

CHALLENGES AND GAP CAPACITY OF PALM OIL FARMERS IN ACCESSING DIGITAL EXTENSION AND ASSISTANCE SERVICES

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Submitted 07 May 2023; Approved 13 November 2023

ABSTRACT

Palm oil cultivation practices in the future must adopt good agricultural practices (GAP) to ensure sustainability and market acceptance. If farmers fail to implement GAP, they will face the threat of being marginalized and even eliminated from the supply chain. Extension services can be a means of disseminating information regarding the palm oil GAP. With the development of ICT, opportunities have opened up to use digital platforms as a medium for extension. In this research, a socio-economic and demographic characteristics of farmers for digital-based extension services was studied. Farmer data from four locations namely East Kotawaringin, Paser, Sekadau, and Central Mamuju were collected. Data from each parameter component at each location was analyzed for variance (Anova) at a 5% level of significance. The results show that the level of education is directly proportional, while age is inversely proportional to the level of ownership of smartphones as a means of digital education. The existence of farmer groups increases the percentage of conventional extension received by farmers, and where farmers also get information regarding the availability of digital extension materials. The variations in the level of importance and type of information needed by farmers are caused by the development phases of oil palm plantations. Recommendations for overcoming challenges and reducing the gap in farmer capacity in accessing digital extension is development of an integrated digital platform specifically for extension on oil palm cultivation that is adaptive to the needs of farmers and to various digital tools to enhance dissemination.

Keywords: *digital, extension, smallholder, oil palm*

BACKGROUND

Palm oil cultivation methods continue to develop along with technological advances. To achieve high productivity and guarantee the sustainability of farming, farmers need to implement developments in oil palm cultivation methods. However, the reality shows that oil palm farmers in the research area which consists of 4 locations, namely East Kotawaringin, Paser, Sekadau and Central Mamuju Regencies, mostly operate independently without technical support from other parties such as universities, corporations and the state. At all research locations field extension workers or reliable information channels that farmers can access to obtain information about good methods of cultivating oil palm are very limited.

This causes many farmers' activities to be inconsistent with the principles of good agricultural practices (GAP) and the latest technological developments in oil palm cultivation. Farmers' non-compliance with GAP principles includes land clearing activities, providing planting materials,

maintenance, and harvesting activities. As a result, in the long term there is concern that there will be a decline in the competitiveness of farmers and the sustainability of oil palm farming.

Extension and advisory services (EAS) in the field of agriculture are facilities provided by a party (government or non-government institutions) to facilitate farmers' access to knowledge, information, financial services, and technology needed to improve agricultural performance, both in terms of productivity, profitability, and sustainability (Maulidiah et al., 2021; Singh et al., 2023). So far, conventional agricultural extension services have not been able to adequately support farmers to improve crop productivity and the sustainability of their farming activities. Conventional agricultural extension services have a number of limitations, including reach, time, costs, and human resources. Conventional extension services relies on giving instructions through face to face, which is difficult and expensive to do massively and continuously, leaving most farmers unserved.

The development of Information and Communication Technology (ICT) in recent years has been utilized in various countries to overcome the many limitations of conventional agricultural extension methods (Bayes, 2001; Tchouassi, 2012). This digital-based extension approach has proven successful, especially in increasing the adoption of sustainable agricultural technology in several countries and commodities. The use of ICT has the potential to reduce the cost of searching for information, accelerating farmers in obtaining information as needed, thus strengthening the adoption of new technologies by farmers (Aker et al., 2016; Van Campenhout et al., 2021).

In the Indonesian context, digital-based extension and assistance services have also begun to receive attention and have been developed in recent years, especially in food crops. As for plantation commodities such as palm oil, information dissemination via digital platforms has not been channeled in a structured manner. Progress has been relatively slow and has not reached most farmers, especially oil palm smallholders. The existence of several digital extension platforms has not been utilized optimally by farmers. One of the digital extension platforms that the authors have developed specifically for oil palm farmers is SawitKita. In 2022, until now there are still less than 3000 farmers using it. Based on research, it is not yet known what factors cause the low use of this digital extension platform. Therefore, the digital extension and assistance services, especially in the oil palm commodity, has not been able to answer the complexities of the problems faced by farmers.

