Design and Evaluation of a Digital Agricultural Insurance Platform to Improve Claims Processing Efficiency in Indonesia: Applications in Agricultural Education

Habdil Iqrawardana, Universitas Islam Indonesia, Indonesia
Novi Setiani, Universitas Islam Indonesia, Indonesia
Amelia Zakiya Sabrina, Universitas Islam Indonesia, Indonesia
Hardianto Hardianto, Cognifera Education Academy, Indonesia

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Abstract

Digital technology innovation plays a pivotal role in enhancing the efficiency of the agricultural sector, including in the management of agricultural insurance. This study aims to design and evaluate a digital agricultural insurance platform that improves the efficiency of claims processing in Indonesia, with a particular focus on its applications within agricultural education. The proposed platform is designed to simplify the process for farmers in submitting insurance claims through an application-based system integrated with digital agricultural data, accelerating claim verification and reducing the potential for human error. The research adopts a user-centered design (UCD) approach combined with user testing involving farmers and agricultural education institutions to ensure usability and contextual relevance. The findings demonstrate that the developed platform significantly improves claims processing efficiency, reduces processing time, and enhances overall user satisfaction. Furthermore, the integration of this digital solution into agricultural education offers a pedagogical innovation by linking practical technology adoption with theoretical learning, equipping students with the digital competencies necessary for future agri-tech ecosystems. The results contribute to the broader discourse on digital transformation in agriculture by providing an implementable framework for efficient, accessible, and educationally relevant agricultural insurance systems in developing countries.

Keywords: digital agriculture, agricultural insurance, claims processing, user-centered design, agricultural education

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Introduction

Agricultural production systems worldwide are increasingly exposed to climate-related risks that threaten food security and farmer livelihoods. Climate change has intensified the frequency and severity of extreme weather events such as droughts, floods, and pest outbreaks, which can significantly disrupt agricultural production systems. According to the Intergovernmental Panel on Climate Change (IPCC, 2022), these environmental changes are expected to further increase agricultural vulnerability, particularly in regions where farming systems depend heavily on natural climatic conditions. Similarly, the Food and Agriculture Organization (FAO, 2022) highlights that strengthening agricultural resilience has become a global priority to ensure sustainable food systems and safeguard rural livelihoods.

Climate-related risks pose particularly serious challenges for agricultural systems in developing countries. As noted by Morton (2007), smallholder farmers are among the most vulnerable groups to climate variability because their livelihoods often depend directly on rainfall-based agricultural production. Wheeler and von Braun (2013) further emphasize that climate change is likely to intensify production risks in agriculture, potentially affecting global food security and increasing economic instability in rural communities. In addition, Challinor et al. (2014) argue that the growing uncertainty of climate patterns may significantly alter crop productivity and farming practices across many regions of the world.

In Indonesia, agriculture remains a fundamental sector supporting both the national economy and rural employment. The World Bank (2021) reports that millions of Indonesian households rely on agricultural activities as their primary source of livelihood, while rice continues to play a central role in maintaining national food security. However, the agricultural sector in Indonesia is highly vulnerable to environmental hazards such as floods, droughts, and pest infestations. These environmental disturbances frequently lead to crop failures that disrupt agricultural production cycles and create severe financial shocks for farmers. Previous research has shown that rice farmers often experience production losses caused by pest attacks and climate-related disturbances, resulting in unstable farm income and increased production risks (Naylor et al., 2007; Saragih et al., 2018).

Given the high level of uncertainty in agricultural production, effective risk management mechanisms are essential to protect farmers from severe economic losses. One of the most widely adopted approaches for managing agricultural risks is agricultural insurance. According to Mahul and Stutley (2010), agricultural insurance programs are designed to provide financial compensation to farmers when crop losses occur due to uncontrollable environmental factors. By stabilizing farm income and facilitating post-disaster recovery, agricultural insurance can play a significant role in improving the resilience of farming systems. Empirical studies also show that agricultural insurance can help reduce economic vulnerability among rural households and encourage farmers to maintain agricultural production following adverse events (Carter et al., 2020; Jensen & Barrett, 2022a).

