

Design of Web-Based Agricultural Product Marketing System in Toapaya Village

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Abstract

Marketing agricultural products remains a major challenge for farmers in Toapaya Village, located in Bintan Regency. The selling prices received by farmers are often significantly lower than the market prices paid by end consumers. This is primarily due to the lengthy distribution chain and dependence on middlemen who take a large portion of the profits. Limited market access further weakens the farmers' position in setting prices and marketing their harvest independently. To address this issue, a web-based marketing system is proposed to facilitate direct transactions between farmers and customers, aiming to shorten the distribution chain and increase farmers' income. The system was developed using the Waterfall software development methodology to support a structured, user-oriented development process, while system modeling was carried out using UML to provide a detailed overview of the system flow. The research results indicate that the developed web-based marketing system can simplify the agricultural marketing process and expand market access. System evaluation will be conducted periodically through direct testing to collect feedback from users. Based on testing results, the system has been proven to enhance product accessibility and facilitate online transactions. Therefore, this marketing system is expected to contribute to economic growth, improve farmers' welfare, and serve as a form of digital transformation in the agricultural sector in Toapaya Village, Bintan Regency.

Keywords: Agricultural, Marketing System, Web, Waterfall, Toapaya Village

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1. Introduction

The advancement of information technology in the current digital era makes information systems an important need [1] in various sectors, especially the agricultural sector. Agriculture is a sector that contributes to national economic growth and an important commodity for people's lives [2]. The use of information technology in the form of *e-commerce websites* that offer practical and applicable solutions to accelerate and simplify business processes. *E-commerce* in the agricultural sector can be used as a means of financing, selling agricultural products, and providing product price information [3]. With *e-commerce*, farmers can reach a wider market [4], reduce dependence on intermediaries, and increase sales of agricultural products [5].

Toapaya Village is one of the villages in Bintan Regency, Riau Islands Province with great agricultural potential, but farmers face challenges in marketing their products. Farmers' harvests are still marketed conventionally by collecting the harvest from middlemen [6]. The selling price received by farmers is often low compared to the price received by customers in the market. This is due to the long distribution chain, which makes it difficult for farmers to get a decent profit from their harvest. In addition, limited market access

makes farmers dependent on middlemen and intermediaries to market agricultural products.

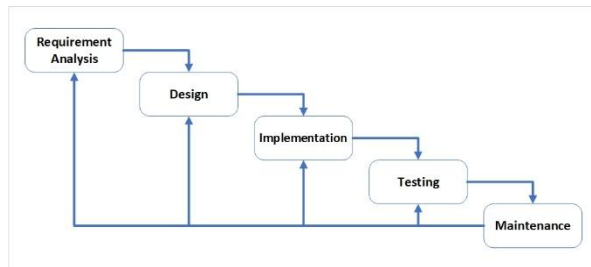
In previous studies, agricultural product marketing still focused on middlemen and caused a long chain of agricultural product marketing [7]. Likewise, research [8] revealed that farmers are often manipulated by market prices which causes farmers to experience losses and discouragement. Research [9] found the same problem, namely that agricultural products are not promising because distribution is still relayed by middlemen. Research [10] found problems with weak infrastructure and market information and high transaction costs. This is supported by research [11] that limited market access and expensive production and transportation costs are the causes of farmers' difficulty in marketing and selling agricultural products.

Based on the description of the existing problems, it is necessary to change the marketing method from conventional to digital-based. Therefore, this study conducted a web-based agricultural product marketing system design. The system was designed using the *waterfall method* and system development using the *Unified Modeling Language (UML)*. The system that has been built will be tested using the *blackbox testing technique*. It is hoped that the birth of this digital-based marketing system will make it easier for farmers to

promote agricultural products [12], increase economic growth and the welfare of farmers in Toapaya village.

2. Research methodology

In the research methodology section, the agricultural product marketing system development method uses *waterfall*. The *waterfall approach* is a classic *Software Development Life Cycle (SDLC) methodology that offers software development with a structured and linear approach* [13]. The stages in the *waterfall* consist of needs analysis, design, development, testing, and maintenance stages [14]. The selection of the *waterfall method* allows all activity processes to be planned and scheduled in a structured manner [15].