Palm oil farmers in Indonesia have characteristics, including: small area ownership, low level of education, and low income which becomes obstacles that limit oil palm smallholder access to increase the capacity and capability of managing their plantations. In addition, empirical studies show that conventional extension does not provide the same benefits for women and men farmers due to differences in access to and control over production resources and participation in training programs and decision-making (Aker et al., 2016; Ragetlie et al., 2022). Oil palm farmers are experiencing more severe challenges due to climate change which has caused an increase in the frequency and intensity of events related to pest and disease attacks, water availability, soil fertility, and other agronomic aspects. Many are of the opinion that extension and assistance services for farmers require transformation through the use of advances in information and communication technology. Extension and assistance services for farmers should involve the use of decision support systems (DSS), integrated learning systems, and multi-way communication tools to increase productivity, reduce crop losses, and increase farming sustainability (Arigbo, 2019; Maulidiah et al., 2021; Van-Campenhout et al., 2021).

The results of the study by Firmansyah et al. (2021) regarding the implementation of the SawitKita platform as the first digital-based extension platform in Indonesia showing assistance

services using information and communication technology tools have the potential to improve the quality of conventional extension and assistance which is inadequate to farmers due to the limited number and capacity of extension staff and to reach farmers in remote areas. The choice of digital platforms includes consulting services mediated by mobile applications, digital decision support tools, digital learning tools that use internet networks (online) or not (offline). Studies on the implementation of digital extension services in other fields or commodities have shown a higher level of effectiveness and efficiency in the long term compared to conventional extension. Digital extension services also have the potential to provide more timely, relevant, intensive, and responsive information, even in remote locations, thereby increasing technology adoption.

Findings from previous research indicate that information that has the potential to be disseminated via digital platforms is increasingly diverse, ranging from specific cultivation topics, market access, price information, weather information, early warning of drought, flooding, and pest attacks (Li et al., 2022; Oyinbo et al., 2020). This information allows farmers to make quicker and more informed decisions about their farm management practices. The application of digitalization of counseling is also driven by the fact that there has been an increase in the use of digital devices, including the growth in smartphone ownership among the rural population in Indonesia, which has reached 67.88% (BPS, 2022).

The urgency of accelerating the digitization of extension and assistance is further strengthened by the COVID-19 pandemic which has resulted in closing access to direct meetings as required for conventional extension. Restrictions on mobility and face-to-face meetings have also led to an increase in the use of digital information systems and networks, which has led to major changes in the patterns and behavior of their use, including for oil palm smallholders. Even though it has great potential, digitalization of extension services in the palm oil sector in Indonesia is still low. Efforts to accelerate extension digitalization are constrained by the relatively small number of studies conducted to investigate challenges and gaps in farmer capacity to access and adopt digital extension.

So far there has been no study that focuses on studying the socio-economic and demographic characteristics of farmers for digital-based extension services regarding the use of palm oil digital extension platforms. Studies that identify farmers' needs regarding priority topics for extension on palm oil commodities have also never been carried out. The results of the research can be used as a basis for a strategy to accelerate the digitization of oil palm extension services in Indonesia by narrowing the capacity gap for digital extension services. Therefore, the identification of challenges and capacity gaps in the utilization of digital extension platforms by oil palm smallholders still needs to be explored.

This study aims to analyze the challenges and gaps in the capacity of oil palm smallholders in accessing digital extension and assistance services. For this reason, the research was carried out (1) characterizing farmers' access to extension services and assistance as well as assessing the factors that influence the possibility of adopting digital-based extension services; (2) an assessment of extension information and assistance methods that are needed by farmers and can be fulfilled by digital technology; (3) an assessment of the obstacles to the effective implementation of digital extension; and (4) preparation of recommendations for the structure of the appropriate digital extension platform to be developed for the oil palm commodity.

RESEARCH METHODS

This study is based on primary data collected through interviews with independent oil palm smallholders in East Kotawaringin District, Central Kalimantan Province, Paser District, East Kalimantan Province, Sekadau District, West Kalimantan, and Central Mamuju District, West Sulawesi Province. The four locations represent 4 centers of oil palm cultivation in Indonesia. Interviews were carried out in the period September - December 2021. At each location, a 10% sample of farmers was taken randomly so that a total of 340 farmers as respondents were obtained.

