



Diversity of Knowledge-Sharing Behavior to Encourage the Practice of Robusta Coffee Red-Picking (Case Study of Temanggung Robusta Coffee Farmer, Indonesia)

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Abstract

Red-picking is the key to good coffee quality and is essential for increasing farmers' income, added value, competitiveness, and development. Knowledge-sharing is one solution to improve the knowledge confidence of farmers and the reach of dissemination of red-picking practices. This research aims to determine the diversity of knowledge-sharing behavior related to red-picking practices according to farmers' socio-economic status. This research was conducted in a constructivist paradigm with a qualitative approach and case study strategy. According to specific characteristics, seven primary informants were determined by staged, purposive, and peer group discussions. Temanggung coffee stakeholders take part as supporting informants. Interviews, focus group discussions, social media and document observations, expert discussions, peer group discussions, literature reviews, and documentation were used to collect research data. The data were analyzed qualitatively using the NVivo 12 Plus. Research has found that diversity of knowledge-sharing tends to encourage red-picking practices. The research findings also stated that group farmers with an area of land ≤ 1 ha, younger generation group farmers, group farmers with roles as gathering traders, and group farmers who use social media have more diverse knowledge-sharing behaviors. The practice of red-picking can be encouraged by supporting farmers in carrying out knowledge-sharing activities with other farmers with different characteristics. This study implies that the resulting findings will enrich the concept of knowledge-sharing by describing how people utilize social and offline media in sharing knowledge to encourage red-picking practices.

Keywords: coffee; farmer; knowledge-sharing; social media

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INTRODUCTION

Coffee is an essential commodity for the world economy (Acıkalın and Sanlier, 2021; Richey and Ponte, 2021). Coffee consumption has increased due to global population growth and increased consumption of coffee drinks by millennials (ICO, 2023). For Indonesia, coffee contributes

to farmers' income and regional economic development and is a source of foreign exchange. Indonesia is ranked third in the world in coffee production after Brazil and Vietnam. Its total production was estimated to be 11.85 million sacks (711 thousand tons) in 2022/2023 (ICO,

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2023), 96.3% of production was exported, and only 3.7% circulated in the domestic market (ICO, 2021). Of several types of coffee, Indonesia's robusta coffee production was reported to be greater than arabica coffee (Statistic Indonesia, 2021).

Temanggung robusta coffee has a distinctive and unique taste, indicated by geographical factors. Geographical factors, human resources, and a combination of these factors influence the distinctiveness of Temanggung robusta coffee. The quality of the taste of Temanggung robusta coffee's wet and dry processing (whole spindles and broken skin) comes from the results of quality testing conducted by the Coffee and Cocoa Plant Research Center (Puslitkoka) in 2014 and 2015. On the other hand, the taste quality of Temanggung robusta coffee with honey coffee processing techniques comes from the results of testing conducted by the Sustainable Coffee Platform of Indonesia (SCOPI) in 2015. One of the distinctive flavors of Temanggung robusta coffee is coffee with the aroma of palm sugar (MPIG-KRT, 2015). This regional robusta coffee is the only coffee in Central Java Province, Indonesia, with a Geographical Indication (GI) certificate from the Ministry of Law and Human Rights of the Republic of Indonesia (DGIP, 2022). GI increase added value, product quality, and production quantity, protect products from fraud, and improve the regional economy (Ramli et al., 2010). The quality and uniqueness of Temanggung robusta coffee must be prioritized to maintain its quality and competitiveness.

Red-picking (coffee harvesting based on quality standards) is the key to success in maintaining coffee's quality, character, and uniqueness. Picking coffee beans when the beans are ripe red will produce high-quality coffee beans with good taste, high yield, heavier weight, healthy glucose levels, and uniqueness (Nogueira Martins et al., 2021; Rosas et al., 2022). Harvesting processes that do not meet standards produce low-quality coffee (Afrizon et al., 2020; Ihsaniyati et al., 2020a).

Many studies have shown that implementing quality standards, including coffee picking, remains low (Rosanti et al., 2020; Rosiana, 2020; Suharto et al., 2020). Research by Ihsaniyati et al. (2020a) states that the level of red-picking practices by Temanggung robusta coffee farmers is still low. Many parties have made various efforts to improve farmers' red-picking practices (Padmaningrum et al., 2019; Ihsaniyati et al., 2020b), but the results have not been optimal.

Many farmers still practice green or rainbow harvesting for various reasons. Among the reasons are that green and mixed picking is more accessible to sell (Purwanto et al., 2023) and inadequate knowledge and confidence in the benefits of red-picking practice (Setyowati et al., 2021). Picking coffee in red conditions risks coffee theft, so harvesting is often done before all red fruits are torn (Wulandari et al., 2022).

The communication carried out in this effort by development agencies is primarily linear and tends to be top-down. The top-down, one-way, and linear approach causes farmers to be passive, lack initiative, and depend on extension workers and their groups (Prayoga, 2017; Baloch and Thapa, 2019). Moreover, instructors are inadequate in quantity and competence (Setyowati et al., 2021), even though the role of extension workers is also essential for disseminating knowledge (Olorunfemi et al., 2020).

Knowledge-sharing is a solution for more participatory and dialogical communication (Wilkins et al., 2014; Flor and Gozales-Flor, 2019; Servaes, 2020). Knowledge-sharing reinforces knowledge (Swanson et al., 2020; Stock et al., 2021), creates open dialogue (Naeem, 2019), strengthens interaction and social exchange (Obrenovic et al., 2020; Jin et al., 2021; Luo et al., 2021), helps get work done (Gagné et al., 2019), and increases competitiveness (Guofeng et al., 2020; Yang et al., 2021). Thus, knowledge-sharing supports the formation of collective knowledge and the reach of knowledge dissemination and confidence in farmers' red-picking practice, as well as becoming a solution to limited extension services.

Social media is engaging because it has proven beneficial and remarkable for knowledge-sharing activities. With social media, farmers can share experiences, post updates on harvests, find information about the market, update the latest news, and solve problems (Thakur and Chander, 2018; Ayisi Nyarko and Kozári, 2021; Fayyaz et al., 2021; Riley and Klein, 2021). Media can reach a wider audience (Nasrullah, 2018), promote faster response, and has the opportunity to create dialogue and interaction for users (Azahari et al., 2021).

