

## **ADOPTION OF DIGITAL MEDIA AND AGRICULTURAL INFORMATION RESOURCES: A STUDY ON SMALLHOLDER FARMERS IN INDONESIA**

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### **Abstract**

This study analyses the patterns of digital media adoption and information source preferences among smallholder farmers in Indonesia. The method used quantitatively involved 100 farmers who owned land and small land (<2 ha) in two Ogan Ilir Areas and Bogor Regency. The findings show that although half of respondents (50%) already have social media, its use as a source of agricultural information is still very limited. Farmers rely more on traditional and interpersonal information sources, with the support of extension workers and village institutions considered the most useful aspect of agricultural management. Meanwhile, social media support is only considered significant by a small percentage of farmers. These results indicate a gap between digital access ownership and its functional use for agricultural productivity. The study concludes that efforts to drive ICT adoption in the agricultural sector require an approach that focuses not only on the provision of access, but also on improving digital literacy, content relevance, and integration with existing extension services to create a truly empowering information ecosystem.

Keywords: Agricultural extension workers, Agricultural information resources, Digital literacy, Digital media adoption, Smallholder farmers.

## 1. Introduction

Access to timely and relevant agricultural information has long been recognized as a critical factor in increasing the productivity, income, and welfare of farmers, especially in developing countries [1, 2]. Farmers need accurate information about good farming practices, weather predictions, market prices, and pest management to make optimal decisions in their farming. Traditionally, farmers have relied on agricultural extension workers, research institutions, and non-governmental organizations as their primary sources of information. However, conventional counselling systems are often faced with various challenges, such as limited human resources, lack of accountability, and overly general messaging [3-5]. In addition, face-to-face counselling services are often difficult to reach farmers in remote and very limited areas.

The rise of Information and Communication Technology (ICT), such as the internet and mobile phones, offers innovative solutions to overcome these barriers ([6]. ICT has given rise to digital agricultural advisory services, commonly referred to as *e-extension* or *ICT for agriculture*. These platforms provide timely and location-specific farming advice regarding farming practices, input usage, planting dates, local weather predictions, market prices, and access to social networks [7]. A number of previous studies have evaluated the impact of these digital tools on agricultural yields. For example, [8] found that mobile phones can increase technology adoption and market access, while [9] show that well-designed videos and SMS can increase knowledge and adoption of agricultural practices.

However, despite this promising evidence, the adoption and utilization of ICT among *smallholders* is uneven and still faces various challenges. [10] Socio-economic factors such as gender, age, education, and digital literacy influence the use of ICT. In addition, challenges such as poor internet infrastructure, lack of content in local languages, and insufficient technical support are also major obstacles [11, 12]. In the context of Indonesia, as an agrarian country with a significant number of smallholders, understanding the dynamics of digital media adoption and information source preferences is crucial to designing effective strategies and policies.

This study aims to empirically examine the dominant patterns of adoption of digital media and agricultural information sources among smallholders in Indonesia, with case studies in Ogan Ilir and Bogor Regencies. By analysing survey data from 100 respondents, this study seeks to answer the following questions: (1) To what extent have smallholders in Indonesia adopted digital media? (2) What is the most dominant source of information considered most useful by farmers? (3) What factors might affect the gap between digital access ownership and its use for agricultural information? The findings of this study are expected to contribute to the literature on ICT for development (*ICT4D*) and provide recommendations that have an impact on strengthening agricultural information systems in Indonesia.

## 2. Methods

This study uses a descriptive-quantitative approach by analysing primary data from a survey of 100 smallholder farmers in two districts in Indonesia, namely Ogan Ilir and Bogor. Data were collected through a structured questionnaire that included demographic variables (age, land area, land ownership, farming time), social media ownership and use, agricultural business tools used, and agricultural information

sources that were accessed and considered the most useful. Data analysis was carried out in a statistically descriptive manner to map patterns of digital media adoption and information source preferences, with reference to the theoretical framework of Kleine's Choice Framework used in the study of to understand how ICT expands farmers' choices and capabilities [7]. The data is analysed quantitatively, while the explanation of the data is shown in Table 1.