Despite these potential benefits, the effectiveness of agricultural insurance programs often depends on the efficiency of their operational processes, particularly in claims management. In many agricultural insurance schemes, the claims process involves multiple administrative stages, including damage reporting, field inspections, document verification, and institutional approval procedures. Mahul and Stutley (2010) note that these administrative processes often require coordination among multiple stakeholders such as farmers, insurance providers, and

government agencies. As a result, the verification and approval of insurance claims may take considerable time before compensation payments are delivered to farmers.

For farmers who rely on timely financial recovery to restart agricultural production, delays in claims processing can significantly affect their ability to resume farming activities. Cole et al. (2013) argue that inefficient insurance procedures may reduce farmers' trust in insurance programs and discourage participation in risk-management initiatives. Similarly, Greatrex et al. (2015) observe that administrative complexity and slow claim settlement remain major challenges in the implementation of agricultural insurance programs in many developing countries. Improving the efficiency and accessibility of claims management systems has therefore become an important priority for strengthening the practical effectiveness of agricultural insurance.

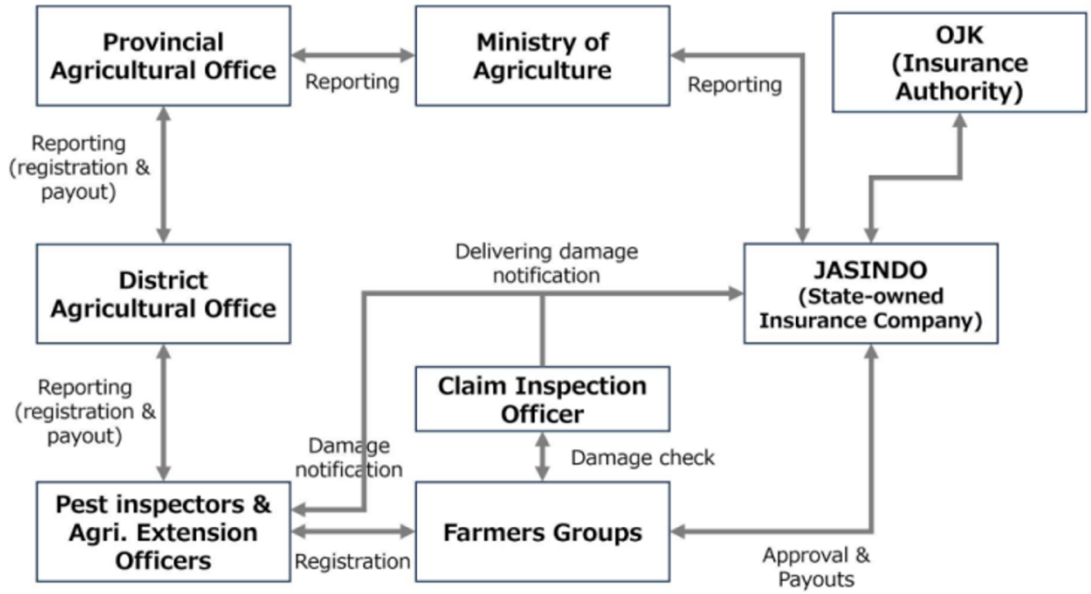
Recent advancements in digital technologies offer promising opportunities to address these operational challenges. Digital platforms can facilitate faster damage reporting, improve coordination among stakeholders, and provide transparent tracking of claim processing. Research on digital agriculture suggests that digital technologies have the potential to transform agricultural services by improving information flows, reducing transaction costs, and increasing operational efficiency (Wolfert et al., 2017). In addition, Klerkx and Rose (2020) emphasize that digital platforms can enhance the delivery of agricultural services and support more efficient agricultural management systems.

However, existing research on digital agriculture has primarily focused on production-related technologies such as precision farming, remote sensing, and farm management systems. Klerkx and Rose (2020) note that most digital agriculture innovations are designed to improve agricultural productivity and resource efficiency. Comparatively limited attention has been given to administrative support systems such as agricultural insurance claims management. Furthermore, many digital initiatives overlook the importance of ensuring that technological solutions remain accessible and usable for farmers with varying levels of digital literacy.

To address these challenges, there is a growing need for approaches that integrate technological innovation with human-centered system design. User-centered design (UCD) emphasizes the active involvement of end users throughout the design process to ensure that technological systems align with users' needs, capabilities, and real-world contexts (ISO, 2019). By incorporating user feedback during system development, UCD can improve system usability and increase the likelihood of successful technology adoption.