Waterfall Model

The design of the agricultural product marketing system in Toapaya Village, named the Agromart System. Based on Figure 1, the work stages include needs analysis, design, implementation, testing, and *maintenance*. The explanation of each work stage is as follows:

1. Requirements Analysis

The initial stage is to conduct a needs analysis. The needs analysis process can identify the business and functional needs of Agromart. The results of the analysis are used as the foundation for designing and developing the system.

2. Design

The second stage is to design the system. In this stage, the system design is made by referring to the results of the needs analysis. The system design and modeling uses UML techniques to describe the system flow at Agromart. The results of the system design will be implemented in the system development process.

3. Development

Based on the system design, the next stage is to develop the system. In this stage, the system design is implemented by creating a web-based program code [16]. The coding process uses a programming language and a *local server*.

4. Testing

After the system development is complete, the next stage is system testing. The testing stage is carried out to ensure that all system functions are in accordance with expectations and can meet all the needs that have

been set in the needs analysis. Testing also functions to detect and fix *errors* and *bugs* in the system.

3. Results and Discussion

In the results and discussion section, the Agromart marketing system development process begins with a needs analysis. After identifying the system needs, the system is designed using UML and implemented into a web-based system. The system development process is expected to be able to help the marketing of agricultural products in Toapaya Village, Bintan Regency.

3.1 . System Requirements Analysis

In the initial stage, a needs analysis is carried out to identify in detail the needs that must be met. needs are divided into two categories, namely functional needs and non-functional needs. Functional needs describe what the system must do while non-functional needs emphasize more on the system must work according to its context. Functional needs analysis can be seen in Table 1.

Table 1. Functional Requirements Analysis

No	Functional Requirements
1	The system must be able to store and manage product data in a structured manner.
2	The system must be able to search and display product search results.
3	The system must be able to store product data in the shopping cart, direct to the <i>checkout page</i> , and display product purchase information.
4	The system must support multilevel access that includes admins and customers with different access rights.

Based on table 1, three functional needs are obtained. After the functional needs are determined, the next step is to analyze the non-functional needs. The analysis of non-functional needs can be seen in Table 2.

Table 2. Non-Functional Requirements Analysis

No	Process Name	Information
1	Product search by <i>customers</i> with a maximum time of 1 minute	Response Time
2	Adding products to the cart by <i>customers</i> with a maximum time of 10 seconds	Response Time
3	<i>checkout</i> process by <i>customers</i> takes a maximum of 30 seconds	Response Time
4	Restricted access rights for each user <i>role</i>	
5	User-friendly interface design	Usability

Based on table 2, five non-functional needs are obtained. The analysis of non-functional needs emphasizes the speed of response time and ease of system access. From the analysis of functional and non-functional needs, it will be processed to the system design stage.

3.2 . System Design

The system design in this stage uses the system requirements that have been identified and described using flowcharts and UML modeling. *Flowcharts* are graphical analysis methods that function as documentation of business processes and document flows in an organization [17]. The following is the Agromart system *flowchart* which can be seen in Figure 2.

