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Utilization of or Codes in Monitoring and Increasing the Effectiveness of Cocoa Farming Results in Sajau Village, Bulungan Regency

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Abstract: This paper discusses the use of QR Code technology in monitoring and improving the efficiency of cocoa farming in Sajau Village, Bulungan Regency. The problem identified is the absence of an adequate monitoring system to manage cocoa farming in real-time. The research methodology used in this study is a descriptive method with a qualitative and quantitative approach to analyze data obtained from the field. using QR Code to track cocoa production and distribution data, which provides accurate information at high speed. The results of the study indicate that the application of QR Code can improve efficiency and transparency in the management of cocoa farming. In conclusion, QR Code is an effective solution to improve the management of cocoa farming in Sajau Village.

Keywords: QR Code, Monitoring, Efficiency, Agricultural Results, Cocoa.

INTRODUCTION

Advances in information technology have brought significant changes to various sectors, including the agricultural sector. In cocoa farming, technological innovation has not been fully utilized, especially in terms of monitoring production results. Sajau Village in Bulungan Regency is one of the cocoa producing areas in Indonesia that still experiences limitations in efficient agricultural management. One of the main obstacles faced is the lack of an appropriate and transparent monitoring system, which has an impact on farmers' difficulties in monitoring the quality and quantity of their agricultural products in real time. One of the technologies that has been applied in the product traceability system is the QR Code. Previous research by Yusriana et al. (2016) showed that QR Code can be used as a tool to improve traceability and transparency of food product information, from raw materials to final products. [1]In addition, Erico Pebriandi (2020) in his article "QR Code Efforts to Develop a Digital-Based Plant Seed System" highlights the application of QR Code in the seed labeling system in the agricultural sector. [2] The use of QR Code aims to increase efficiency and ensure the accuracy of information related to varieties, quality, quantity, and seed status. This technology not only accelerates access to information but also functions as a more transparent monitoring tool, reduces the risk of seed counterfeiting, and increases consumer confidence. This study aims to

examine the use of QR Codes in monitoring cocoa farming results in Sajau Village and identify its impact on increasing the effectiveness of cocoa production management. This literature review and research are expected to contribute to developing technology-based solutions to improve cocoa farming results in the area.

Literature Review

There are several references in this research, namely:

Application of QR Code in Agricultural Information System

The article by Wisnu Wahyu Aji and Heru Supriyono (2020) entitled "Plant Collection Information Display System Based on QR-Code" describes the use of QR Code for plant collection information system. This study applies QR Code in greenhouse to facilitate the management of plant information, including collection identity and description.[3] The method used involves System Development Cycle (SDLC) with Waterfall model approach, as well as the use of software and hardware to build a web-based system. This system integrates QR Code with web server to display detailed information of each plant through QR Code scanning, facilitating data access and management.

Monitoring and Estimation of Cocoa Agricultural Results

Cocoa crop management at the farmer level often still relies on traditional practices, as shown in a study by Welminci Elake, Johan Riry, and Roberth Berthy Riry (2024) in the article "Cocoa Plant Management (Theobroma cacao) by Farmers in Makububui Village, Taniwel Timur District, West Seram Regency".[4] This study revealed that farmers in the village tend to use traditional methods for watering, fertilizing, pruning, and seeding. However, this practice still faces various challenges, including limitations in marketing, pest and disease control, and the use of more modern tools.

In the context of cocoa crop management described in this study, the application of QR Codes can be a solution to improve monitoring and estimation of agricultural results. QR Codes can be used to:

- Monitor the Quality and Quantity of Harvest Results: By providing a unique ID to each cocoa fruit, QR Codes can help in tracking fruit size, ripeness level, and flowering conditions in real-time.
- Increase Transparency and Access to Information: QR Codes can provide easy and fast access to detailed information about each plant, allowing farmers to better manage their harvests and increase transparency in the management process.