Therefore, this study aims to design and evaluate a digital agricultural insurance platform that improves the efficiency of claims processing in Indonesia. The research adopts a user-centered design approach to develop a farmer-friendly digital claims prototype and explores the integration of the platform within agricultural education contexts to support technology adoption among farmers.

Figure 1
Conventional Agricultural Insurance Claims Workflow



Source: Directorate Agricultural Financing, MoA, Indonesia

Literature Review

This section reviews relevant studies related to digital transformation in agriculture, agricultural insurance systems, and user-centered design approaches. The review aims to identify key findings from previous research and highlight the research gap addressed in this study.

Digital Transformation in Agriculture

Digital transformation has become a key driver of innovation in modern agricultural systems. Digital technologies such as mobile applications, data analytics, and digital platforms have the potential to improve agricultural productivity and enhance service delivery within agricultural value chains. Digital platforms can facilitate communication between farmers and institutions, enabling more efficient exchange of information and improving access to agricultural services (Klerkx & Rose, 2020).

However, most digital agriculture initiatives focus primarily on improving farm-level productivity rather than administrative support systems. As a result, important components of agricultural services, such as insurance management, often remain characterized by inefficient administrative procedures.

Agricultural Insurance and Risk Management

Agricultural insurance plays an important role in protecting farmers from financial losses caused by environmental risks. By providing financial compensation following crop failure, insurance systems can reduce income volatility and enable farmers to continue investing in agricultural production (Jensen & Barrett, 2022b).

Nevertheless, the effectiveness of agricultural insurance programs often depends on how efficiently claims are processed. Slow verification processes and administrative complexity can

discourage farmers from participating in insurance schemes and reduce the overall impact of these programs (Miranda & Farrin, 2021).

User-Centered Design in Digital Systems

User-centered design (UCD) provides a methodological framework that emphasizes designing systems based on the needs and capabilities of end users. By involving users throughout the development process, UCD helps ensure that digital systems are usable, accessible, and aligned with real-world contexts (ISO, 2019).

In agricultural contexts where digital literacy levels vary widely among farmers, incorporating user-centered design principles is particularly important for ensuring successful technology adoption.

Methodology

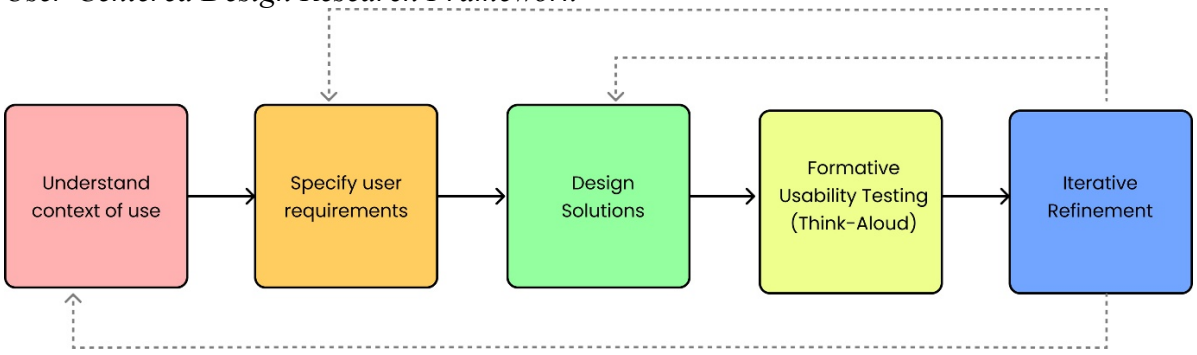
This study adopts a user-centered design (UCD) approach based on the ISO 9241-210 framework for human-centered system development. The UCD approach emphasizes iterative design and active user involvement throughout the system development process.

The research process consisted of five main stages:

1. Understanding the context of use
2. Specifying user requirements
3. Designing the solution prototype
4. Conducting usability testing
5. Iterative refinement of the system

Figure 2

User-Centered Design Research Framework



Source: ISO 9241-210 (2019)

Participants

A total of 44 participants were involved in this study, consisting of:

- 24 farmers
- 20 agricultural education students

Participants were selected through purposive sampling to represent different agricultural contexts and levels of digital literacy.