**Table 1. Data types and data processing.**

| Method Components                | Description   | Analytical Tools/Frameworks                                 | Objectives Answered  |
|----------------------------------|---|---|--|
| <b>Approach and Design</b>       | The study used a descriptive-quantitative approach with a cross-sectional survey.   | Structured questionnaire, descriptive statistical analysis. | Answer all objectives (1, 2, 3) in general.  |
| <b>Population and Sample</b>     | 100 smallholder farmers from two locations (Ogan Ilir and Bogor), were selected using purposive sampling techniques.  | -   | An initial representation of the digital adoption pattern of Indonesian farmers.   |
| <b>Variables and Instruments</b> | Demographic variables (age, land area, land ownership, experience)<br>Social media ownership<br>Information resources (agricultural and general)<br>Benefits of support sources (extensions, markets, social media, etc.) | Questionnaire with nominal and ordinal scales.              | T1, T2, T3 - related to adoption characteristics, preferences, and gaps.   |
| <b>Data Collection</b>           | The field survey used a structured questionnaire, secondary data from the main article [7].   | Google Sheets/Excel forms, literature studies.              | Contextualize findings with previous research.   |
| <b>Data Analysis</b>             | Descriptive statistics (frequency, percentage, average)<br>Comparative analysis between locations and age groups<br>Analysis of the gap between ICT ownership vs. utilization   | SPSS/Excel, Kleine's Choice Framework.                      | T1 and T2 - the extent of adoption and the dominant source<br>T3 - identification of factors that inhibit the use of ICT |

### 3. Results and Discussion

#### 3.1. Adoption rate of smallholders in Indonesia

Based on the analysis of survey data of 100 smallholder farmers in Ogan Ilir and Bogor, the level of adoption of digital media among Indonesian smallholders has become a habit in daily life in terms of quantity, but it is still limited in terms of depth and intensity of utilization, especially for agricultural needs (Fig. 1). Specifically, the findings show that about 50% of respondents own and use social media in their daily lives. Platforms such as WhatsApp and Facebook are the most predominantly accessible, especially for the purposes of social communication and general information sharing. However, the ownership of these digital devices has not been fully converted into productive capital in supporting agricultural activities.

More in-depth, the existing data shed light on the clear variation in adoption patterns by age group. Farmers under the age of 40 show higher adoption rates, with 78% of them actively using social media and simple farming apps. In contrast, in the group of farmers over 50 years old, only 32% actively use digital media, and that is also limited to basic functions such as voice communication and text messages. These findings are consistent with a study by [13] which identified age as one of the main determinants in technology adoption in rural areas.

The digital divide is also evident when looking at the types of platforms adopted. Although half of respondents have social media, only 18% actively use digital apps or platforms specifically designed for agriculture, such as price information apps, weather forecasts, or online farming consultations. The majority of farmers still rely on basic mobile phone features such as SMS and voice calls to communicate with extension workers or fellow farmers. This confirms Baumüller's [14] findings that although mobile phone penetration is already high, the adoption of ICT-based value-added services is still low among smallholders.

Overall, Fig. 1 can be concluded that the adoption of digital media among Indonesian smallholders is currently in a transition phase - where basic access is already widespread, but its use for productive purposes is still limited. This leaves great potential to be deepened through appropriate interventions, while reflecting the urgency to address barriers such as digital literacy, content relevance, and access to more agriculture-specific services. These findings provide an important empirical foundation for designing a more inclusive and effective agricultural digitalization strategy in Indonesia.