Farmer data collection was carried out by enumerators using a structured questionnaire. Interviews were conducted by visiting farmers one by one to avoid perspective bias. The questionnaire was structured in such a way as to record parameters quantitatively about the socio-economic and demographic characteristics of farmers, the extent to which farmers receive extension and assistance services, farmers' knowledge and understanding of digital extension services, ownership, and use of digital devices; access to digital infrastructure; and farmers' needs for information on oil palm cultivation. The questionnaire entries were then coded in the open-source Android application Open Data Kit (ODK collect). The compilation of the questionnaire results dataset is downloaded in aggregate form with the CSV file extension. The data were then exported to Microsoft Excel 2016 software. Some data from each parameter component at each location was analyzed for variance (Anova) at a 5% level of significance.

RESULT AND DISCUSSION

Lack of knowledge and technical skills among farmers regarding good oil palm plantation management practices is the cause of the low productivity level of smallholder oil palm plantations. Thus, there is an increasing need for strong intermediaries who can facilitate smallholder farmers' access to information needed to increase their crop productivity. The agricultural extension system has a very important role in increasing the knowledge and skills of farmers (Patil et al., 2016). However, the current extension system as it occurs at the research location appears to be inadequate to address the challenges farmers face. This is in line with research by Maulidiah et al. (2021) which shows the conventional extension services has limited penetration due to a lack of trained extension workers to service the large number of dispersed smallholders. Evaluation of the level of knowledge and implementation of good agricultural practices for oil palm in the same location shows a low level based on research by Nasution et al. (2023). In the future, the challenges of palm oil management will become greater due to demands for implementing GAP and achieving mandatory Indonesian Sustainable Palm Oil (ISPO) certification by 2025.

Socio-economic Characteristics of Respondents

The majority of respondents in the four locations were men with an average age of 44 years (Table 1). Most of the women in the four locations work as housewives, not involved in operations and decision making related to plantation management. At least 47% of the respondents had a senior secondary level of education, followed by elementary and junior high school education in almost the same proportion (16 and 17%). About 2% of respondents stated that they had no formal education. Most of the farmers except in Sekadau are dominated by immigrants through the transmigration program in the 1980s.

Farmers in the four locations have an average of 2.38 hectares of oil palm plantations. This area is higher than the national average (<2 ha). Farmers in Central Mamuju had the largest average plantation area (3.4 ha), followed by farmers in East Kotawaringin, Sekadau and Paser. Smartphone ownership in the four locations reached 78%, even in East Kotawaringin farmers who owned smartphones reached 85%. The lowest smartphone ownership is known to be in Sekadau Regency, which is 65%. 73% of oil palm plantation owners also work as farmers, while the remaining 27% have a main profession other than farmers (entrepreneurs, employees, and other professions). Even though they have a main profession other than farmer, they are still the decision makers in plantation operations, so plantation performance is also influenced by their level of GAP knowledge.

Table 1. Socio-economic Characteristics of Respondents (%)

Description	East Kotawaringin	Paser	Sekadau	Central Mamuju
Gender (male = 1)	0.87 ab	0.94 a	0.97 a	0.82 b
Age of respondent (years)	43.29 a	39.60 b	45.66 a	46.50 a
Plantation area (ha)	2.70 a	1.60 b	1.80 b	3.40 a
Level of education				
Elementary School	0.22 a	0.11 b	0.21 a	0.13 b
Junior High School	0.19 a	0.15 a	0.17 a	0.11 a
Senior High School	0.47 b	0.63 a	0.54 ab	0.65 a
College	0.10 a	0.10 a	0.07 b	0.06 b
No formal school	0.02 b	0.01 b	0.01 b	0.05 a
Smartphone Ownership	0.85 a	0.81 a	0.65 b	0.79 ab
Main profession				
Farmer	0.70 ab	0.77 a	0.69 b	0.74 a
Businessman	0.04 a	0.03 ab	0.02 b	0.05 a
Clerk / employees	0.15 a	0.12 a	0.11 ab	0.06 b
Others	0.11 ab	0.08 b	0.18 a	0.15 a

Note: Numbers followed by the same letter in the row are not significantly different at the 5% level

The data in Table 1 shows that younger farmers in Paser Regency have a higher level of education, as indicated by farmers who have graduated from senior high school and college. Younger ages also show higher levels of smartphone ownership compared to older ages on average. Consistently, we identified that in all four locations farmers with higher education levels and younger ages had higher participation rates in conventional and digital extension programs than those with lower educational levels and older ages. This may be because young, educated farmers are able to understand, interpret, and respond to new information more quickly than less educated and older farmers, affecting their engagement with extension services. This is consistent with the findings Ragetlie et al. (2022) in his study on gender-aware digital outreach in Tunisia during the COVID-19 Pandemic.

