

SITAMPAN: Mobile application for planting and harvesting of horticultural crops in Garut Regency

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Abstract: Garut Regency's agriculture sector has the most impact on the region's GDP compared to other sectors. The Central Statistics Agency reports that the agricultural sector's contribution was 39.11% in 2014 and will be 37.97% in 2020. The farmer's inability to manage their crop goods is the primary cause of the contribution decline. The study aims to build a prototype of a mobile application information system for planting and harvesting commodities based on a geospatial information system. The research method used was field surveys, interviews, and focus group discussions (FGD) with farmers, farmer group leaders, agricultural extension workers, and officials at Garut Regency Agriculture Office. The designed application is Sitampan which stands for Sistem Informasi Tanam dan Panen (Planting and Harvesting Information System). The users of this application are farmers, farmer group leaders, agricultural extension workers, and Garut Regency Agriculture Office. Each user will have a specific role and access based on their roles. The public can only see the data contained in this application. In conclusion, this app can serve as a platform for information and communication for farmers. Farmers can use this app as a decision-making tool to manage their crops, including when to sell, plant, and harvest. Hopefully, this application will enhance the welfare of farmers, particularly those in Garut district, one of the industries that have the most impact on the Indonesian agricultural sector.

Keywords: application, harvesting, mobile, planting, prototype

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Introduction

The agricultural sector in Garut Regency is the most significant contributor to the regional gross domestic product (GDP) compared to other sectors. Data from the Central Statistics Agency show that in 2014 the agricultural sector's contribution was 39.11%, but in 2020, it became 37.97% [1], [2] shown in Figure 1. One obstacle farmers face in managing their crop products is the marketing aspect. Even in this digital era, various applications can facilitate product marketing. In addition, the entrepreneurial aspect of agriculture is also poorly understood by farmers in rural areas.

The entrepreneurship field is considered essential to improve the economy in a region. Thus, entrepreneurship in agriculture is vital to design practical and durable mechanisms in applying the triple bottom line to develop entrepreneurial agricultural education programs. It is because many small-scale farmers have many qualities as business owners. For small-scale farmers to become entrepreneurs, they must be innovative and forward-looking. Farmers need to be able to recognize opportunities and take advantage of them. Some small-scale farmers have high quality but remain focused on preserving traditional life. Their production choices are based on what they need rather than what is possible [3], [4].

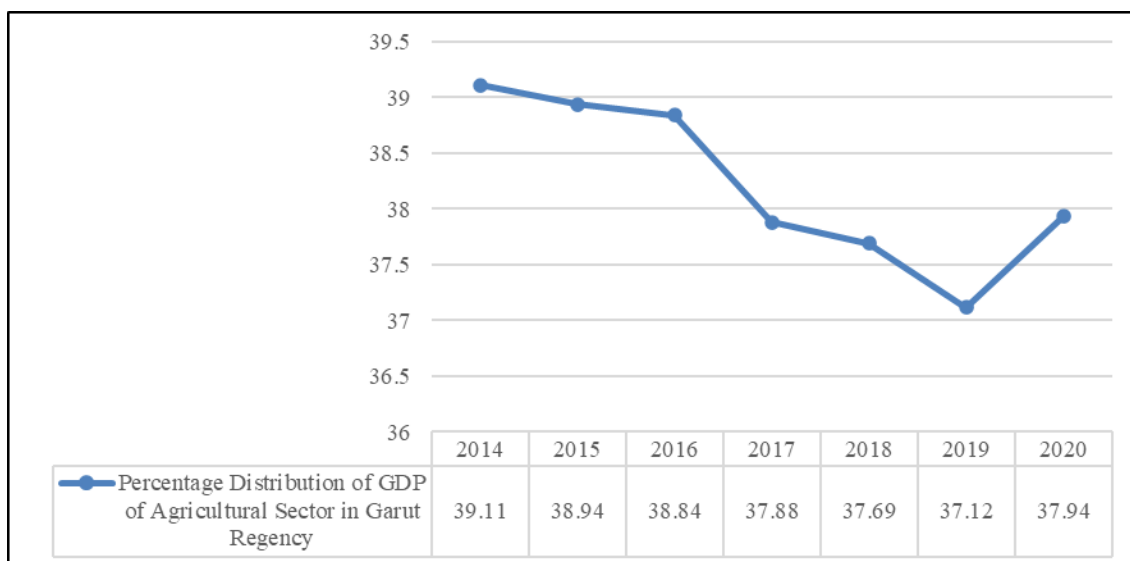


Figure 1. Percentage of distribution of the agricultural sector in Garut Regency in 2014-2020 [1,2]