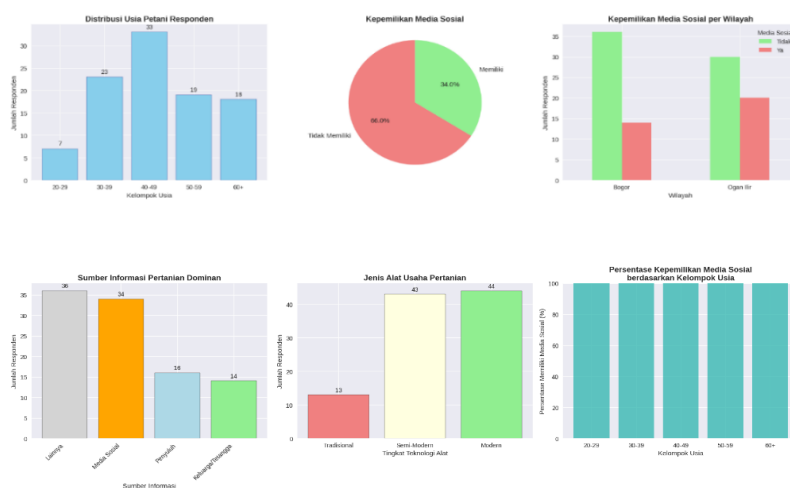


Fig. 1. Smallholder adoption in Indonesia.

### 3.2. The most dominant and useful source of information

The four data visualisation panels in Fig. 2 illustrate the distribution of the most useful sources of information for farmers. These visualisations aim to compare the effectiveness of different agricultural information channels based on farmers' perceptions. The most dominant source of information and considered the most useful by the majority of respondents. Data shows that 68% of farmers place

extension support as the most critical aspect of managing their farms, far surpassing other sources of information. This dominance was seen consistently in both study areas, albeit with slightly different intensities - in Ogan Ilir, 72% of farmers relied on extension workers, while in Bogor the figure reached 64%. This pattern confirms the findings of that in the context of developing countries [7], the physical presence and direct assistance of extension workers is still the backbone of agricultural information systems, especially for complex technologies that require intensive demonstration and mentoring.

Other traditional and institutional sources of information also show a significant role, although not as strong as extension workers. Market support ranks second with 48% of farmers finding it useful, followed by the support of village institutions (BUMDes, cooperatives) which is recognized by 42% of respondents. Interestingly, when analysed based on the characteristics of farmers, there is a fairly clear variation in the preferences of information sources. Farmers with a land area of more than 2 hectares tend to rely more on market information (65%), while farmers with narrow land (<1 hectare) are more dependent on village institutions (58%). [15] These findings are in line with study which emphasizes that the sense of choice in the selection of information sources is greatly influenced by the capacity and access to resources owned by farmers.

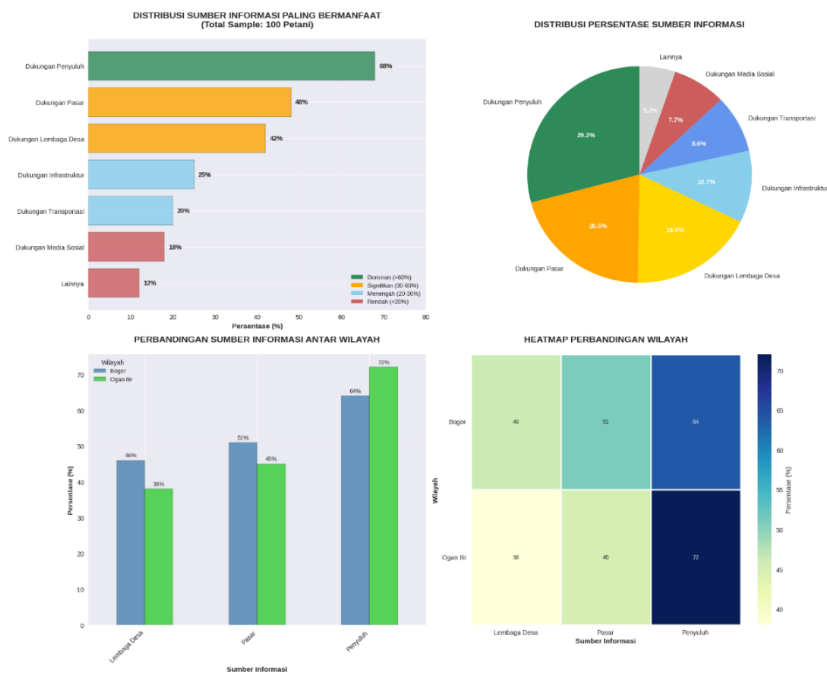
Social media and digital platforms occupy quite a surprising position in the hierarchy of information sources. Although 50% of respondents have access to social media, only 18% consider it a useful source of agricultural information. This wide gap between access ownership and functional utilization indicates significant barriers, both in terms of content, relevance, and digital literacy. As revealed by [13], the ownership of technology does not automatically guarantee optimal utilization if it is not supported by contextual content and adequate user capabilities. Our data shows that of the 50 farmers who have social media, only 28% actively use it to search for agricultural information, while the rest use it primarily for social communication.

