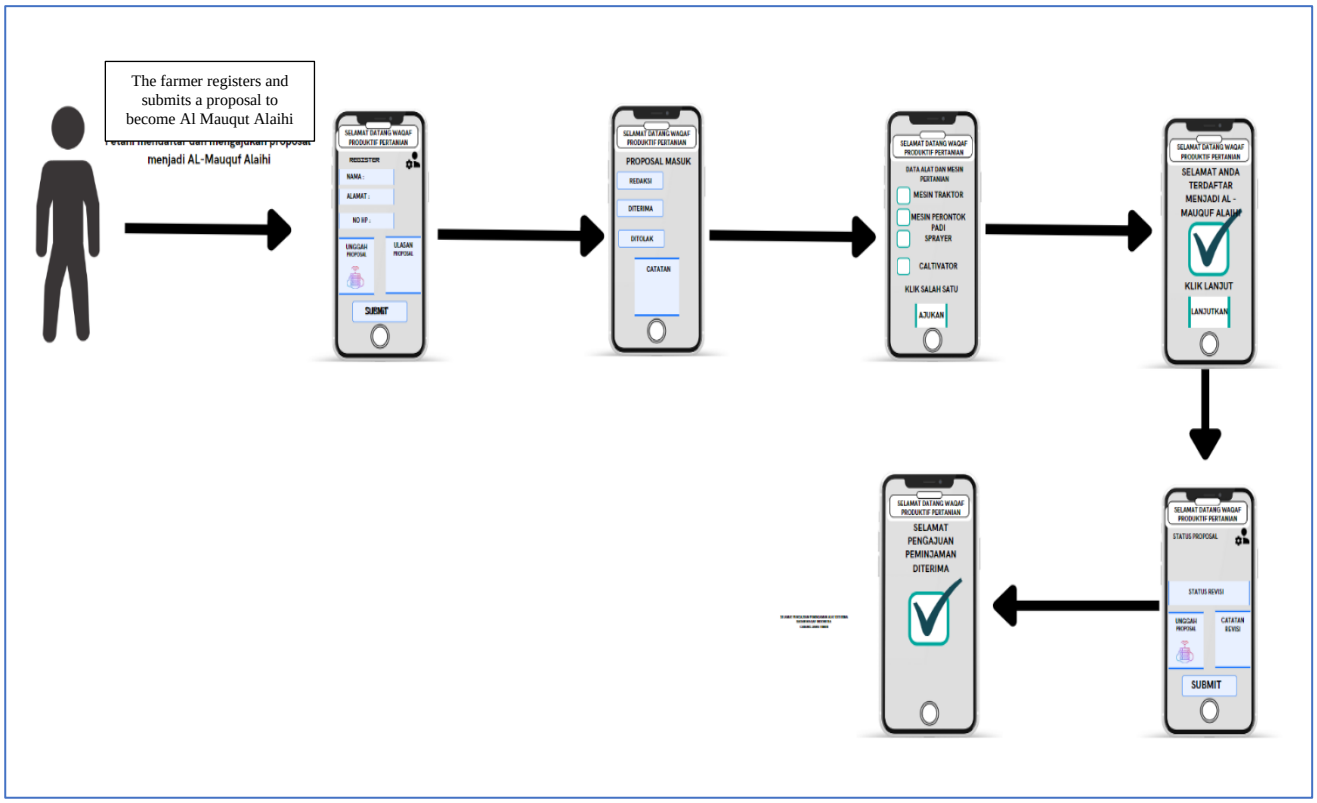

Figure 6. Process Flow of the Agricultural Machinery Lending Model through the Digitalization of Productive Waqf Based on Crowdfunding for Al-Mauquf ‘Alaih (Farmers)
(Source: data processed, 2025)