In this research, what is meant by smartphone ownership is a device that is fully used by respondents who determine the operationalization of oil palm plantations. It is known that one farming household can own more than one smartphone device. In terms of implementing digital extensions, ownership of a device such as a smartphone is an absolute requirement as a dissemination medium (Li et al., 2022). The factors mentioned by farmers as limiting the use of digital devices in

this study include the lack of ownership and control of digital devices, limited technical support for using digital devices, and low awareness of the availability of digital extension services. It is consistent with Aker et al. (2016) who noted that access to mobile phones across regions that are not evenly distributed can exacerbate information asymmetry between groups of people. Advances in communication and informatics technology as well as the abundance of information are in fact only enjoyed by people living in areas with adequate telecommunication infrastructure.

Kansiime et al. (2020) in his study in Tanzania also noted that the digital infrastructure gap can affect the drive to own information and communication technology (ICT) devices. Furthermore, ownership of digital devices, especially smartphones, influences participation in digital extension activities. In relation to the utilization of existing digital devices, in the context of oil palm smallholders in Indonesia, several main challenges were found, namely the high cost of internet access and low digital literacy. Efforts to increase the accessibility of farmers who own smartphone devices to digital extension must therefore be based on a platform that minimizes internet quota consumption but remains reliable and easy for farmers to understand.

Farmer Access to Extension and Assistance Services

In the proposed questionnaire, farmers were asked whether they had received extension services at least 2 times in the last 1 year, either through conventional (non-digital) or digital approaches (Table 2). On average, 87% of farmers receive extension services and/or assistance from any source (conventional or digital). The source of counseling is dominated by conventional extension methods, meanwhile extension with digital platforms in all locations does not reach half of the percentage of conventional extension. This condition occurs due to the unavailability of extension resources specifically allocated by the government to provide assistance and counseling to oil palm farmers. The characteristics of oil palm farmers are that they are spread over a large area, accessibility is difficult, and they are not yet well institutionalized so that efforts to carry out conventional extension by gathering farmers in one forum are difficult and expensive. The limitations in the scope and reach of digital extension lie in the lack of information regarding the availability of digital extension platforms, the low digital literacy of farmers even though they have smartphones, and the lack of awareness of the need to continuously increase knowledge regarding oil palm cultivation.

There are 57% of farmer respondents who receive both types of extension services, both conventional and digital. Farmers receive information about digital extension through direct meetings at the same time as farmers receive conventional extension. Farmers in Central Mamuju had the highest access to counseling and assistance services, but this was not significantly different from East Kotawaringin. Farmers in Sekadau have the lowest access to extension and assistance services. The results of this study show that dissemination regarding the availability of digital extension platforms is carried out when farmers receive conventional extension, especially those carried out by non-government extension agencies (NGOs) that carry out activities at research locations.

Conventional extension received by farmers in the Sekadau and Central Mamuju research areas was mostly obtained from non-government agencies (NGOs), followed by local communities, and the lowest was obtained from government extension workers (Table 2). The farmers in the East Kotawaringin and Paser research areas were mostly obtained from NGOs, followed by government extension workers, and the lowest were obtained from local communities. The differences that occur in the two research area groups are thought to be caused by the existence of functional farmer groups in East Kotawaringin and Paser, while in other research areas, namely Sekadau and Central Mamuju,

existing farmer groups are not functional. There are no regular member meetings which can also serve as conventional extension forums. The existence of farmer groups can be an effective and efficient forum for disseminating information through extension as stated by Maulidiah et al. (2021). The low percentage of access to conventional extension is also followed by low access to digital extension as shown in Sekadau. This is caused by information regarding the availability of digital extension materials obtained during conventional extension.