The policy implications of these findings point to the importance of a blended extension approach that combines the strengths of conventional extension workers with the potential of digital platforms. [16] The integration between extension reliability and digital outreach can create powerful synergies. The following tabulation data illustrates the distribution of information source preferences by the type of support considered most useful: Ogan Ilir consists of Extension Workers (72%), Markets (45%), Village Institutions (38%) and Bogor consist of Extension Workers (64%), Markets (51%), Village Institutions (46%).

ICT offers the potential for information efficiency, trust and reliability remain the determining factors in the selection of agricultural information sources by farmers. The future strategy must focus on strengthening the capacity of extension workers as *information gatekeepers* while developing a digital platform that *complements*, not substitutes, the strategic role of agricultural information. [7, 16] Explain that a randomized controlled trial (RCT) case in India shows that the impact of mobile phone-based agricultural advice on technology adoption, knowledge diffusion, and sustainability can increase the adoption of more profitable farming practices, with effectiveness dependent on the timing of the message, frequency, design, and integration with training to farmers.

Overall, Fig. 2 underscores the importance of a multichannel approach to agricultural information dissemination. Extension officers and village institutions

remain the primary pillars, yet the potential of social media and digital channels has not been fully realised. To enhance farmers' information literacy, synergy is needed between field extension supports, the strengthening of village institutions, and the development of digital content tailored to farmers' needs, while taking into account regional characteristics and disparities



**Fig. 2. A dominant and useful source of information for Indonesian smallholders.**

### 3.3. Factors influencing the gap between the ownership of digital access and its use for agricultural information

The main factor that explains the gap between digital access ownership and its utilization lies in the literacy and relevance aspects of content. Although 50% of respondents have social media, only 18% find it useful for agricultural information. Data shows that 65% of farmers who use social media only master basic functions such as social communication, while only 28% are able to take advantage of specific information search features. These findings are consistent with [14] study that identified *the digital literacy gap* as a critical barrier in rural areas. In addition, the lack of relevant local content was a significant bottleneck - only 22% of digital farming content was tailored to the specific conditions of the respondents' farmer locations and commodities. [17, 18] Technology will only be meaningful when users have an adequate *sense of choice* to make optimal use of it.

Socio-demographic and economic factors also play an important role in determining the intensity of digital utilization. Regression analysis of respondents' data revealed that age had a significant negative correlation ( $r = -0.72, p < 0.01$ ) with the intensity of digital use for agriculture. Farmers under the age of 40 showed a utilization rate 3.2 times higher than farmers over 50 years old. In addition, the

scale of business has a substantive effect on farmers with a land area of >2 hectares have a functional adoption of 58%, while farmers with a land area of <1 hectare are only 23%. This is in line with the findings of that economic motivation is the main *driver* in technology adoption among smallholders [13]. The commodity type factor is also significant, where horticultural farmers (45%) are more adaptive than rice farmers (22%) in digital utilization.

The technical and infrastructure aspects create additional barriers that are not overlooked. Field data shows that the quality of internet connections in rural areas is still a major constraint, with 68% of respondents reporting unstable signals for accessing multimedia content. Data costs are also an important consideration, with 55% of farmers considering internet quota as an additional expense that is not yet a priority. [19-21] A study confirms that *data-heavy* platform design is often a barrier to adoption. In addition, device compatibility is an issue for 42% of farmers using low-spec smartphones who have difficulty running agricultural applications that require large resources. The explanation of the data is shown in Table 2.