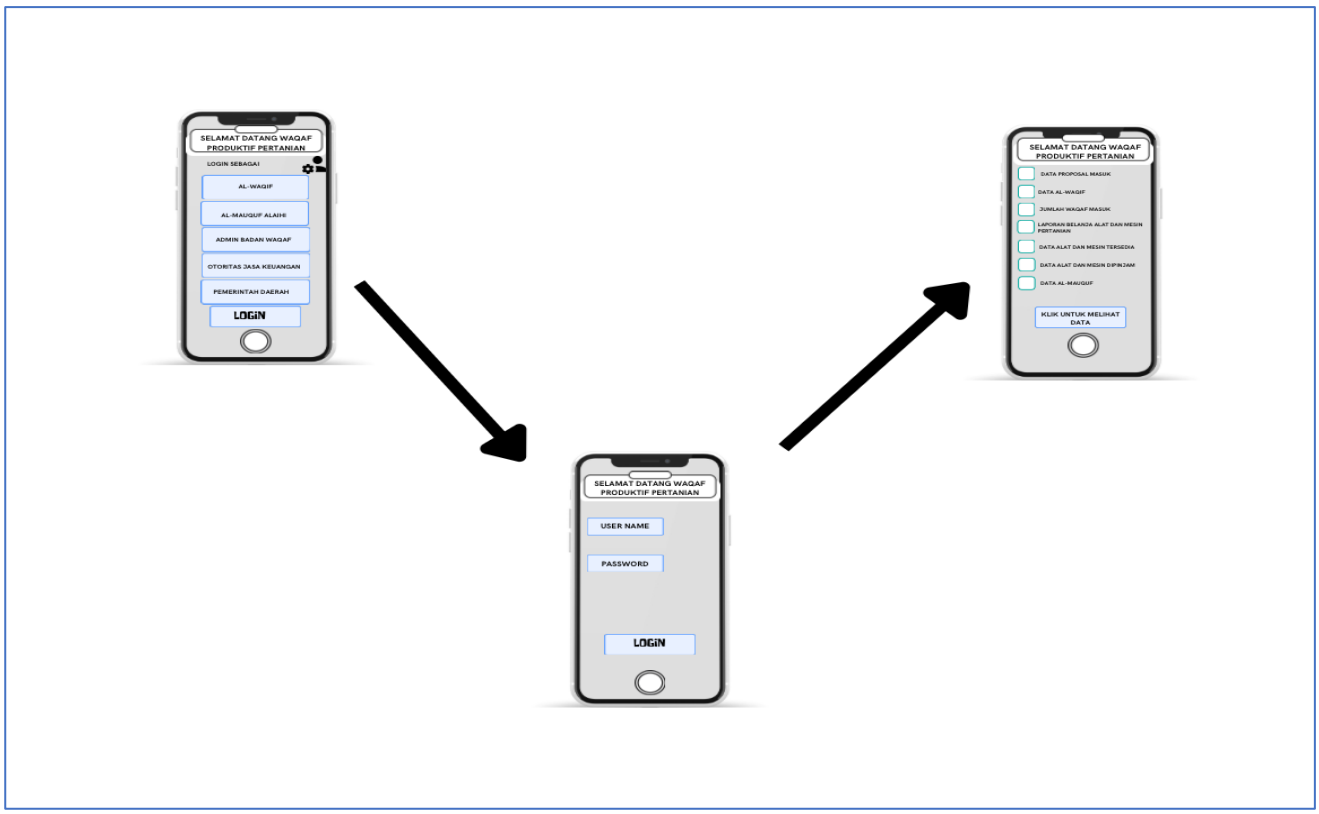

Figure 7. Accounts of the Financial Services Authority (OJK) and Regional Government as Supervisory Institutions
(Source: data processed, 2025)

The development of this agricultural machinery lending model through the digitalization of productive waqf based on crowdfunding can also indirectly enhance community participation by fostering a spirit of mutual cooperation in supporting economic development in East Java. It is expected that poverty rates can be reduced, in part, through advancements in the agricultural sector, particularly in East Java Province. Increased agricultural productivity may contribute significantly to ensuring food security and meeting the nutritional needs of the population.

Discussions

Based on the thematic analysis presented in Table 2, this study identifies several structural challenges and opportunities in agricultural development, particularly related to smallholder farmers' access to agricultural machinery and financing mechanisms. The findings indicate that limited mechanization, financial exclusion, and institutional coordination constraints remain significant barriers to improving agricultural productivity. In response to these challenges, this study proposes an integrated model that combines digital waqf crowdfunding, agricultural machinery leasing, and multi-stakeholder collaboration through the Penta Helix framework. The following discussion elaborates on the analytical implications of these findings and the proposed model.