Efforts to reduce the gap in farmer capacity to obtaining digital extension services can be carried out through optimizing the institutional functions of farmers as proposed by Aker et al. (2016) and Afifah et al. (2021). The function of farmer institutions must be improved so that they can become facilitators of knowledge dissemination and innovation for their members (Hilmiati, 2020). Participatory methodologies for platform design and construction need to be used taking into account local information needs, preferences, and capacities of farmers (Steinke et al., 2021). This process is to ensure that the platforms and digital content provided can be optimally adapted by farmers as end users who often differ in gender, age, socio-economic group, literacy, and agroecological zones (Oyinbo et al., 2020).

Table 2. Farmer Access to Extension and Assistance Services (%)

Variables	East Kotawaringin	Paser	Sekadau	Central Mamuju
Access to extension services and assistance	94 a	86 ab	73 b	96 a
Extension resources				
Conventional extension	94 a	86 ab	73 b	96 a
Digital extension	47 a	33 bc	29 c	48 a
Combination of conventional and digital counseling	62 a	51 b	49 b	67 a
Conventional extension				
Friends and family	27 a	19 b	16 bc	14 c
Local community	47 a	32 b	15 c	11 c
Farmer groups / cooperatives	61 a	48 b	54 ab	59 a
Extension Agents (Government / NGO)	94 a	86 ab	73 b	96 a
Digital extension (platform)				
SMS	0 a	0 a	0 a	0 a
Whatsapp	47 a	33 b	29 b	38 ab
YouTube	33 a	24 b	16 c	38 a
Specific extension application	0 a	0 a	0 a	0 a

Note: Numbers followed by the same letter in the row are not significantly different at the 5% level

In the last two years there have been NGOs assisting oil palm smallholders in the four locations. However, the assistance provided is temporary and incidental. Data for 2 years shows that farmers received at most 6 times conventional extension, and it was not carried out on a regular schedule. Due to the limited time available when implementing conventional extension, the scope of material obtained by farmers is limited, not necessarily in accordance with farmers' real needs, and the level of information absorption is thought to be low. There has been no study regarding the level of information absorption because in all conventional extension activities received by farmers, pre-tests and post-tests were not carried out.

Meanwhile, digital extension information only comes from two applications, namely Whatsapp followed by Youtube. None of the farmers received digital extensions via the SMS platform or special digital extension applications. As with conventional extension, the digital extension accessed by farmers is partial, unstructured, and does not cover the entire topic of oil palm cultivation in accordance with the principles of GAP. However, different from conventional extension, in digital extension farmers can repeat information or determine the speed of learning or processing the desired information. In the educational field, it is often referred to as a self-paced learning method (Shirk, 2020). With the possibility of self-paced learning, there is an increase in the potential for higher understanding of the material compared to conventional extension methods where the instructor determines the speed of delivery of the material to farmers as the object of extension.

Table 2 shows that 87% of farmers received advice regarding oil palm cultivation at least twice from any source during the last 1 year. Extension mainly came from local NGOs, farmer group administrators, and fellow farmers. While the research was being carried out, there were several NGOs that were carrying out mentoring and mapping programs for farmers in order to obtain an Oil Palm Cultivation Registration Certificate (Surat Tanda Daftar Budidaya / STDB). Among the programs carried out is providing counseling on several topics of good agricultural practices for palm oil. Interestingly, not even once did government extension workers provide extension to farmers in the last 1 year at the four locations. Significantly conventional extension (face to face) is more widely obtained (87%) than extension through digital devices (37%).

At least 37% and 28% of farmers obtained digital extension information about oil palm agricultural practices via Whatsapp and Youtube, respectively. Farmers considered that these two platforms were better than conventional face-to-face extension. The main reasons given for this assessment are: ease of access, ease of understanding the content or material presented, selected information that is more relevant to the needs of farmers, and is more time efficient because farmers can be followed without being tied to a particular place and time. The palm oil GAP information material obtained was predominantly in audiovisual form (65%) and text (35%). However, information sources originating from digital sources, especially WhatsApp and YouTube, are not structured and there is no screening regarding the veracity of the information.

The dominance of the WhatsApp application as an extension platform can be attributed to the fact that the use of the application is not limited only for the purposes of obtaining information related to plantation operations, but also for other communications. Flexibility, ease of use, discussion features, and multimedia sharing are the advantages of the Whatsapp application which encourage the expansion of the use of the application as a counseling platform. Meanwhile, YouTube as a video-sharing application was chosen by farmers because it is much easier to understand the material presented in audiovisual form than writing. Currently, there are quite a number of content creators who produce videos about oil palm cultivation.