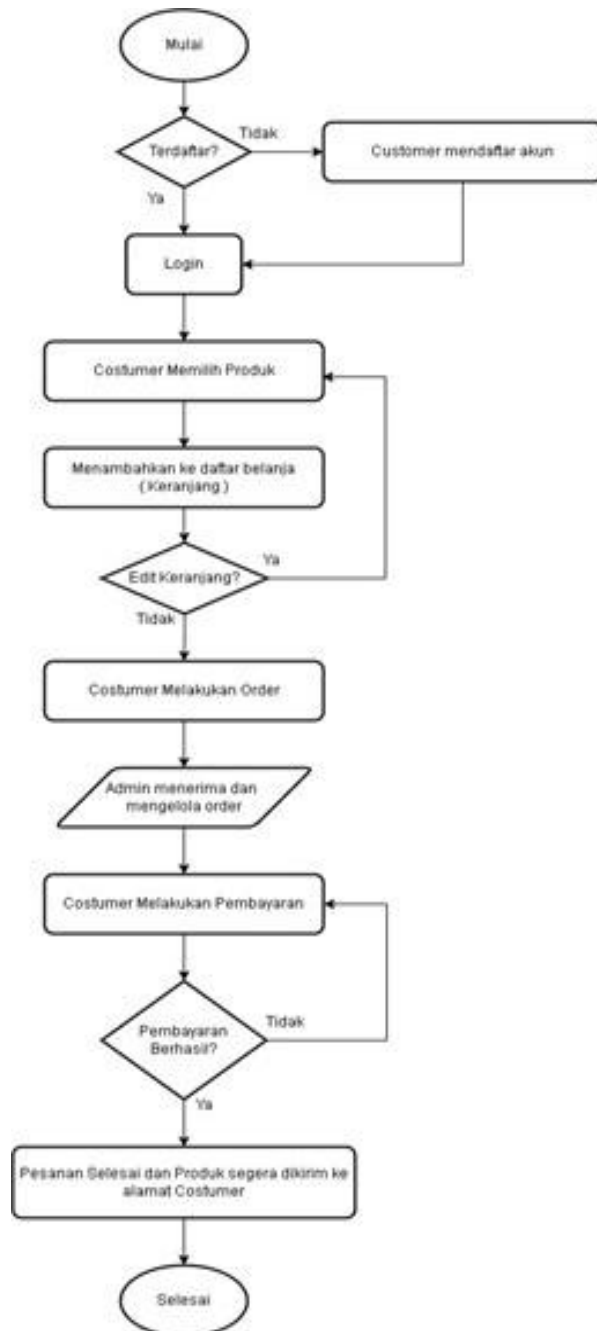


Figure 2. Agromart System Flowchart

Figure 2 shows the Agromart system *flowchart* starting from checking the *customer account* . If the *customer account* is registered, they can log in, but if not, they need to register. After logging in, *customers* can view

products, add selected products to the shopping cart, and edit cart data if necessary. If they do not edit the shopping cart, *the customer* makes a product order and makes a payment. If the payment is successful, the order is complete and the product will be sent to the destination address, while the payment fails, *the customer* repeats the payment process. The series of processes will end when the order is complete and the product is successfully sent. UML is a visual modeling method for designing and developing object-based systems [18] by describing, building, and documenting the system as a whole [19]. In this study, the UML diagrams used are *use case diagrams* and *class diagrams* .

a. Use Case Diagram

Use case diagram is a tool that presents the interaction between actors (users) and the system being designed in the form of visualization [20]. With *use case diagrams*, the overall capabilities of a system can be described. The system design modeled with *use case diagrams* is as shown in Figure 3.

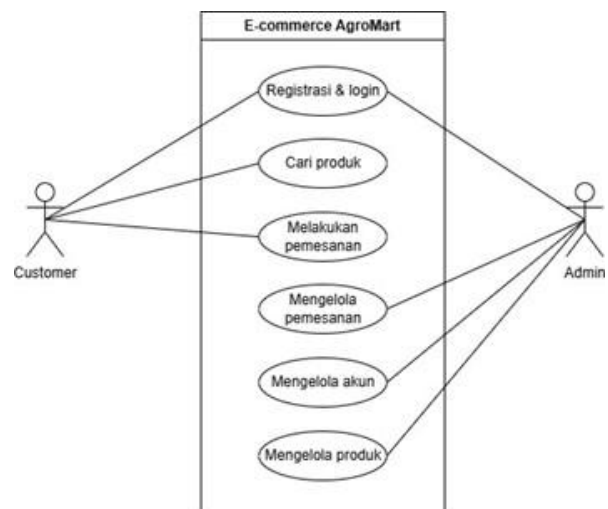


Figure 3. Use Case Diagram

In Figure 3 is a *use case diagram* of the Agromart system. Based on *the use case diagram* shows the interaction between two actors, namely *Customer* and *Admin*. The *customer actor* is related to the registration and login process, searching for products, placing orders, and paying for orders. While the admin is related to the process of managing orders, managing user accounts, and managing product data.

b. Class Diagram

Class diagram as a set of objects with the same attributes and behavior. *Class diagrams* are used as visualizations between classes that are related to each other in a system [21]. The system design is modeled with a *class diagram* as in Figure 4.

Figure 4 is a *class diagram* of the Agromart system. Based on *the class diagram* above, it has five main *classes* that interact with each other and communicate

data. *Class diagram* as a basic structure in a database that is used as a container for storing information about products, customers, orders, and administrative activities.