Farmers use social media to share knowledge (Thakur and Chander, 2017; Kandagor et al., 2018; Thakur et al., 2018). *WhatsApp* social media is essential and helpful in discussing livestock business issues, increasing networks

between farmers and livestock sector actors, and helping farmers get enough information for decision-makers on their livestock business (Thakur and Chander, 2017; Thakur et al., 2018). Knowledge-sharing is an effort to increase information networks among farmers and make knowledge available to them. In addition, knowledge-sharing activities are very effective in promoting the adoption of innovation or technology (Perosa et al., 2021). Research by Kabir et al. (2023) found that *Facebook* groups play an essential role in getting rooftop garden farmers the knowledge and advice they need, which they should receive from extension organizations. Various studies have been done on the use of social media for knowledge-sharing. The authors have reviewed 57 high-quality articles from trusted sources using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) protocol. Studies investigating farmers are still limited (3%), and only 5% have examined the agricultural sector, 60% of studies have applied quantitative methods, and no studies are in Indonesia. This study is becoming a trend and more enjoyable, considering the increasingly rapid development of digital technology (Ihsaniyati et al., 2023).

Knowledge-sharing via offline media has also been widely studied (Evers and Chappin, 2020; Guofeng et al., 2020; Lyu Chongchong et al., 2020; Vătămănescu et al., 2020; Wang et al., 2020; Aalbers and Whelan, 2021; Zhang

et al., 2022; Cortes Arevalo et al., 2023). Farmers and the agricultural sector have also received little attention in previous research, and qualitative methods are rarely applied. Farmers' knowledge-sharing behavior differs depending on socio-economic status, such as land area, generation, supply chain actors, and access to social media, which have not been widely explored.

Future research should delve deeper into farmers' knowledge-sharing behavior in the agricultural sector and the context of developing countries such as Indonesia. Qualitative methods are necessary to provide new facts and better understand this study. Therefore, this research aims to formulate variations in knowledge-sharing behavior to encourage the practice of robusta coffee red-picking based on farmers' socio-economic status (land area, generation, supply chain actors, and social media access). This research will add new facts, enrich the concept of knowledge sharing, and contribute to developing the Unified Theory of Acceptance and Use of Technology (UTAUT).

MATERIALS AND METHOD

Research location

The research location was determined purposively, namely Temanggung Regency, Central Java Province, Indonesia. Temanggung robusta coffee is the only one in Central Java Province with a GI certificate. Temanggung

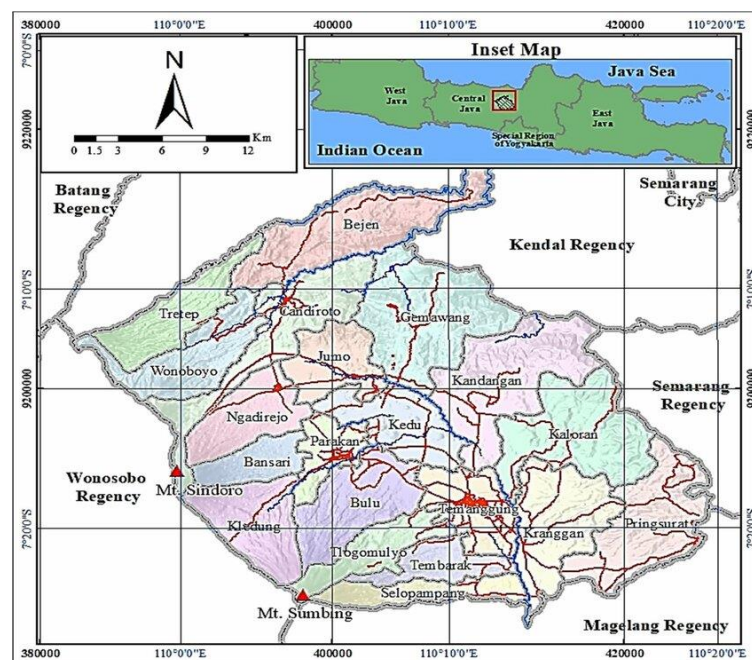


Figure 1. Map of Temanggung Regency (Wilopo et al., 2023)

Regency is astronomically located at 110°23' to 110°46'30" E and 7°14' to 7°32'35" S, with an area of 870.65 km² (87,065 ha). This region is a plateau and mountain range with cold and humid air with an average temperature of 20 to 30 °C and rainfall above 2,000 mm per year. Temanggung robusta coffee is produced from plains 400 to 1,200 meters above sea level. The planting area of robusta coffee in 2021 is 11,724.46 ha, with a production of 10,434.48 tons. Figure 1 presents a map of Temanggung Regency to clarify the research location.

Case study design and research informants

This study falls under the qualitative (exploratory) research category employing constructivism (Figure 2). This research strategy takes the form of an embedded multiple-case and instrumental analysis. The case unit of this research is informant farmers with specific characteristics, including the application level of robusta coffee quality standardization (SOP), land area, generation, supply chain actors, and social media access. Land area affects the application of innovation (Gandasari et al., 2021). Generation will determine individuals in knowledge-sharing activities (Rahman et al.,

2017; Obermayer and Toth, 2020; Kaba et al., 2023). A person's actors in the supply chain will shape communication behavior and knowledge-sharing to fulfill their role (Ellyta et al., 2019; Halim et al., 2019). Individuals' utilization of social media will determine how they share knowledge (Naeem and Khan, 2019).