Limited Access to Agricultural Machinery and the Need for Alternative Mechanisms

One of the most critical issues identified in the literature is the limited access of smallholder farmers to modern agricultural machinery. Agricultural mechanization is widely recognized as a key factor in increasing farm productivity, reducing labor intensity, and improving production efficiency. However, many smallholder farmers cannot afford modern agricultural equipment due to high capital costs and limited financing options (Chen et al., 2025; Mohammed et al., 2023).

Furthermore, the distribution of agricultural machinery often favors large-scale agricultural enterprises rather than smallholder farmers (Daum, 2022; Rojas, 2024). As a result, farmers frequently rely on traditional labor-intensive methods that limit their productivity and income potential. Previous studies have also shown that limited mechanization significantly affects agricultural productivity and rural income levels (Qiu et al., 2023; Wei & Lu, 2024). In many developing countries, the mechanization gap between large farms and smallholders remains substantial, creating structural inequality in agricultural productivity.

These findings highlight the importance of developing alternative mechanisms that enable farmers to access agricultural machinery without requiring large capital investments. The agricultural machinery leasing model proposed in this study addresses this issue by enabling farmers to utilize shared equipment rather than purchasing machinery individually. This shared-access mechanism aligns with previous research suggesting that machinery-sharing systems, cooperative ownership, and rental services can significantly improve mechanization access among smallholder farmers (Daum, 2022; Qiu et al., 2023).

Compared with conventional approaches such as government subsidies or commercial agricultural loans, the leasing mechanism proposed in this study offers several advantages. Government subsidy programs often face limitations related to fiscal sustainability, bureaucratic allocation processes, and unequal distribution of benefits. Similarly, commercial loans may not be accessible to smallholder farmers due to collateral requirements, high interest rates, and financial risk associated with agricultural production. In contrast, a shared-access leasing system supported by social finance mechanisms can reduce the financial burden on farmers while ensuring broader access to agricultural technology.

In addition, the proposed model integrates the leasing mechanism with Islamic social finance instruments, particularly productive waqf and crowdfunding, which creates a more inclusive financing structure. Through this integration, philanthropic funds can be mobilized to acquire agricultural machinery that is subsequently leased to farmers at affordable rates. The revenue generated from leasing activities can then be reinvested to maintain equipment, expand services, and

support additional agricultural development initiatives. This mechanism allows the model to maintain long-term financial sustainability while continuing to provide social benefits.

However, despite these potential advantages, several risks and implementation challenges must also be considered. One potential challenge is the operational management of shared agricultural machinery, including scheduling, maintenance, and equitable access among farmers. Without effective coordination mechanisms, equipment utilization may become inefficient or dominated by certain users. Another challenge relates to the governance of the leasing system, particularly in ensuring transparency and accountability in the management of waqf-funded assets.

Additionally, logistical challenges may arise in rural areas with limited infrastructure, where transporting agricultural machinery between farms can increase operational costs. Therefore, the success of the proposed model depends not only on financial innovation but also on effective institutional coordination, local management capacity, and digital monitoring systems that can ensure transparent and efficient machinery allocation.

Overall, these findings indicate that improving farmers' access to agricultural machinery requires not only technological solutions but also innovative institutional and financial mechanisms. The proposed leasing-based approach, supported by digital waqf crowdfunding and multi-stakeholder collaboration, provides a promising pathway to reduce mechanization inequality while strengthening the economic resilience of smallholder farmers.

Financial Constraints and the Role of Islamic Social Finance

In addition to technological constraints, financial exclusion remains a major barrier for smallholder farmers. Conventional financial institutions often perceive agriculture as a high-risk sector due to climate uncertainty, fluctuating commodity prices, and production risks. Moreover, many farmers lack the collateral required to obtain loans from banks or formal financial institutions (Al-Tulaibawi et al., 2024; Hardana et al., 2025). These structural barriers make it difficult for smallholder farmers to access credit, even though financial capital is essential for investing in agricultural inputs, technology, and equipment.