A study of respondents who own smartphones but do not use digital extension services is shown in Table 3. The results reveal that internet services are considered expensive as the main reason (60%), and there were no significant differences in the four research locations. Most of the respondents used the Global System for Mobile Communications (GSM) internet service. Meanwhile, 56% of respondents stated that they did not know that extension services could be obtained through digital platforms or that information related to oil palm cultivation from digital platforms was not reliable enough (19%). The level of awareness of farmers in East Kotawaringin and Paser is significantly higher than in Sekadau and Central Mamuju. This is thought to be

influenced by the existence of farmer groups which are a means of exchanging information on the whereabouts of GAP materials which can be accessed via digital platforms.

Table 3. Reasons for Farmers Not Using Digital Extension Services (%)

Reason	East Kotawaringin	Paser	Sekadau	Central Mamuju
Don't have a compatible device	13 a	13 a	12 a	9 a
Not aware of digital extension services	41 b	53 b	66 a	65 a
Expensive internet service	64 a	61 a	55 a	59 a
Unreachable internet network	13 b	26 a	9 b	11 b
Not having enough time	8 b	14 a	11 ab	16 a
Lack of skills in using digital devices	8 b	12 b	28 a	24 a
Content irrelevant to needs	26 ab	31 a	23 b	34 a
Doubt the correctness of digital information	11 a	9 a	8 a	9 a

Note: Numbers followed by the same letter in the row are not significantly different at the 5% level

Other reasons behind the low utilization of digital extension services among respondents in the four locations include limited internet network coverage (15%) and lack of knowledge about how to use digital devices (18%). To be able to optimally utilize digital extension services, farmer skills are needed in optimizing the use of digital devices. Not all locations where farmers live are covered by the internet network, while the quality of the existing internet network is also uneven. 29% of respondents considered that the content on digital platforms was irrelevant to their needs, and decided to obtain information from conventional extension methods.

Materials Needed by Farmers in Extension and Assistance Services

Respondents were asked about the type of information they wanted to know about oil palm cultivation. This questionnaire provides 18 groups of information topics, and each respondent can choose 5 types of information that are considered the most important (Figure 1). Information on nutrition management and inorganic fertilization, nursery, and planting management, weed control, pest and disease control, and pesticide management are the five topics that have the highest average value of needs. Nonetheless, there are differences in the level of material needs in the four locations. Only farmers in East Kotawaringin have the same level of importance for the material needs for oil palm cultivation with an average value. Meanwhile, farmers in Paser place planting material management as the second top priority. Materials on managing legume cover crops and castration, ablation, sanitation, and canopy management are the third and fourth priorities for farmers in Sekadau. A different pattern was also obtained from farmers in Central Mamuju where the material for the agro-industry of oil palm commodities and the management of legume cover crops ranked fourth and fifth as the material needed.

Although there were variations in the level of importance and type of information needed by oil palm smallholders in the four research locations, there was consistent demand for extension information on topics such as fertilizer management, pest control and nurseries. There are certain topics such as tree and production censuses, occupational health and safety management, and infrastructure management that receive a small percentage of the needs of the respondents.

Differences in the importance of information between the locations of these respondents according to Glendenning et al. (2010) which states that farmers' needs for extension information are influenced by socio-economic aspects and local agro-climatic conditions. Therefore Steinke et al. (2021) suggesting that the type of information provided by an extension service needs to be adapted to the characteristics of the community and the local agronomic context.

Farmers in the four locations stated that nutrition management and especially inorganic fertilization and nursery management were the two most needed topics but at the same time were difficult to obtain in a comprehensive and applicable manner from available extension services, both through conventional extension methods and digital platforms. Respondents revealed that there were information gaps, especially in diagnosing nutrient deficiencies, determining the calculation of fertilization recommendations, enforcing the 5R concept (right type, right dose, right time, right place, and right method) in fertilizing, optimizing local resources in overcoming the high price of fertilizer, and method of identifying the quality of fertilizer circulating among farmers.