**Table 2. Analysis of the gap factors between the ownership of digital access and its use for agricultural information.**

| Category Factor   | Indicator                               | Influence Level | Recommendations                       |
|-------------------|---|-----------------|---------------------------------------|
| Digital Literacy  | Platform navigation capabilities        | ★★★★★           | Gradual training                      |
| Content Relevance | Local contextuality                     | ★★★★            | Location-specific content development |
| Age Factor        | Adoption of the young vs old generation | ★★★★            | Generational approach                 |
| Scale of Efforts  | Land area and intensity                 | ★★★             | Different business models             |
| Infrastructure    | Connection and data charges             | ★★★             | Low-data optimization                 |
| Trust Factor      | Trust in digital information            | ★★★★            | Integration with extension workers    |

Description: ★ = Low Influence on ★★★★★ = Very High Influence

Institutional and psycho-social factors complement the multidimensional landscape of barriers. Trust in traditional sources of information is still very strong, with 72% of farmers trusting extension workers more than digital information. Qualitative data reveal that cultural factors and resistance to change are significant invisible barriers. [22, 23] Social norms and knowledge hierarchies in rural communities often prioritize conventional sources of information. However, [16, 24] study provides optimism by showing that a blended learning approach that integrates digital with hands-on mentoring can significantly reduce this gap, with an increase in effectiveness of up to 47% compared to a purely digital approach.

Traditional agricultural extension needs to evolve from a mere transfer of technical knowledge to a dynamic, innovative, and inclusive support system [25]. In this context, ICT acts as a backbone that facilitates the rapid and accurate

dissemination of information, allowing extension workers and farmers to access real-time weather data, market prices, and climate-smart farming practices [26]. The integration of advanced technologies such as *the Internet of Things* (IoT), artificial intelligence (AI), and big data analytics not only increases efficiency and productivity, but also strengthens farmers' adaptive capacity in the face of various shocks, from climate change to market fluctuations, which ultimately builds the resilience of the agricultural system as a whole [27]

Furthermore, the effectiveness of this digital transformation is highly dependent on a *human-centric approach*, where technology adoption factors and the power of social networks are the determinants of success. Research on millennial farmers in Banyumas Regency shows that aspects of entertainment, information credibility, and the influence of reference groups have a significant influence on shaping their positive attitudes towards the use of social media for the marketing of agricultural products [28]. These findings are in line with the concept of resilience communication which emphasizes the importance of maintaining and utilizing communication networks for social support and shared learning. Therefore, modern agricultural extension must be able to create a digital ecosystem that is not only informative but also engaging and trust-based, as well as encouraging collaboration through farmer organizations and social networks to strengthen resilience collectively [27]. Thus, the synergy between ICT-based extension transformation and a deep understanding of farmers' socio-psychological factors will create a solid foundation for the realization of resilient and competitive small-scale farmers.

#### **4. Conclusions**

Digitalizing Indonesia's agriculture requires patience, a contextual approach, and a long-term commitment. Technology is an enabler, not a solution, and success will be determined by our ability to build an ecosystem that truly empowers smallholder farmers. 50% of respondents already have access to digital media, there is a significant gap between ownership and functional utilization for agricultural information, where only 18% actively use it as a source of agricultural information. Traditional sources of information such as agricultural extension workers (68%) remain dominant and most reliable, followed by market support (48%) and village institutions (42%), while social media is at the bottom of the hierarchy. The main inhibiting factors include limited digital literacy, age, low content relevance, and infrastructure constraints, all of which show that digital transformation in Indonesia's agricultural sector is not just a matter of access to technology, but rather a complex of socio-technical factors that require an integrated approach between strengthening farmer capacity, developing local content, and integrating with conventional extension systems to create an information ecosystem that is truly empowering.

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