Informants are determined purposely through two focused group discussions (FGDs) and peer group discussions based on predetermined characteristics. In the first FGD, researchers invited Temanggung robusta coffee stakeholders, including extension coordinators from 11 Temanggung robusta coffee center area sub-districts. According to the agreement in the FGD forum, researchers then sent a formula in Google Form format to the extension coordinator to get a list of coffee farmers as potential informants. Researchers obtained 32 potential informants, some with a combination of characteristics but no supporting data, then invited them to the second FGD and verified the data; finally, 18 future informants were obtained. Next, researchers conducted on-topic interviews with 18 potential informants and discovered that their behavior patterns were similar. As the

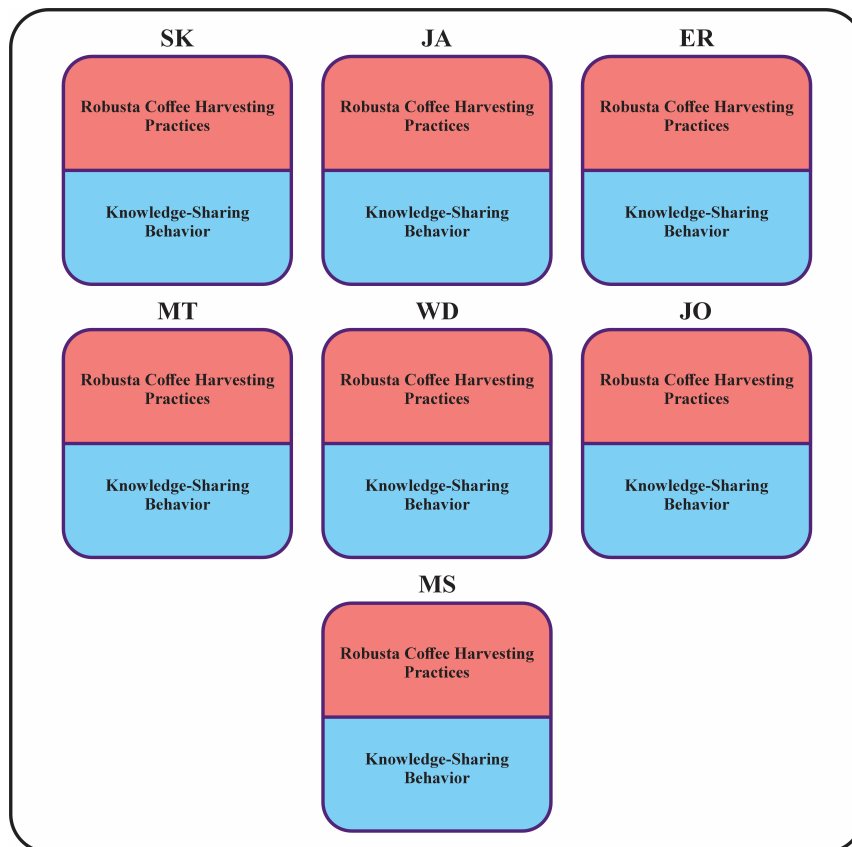


Figure 2. Case study design

INFORMANT/ CASE	application level of GS standard			land area		generation			supply chain actor		access to social media	
	high	medium	low	≤1 ha	>1 ha	baby boomer	generation X	generation Y	producer	collecting trader	using social media	not using social media
SK												
JA												
ER												
MT												
WD												
JO												
MS												

Figure 3. Case units based on informant characteristics

Note: SK, JA, ER, MT, WD, JO, and MS are the case names/initials of the research informant

research progressed, researchers added gender and considered the location of the coffee plantation. After peer group discussion, researchers determined seven farmers as the primary informants. The number of informants is determined and adjusted to the research information needs and data saturation (Creswell and Creswell, 2018). Figure 3 shows informants with each characteristic that represents a research case. Researchers also interviewed supporting informants such as extension workers, local governments, related agencies, coffee farming communities, buyers, and coffee experts.

Data collection techniques

Research data were collected through in-depth interviews, FGD, observation (social media and document study), literature review, peer group discussions, and documentation. Apart from face-to-face meetings, interviews were also conducted via *WhatsApp* voice calls and *WhatsApp* chats. Direct interviews with each informant are conducted at a time and place agreed between the informant and the researcher. Interviews were performed 2 to 3 times with an average duration of 1.5 hours for each informant. The interview process was recorded with a recorder or export chat and transcribed verbatim. The FGD was conducted at the research location by inviting key and supporting informants to confirm the study results. Observations are made by directly observing informant knowledge-sharing activities on social media and face-to-face. Discussions are held with supervisors, colleagues, and experts to strengthen the concept. Documentation was done by archiving daily notes, photos of activities, interview recordings, interview transcripts, observation notes, and FGD results notes. Credibility and consistency of research were sought by source and technique triangulation, FGD to confirm results, peer group discussions,

expert discussions, and monitoring of the research location.

Data analysis

Research data analysis was carried out using an interactive model (Miles et al., 2014). Analysis was performed using qualitative techniques with the help of the NVivo 12 Plus application. The analysis stages included first-cycle and second-cycle coding. The first cycle of coding was sequential and comprised meaning units, condensed meaning units, code, category, and theme (Figure 4). The second coding cycle consisted of matrix and crosstab coding on NVivo 12 Plus applications. The matrix and crosstab coding process results are exported into Ms. Excel for further analysis to support data visualization. Data visualization was carried out with the help of Ms. Excel 2021, Adobe Illustrator CC 2023, and Corel Draw Graphic Suite 2020.

RESULTS AND DISCUSSION

Robusta coffee picking practices based on the cases identified in research

Temanggung robusta coffee has had a GI certificate from the Ministry of Law and Human Rights since 2015. Other GI-certified coffees in Indonesia include Gayo, Kintamani Bali, and Flores Bajawa arabica coffee (DGIP, 2021). GI helps improve quality, added value, product diversification, protection of products, competitiveness in domestic and foreign markets, and enhancing regional economies (Ramli et al., 2010). GI-quality coffee has a higher selling value (Padmaningrum et al., 2019), generates greater profits, saves costs, and facilitates access to world markets (Yulisti et al., 2019), as well as provides uniqueness and added value (Setyowati et al., 2021). To produce consistent coffee quality from time to time, a production process that complies