As a consequence, many farmers rely on informal financing sources such as local moneylenders, informal cooperatives, or family networks. Although these mechanisms may provide short-term financial relief, they are often limited in scale and may involve unfavorable financing terms. Previous studies have emphasized that the lack of inclusive financial services in rural areas contributes to persistent productivity gaps and income inequality among smallholder farmers (Majid, 2022; Majid & Sukmana, 2023; Napitupulu et al., 2025). Farmers who are excluded from conventional financial systems require alternative financing models.

In this context, Islamic social finance instruments offer a promising framework for addressing financial inclusion challenges in agriculture. Islamic social finance encompasses various philanthropic and redistributive instruments such as zakat, sadaqah, and waqf, which aim to promote social welfare and economic justice. Among these instruments, productive waqf has gained increasing attention as a sustainable financing mechanism for community development. Unlike traditional charitable donations that are typically consumed immediately, productive waqf enables philanthropic funds to be invested in income-generating assets while preserving the principal asset for long-term social benefit.

The integration of productive waqf into agricultural development programs offers several advantages compared to conventional financing mechanisms. First, waqf-based financing does not require collateral from beneficiaries, making it more accessible for marginalized farmers who lack formal assets. Second, waqf funds, being philanthropic in nature, can significantly reduce the financial burden on farmers compared to interest-based commercial loans. Third, productive waqf allows the funded assets to generate continuous economic benefits, creating a sustainable cycle of social investment that can support rural development over time.

Within the context of this study, waqf funds are proposed to finance the acquisition of agricultural machinery that can be utilized through a shared leasing system. This approach transforms

waqf assets into productive infrastructure that directly supports farmers' productive activities. In contrast to short-term subsidies or grants, which often depend heavily on government budgets, the productive waqf mechanism enables long-term asset management where the benefits can be continuously distributed to the community. This characteristic makes waqf-based financing particularly suitable for supporting agricultural mechanization programs in resource-constrained rural areas.

From a theoretical perspective, the proposed model contributes to the growing literature on Islamic social finance for economic empowerment. Previous studies have highlighted the role of waqf in supporting education, healthcare, and social welfare programs, but its application in agricultural mechanization remains relatively limited. By linking productive waqf with agricultural machinery leasing, this study expands the scope of waqf utilization toward productive rural economic development. The model therefore demonstrates how Islamic social finance can function not only as a redistributive instrument but also as a strategic development tool.

Nevertheless, several challenges must be addressed to ensure the effective implementation of waqf-based agricultural financing. One major concern relates to governance and institutional management. Effective waqf management requires professional institutions capable of maintaining transparency, accountability, and efficient asset utilization. Weak governance structures could reduce public trust and limit the sustainability of waqf-based programs. Additionally, regulatory frameworks in some countries may not yet fully support the integration of waqf assets with innovative financing mechanisms such as digital crowdfunding or agricultural leasing services.

Another potential challenge is ensuring that the benefits of waqf-funded agricultural assets are distributed fairly among farmers. Without appropriate management systems, there is a risk that access to shared machinery could become unequal or dominated by certain groups. Therefore, strong institutional coordination and community participation are essential to ensure that the model operates in an inclusive and transparent manner.

Overall, these findings suggest that integrating Islamic social finance, particularly productive waqf, into agricultural development strategies can provide an inclusive and sustainable alternative to conventional financing mechanisms. By reducing financial barriers and enabling collective access to productive assets, waqf-based financing has the potential to strengthen the economic resilience of smallholder farmers while contributing to broader rural development objectives.

Why Waqf Crowdfunding Offers a More Sustainable Financing Mechanism

One of the key contributions of this study lies in demonstrating how digital waqf crowdfunding can function as a more sustainable financing mechanism compared with conventional approaches such as government subsidies or commercial loans. Traditional agricultural financing programs often rely on fiscal support from governments or credit provision from financial institutions. While these mechanisms can provide important financial assistance, they frequently encounter structural limitations that reduce their long-term effectiveness in supporting inclusive agricultural development.