Research conducted in Nigeria found that entrepreneurship in agriculture is used as a strategy to reduce unemployment and poverty by applying associative concepts and entrepreneurial ideas in agriculture. Entrepreneurship aims to increase productivity, decrease actual food prices, increase rural incomes, create jobs, and generate financial benefits from activities or activities at every stage of agricultural value. The application of entrepreneurship in agriculture that has been applied in Nigeria is vegetable farming [5], [6]. In contrast, research conducted in three different countries, namely Nigeria, India, and Bangladesh, found that entrepreneurship in agriculture aims to better connect farmers and aggregators with markets and consumers. However, applying entrepreneurship in agriculture requires government, the private sector, NGOs, and other supporting communities' participation. In addition, rural youth capacity building is needed [7]–[9].

The concept of agricultural entrepreneurship is to combine agricultural and non-agricultural activities with environmentally friendly, innovative, and educational concepts. Cases analyzed in three countries (Poland, Spain, and Romania) show that entrepreneurship in the countryside is conducted with the principle of sustainable development. The multifunctional nature shows that small farming types can survive and be aligned with sustainable development goals (SDGs). The statement supports this by saying that farming is an activity that helps farmers adjust to a free market economy. Self-employment is a significant need for farmers to survive in a volatile business environment [10], [11]. Farmers around the world are already showing incredible quality to adapt. They started looking for better ways to manage their farm. They try to grow new plants and cultivars, raise healthier animals, use alternative technologies to increase efficiency, expand production, minimize threats, and increase profits. The standard technology used in agriculture is pasture repair activities, genetics, administration, and technical procedures [12]–[14]. Based on other research, some countries already use the Internet of Things (IoT) to improve productivity and quality of agribusiness, monitoring the behavior of fruit maturity, plant and soil moisture, nutrient levels of water and soil, and environmental temperature. Instead, agriculture in Kenya uses information and Communication Technology for agricultural commodity exchange by developing a short message service in collaboration with a mobile phone provider Safaricom [15], [16]. Information and Communication Technology helps each farmer access the latest market information on commodity prices and offerings and the right Hybrid Corn seeds to be grown in their respective agroecological zones. The system is integrated with Kenya Seed Company Ltd, a major seed distributor in the East African region, using only their mobile phone [13], [17], [18].

Findings from MercyCorps & Agrifin [19], there are 55 agricultural digital technologies in Indonesia, on average, are still in the early stages. Currently, 60% of agricultural digital applications in Indonesia still target digital information such as market information or prices. While the other 40% focus on market access and almost a third on the supply chain and data management area. The rests are financial services and precision agriculture, such as satellites, sensors, and agricultural mechanization. So digital applications are still needed, especially those that can help farmers with management efficiency and entrepreneurship.

The research aims to develop a mobile application to manage agricultural business data, including planting schedule, location, planted area and harvesting schedule & volume, and market prices. In the early stages, the types of commodities in the application are oranges, shallots, and red chilies. The selection of these three commodities is based on the Agriculture Office's advice because these commodities are leading commodities in Garut Regency. The application's name is Sitampan which stands for Sistem Informasi Tanam dan Panen or Planting and Harvesting Information System. This mobile application is based on a geographic information system. The expected benefit of this research output is to provide information through maps and data in the form of tables, which will assist the Agriculture Office of Garut Regency in preparing reports and formulating strategies related to the economic development of three commodities.