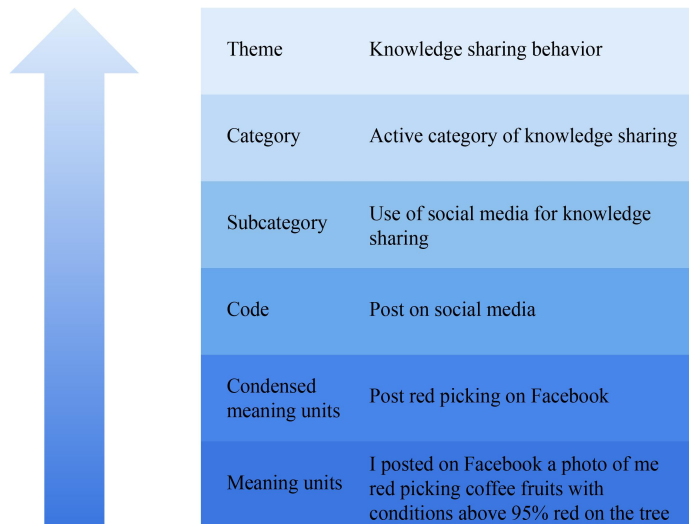


Figure 4. First step coding stages and example (Modified from Erlingsson and Brysiewicz, 2017)

with quality standards is needed, including in the coffee harvesting process (Setyowati et al., 2021). For this reason, in coffee harvesting research, according to quality standards, coffee harvesting practices are called GI standards.

Harvesting robusta coffee in Temanggung generally consists of three harvest times: the early harvest or '*wiwit*', the big harvest, and the final harvest or '*lelesan*'. The harvest is held around March or April, between July and August, and the last harvest is held around September. Farmers selectively select red and damaged coffee fruits at early harvest due to coffee fruit borer (PBKo) attacks or other causes. There are differences in harvesting or subsequent yields carried out by farmers. This research found disparities in harvesting practices between cases (Figure 5). Coffee-picking practices by informants are classified into three categories: picking according to, above, and below GI standards. The criteria for each coffee harvesting/picking practice are presented in Table 1. The final harvest, or "*lelesan*" is carried out by farmers by picking all fruits, both red and non-red, including damaged fruits. They try to clean trees from coffee fruits so that the coffee flowering process for the next year is not disturbed. The study's results found no difference in early harvest and final harvest practices carried out by informants.

Different coffee-picking processes determine the quality of the coffee produced and the price, added value, and competitiveness (Setyowati et al., 2020). Value addition will increase the economic value of agricultural products and farmers' incomes (Sati, 2022). When processed,

coffee picked in ripe red condition has a higher yield, heavier weight, and a good taste. In addition, the price of coffee picked in red states is more elevated than in green or rainbow states. Farmers who engage in red-picking generally process coffee according to standards, sun-drying coffee with quality standards, practicing good pulping and hulling, and presenting it with good packaging and storage. There is no guarantee that coffee picked in green or rainbow conditions will be processed according to quality standards. Coffee picked red and processed to quality standards is more valuable than coffee picked green or rainbow in color. In 2022, red-picked Temanggung robusta coffee sold for 40 to 60 thousand rupiahs (2.6 to 3.9 USD) per kilogram, while rainbow-picked coffee sold for 24 to 27 thousand rupiahs (1.6 to 1.7 USD) per kilogram.

Knowledge-sharing behavior and practice of robusta coffee red-picking

The research found new facts about knowledge-sharing behavior related to picking robusta coffee (Figure 6). The study details the diversity of knowledge-sharing behavior by farmers. Knowledge-sharing behavior by informants is divided into three types: active, passive, and combination categories. First, knowledge-sharing behavior is in the active category, where farmer informants not only receive or seek knowledge through the media (offline and social media) but also share knowledge obtained through the media. The use of social media for active types includes two events, namely discussions and posts on social media. The use of offline media for the active

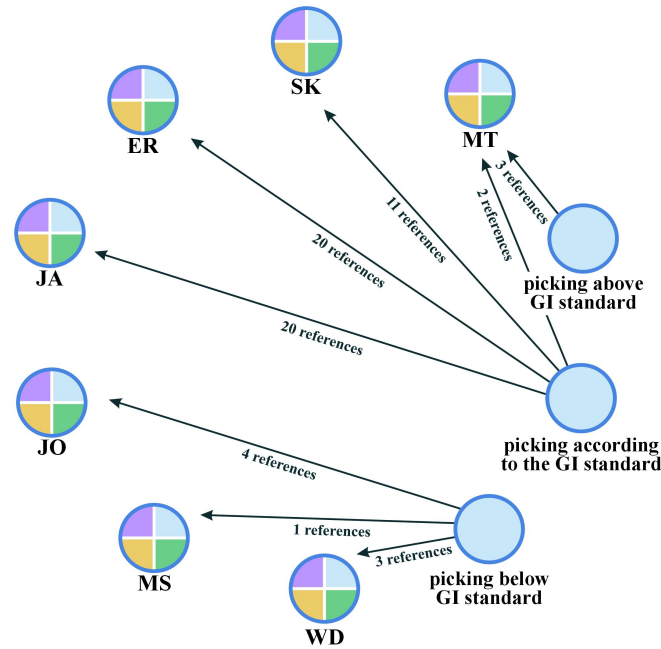


Figure 5. Robusta coffee picking practices based on case units identified in research
Note: SK, JA, ER, MT, WD, JO, and MS are the case names/initials of the research informant

Table 1. Categorization of robusta coffee harvesting practices by farmers

Category	Coffee harvesting practice categories based on GI standards		
	Above	According to	Below
Percentage of red coffee fruit on the tree	90-95% red	90-95% red	70-80% red, already harvested
How to harvest	Selective red (harvesting red coffee fruit)	Selective red (harvesting red coffee fruit)	Non-selective (harvest all existing coffee fruits/ 'rampesan')
Picking frequency	More than three times a year (many times)	More than three times a year (many times)	Three times a year ('wiwit' harvest, big harvest, 'lelesan' harvest)
Harvest time	Morning to 12 noon	Not specified	Not specified

type consists of discussing offline and from offline media to offline media. Farmers use social and offline media to discuss and actively share their knowledge. Second, sharing research in the passive category, namely, farmer informants only receive or seek knowledge through social or offline media. Third, the combination category of knowledge-sharing behavior means that informants combine both types of media (offline and social media) and knowledge-sharing categories (active and passive). The combination of knowledge sharing includes two behaviors: from social media to offline media and from offline media to social media. For example, farmers listen to offline forums and then share the knowledge on social media, or vice versa. They listen to knowledge on social media and then share the knowledge gained on offline

platforms. It is important to note that active-passive combination behavior always ends with active behavior. Active-passive combinations only occur when followed by an active action, which is impossible to complete in passive behavior.