Benefits of Digital Technology in Agriculture

Digital technology in the agricultural sector offers various benefits, such as increasing efficiency and productivity through information and communication applications. According to Indra Setiawan (2021), digital technology such as QR Codes can accelerate access to information, facilitate decision-making, and increase transparency and traceability of products.[5] In the context of cocoa farming, the application of QR Codes can help in monitoring harvest results more effectively, allowing farmers to monitor the size, ripeness level, and condition of the fruit in real-time. This technology has the potential to increase management efficiency and improve the quality of cocoa farming results in Sajau Village by providing accurate and easily accessible information.

Case Studies and Implementation of QR Codes in Other Sectors

The use of QR Codes in plant identification at De-Djawatan Tourism shows how this technology can enrich the visitor experience by providing detailed information about various

plant species directly through scanning. Research by Hadi et al. (2022) illustrates the application of QR Codes to facilitate access to information and increase tourist interaction with natural attractions.[6] In the context of your research on the use of QR Codes in monitoring and improving the efficiency of cocoa farming, a similar approach can be applied. QR Codes can be used to store and disseminate important data on the condition of cocoa plants, such as health status and fruit ripeness, allowing farmers to manage their cocoa gardens more effectively and be responsive to emerging problems.

METHODS

This research was conducted in Sajau Village, Bulungan Regency, which is one of the cocoa producing areas in Indonesia. The method used in this research is a descriptive method with a qualitative and quantitative approach to analyze data obtained from the field.

Research Location

The research was conducted on a cocoa plantation owned by farmers in Sajau Village, Bulungan Regency. This location was chosen because of the limited use of technology in the cocoa farming monitoring system. [7] Sajau Village is also the object of research for the application of QR Code technology in real-time cocoa farming management.

Number of Respondents

The respondents of this research included cocoa farmers who participated in the QR Code-based monitoring system. The selection of respondents was carried out by purposive sampling, where farmers who already had cocoa production land and were involved in the agricultural assistance program were selected as the main subjects.

Data Collection

The research data was obtained through several data collection methods, namely:

a. Field observation: Conducted by directly observing the process of implementing QR Code in cocoa farming activities, from harvesting to distributing results.
b. Interviews: Interviews were conducted with cocoa farmers to obtain information about the obstacles they face in managing agricultural products, both before and after the implementation of the QR Code.

Data Processing

Data obtained from observations and interviews were analyzed using a qualitative approach to dig deeper into farmers' perceptions and experiences in using QR Code technology. Quantitative analysis was used to measure the impact of QR Code implementation on the efficiency of cocoa production and distribution through performance indicators.

Performance Indicators

Performance benchmark measurements were carried out using several indicators as follows:

a. Monitoring time: Measuring how quickly production and distribution data can be accessed after the implementation of the QR Code.
b. Data accuracy: Analyzing the extent to which the QR Code improves the accuracy of information regarding the quantity and quality of cocoa agricultural products.
c. Transparency: Measuring the increase in transparency of information in the process of managing agricultural products, both at the farmer and consumer levels.[8]

Technology Used

The implementation of QR Code in this study uses software and hardware to generate a unique code that is attached to each cocoa tree owned by farmers. The QR Code is used for cocoa fruit estimation, namely estimating the harvest. When the QR Code is scanned, the user will be directed to a prepared Google Form. This form functions to enter data on each tree, including the classification of cocoa fruit based on size (cm), ripeness level (color), and flowering conditions (little, medium, lots, or no flowering). After the data is filled in, the information is automatically transferred to Google Spreadsheet, where the data is managed and analyzed further. [9] This system increases efficiency and accuracy in managing cocoa agricultural products, facilitating monitoring and decision-making for farmers.[10]

RESULTS & DISCUSSION

Data Analysis Results

Data analysis based on respondents' answers through a questionnaire where data collection and processing are presented in numerical form. The analysis used here is percentage analysis where the comparison of the number of respondents who choose from each variable with the total number of respondents is then multiplied by 100%. This description includes a general description of the respondents, namely regarding their characteristics and regarding the answers to questions regarding the variables.