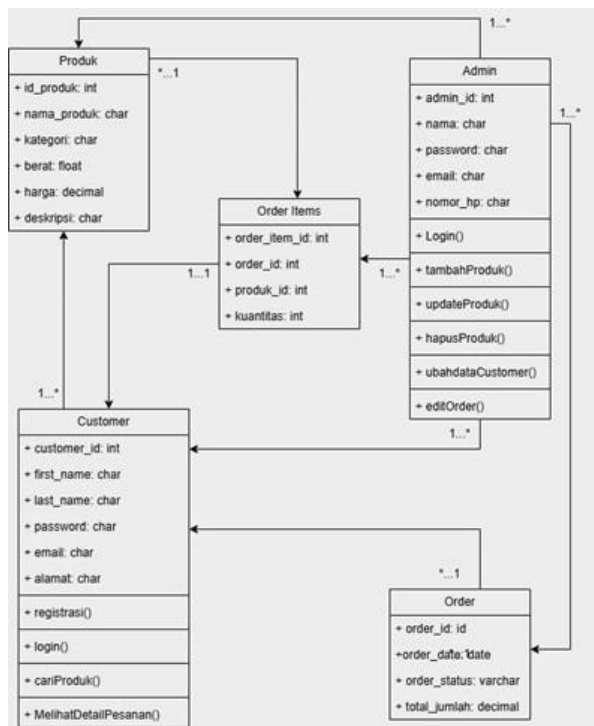


Figure 4. Class Diagram

c. Sequence Diagram

Sequence diagram as a diagram that describes the stages that correspond to the *use case diagram*. With a *sequence diagram* provides a detailed description of the stages or process flow of the system. The system design using a *sequence diagram* is shown in Figure 5.

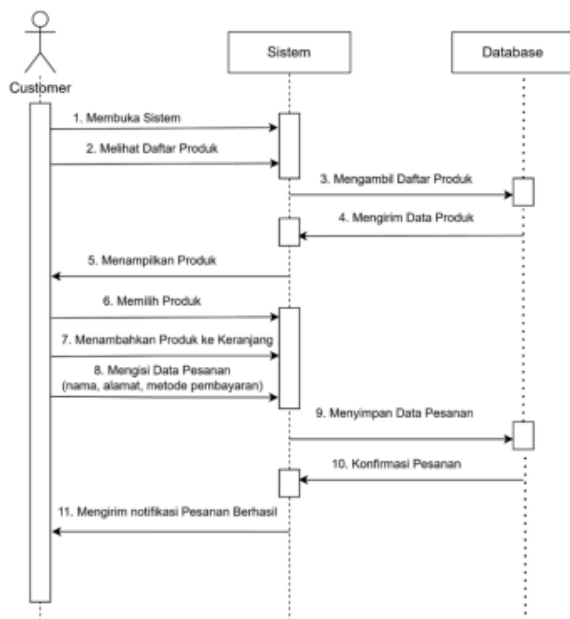


Figure 5. Ordering Sequence Diagram

Figure 5 is a *sequence diagram* of an order that interacts between the customer and the Agromart system. The process begins with the customer accessing the web and viewing the product list, the customer selecting the product, until the notification of the order being successful is given.

3.3 . System Development

Based on the system design that has been designed, the system development process is carried out by implementing it into a website that includes a registration page, login page, home page, product page, cart page, admin dashboard page, product data management page, product stock management page.

a. Register Page

The register page is a page for carrying out the user account registration process. The user registration process is considered important for user identification and providing access to the Agromart system. The appearance of the registration page can be seen in Figure 6.

The register page features a search bar at the top with the text 'AGROMART' and a 'Cari produk...' input field. Below the search bar, there are navigation links: Home, Produk, Tentang Kami, Panduan, and a user icon. The main content area is titled 'Register' and contains the following form fields:

- Nama:** A text input field.
- Email:** A text input field.
- username:** A text input field.
- No Telp:** A text input field.
- Password:** A text input field.
- Konfirmasi Password:** A text input field.

 At the bottom of the form is a green 'Register' button.