Methodology

This research uses a descriptive analysis research method with a qualitative approach. The system development method used is a prototype with five stages of development (Figure 2). Android Studio will be used as an application development tool at the prototype manufacturing stage. Android Studio is an open-source application creation platform that allows users to build android-based applications with Kotlin Framework. Android Studio is an open-source application builder built with Eclipse IDE (Integrated Development Environment), the Java IDE. An application that anyone can use for Android application development. A module collects source files and builds settings that allow users to divide a project into separate functional units. Each project in Android Studio contains one or more modules with source code files and resource files as tendencies. Users can build, test, and debug each module separately. The modules include Android application modules, library modules, and Google App Engine modules. By default, android studio displays android projects organized by the module to provide quick access to the user project's main source files [20]–[23]. Emulators are used to test applications that have been created.

Throughout this prototype creation phase, we had a focus group discussion (FGD) with potential users, including farmers, farmer group leaders, agricultural extension officers, and Garut Regency Agriculture Office staff. This FGD was held at Garut Regency Agriculture Office on March 29 and September 20, 2022. In the FGD, potential users offer feedback, ideas, and requests for the application's excellence and simplicity.

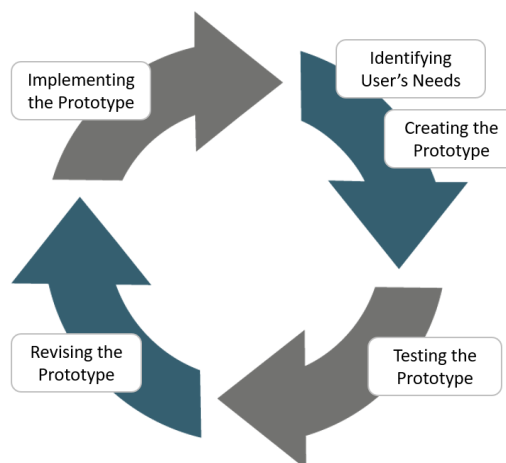


Figure 2. Prototype of development model [22].

Based on the figure above, we use the prototype method in the application development process. We chose this process to structure the application development process, starting from

identifying user needs to implement. The following is an explanation of each prototype process that we use:

1. Identifying user needs

In this process, we conducted a group discussion forum with the Garut Regency Agriculture Office selection and the farmers. As a result, the FGD process was carried out to find the main problems in the field. This problem is what we will focus on in application development. In the FGD, we found several main problems that we can make our main focus. Garut Regency Agriculture Office needs help knowing the planting and harvesting data carried out by farmers. Hence, they need an application that can provide information related to the data. Furthermore, the problems that become our main focus are from the farmers themselves, where farmers need an application that can provide updated information regarding the selling price of plants and vegetables. The selling price needed is divided into 3: the selling price from farmers to collectors, from collectors to the local market, and from the local market to the main market. The extension workers also provided some input regarding application development. They hoped that the application could be a container that could accommodate all farmer groups and all commodities in Garut district to make it easier for them to monitor the planting and harvesting processes there.

2. Creating the prototype

After we get the data we need, we make a prototype to provide an overview of the application's initial design. The prototype created will be the initial stage and the transformation process of the existing request.

3. Testing the prototype

The prototype that has been made will be tested regularly to see if the application that has been built is under our main focus. Our testing process is carried out directly with Garut Regency Agriculture Office, Garut Regency Extension Officers, and farmers from various commodities in Garut Regency. It is so that we get input from all users who will use the application.

4. Revising the prototype

Based on the testing that we have done, we found some small discrepancies in the applications that have been built. This happened because there were some differences of opinion between the agriculture office, extension workers, and farmers. Therefore, we are revising the applications that have been built under the revisions that users have given.

5. Implementing the prototype

After we found a match between the application built and the user's wishes, we continued with the implementation of the application. With this implementation, it is expected to greatly benefit arrowroot farming, especially for farmers, so it can be one of the elements that can improve their welfare.

Results and Discussions

System Design

Before system development, the system was designed to ensure the system's suitability with the analysis of user needs to be met as expected in Unified Modeling Language (UML), which had been established as a tool for designing the proposed system [17], [24].