Based on the results of data collection, the following data were obtained:

a. The male respondent group is the dominant respondent group because it is known that out of 20 respondents, 11 people (55%) are male, while the remaining 9 people (45%) are female.
b. The characteristics of the respondents are farmers with a range of respondent groups whose ages are between 25 and 31 years with a total of 13 respondents (65%), The second order is respondents whose ages are between 32 and 38 years with a total of 4 respondents (20%), and the last or the rest are respondents who are over 38 years old with a total of 3 respondents (15%).
c. The group of respondents whose final education level is high school is the dominant group of respondents because it is known that out of 20 respondents, there are 14 people (70%) respondents whose final education level is high school, while the group in second place is respondents whose education level is below high school, there are 6 people (30%)
d. Respondents' responses to performance variables/indicators, namely Monitoring time, Data accuracy and Transparency as follows:

Table 1 Respondents' responses to Monitoring Time

Respondents' Responses	Frequency	Percentage
Strongly Agree	4	20%
Agree	15	75%
Disagree	1	5%
Strongly Disagree	0	0%

Based on the table of Respondents' Responses to Monitoring Time, it can be interpreted that 75% of respondents agree that the implementation of QR codes in monitoring cocoa farming results can be more effective.

Table 2. Respondents' responses to Data Accuracy

Respondents' Responses	Frequency	Percentage
Strongly Agree	3	15%
Agree	17	85%

Disagree	0	0%
Strongly Disagree	0	0%

Based on the table of Respondents' Responses to Data Accuracy, it can be interpreted that 85% of respondents agree that with the implementation of QR codes in monitoring cocoa agricultural products, it can be more complete, appropriate and reliable.

Table 3. Respondents' responses to Data Accuracy

Respondents' Responses	Frequency	Percentage
Strongly Agree	2	10%
Agree	17	85%
Disagree	1	5%
Strongly Disagree	0	0%

Based on the table of Respondents' Responses to Data Transparency, it can be interpreted that 85% of respondents agree that with the implementation of QR codes in monitoring cocoa agricultural products, it can be more effective and can measure the increase in information transparency in the process of managing agricultural products, both at the farmer and consumer levels.

Next, the reliability test is carried out by calculating the Cronbach Alpha, which shows that the variables used to measure the concept in this study are quite reliable.

Table 4. Number of Samples (Respondents)

		N	%
Cases	Valid	20	100.0
	Excluded[a]	0	
	Total	20	100.0

The output table above provides information about the number of samples or Respondents (N) analyzed in the SPSS Program, namely N as many as 205 people. Because there is no empty data (in the sense that all Respondents' answers are filled in) the number of Valid is filled in 100%.

Implementation Results

1) Implementation of QR Code in Monitoring and Management of Cocoa Agricultural Products

The results of the study show that the implementation of QR Code in the cocoa agricultural monitoring system in Sajau Village has a positive impact on the efficiency of agricultural product management. Based on observations, here are some key findings:

a. **Monitoring Time**: Before the implementation of QR Code, the process of monitoring cocoa agricultural products was carried out manually and took a long time, often resulting in delays in data collection. After the implementation of QR Code, the time required to monitor cocoa production and distribution was significantly reduced. Data from Google Form can be accessed in real-time via mobile devices, thus accelerating the decision-making process.

b. **Data Accuracy**: The implementation of QR Code has succeeded in increasing the accuracy of information inputted by MBKM interns who are tasked with inputting data per cocoa tree.[11] Data on the quantity of harvest, quality of cocoa fruit, and level of ripeness can be recorded systematically. For example, the size and color of cocoa fruit are classified directly through Google Form, which significantly reduces the risk of errors from manual recording and ensures more valid and accurate information for use in

analysis and decision-making.