Active, passive, and combined behavior in knowledge sharing by farmer informants is related to picking coffee. Although there are knowledge-sharing behaviors by informant farmers related to picking practices under GI standards, there are far more varieties of knowledge-sharing behaviors that encourage picking practices according to GI standards (Figure 6). Active (knowledge donation) and passive (knowledge collection) behaviors influence performance (Nguyen et al., 2019) and then increase income (Jatav and Naik, 2023).

Many factors shape farmers' robusta coffee red-picking practice. This research found that the factors that shape this behavior are the adequacy of knowledge and confidence and the farmers' enthusiasm for carrying out robusta coffee red-picking practices. This research focuses on farmers' knowledge-sharing behavior and media use to share knowledge, with less emphasis on the knowledge-sharing process, considering that this area needs to be further explored (Ihsaniyati et al., 2023). Farmers' knowledge-sharing activities shape their knowledge, enthusiasm, and confidence in red-picking. The following are some of the informants' statements.

"Knowledge-sharing increases not only knowledge but also enthusiasm and inspiration, and makes us happy" (SK, 2022)

"Sharing knowledge on YouTube is my encouragement" (ER, 2022)

"Knowledge-sharing increases relationships and reduces leisure time" (JA, 2022)

Knowledge-sharing behavior by case

In implementing coffee harvesting practices according to standards, knowledge-sharing allows farmers to share and seek information that

supports coffee production with optimal quality by established standards. Knowledge-sharing is a necessary process that can benefit individuals, groups, and organizations. Knowledge-sharing can be done in various ways, such as through communication, discussion, training, and social media (Ahmed et al., 2019). Knowledge-sharing is crucial in the context of robusta coffee farmers in the Temanggung region. Each informant brought a diversity of knowledge to the coffee harvest, which resulted in variations in the red-picking practices applied.

Figure 7 shows differences in the diversity of knowledge-sharing behavior according to informant cases based on farmer characteristics. Research shows the diversity of knowledge, media, and content-sharing behavior in knowledge-sharing activities. This diversity is behind the differences in farmers' coffee harvesting practices. Initial suspicion: this is evidence that diversity of knowledge as a result of knowledge sharing affects the application of red-picking practices. The case study explains that the highest diversity is demonstrated by ER informants who practice according to standards. However, the case study found a new fact that diversity of knowledge sharing is not the only driving factor. In the case of JO and WD informants, knowledge-sharing