Use case diagram

One of the tools in UML that we used is the use case diagram. It describes the relationship between actors in a system. It can describe the interaction between one actor and another actor in the design of the system created. In addition, database design is a process that will determine the management of the data and content needed to support the design. There are two system designs in question. The first level designs the system by analyzing, while the second is the

general design to determine the user’s needs. The use case diagram of Sitampan is shown in Figure 3. The use case diagram has several use cases and actors with each function. The following is the description of the use case and actor shown in Tables 1 and 2.

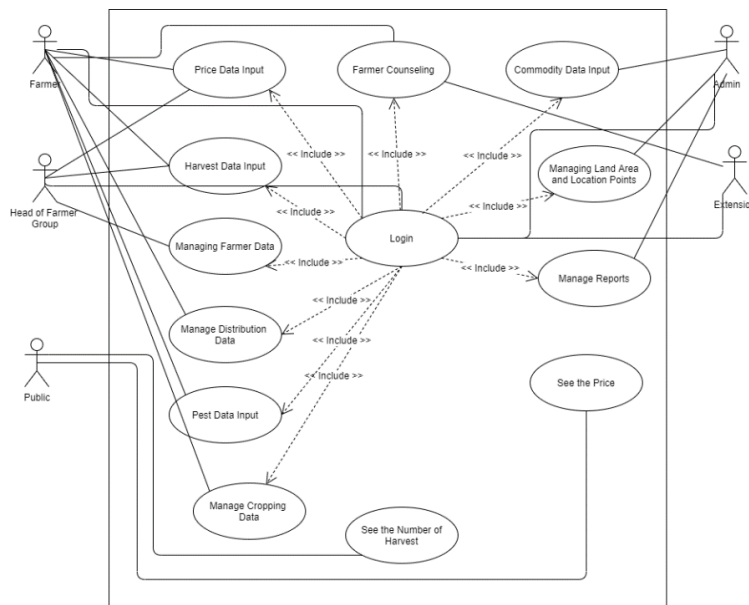


Figure 3. Use case diagram of the SITAMPAN application

Table 1. Description actor at use case diagram






No	Actor	Description
1	 Farmer	The farmer is an actor who becomes the first layer in this application system because all real-time data comes from farmers, ranging from price data, harvest data, pest data that is attacking, and planting time data.
2	 Farmer Group Leader	The head of the farmer group is responsible for managing the farmer data in the farmer’s group. In addition, the farmer group leader can verify data from farmers, such as harvesting and planting time data.
3	 Admin	Admin on this system is an officer of Garut Regency Agriculture Office, who manages commodity data, report data, location, and market price data.
4	 Extension officer	The extension officer is an actor from the Agriculture Office of Garut Regency. The extension officer is responsible for managing the extension process directly to the farmer. Farmers can ask about the problems faced during the planting period until harvest.
5	 Public	The general public or anyone who uses the Sitampan application without logging in can see the location of commodities, market prices, and data on the number of harvests per commodity.

Table 2. Use case description

No	Actor	Description
1	Price Data Input	The <i>use case</i> process is an activity of inputting price data. obtained by farmers when selling crops. Then, the Admin will verify the price data before appearing on the main page of the price chart application.
2	Harvest Data Input	The process of inputting harvest data is uploaded by Farmers, who will then be validated by the farmer group leader so that the farmer's harvest number data can enter the overall harvest number.
3	Managing Farmer Data	The head of the farmer group carries out the process of adding farmer data. In this process, the farmer group leader can add, edit, or delete farmers' accounts in the farmer group.
4	Manage Distribution Data	Farmers and buyer information such as collectors, local markets, or cooperatives will input this distribution data.
6	Pest Data Input	Farmers can input in real-time to the application regarding the type of pest that is attacking.
7	Manage cropping data	Farmers can input a description of planting time so that other farmers can manage their planting period, with the goal that the harvest period does not coincide, which can finally maintain market price stability.
8	Farmer Counseling	This process can be done by Farmers and Extensionists so that Farmers can consult directly with extensionists if there are obstacles to the planting and harvesting process.
9	Commodity data input	Admin does this process to add the type of commodity in the system.
10	Managing Land Area and Location Points	This process is inputting land data to GIS maps conducted by admins.
11	Manage Reports	Admins can access this report for physical data output purposes, and can be filtered by time or commodity.
12	See the Price	The farmer's price input is then validated by the Admin to be displayed on the public page.
13	See The Number of Harvests	Data on the number of harvests validated by the farmer group leader will be viewable on the general page of the application to be accessed by anyone using the Sitampan application without the need for <i>login</i> .