Government subsidy programs, for example, are often designed to provide short-term support for farmers through equipment assistance, input subsidies, or temporary financial aid. However, these programs depend heavily on government fiscal capacity and political priorities, which may fluctuate over time. As a result, subsidy programs are often inconsistent and may not provide continuous support for farmers, particularly in developing countries where public budgets for agriculture are limited.

Commercial agricultural loans represent another common financing mechanism, yet they also present significant barriers for smallholder farmers. Financial institutions generally perceive agriculture as a high-risk sector due to climate variability, fluctuating commodity prices, and production uncertainty. Consequently, farmers are typically required to provide collateral and meet strict creditworthiness criteria before receiving loans. Many smallholder farmers cannot fulfill these requirements, resulting in limited access to formal credit markets.

In contrast, waqf crowdfunding combines philanthropic financing with productive asset management, creating a financing mechanism that is both socially inclusive and economically sustainable. Digital crowdfunding platforms enable individuals to contribute relatively small amounts of funds collectively, thereby mobilizing a large pool of capital for social investment (Fahmi et al., 2025; Lahuri & Lutfiah, 2024). At the same time, productive waqf ensures that these philanthropic funds are invested in assets that generate long-term economic benefits while preserving the principal asset for future generations.

Within the context of this study, waqf crowdfunding is utilized to finance the acquisition of agricultural machinery that can be leased to farmers through a shared-access system. This mechanism creates a sustainable financial cycle in which the initial philanthropic capital supports the acquisition of productive assets, while revenue generated from leasing services contributes to operational maintenance and potential expansion of the program. Compared with one-time subsidies or debt-based financing, this model allows resources to be continuously reinvested in agricultural development.

Previous studies have demonstrated that crowdfunding platforms can significantly enhance the mobilization of philanthropic resources and broaden community participation in development initiatives (Mansyur & Isman, 2024; Marpaung & Lubis, 2024; Nita et al., 2025; Sayuti et al., 2023). By integrating crowdfunding mechanisms with productive waqf, the proposed model strengthens both financial sustainability and social participation. This hybrid financing structure enables wider public involvement in agricultural development while reducing dependency on limited government budgets.

Nevertheless, several challenges must be considered in implementing waqf crowdfunding models. Public trust remains a critical factor in crowdfunding initiatives, particularly when managing philanthropic funds. Transparent governance systems and effective monitoring mechanisms are therefore essential to ensure accountability in fund management. In addition, regulatory frameworks for integrating waqf institutions with digital crowdfunding platforms may still be underdeveloped in some jurisdictions, potentially limiting the scalability of such initiatives.

Overall, the findings suggest that waqf crowdfunding offers a promising alternative financing mechanism capable of mobilizing social capital for productive investment. By combining philanthropy, digital technology, and productive asset management, the proposed model provides a more sustainable pathway for financing agricultural development in resource-constrained environments.

The Role of Digitalization in Strengthening Islamic Social Finance

The success of the proposed model is closely linked to the digitalization of Islamic social finance systems. Digital technologies play an increasingly important role in improving transparency, efficiency, and accessibility in the management of philanthropic funds. The integration of digital platforms into Islamic social finance institutions has significantly transformed the way funds are collected, managed, and distributed.

Digital platforms enable faster and more efficient fundraising processes by allowing donors to contribute through online payment systems and mobile applications. This accessibility significantly expands the potential donor base beyond geographical limitations, enabling waqf institutions to mobilize funds from a broader segment of society. Several studies emphasize that digital technology enhances public participation and trust in Islamic social finance institutions by providing transparent reporting and real-time monitoring systems (Haidar et al., 2024; Haji-Othman et al., 2025).

In addition to expanding participation, digitalization also strengthens governance and accountability in philanthropic fund management. Digital financial systems allow institutions to track financial flows more accurately and provide transparent reporting mechanisms for donors and stakeholders. Previous research indicates that digital monitoring systems can improve institutional credibility and increase donor confidence in philanthropic organizations (Junarti et al., 2024; Matla'il Fajar et al., 2024).

For waqf crowdfunding initiatives, digital platforms serve as the core infrastructure that connects donors, waqf institutions, and program beneficiaries. Through integrated digital systems, it becomes possible to provide transparent information regarding fundraising progress, asset acquisition, and program outcomes. Such transparency is essential for maintaining long-term donor engagement and ensuring the sustainability of philanthropic financing mechanisms.