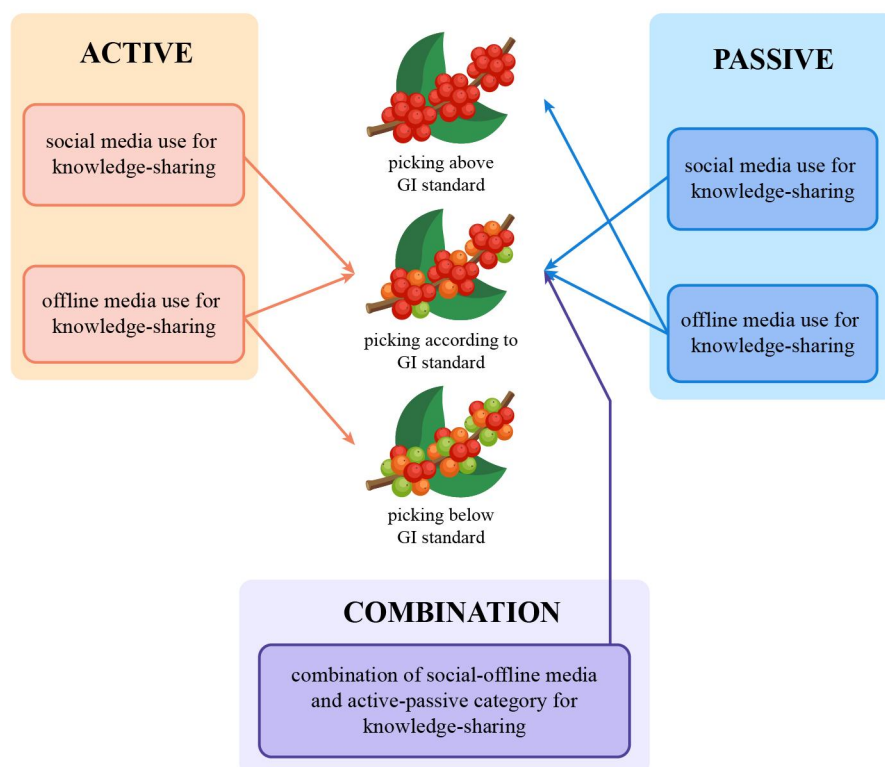


Figure 6. Knowledge-sharing behavior related to the practice of red-picking

ACTIVE	SK	JA	ER	MT	WD	JO	MS
Use of Social Media for Knowledge Sharing							
Discuss on Social Media (WhatsApp, Facebook, and Instagram)							
coffee marketing	+	++++	+		+	++++	+
coffee harvest (red picking)	+		+			+	
Post on Social Media (Facebook, Youtube, WhatsApp, and Instagram)							
coffee harvest (red picking)	+	+	+				
coffee marketing	++	+++	++		+	+++	
Use of Offline Media for Knowledge Sharing							
Offline Discussions (Discussing with Experts, Training, Other Farmers, PPL, Comparative Studies)							
coffee cultivation	+	+++	++	++++	++	++	+
coffee marketing	+	++	+	+	+	++	+
coffee harvest (red picking)	+	+	+				
from Offline Media to Offline Media (Other Farmers, Training, Expo, Online Forum)							
coffee harvest (red picking)	+	++	+	+	+	+	
Coffee SOPs		+	+	+++	+	+	
coffee marketing	+	++	+	++	+	+	
COMBINATION							
Combined Use of Social and Offline Media							
From Social Media to Offline Media (Whatsapp, Youtube, Other Farmers, Comparative Studies)							
coffee cultivation					++	+	+
coffee marketing		+			+	+	
coffee harvest (red picking)						+	
From Offline Media to Social Media (Offline Forum, WhatsApp, Facebook, Instagram, Youtube)							
coffee marketing	+				+		
coffee harvest (red picking)	+	+	+		+		
PASSIVE							
Use of Social Media for Knowledge Sharing (Social Media Listening)							
coffee marketing		+++	+		+	+++	
Use of Offline Media for Knowledge Sharing (Listening to Online Forums)							
red picking products				+			
coffee marketing		+	+	+			
coffee harvest (red picking)				+			
DIVERSITY/REFERENCE	62%/304	71%/726	76%/319	43%/351	67%/623	71%/603	24%/296
Pick above GI standard							
Pick according to GI standard							
Pick under GI standard							

Figure 7. Knowledge-sharing behavior by the case

Note: SK, JA, ER, MT, WD, JO, and MS are the case names/initials of the research informant

behavior is classified as having high activity and variety, but picking is below standard in practice. This phenomenon is supported by cases such as JO and WD. Informants do not add red quotation discussions even though they carry out some diverse knowledge sharing, such as offline discussions and sharing the results of conversations through social media.

This condition reinforces that other factors jointly encourage farmers to conduct coffee harvesting practices according to standards. Individual characteristics in the form of education, knowledge, and enthusiasm can increase SOP compliance behavior (Rahmawati,

2019). Motivation has a direct and significant favorable influence on employee performance (Alhempri et al., 2024). The variable that has a dominant impact on performance is motivation, while the variable that has a dominant influence on motivation is compensation (Mulyani et al., 2019). In this study, another fact was found: the best picking practices were carried out by MT informants who had red-picking practice behavior above GI standards and moderate knowledge diversity. This behavior is because MT informants are more active and superior to other farmers in discussing coffee cultivation and SOPs with experts in training. In addition, MT farmers

ACTIVE	land area		generation		supply chain actors		social media access			
	Use of Social Media for Knowledge Sharing									
	Discuss on Social Media (WhatsApp, Facebook, and Instagram)									
	coffee marketing	++++++ ++++ ++	+	+	+++++	++++++	+	++++++ ++++ ++	++++++ ++++ ++	
	coffee harvest (red picking)	+		+		+	+	+	+	
	Post on Social Media (Facebook, Youtube, WhatsApp, and Instagram)									
	coffee harvest (red picking)	+++		+	+	+	+	++	+++	
	coffee marketing	++++++ ++	+	++	+++	+++++	++	++++++ ++	++++++ +++	
	Use of Offline Media for Knowledge Sharing									
	Offline Discussions (Discussing with Experts, Training, Other Farmers, PPL, Comparative Studies)									
coffee cultivation	++++++ ++	++++++ +	+	++++++ ++	+++++	++	++++++ ++++++	++++++ ++++++	+++++	
coffee marketing	++++	++	+	++++	++	+	++++++	+++++	+	
coffee harvest (red picking)	+		+	+	+	+		+		
from Offline Media to Offline Media (Other Farmers, Training, Expo, Online Forum)										
coffee harvest (red picking)	++++	+	+	++	++	+	++++	++++	+	
Coffee SOPs	+++	+++		++++	++		++++++	+++	+++	
coffee marketing	+++	++	+	+++	++	+	++++	+++	++	
COMBINATION	Combined Use of Social and Offline Media									
	From Social Media to Offline Media (Whatsapp, Youtube, Other Farmers, Comparative Studies)									
	coffee cultivation	+	++		+	++	+	++	+++	
	coffee marketing	+	+		+	+		+	+	
	coffee harvest (red picking)	+				+		+	+	
	From Offline Media to Social Media (Offline Forum, WhatsApp, Facebook, Instagram, Youtube)									
	coffee marketing	+	+	+		+	+	+	+	
	coffee harvest (red picking)	+	+	+	+	+	+	+	+	
PASSIVE	Use of Social Media for Knowledge Sharing (Social Media Listening)									
	coffee marketing	++++++	+		+++	++++		+++++		
	Use of Offline Media for Knowledge Sharing (Listening to Online Forums)									
	red picking products		+		+			+		+
	coffee marketing	+	+		+	+		+	+	+
	coffee harvest (red picking)		+		+			+		+
	DIVERSITY/REFERENCE	90%/2248	81%/974	62%/304	86%/1373	90%/1545	67%/600	100%/2622	90%/2871	43%/351
		≤ 1ha	> 1ha	baby boomer (born in 1946-1964)	X generation (born in 1965-1980)	Y generation millennials (born in 1981-1996)	producer	trader collectors	using social media	not using social media

Figure 8. Variations in knowledge-sharing behaviors related to red-picking practice based on farmers' socio-economic status

also distribute coffee SOPs to other farmers offline and follow products to domestic and foreign expos.

Diversity of knowledge-sharing behavior based on socio-economic status

This study discovered differences in farmers' media use for knowledge-sharing based on their socio-economic status (Figure 8). Aside from that, it is evident that the advantages of knowledge-sharing activities that encourage red-picking include not only red-picking knowledge but also marketing knowledge.

Knowledge-sharing behavior based on land area

One of the factors influencing farmer behavior is land area. Gandasari et al. (2021) discovered that farmers with larger land areas are more likely to seek or obtain information from outside sources to reduce agribusiness uncertainty. The farmers studied were mostly cattle breeders with less than a hectare of land. The current study has a different context than previous studies, and the results differ. Farmers in this study cultivate coffee in monoculture, with the majority having land areas

of < 1 ha. They do not practice agricultural diversification, which can provide additional income. Farmers with a land area of ≤ 1 ha have more diverse knowledge-sharing behaviors than farmers with a land area of > 1 ha.