Data Collection

Data were collected through several methods:

- Semi-structured interviews
- Field observation
- Usability testing using think-aloud protocol

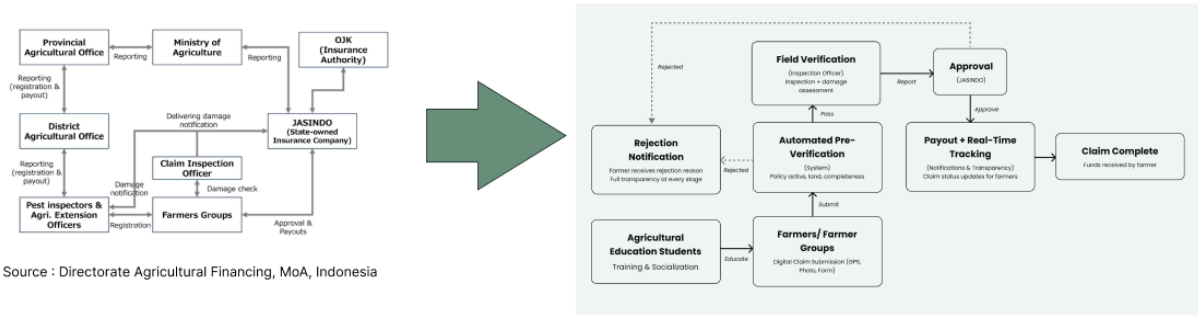
The think-aloud method allowed researchers to observe user interactions with the prototype while participants verbalized their thoughts during task completion.

Results and Discussion

Current Insurance Claims Process

Field observations revealed that the existing agricultural insurance claims process involves multiple administrative stages and relies heavily on manual documentation. Farmers are typically required to report crop damage to local agricultural officers, after which field inspections and document verification procedures are conducted before claims can be approved.

Figure 3
Current vs Proposed Insurance Claims Workflow



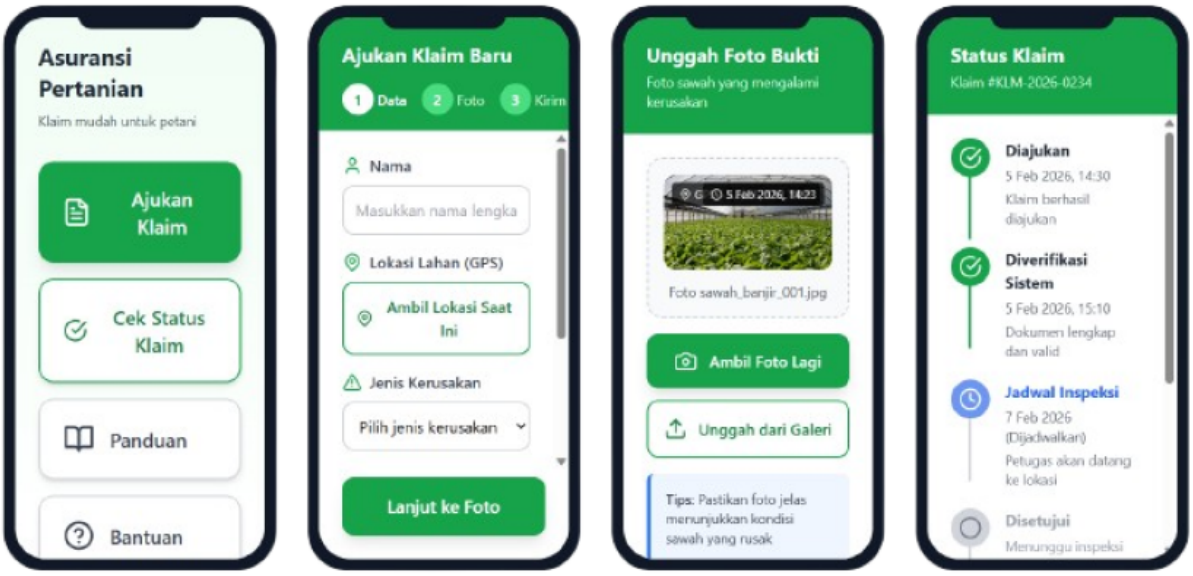
Source : Directorate Agricultural Financing, MoA, Indonesia