Figure 1: QR Code Implementation Process

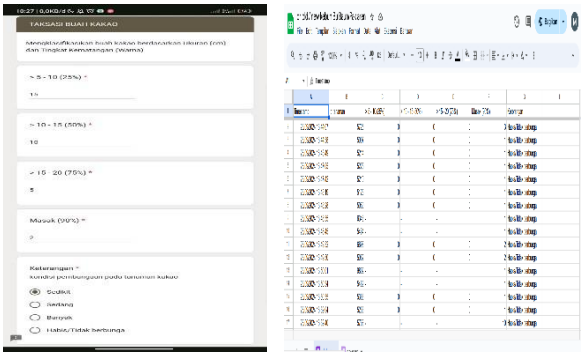


Figure 2: Example of QR Code and Resulting Data.

2) Impact on Farmer Efficiency and Productivity

Farmers who were respondents to the study reported that the implementation of QR Codes has had a significant impact on production and distribution efficiency. Several indicators observed are:

a. **Transparency and Data Access**: QR Codes make it easier for farmers to track each cocoa tree, including the quantity and quality of fruit produced. However, because most farmers are elderly and less tech-savvy, data input is carried out by MBKM student interns. This data is then managed by PT PKN, which uses Google Spreadsheets to enable more transparent evaluation, especially in terms of estimated harvest results (cocoa fruit estimates). Farmers can more easily monitor plant development through assistance, so that they can take timely action to control pests or increase productivity.

b. **Increasing Distribution Efficiency**: In addition to being used in monitoring harvest results, QR Codes are also useful in distributing cocoa products. Information about distribution status, such as the number of products sent, quality, and destination, can be quickly accessed by managers and distributors. This helps speed up the distribution process and increase consumer confidence in the quality of the products sent.

3) Implementation Challenges

Although the results of the QR Code implementation were generally positive, there were several challenges faced during the study:

a. **Access to Technology and Training**: Since the majority of farmers in Sajau Village are elderly and not yet familiar with digital technology, they face difficulties in using technological devices such as smartphones and Google Form applications. Therefore, data input was carried out by MBKM student interns. Intensive mentoring and further

training are needed so that farmers can be more involved in the process of monitoring and managing agricultural products with this technology.

b. **Internet Connectivity**: Limited internet access in some parts of Sajau Village is an obstacle to optimal use of QR Codes. During the scanning and data entry process, interns and farmers sometimes experience problems with slow connections, which hinders the flow of information in real time.

4) Potential for Further Development and Application

Based on the results obtained, QR Codes have proven to be an effective tool for increasing efficiency and transparency in the management of cocoa farming products. Potential for further development includes:

a. Application Expansion: The use of QR Codes can be expanded to other aspects of the cocoa production chain, such as fertilizer management, irrigation, and plant disease control. This technology can be integrated with weather monitoring systems and soil sensors to provide more comprehensive data for farmers.
b. Integration with Production Management Systems: QR Codes can be connected to more sophisticated farm management software to provide predictive analysis based on the data collected. This can help farmers plan better production strategies and estimate harvest yields more accurately.

Based on this, it can be concluded that the implementation of QR Code in monitoring and managing cocoa agricultural products in Sajau Village, Bulungan Regency, has a positive impact on efficiency and transparency. The implementation of QR Code has succeeded in increasing the speed and accuracy of data collection on cocoa production and distribution, thus facilitating the monitoring and decision-making process for farmers. QR Code also facilitates transparency in the product distribution chain, providing real-time access to important information related to plant conditions and harvest results.

However, several challenges such as limited access to technology and the internet, as well as the need for training for farmers, still require further attention. For this reason, the development of this technology can include intensive training for farmers and improving internet infrastructure in the area.

Overall, QR Code has proven to be an effective solution to increase efficiency and accuracy in managing cocoa agricultural products, with the potential for further development in various other aspects of agriculture.

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