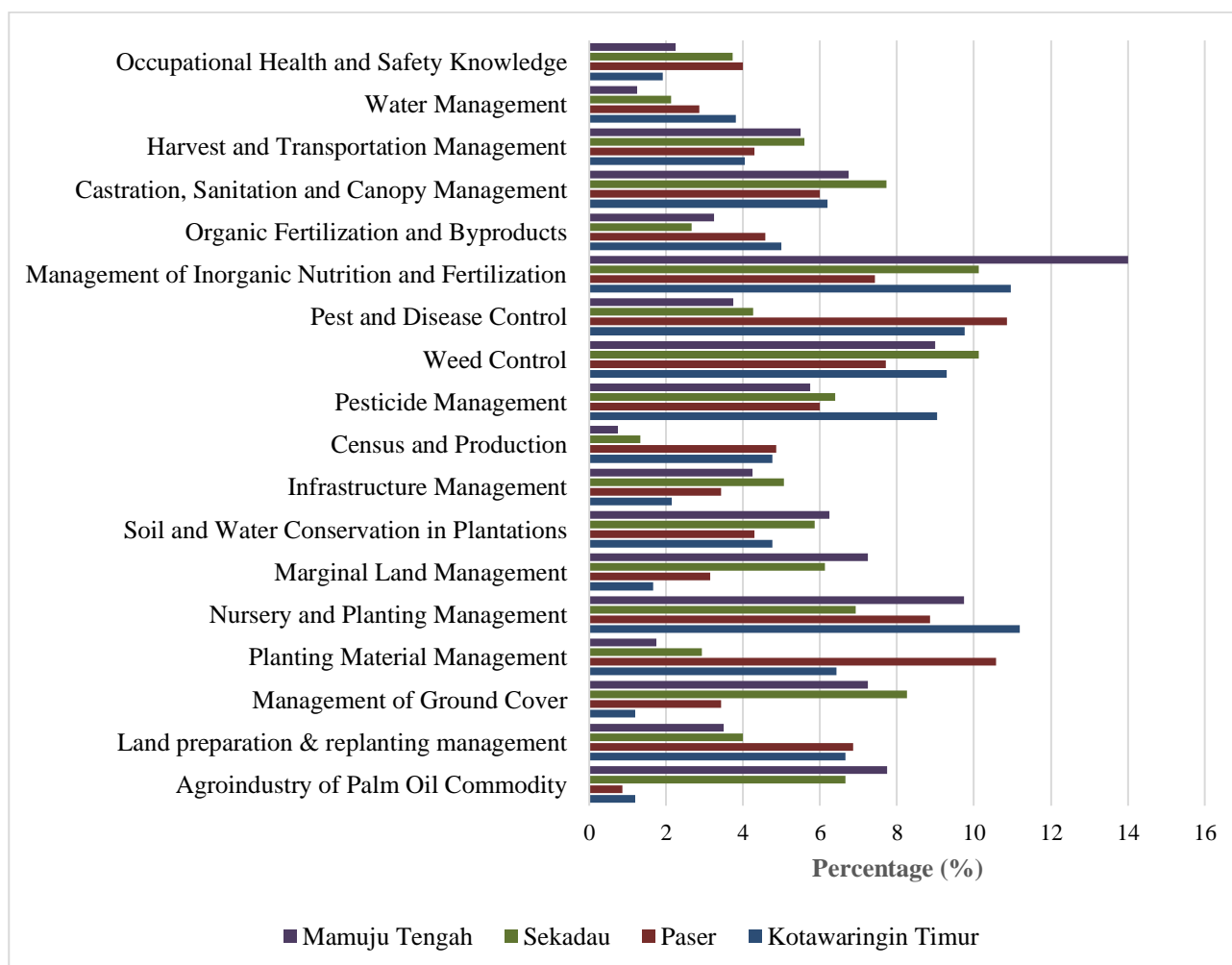


Figure 1. The Priority Topics for Oil Palm Cultivation Expected to Be Obtained from Extension Services

Differences in information needs between farmer groups are caused by the development phases of oil palm plantations in each of the areas. The oil palm plantations in East Kotawaringin and Paser are dominated by mature plantations and some are entering the replanting stage. This

encourages the important value of information regarding aspects of cultivation such as land preparation and nurseries to support replanting activities. As for information regarding the management of fertilization and pest control, including the management of pesticides is needed by farmers to increase productivity. Farmers from Sekadau and Mamuju have a higher preference for obtaining information on the oil palm agro-industry, management of marginal lands, management of legume cover crops, castration, and canopy management allegedly because plantations in these areas are dominated by new planting on marginal lands and immature stage.