Aside from that, farmers in the first group actively share their knowledge more than farmers in the second group (Figure 8). Farmers at the research location cultivate coffee in monoculture, and most coffee farmers at the research location acquire land < 1 ha. Farmers with small plots of land have few options for expanding their land because coffee land is not cheap. The coffee-farming income is insufficient to allow them to develop their land. For them, increasing the quantity and quality of coffee is the best way to increase revenue.

“Land of less than one hectare does not meet sufficient standards, so how can we maximize productivity with small land?”
(WD, 2022)

To increase coffee productivity and quality, farmers in the ≤ 1 ha land area group carry out a variety of knowledge-sharing activities. Apart from looking for information on social media and offline media, they actively discuss on social media (*Facebook, Instagram, and WhatsApp*), share knowledge on social media (*Facebook, YouTube, WhatsApp, and Instagram*), discuss offline with other people (farmers, experts, and buyers), discuss in offline group meetings, and provide education to other farmers and the community in offline training. For these reasons, this study assumes that group farmers with a land area of ≤ 1 ha have more active and diverse knowledge-sharing behavior than group farmers with a land area of > 1 ha.

Knowledge-sharing behavior based on generational groups

Age has an impact on knowledge-sharing behavior. Pew Research Center states that there are five generational groups. The five generations are the silent generation (born 1928 to 1945), the baby boomer generation (born 1946 to 1964), generation X (born in 1965 to 1980), generation Y (born in 1981 to 1996), and generation Z (born in 1997 to 2010s) (Hamdi et al., 2021). Respondents aged 50 and up (generation X and baby boomers) demonstrated the highest knowledge-sharing attitudes and behavior levels. Findings show that older generations are more likely to share knowledge than younger generations (Tonessen et al., 2021; Kaba et al., 2023).

This study shows different results. generation Y (millennial) farmers have more diverse knowledge-sharing behavior than generation X and the baby boomer. Generation Y employs a broader range of social and offline media platforms for knowledge-sharing. They use *YouTube, Facebook, Instagram, and WhatsApp* to discuss, share knowledge, or search for information. *YouTube* is a social media platform only utilized by generation Y farmers. Generation Y farmers combine social media and offline media more than previous generations.

Generation Y shares the knowledge they have gained offline on social media. They also engage in more active knowledge-sharing than previous generations. They receive knowledge and share it via social media, offline media, or a combination. They are more open to sharing their understanding than generation X. Generation Y still values community knowledge-sharing, demonstrating a strong desire to share or learn from others (Liu and Bakici, 2019; Younas and Bari, 2020; Hamdi et al., 2021).

Figure 8 illustrates that generation X farmers are more diverse than the baby boomer generation. Although baby boomer farmers use social media to seek information, discuss, and share knowledge, their knowledge and use of social media are less diverse than generation X farmers. This study's results align with the research of Alemu et al. (2022), which states that age is a factor that influences dis-adoption. In other words, the older farmers are, the more sustainable land management technology adoption will decrease.

Farmers from different generations make up a group or region of farmers. This study suggests that cross-generational synergy in knowledge sharing will support knowledge dissemination and community strength (Okros, 2020). This intergenerational collaboration will aid in developing group or community-based coffee, which has been proven more effective in preserving the uniqueness of coffee based on geographical indications. Based on the description above, this research assumes that younger-generation group farmers have more active and diverse knowledge-sharing behavior than older-generation group farmers.

Knowledge-sharing behavior based on the supply chain actor groups

Farmers who play the role of collecting traders engage in more active and diverse knowledge-sharing than farmers who play the role of

producers. Collecting trader farmers use a broader range of media, including social media, offline media, and a combination of the two (Figure 8). These behavioral differences are attributed to differences in roles, needs, and interests. Farmers who act as collecting traders must maintain a stock of coffee products that meet buyer specifications. They have a specific buyer or market in mind. Managing trader farmers is not the same as middlemen. They produce red-picked products, buy and sell coffee, and educate farmers about red-picking. Therefore, other farmers have more trust in them. Trust is essential in knowledge-sharing (Imam and Zaheer, 2021). Collecting trader farmers are estimated to have broader networks and are part of more cosmopolitan communities. They have societies and networks where they can find reliable information, communicate, and learn from one another (Skaalsveen et al., 2020; Gandasari et al., 2021). Farmers' networks impact income and stability (Albizua et al., 2020).

The study found that producer-group farmers tend to have less diverse knowledge-sharing behaviors than gathering trader-group farmers, thus influencing their knowledge limitations, especially about potential buyers. Coffee farmers with poor access to marketing information (buyers) tend to practice substandard coffee picking. They do not have buyer information who is willing to buy red-picked coffee products if they produce them. The results of this study show things that are different from those of previous studies. Research by Alemu et al. (2022) found that farmers with good market access

will encourage them to adopt sustainable land management technologies. A farmer's good access to markets increases non-agricultural opportunities for them. Therefore, farmers will resist re-adoption or adopt at lower rates.

To fulfill all roles, collecting trader farmers engage in more diverse information-sharing activities and engage in a great deal of active knowledge-sharing. For these reasons, the study suspects that collecting trader farmers have more active and diverse knowledge-sharing activities than producer farmers.

Knowledge-sharing behavior based on access to social media

Figure 8 shows that farmers who use social media engage in more active and diverse knowledge-sharing than those who do not. Farmers use social and offline (face-to-face) media for knowledge-sharing and social media combinations. It means that after discovering information on social media, they share it on offline media. Moreover, they discuss using offline media and then share their findings on social media. Farmers modify their acquired knowledge before sharing it, for example, by conducting trials and creating posters, narratives, videos, and photos (Figure 9). In addition, more knowledge-sharing behaviors that fall into the active category use social media than those without social media.