The prototype of the Sitampan mobile application was developed to assist agricultural planting and harvesting management in Garut Regency. The data provided by this application includes the types of commodities planted, planting time, estimated harvest time, fertilizers used, and commodity yield prices. Through this application, farmers can see information on the types of plants planted in other areas and when to plant, and harvest time. In addition, the agricultural service can obtain accurate data from growing time and harvest time for each type of commodity.

Diagram Activity

At the development stage of this application, we also create activity diagrams to describe the flow of activities from farmer entities, starting from the login process to inputting data into the system [25]. This activity diagram is useful to see whether existing procedures are appropriate. The activity diagram that has been created can be seen in Figure 4.

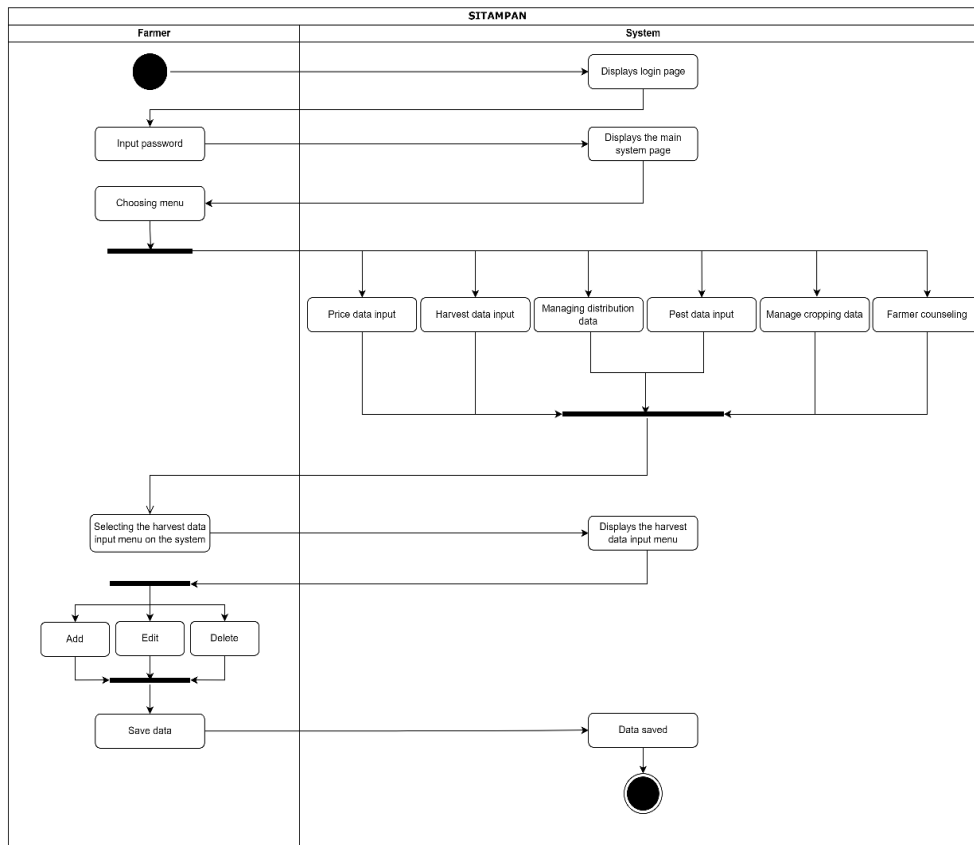


Figure 4. Activity diagram

The process contained in the storage system can be seen in the activity diagram above. According to Figure 4, there is only one actor in the system: the farmer. The farmer first logs in to access the application. Following a successful login, the system will display the main page, which includes the price data input menu, harvest data input menu, distribution menu, pest menu, crop menu, and farmer consultation menu. After the user selects a menu, the system will direct them to that menu, where they can add, change, and delete data. Once the entered data is appropriate, the user can save it, and the system will save it automatically [26].