However, the digitalization of Islamic social finance also introduces several technical and institutional challenges. One important challenge relates to digital infrastructure and digital literacy, particularly in rural areas where internet access and technological capabilities may still be limited. Another concern involves cybersecurity risks and data protection, which require robust digital governance frameworks to safeguard financial transactions and user information.

Despite these challenges, digitalization remains a crucial enabling factor for expanding the scale and effectiveness of Islamic social finance programs. By improving transparency, accessibility, and operational efficiency, digital platforms can significantly enhance the effectiveness of waqf crowdfunding initiatives designed to support agricultural development.

Multi-Stakeholder Collaboration and the Penta Helix Governance Model

The implementation of innovative financing models for agricultural development requires coordinated collaboration among multiple stakeholders. Agricultural innovation systems are inherently complex and involve interactions between various actors with different roles and resources. In this context, the Penta Helix framework provides an appropriate governance model by integrating the roles of government, academia, industry, community, and media.

Government institutions play a critical role in establishing regulatory frameworks and providing policy support for both Islamic social finance and agricultural development programs. Supportive regulations are essential to facilitate the integration of waqf institutions, digital financial platforms, and agricultural development initiatives (Heryadi et al., 2022; Larasati et al., 2024). In addition, government agencies may provide institutional support for the coordination and oversight of agricultural mechanization programs.

Academic institutions contribute by generating research-based knowledge that supports evidence-based policymaking and program design. Universities and research institutions can also provide technical expertise related to agricultural mechanization, digital finance systems, and impact evaluation. Such contributions are essential for ensuring that innovative financing models are grounded in empirical evidence and best practices.

The private sector, particularly financial technology companies, plays a crucial role in developing the digital infrastructure required for crowdfunding platforms and online financial systems. Fintech companies provide the technological tools that enable secure transactions, digital fundraising campaigns, and real-time financial monitoring. Meanwhile, waqf institutions and community organizations act as key implementing actors responsible for managing funds, acquiring agricultural machinery, and distributing services to farmers (Nurhaida et al., 2024; Shkarupeta & Babkin, 2024).

The media also serves an important function in promoting transparency and public engagement. Through information dissemination and public communication, media institutions can increase awareness about waqf crowdfunding initiatives and encourage broader community participation (Sundari & Mawardi, 2024; Suryana et al., 2025). Public visibility is particularly important for crowdfunding campaigns, as donor participation is often influenced by the credibility and visibility of social initiatives.

Despite its potential advantages, implementing the Penta Helix model also presents coordination challenges. Differences in institutional priorities, governance structures, and operational capacities among stakeholders may create barriers to effective collaboration. Therefore, clear institutional arrangements and communication mechanisms are necessary to ensure that stakeholder roles are well defined and coordinated.

Overall, the Penta Helix framework provides a collaborative governance structure that supports the implementation of digital waqf crowdfunding programs for agricultural mechanization. By integrating the capacities of government, academia, industry, community organizations, and media institutions, the proposed model creates a more comprehensive ecosystem for addressing the structural challenges faced by smallholder farmers.

Practical Challenges in Implementing the Proposed Model

Although the proposed model offers several advantages in addressing financial and technological barriers in agricultural development, its implementation may encounter a number of practical challenges. These challenges are related to governance, digital infrastructure, and operational management, which have also been highlighted in previous studies on Islamic social finance and agricultural innovation systems.

a) Transparency and Governance in Waqf Crowdfunding

One of the primary challenges in implementing digital waqf crowdfunding initiatives is ensuring transparency and accountability in the management of philanthropic funds. Crowdfunding platforms rely heavily on public trust, and therefore transparent governance mechanisms are essential to maintain donor confidence and ensure responsible fund utilization.

Previous studies have shown that governance quality and transparency are critical factors influencing the credibility of Islamic social finance institutions. Research by Haji-Othman et al (2025) emphasizes that clear reporting systems, independent audits, and transparent financial management practices significantly increase public trust in waqf and other Islamic philanthropic institutions. Similarly, (Haidar et al., 2024) argue that digital transparency tools, such as real-time financial reporting and impact monitoring systems, play an important role in strengthening accountability in Islamic social finance platforms.