Social media is a powerful and valuable means to share knowledge (Hosen et al., 2021). On the other hand, farmers' discussions in groups and offline meetings can increase dissemination

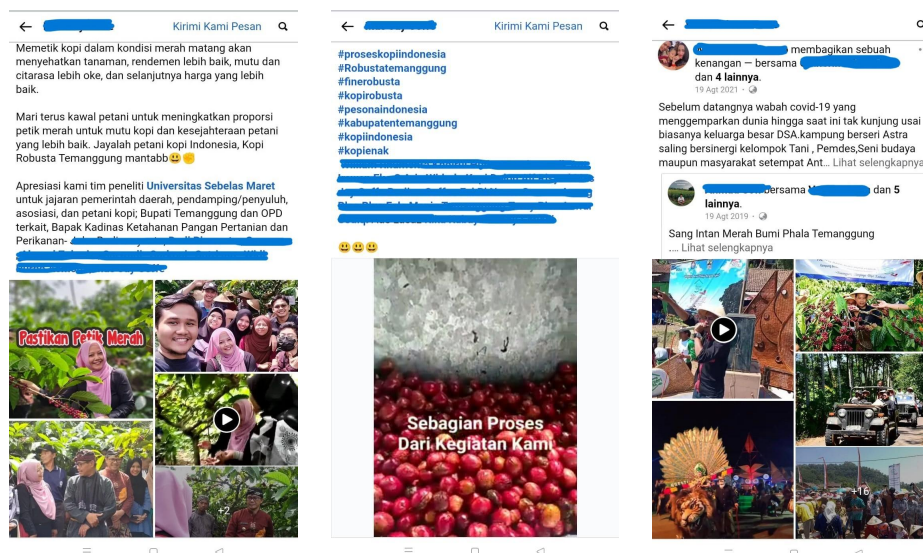


Figure 9. Red-picking posts on social media by informant (source: The informant's Facebook account)

outreach because not all farmers are familiar with social media (Dilleen et al., 2023). Thus, the synergy in knowledge-sharing between farmers who use social media and those who do not will promote problem-solving (Fayyaz et al., 2021). It supports the notion of farmers' behavior of combining media use to help spread knowledge and confidence among groups or communities to engage in red-picking. With this synergy, geographical indication-based coffee development can be realized based on evidence that group or community-based commodity development, including coffee, is more effective than individual development. Community-based development is participatory and long-term (Jafaruddin et al., 2020). Considering the existing findings, this research assumes that farmers who use social media have more active and diverse knowledge-sharing behavior than farmers who do not use social media.

This study found that knowledge-sharing activities by farmers encourage the practice of red-picking. By sharing knowledge through social media and offline media, farmers can synergize with other farmers or other actors (extension workers, traders, related agencies, universities, experts, and researchers) to increase knowledge and confidence in red-picking. Their behavior is a solution for strengthening collective knowledge to realize competitive Temanggung robusta coffee, with distinctive characteristics indicated due to geographical factors.

This study is the first to reveal the diversity of knowledge-sharing behavior by coffee farmers based on socio-economic status (land area, generation, supply chain actors, and social media access). This new fact has not been explored by many similar studies before. This study found that the knowledge-sharing behavior of coffee farmers includes active, passive, and combination behaviors. Active and passive knowledge-sharing behaviors include social media and offline media (face-to-face). The combined behavior of knowledge sharing is the combined behavior of media use, namely social and offline media, as well as a combination of active and passive categories. The research also revealed the content or knowledge shared, the knowledge that is proven to drive robusta coffee harvesting practices by farmers.

The study found details of the behavior of practicing social media to share knowledge, which has not been explored by many similar studies before. Research on practicing social

media to share knowledge has been widely conducted. Ihsaniyati et al. (2023) examined 57 highly reputable articles using the PRISMA protocol. Similar studies have previously presented definitions of social media use for knowledge sharing. Still, most of these studies do not detail or divide social media usage behavior for knowledge sharing into parts such as those found in this study. These studies include Etemadi et al. (2019); Udem et al. (2020); Luo et al. (2021) and Yao et al. (2021).

This research also develops the concept of sharing knowledge, primarily through social media, from the research of Fayyaz et al. (2021) which mentioned that knowledge-sharing involves collecting and donating knowledge. Individuals who donate knowledge are called active category knowledge-sharing behaviors, while those who accumulate knowledge are called passive knowledge behaviors. The results of this study add media types to each of these knowledge-sharing categories, namely the use of social media and offline media for active and passive categories. In addition, this study also presented the category of a combination of knowledge sharing.

Regarding the study of the use of information system technology, the results of this study are fascinating new facts about the behavior of using social media to share knowledge. UTAUT is one of the models of adoption of information system technology, including comprehensive social media. This theory or model is widely used in various studies with consideration because each individual is different in adopting information system technology. At UTAUT, seven constructs are significant direct determinants of individual intentions or use of information systems technology. The use of information systems in this model is interpreted as the duration of use of information systems (Venkatesh et al., 2003). In addition, most previous studies with the UTAUT model did not divide the use of information systems into several models of usage behavior (Etemadi et al., 2019; Beqqali Hassani et al., 2020; Cavdar Aksoy et al., 2020).

The results of this study also present new facts on the practice of social media to share knowledge with behavioral diversity, including the use of social media in active, passive, and combination categories. The social media usage in the active category consists of discussing social media and posting on social media. Social media usage in the passive category consists of seeking and listening

to knowledge on social media. The combination category comprises knowledge-sharing behavior from social media to offline media and offline media to social media.

CONCLUSIONS

This study presents new facts, especially details of knowledge sharing behavior of coffee farmers to encourage robusta coffee-picking practices according to GI standards. Farmers engage in diverse knowledge-sharing behaviors in active, passive, and combination categories. Active and passive category knowledge-sharing involves social media, offline media (face-to-face meetings), or both media types. This study also found differences in the diversity of knowledge-sharing behavior according to farmers' socio-economics (land area, generation, role in supply chain, social media access). As a technical implication in the field, differences in the diversity of farmers' knowledge-sharing behavior become a reference for efforts to encourage a culture of knowledge-sharing by robusta coffee farmers. The synergy between different farmers in socio-economic conditions will support efforts to build collective knowledge that accelerates the number and range of robusta coffee harvesting practices according to quality standards. The culture of knowledge sharing that is formed will also solve the limited number and competence of agricultural extension workers. As a theoretical implication, diversity of knowledge-sharing behavior of coffee farmers based on farmer socio-economics contributed to the development of the concept of knowledge-sharing for previous similar studies. Future studies can test the allegations found in this study with a different approach.

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