Database

The database created is a database proposed at the Department of Agriculture which in its design has adapted to the existing and proposed system [27] (Figure 5).

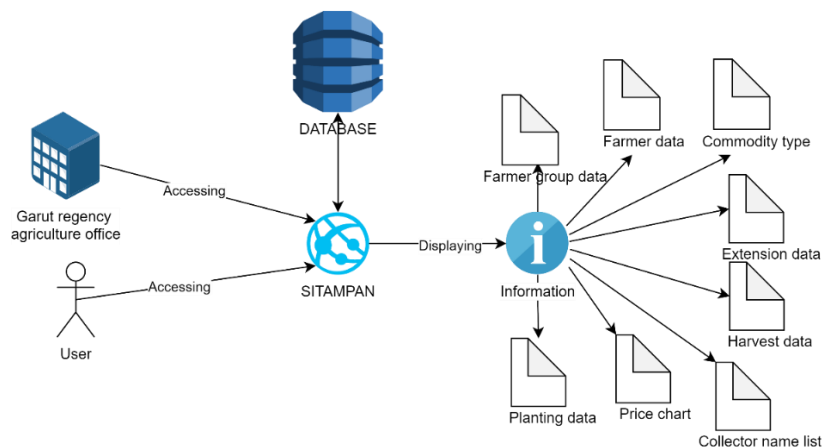


Figure 5. Proposed database

Class Diagram

Class diagrams explain the connection between classes in the food cropping information system. The class diagram is formed by entities or objects with attributes and operations [29]. From this class, a table can be formed that can be associated with other tables (Figure 6).

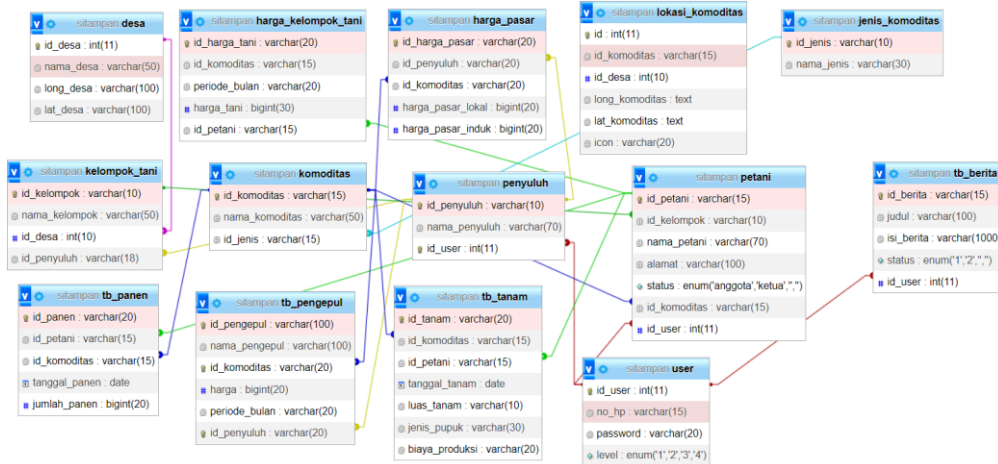


Figure 6. Class diagram

Interface Design

The interface comes with functions providing an overview of the application design. The following is the implementation of the interface under construction and the functionality and description of the display.

Homepage

The SITAMPAN application will be managed directly by the Agriculture Office of Garut Regency to record the users accurately. Therefore, the Agriculture Office provides the account that can be accessed. Before logging into the app, users must log in to Stampan's account via the Login page. The home page and login Sitampnan app are shown in Figure 7.