Without such governance mechanisms, crowdfunding initiatives may face difficulties in attracting sustained donor participation. Therefore, the implementation of digital waqf crowdfunding requires strong institutional governance structures that ensure transparency, accountability, and effective monitoring of fund allocation.

b) Digital Infrastructure and Technological Reliability

Another important challenge concerns the development of reliable digital platforms that can support secure and efficient crowdfunding activities. Digital Islamic social finance platforms must ensure secure financial transactions, user-friendly interfaces, and reliable monitoring systems to maintain donor trust and encourage participation.

Several studies highlight the importance of technological reliability in the adoption of digital financial services. Junarti et al,. (2024) note that digital financial platforms enhance transparency and efficiency in philanthropic fund management, but their effectiveness depends on the reliability of the technological infrastructure. Similarly, Matla'il Fajar et al,. (2024) found that user trust in digital crowdfunding systems is strongly influenced by platform security, data protection mechanisms, and ease of use.

In addition, digital literacy and internet accessibility remain important considerations, particularly in rural areas where technological infrastructure may still be limited. Therefore, implementing digital waqf platforms requires not only technological innovation but also supportive infrastructure and digital literacy initiatives that enable broader community participation.

c) Operational and Logistical Challenges in Agricultural Machinery Management

Beyond financial and technological considerations, operational challenges may also arise in the management and distribution of agricultural machinery. The shared-access leasing system proposed in this study requires effective coordination mechanisms to ensure equitable access and efficient utilization of agricultural equipment among farmers.

Research on agricultural mechanization services suggests that machinery-sharing systems can significantly improve farmers' access to modern agricultural equipment, particularly in developing countries. However, these systems also face operational challenges related to equipment maintenance, scheduling, and transportation logistics. Daum (2022) highlights that machinery service models often encounter difficulties in maintaining equipment efficiency and managing operational costs, particularly in rural areas with limited infrastructure.

Similarly, Qiu et al,. (2023) found that although agricultural machinery services can increase farm productivity, their effectiveness depends on well-organized institutional arrangements that regulate equipment allocation, maintenance, and farmer coordination. Without effective management structures, there is a risk that agricultural machinery may be underutilized or dominated by certain groups of farmers.

These findings indicate that successful implementation of machinery-sharing systems requires strong local management institutions capable of coordinating equipment distribution and maintenance activities.

d) The Need for Collaborative Governance

Addressing these challenges requires coordinated collaboration among multiple stakeholders involved in agricultural development and Islamic social finance. Collaborative governance models have been widely recognized as effective mechanisms for managing complex development initiatives that involve diverse actors and institutional interests.

Previous research highlights that multi-stakeholder collaboration can improve the effectiveness of development programs by integrating the resources and expertise of different sectors. According to Nurhaida et al., (2024), collaboration between government institutions, financial technology providers, community organizations, and academic institutions is essential for developing innovative financing mechanisms that support inclusive economic development.

In the context of agricultural innovation, Shkarupeta & Babkin (2024) emphasize that coordinated governance systems can enhance policy implementation and institutional capacity by fostering cooperation among public institutions, private sector actors, and civil society organizations. Such collaborative frameworks are consistent with the Penta Helix model, which integrates the roles of government, academia, industry, community, and media in supporting sustainable development initiatives.

Therefore, the successful implementation of the proposed model depends not only on financial innovation but also on the establishment of collaborative governance structures that facilitate coordination among stakeholders involved in waqf management, digital crowdfunding platforms, and agricultural development programs.

Theoretical and Practical Implications

From a theoretical perspective, this study contributes to the expanding literature on Islamic social finance by demonstrating how productive waqf can be integrated with digital crowdfunding and agricultural development initiatives. Traditional studies on waqf have largely focused on its role in supporting charitable and social welfare activities such as education, healthcare, and poverty alleviation.

However, recent research suggests that waqf can also function as a strategic instrument for productive economic development when managed through professional institutional frameworks. For instance, studies by Majid & Sukmana (2023) and Napitupulu et al., (2025) highlight the growing role of productive waqf in supporting community-based economic empowerment programs.