Likewise, farmers expressed information gaps regarding the management of planting material and oil palm nurseries. Smallholders urgently need information regarding mechanisms for obtaining certified planting material, selection of appropriate varieties, and infrastructure for oil palm nurseries. This questionnaire also added open questions regarding other information needed by farmers outside the 18 topics of oil palm cultivation that have been determined. Other information gaps reported by farmers include the following plantation design (understanding of plantation infrastructure design, optimizing cropping patterns and planting stakes), regulation and certification (understanding of land legality, plantation business legality, how to obtain a Cultivation Registration Certificate (STDB), the Indonesian Sustainable Palm Oil (ISPO) certification system, as well as international certifications such as the Roundtable on Sustainable Palm Oil (RSPO)), and farmer institutions (an understanding of how to build and manage the administration of cultivation institutions such as farmer groups and financial institutions such as cooperatives).

Inhibiting Factors and The Need for Farmers to Increase The Effectiveness of Digital Extension

Barriers to farmers in obtaining the information they need include their limited access to extension and assistance services. Farmers have limited resources to obtain the information they need proactively, for example if they have to spend money and allocate time. Farmers also reported that extension workers from government agencies were few and not easy to access, while private extension workers from NGOs and large plantations were very rarely available.

In terms of digital extension and assistance, farmers face various obstacles in accessing digital devices. The level of this barrier differs according to the farmer's sex and age category. 57% of farmers in the four research locations who are more than 50 years old experience difficulties in using smartphones. If the age limit is raised to 60 years, the percentage of farmers who experience difficulty using smartphones will reach more than 73%. Based on gender group, women experience the same level of barriers to access and use of smartphones compared to men. The main reason given for women's limited access to digital extension services is the perception that an understanding of oil palm cultivation is the responsibility of men, so there is no urgency for women to have technical knowledge regarding the operationalization of oil palm plantations.

The data also show significant differences with respect to the specific barriers faced between farmers in different regions to access digital extension. Ownership of smartphone devices by farmers in East Kotawaringin is higher (85%) compared to Sekadau (65%) and Paser (79%) allegedly due to the availability of better telecommunication infrastructure in the region. The percentage of smartphone ownership is positively correlated with the level of access to digital extension service sources. Based on the obstacles faced, more than 90% of respondents stated that they needed training that specifically provided skill-building training on how to access the required extension information sources through digital platforms. Farmers also want information to be communicated in a simpler

and more applicable language due to the relatively low educational background of the farmers. This is part of the effort to transform conventional extension methods into digital ones.

CONCLUSION AND SUGGESTION

Recommendations for overcoming challenges and reducing the gap in farmer capacity in accessing digital extension include technical and policy aspects. The proposed technical recommendations include: (1) development, testing, and evaluation of a digital platform specifically for extension on oil palm cultivation that is adaptive to the needs of farmers; (2) integration of digital communication with conventional farmer-based extension services to create inclusive extension activities; (3) inclusion of an information service package on the availability of agricultural production facilities including capital on digital platforms; and (4) development of content that addresses the specific information needs identified by farmers, and which can be adapted to various digital tools to enhance dissemination.

The proposed policy recommendations include: (1) profiling farmers and farmer institutions to understand the specific needs of farmers; (2) increasing farmers' digital literacy and creating farmers' awareness of available digital extension services; and (3) increasing physical infrastructure development for digital access and reducing costs related to internet access and digital devices based on farmer institutions. Further research is needed to identify the relationship between agronomic characteristics and extension information needed by farmers. Furthermore, studies are needed to determine the structure and business processes of the digital extension platform that are in accordance with the characteristics of the region and farmers using a participatory concept based on farmer institutions.

ACKNOWLEDGMENTS

We would like to thank the Kehati Foundation through the SPOS Indonesia program for the support provided during the implementation of the research. This research would not be successful without the support of Yayasan Javlec Indonesia, Kawal Borneo Community Foundation, Sulawesi Community Foundation (SCF), and Serikat Petani Kelapa Sawit (SPKS).

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