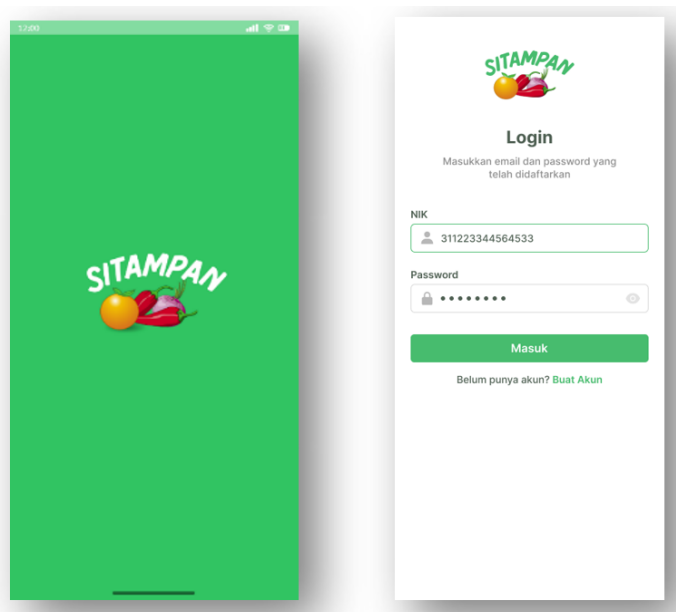


Figure 7. SITAMPAN app home and login page

SITAMPAN App Home Page

In the early stages of developing this prototype, shallots, red chilies, and oranges were the primary commodities. Once the user logs in, they will be directed to the application's main page, whose main feature is a map of the three commodities. The home page and login Stampan app are in Figure 8.



Figure 8. App home page

In the Sitampam application, a distribution map can be accessed to see the information and location points of the commodity. The map can be selected based on the sub-district. For example, suppose the Bayongbong sub-district is clicked. In that case, the plant's location will be displayed along with information about the location point and what plants are planted at that location. Details of the map are shown in Figure 9.

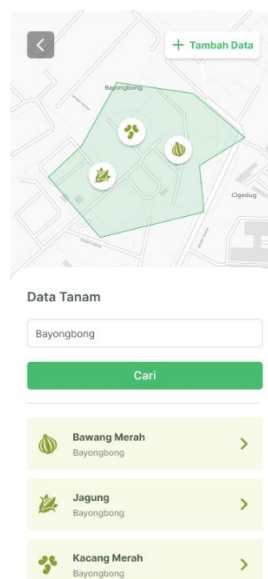


Figure 9. Map detail page

Menu Application

The SITAMPAN application has eight main menus: Crop Data, Commodity Prices, Harvest Data, Collectors Data, Extension Workers, Farmers Groups, Farmers and Commodities (see Figure 10). The menu on the application aims to make it easier for users to get information based on their needs [30], [31]. The Planting Data menu is accessed by farmers to input data when carrying out the planting process. Farmers need to fill in the planting area, type of fertilizer, and production costs for each planting commodity. Farmers carry out the harvest menu after the harvest period takes place. In the process, farmers need to fill in the date of harvest and the amount of harvest produced based on the planting data that has been previously inputted. Market price data and farmer prices can be used as benchmarks when farmers want to sell their crops. Market price management is carried out by extension workers who directly access the Department of Agriculture price data. The market price is divided into the local market price and the parent market price. Market price data is updated monthly to provide information on price fluctuations. The extension worker also inputs the data collector by providing accurate information in the form of the purchase price, the commodity purchased, and the distribution location of the collector.

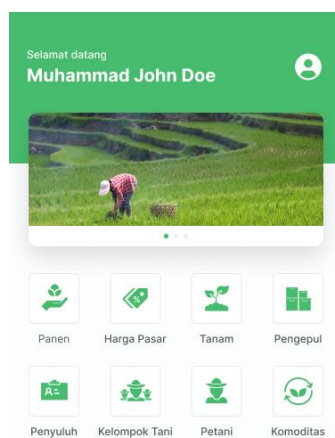


Figure 10. SITAMPAN app menu

Harvest Data Menu

Farmers, as users, can input the harvest data obtained into the application on the harvest data page, which the Admin will verify. Verified data will be displayed in graph form when the user finishes input and verification (Figure 11).