By integrating waqf with digital crowdfunding mechanisms, this study expands the conceptual application of waqf as a financing instrument capable of mobilizing collective social capital for productive investment. This integration illustrates how Islamic social finance instruments can be adapted to modern digital ecosystems and used to support economic sectors such as agriculture.

Furthermore, the study contributes to the broader literature on crowdfunding and collaborative governance. Previous research on crowdfunding has mainly focused on entrepreneurial financing and startup ecosystems. However, Mansyur & Isman (2024) and Marpaung & Lubis (2024) suggest that crowdfunding platforms also have significant potential to mobilize resources for social and community-based development initiatives.

By combining crowdfunding mechanisms with the Penta Helix governance framework, the proposed model demonstrates how digital platforms and multi-stakeholder collaboration can be integrated to support inclusive agricultural development. This interdisciplinary approach provides a conceptual contribution by linking Islamic social finance, digital financial innovation, and agricultural development strategies.

From a practical perspective, the findings of this study provide several important insights for policymakers, Islamic financial institutions, and waqf organizations seeking to develop innovative financing mechanisms for agricultural development. For policymakers, the proposed model offers a complementary approach to conventional agricultural financing policies. Previous research indicates that government subsidies and credit-based financing programs often face limitations in reaching smallholder farmers due to fiscal constraints and financial eligibility requirements (Majid, 2022). By integrating waqf crowdfunding into agricultural development strategies, governments can leverage philanthropic resources to support rural economic development.

For Islamic financial institutions and waqf organizations, the model highlights the importance of adopting digital technologies and professional governance systems to enhance transparency and expand donor participation. Digital platforms allow waqf institutions to reach a broader audience and mobilize funds more efficiently while maintaining transparent financial reporting mechanisms.

At the community level, the proposed model has the potential to improve farmers' access to agricultural machinery through a shared-access leasing system. Previous studies have shown that access to mechanization services can significantly increase agricultural productivity and reduce labor constraints among smallholder farmers (Daum, 2022; Qiu et al., 2023).

Overall, the integration of digital waqf crowdfunding, agricultural machinery leasing, and Penta Helix collaboration provides a comprehensive approach to addressing structural constraints in agricultural development. By combining financial innovation, technological infrastructure, and collaborative governance, the model offers a sustainable pathway for improving farmers' access to productive assets and strengthening rural economic resilience.

4. Conclusions

The proposed model offers an alternative solution by mobilizing philanthropic funds through digital waqf crowdfunding and investing them in productive agricultural assets that can be accessed by farmers through a shared leasing system. This approach enables smallholder farmers to utilize modern agricultural machinery without requiring large capital investments, thereby improving productivity and reducing structural inequalities in agricultural development. From a theoretical perspective, this study contributes to the literature on Islamic social finance by demonstrating how productive waqf can be integrated with digital crowdfunding as a sustainable financing mechanism for rural economic empowerment. By incorporating the Penta Helix framework, the study also highlights the role of multi-stakeholder collaboration in supporting innovative financing models for agricultural development.

From a practical and policy perspective, the model provides insights for governments, Islamic financial institutions, waqf organizations, and fintech providers to develop collaborative financing mechanisms that support agricultural mechanization and rural development. By leveraging digital technologies and philanthropic funding, policymakers can complement conventional agricultural financing programs while improving transparency and community participation. The proposed model also has broader social implications, as improving farmers' access to agricultural machinery can enhance productivity, increase income opportunities, and strengthen rural economic resilience, ultimately contributing to poverty reduction and food security. However, successful implementation

of the model requires addressing several practical challenges, including transparent governance of waqf funds, reliable digital platform development, and effective management of shared agricultural machinery. Strong institutional coordination, supportive regulatory frameworks, and active stakeholder participation are essential to ensure the sustainability of the model. Future research should focus on empirically testing the proposed model through pilot projects or case studies in different regions to evaluate its feasibility, scalability, and long-term socio-economic impacts. Such studies would provide valuable insights for refining the framework and supporting its practical implementation in agricultural development programs.

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