Digital Claims Prototype

Based on the user-centered design process, a digital claims platform prototype was developed. The prototype includes several key features:

- Digital claim submission
- Photo-based evidence upload
- GPS and timestamp verification
- Real-time claim status tracking
- Dashboard interface for insurance administrators

Figure 4
Digital Claims Platform Prototype Interface



Usability Testing

To evaluate the usability of the proposed digital agricultural insurance platform, usability testing was conducted with representative users, including farmers who are potential end users of the system. The testing focused on assessing how easily participants could complete key tasks such as submitting claims, uploading evidence of crop damage, and monitoring claim status. User feedback was also collected to identify usability issues related to navigation, interface clarity, and overall system interaction.

Table 1
Usability Testing Results of the Digital Agricultural Insurance Prototype

Feature / Task	Description	User Feedback	Improvement Outcome
Claim Submission Process	Step-by-step process for submitting agricultural insurance claims through the platform	Users reported that the digital workflow simplified the claim submission process compared to conventional manual procedures	Reduced administrative complexity and improved task completion
Photo Evidence Upload	Feature allowing farmers to upload photographic evidence of crop damage directly through the system	Farmers appreciated the ability to document crop damage quickly without relying on manual reporting	Improved documentation efficiency and reduced reporting time

Claim Status Tracking	Real-time monitoring of claim processing status within the platform	Users valued the transparency provided by real-time updates on claim progress	Increased user confidence and reduced uncertainty
System Navigation	Navigation structure guiding users through the main functions of the platform	Initial testing showed minor confusion in menu structure	Interface layout refined to improve navigation clarity
Interface Clarity	Visual presentation of system menus, icons, and instructions	Early prototypes required clearer instructions for some tasks	Improved labeling and simplified interface design
Task Completion	Ability of farmers to complete key tasks such as submitting claims and tracking claim status	After several iterations, users were able to complete tasks with fewer errors	Improved usability for users with limited digital experience

The results presented in Table 1 indicate that the digital prototype improved the usability of the agricultural insurance claim process. Participants highlighted that the system reduced the complexity of administrative procedures and provided greater transparency during the claim process. Iterative design improvements also enhanced navigation and interface clarity, enabling farmers to complete key tasks more efficiently, even among users with limited digital experience.

Conclusion

Agricultural insurance is an important risk management tool for protecting farmers from crop losses caused by environmental hazards. However, the effectiveness of agricultural insurance programs often depends on the efficiency of their operational systems, particularly the claims management process.

This study demonstrates that a user-centered digital platform can significantly improve the efficiency and accessibility of agricultural insurance claims processing. By simplifying administrative procedures, enabling digital evidence submission, and providing real-time claim tracking, the proposed system reduces complexity for farmers and improves transparency within the insurance process.

Furthermore, integrating the digital platform into agricultural education offers an innovative pathway for technology adoption. By positioning agricultural students as facilitators who support farmers in using digital systems, educational institutions can contribute to strengthening digital literacy and promoting wider adoption of agricultural technologies.

Overall, this research contributes an implementable framework that connects digital system design with education-based facilitation to improve agricultural insurance services in developing country contexts. Future research should explore the implementation of the platform in larger-scale pilot programs and evaluate its long-term impact on claims processing efficiency, farmer satisfaction, and insurance adoption rates.

Future Research

Future research may further explore the large-scale implementation of digital agricultural insurance platforms in different agricultural regions to evaluate their effectiveness in diverse farming contexts. Additional studies could also examine the long-term impact of digital claims systems on farmers' participation in agricultural insurance programs, particularly in terms of trust, accessibility, and adoption rates. Furthermore, future research may investigate the integration of emerging technologies such as satellite imagery, remote sensing, and artificial intelligence to enhance the accuracy and efficiency of damage verification in agricultural insurance systems. Expanding the role of agricultural education institutions in supporting digital technology adoption among farmers also presents an important area for further investigation.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that AI-assisted technologies were used during the preparation of this manuscript solely for language refinement, including proofreading, grammar correction, and improving clarity of expression. The use of these tools was limited to editing support and did not contribute to the generation of the research content. All research ideas, study design, data collection, analysis, findings, and discussions presented in this paper are the original work of the authors and are derived from the careful and systematic conduct of the research.

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Contact email: habdil.iqrawardana@students.uii.ac.id