Figure 11. Harvest data page

On the Harvest Data page, farmers must fill in several data columns such as Name, Location, Commodities, Number of harvests, Harvest Area, Product Photos, Crop Age, and Harvest Time. In the commodity column, farmers can choose the commodity type from the product, where each commodity will have a different data column to fill.

Commodity Price Menu

This application also has a commodity price data menu containing real-time market price updates. Users can see price charts of each commodity, such as citrus, shallots, and chilies. On the existing chart, information can be seen about price fluctuations (Figure 12).

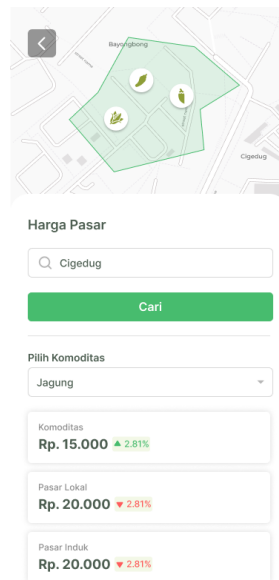


Figure 12. Commodity price menu

The commodity price page is useful to help farmers adjust the selling time of their products. With this feature, farmers are expected to know the market conditions and choose the right time to sell their products to achieve maximum selling results.

The application development team conducted a Focus Group Discussion with participants representing farmers, farmer group leaders, agricultural extension workers, and several Garut Regency Agriculture Office officials to explain and test the application prototype design. FGD participants appreciated the design of the storage application. They proposed additional features for varieties of commodities and market prices based on three locations: prices at farmers, local markets, and wholesale markets. Additional features requested are commodity price links on commodity association data and prospective buyers. In addition, there are feature adjustments according to the condition of the type of commodities, such as planting time which will only be served on red chili and shallot plants.

Based on the results of discussions with stakeholders, it can be concluded that the needs of stakeholders will be accommodated in improving the Sitampan application. Based on various countries' studies, mobile agriculture applications cannot meet all stakeholder needs. The research in India states that mobile applications range from crop information, market prices, online shopping for farmers, weather forecasts, and daily agricultural news. However, only a few can fully meet all the needs of farmers [32]. The research on mobile applications in India for disseminating agricultural information concluded that for expanding application-based information, there must be considered, such as better simple handsets, compatible smartphones, multilingual platforms, subsidized internet packages, regular training, and awareness among farmers [33]. The results of a study in Punjab, Pakistan, on mobile phones to access agricultural information show that market information and financial issues are reported to be the most widely accessed. Mobile phones show farmers' dependence on market information and financial transactions via mobile phones has connected farmers more [34]. Research on mobile

applications in India shows that mobile technology agriculture and related sectors are becoming more integrated. The use of accessible, farmer-friendly, and inexpensive mobile application devices in agriculture has dramatically changed the interface of production consumption [35].

Conclusion

Focus group discussions (FGD) were conducted as we designed the Sitampan application. The focus group discussion participants were farmers, farmer group leaders, agricultural extension workers, and Garut Regency Agriculture Office staff. The primary commodities used in creating this application were shallots and red chilies. During the FGD, the participants acknowledged their appreciation and offered ideas for improving the application. Additional features requested are commodity price and prospective buyers. In addition, there were feature adjustments according to the condition of the type of commodities, such as harvesting time on red chili that will be more than once for every planting area. These are just a few advantages this application offers to farmers: managing planting and harvesting, viewing market prices, managing the list of collectors and extension agents, and merging the list of farmer groups, commodities, and farmers. It is intended that by employing this application, the agriculture of Garut district can continue to be one of the most superior sectors, given how much Garut farming impacts the Indonesian agricultural sector. It is envisaged that farmers won't anymore be bothered by the difficulty of choosing a planting schedule that does not overlap with other farmers in the same region, which indirectly affects their well-being. Additionally, Garut Regency Agriculture Office can use this application to make it simpler to gather information on planting and harvesting agricultural products in each sub-district within Garut Regency. This application provides any data input directly from the farmer in real-time. With this application, the Department of Agriculture can obtain data directly without the need to collect data through a long bureaucracy to make reports to the Central Bureau of Statistics.

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