Figure 6. Register Page

Based on image 6 is the Agromart system registration page. This page functions to register an account by filling in the form of full name, *username*, email, *password*, and password confirmation. After filling in all the forms correctly, the user can click the Register button.

b. Login Page

The login page is the main entrance to the system for users who have an account. For users who do not have an account, they can register on the register page. The login page display can be seen in Figure 7.

The login page features a search bar at the top with the text 'AGROMART' and a 'Cari produk...' input field. Below the search bar, there are navigation links: Home, Produk, Tentang Kami, Panduan, and a user icon. The main content area is titled 'Login' and contains the following form fields:

- username:** A text input field.
- Password:** A text input field.

 At the bottom of the form are two buttons: a green 'Login' button and a blue 'Daftar' button.

Figure 7. Login Page

Based on Figure 7 is the Agromart system login page. On the login page, users need to enter their registered email and *password*. The system will verify the

credentials and if the login check is successful, the user will be directed to the dashboard page.

c. Home Page

home page is the main page that will appear when users visit the Agromart web page. On the home page there are Home, Products, About Us, Cart, and Login menus. The appearance of the home page can be seen in Figure 8.



Figure 8. Home Page

Based on Figure 8 is the home page of the Agromart system. The main page display (home page) has a search feature to make it easier to find the desired product. This page plays an important role in providing a good first impression for users.

d. Product Page

The product page is a page that presents a complete list of agricultural products. Users can see the complete agricultural products available in the Agromart system. The appearance of the product page can be seen in Figure 9.

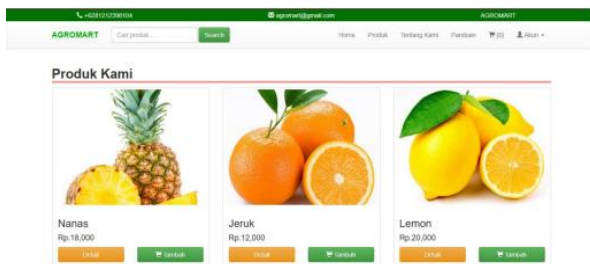


Figure 9. Product Page

Based on Figure 9 is the product page on the Agromart system. On the product page displays a list of agricultural products sold. The products displayed use images, product names, prices. In addition, each product displayed has a Detail button to see more complete product details and an Add button to add products to the shopping cart (this feature is available if the user has logged in).

e. Cart Page

The cart page is a page that displays the products selected by the user before continuing the checkout process. The cart page is one of the important components in an e-commerce-based system. The appearance of the cart page can be seen in Figure 10.

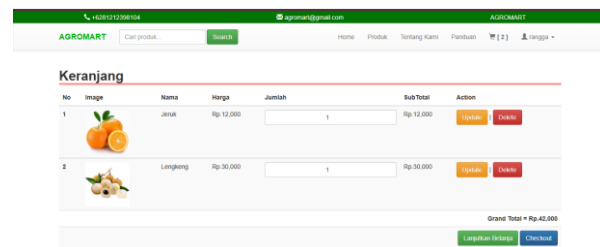


Figure 10. Cart Page

Based on figure 10 is the cart page on the Agromart system. In the cart page, users can see details of the products to be purchased. Users can also edit the number of products or delete products from the cart. At the bottom there is a checkout button to continue the payment process.

f. Dashboard Page

The dashboard page is the main page for users with admin and customer roles who have successfully logged in to their accounts. The dashboard functions as a control center that provides important information visually. The dashboard page display can be seen in Figure 11.

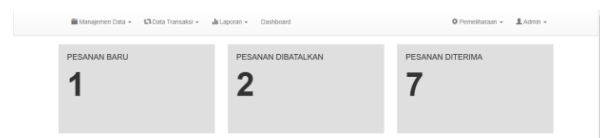


Figure 11. Dashboard page

Based on Figure 11 is the Agromart system dashboard page. With the dashboard, users can see a summary of data and store management statistics, for example, there are new orders, canceled orders, and orders received. With the information available on the dashboard, it makes it easier for users, especially admins, to manage their business more effectively.

g. Manage Product Data Page

The product data management page is a page that allows users, especially admins, to manage product data. This management page is important to keep the products displayed always relevant and up to date. The appearance of the product data management page can be seen in Figure 12.

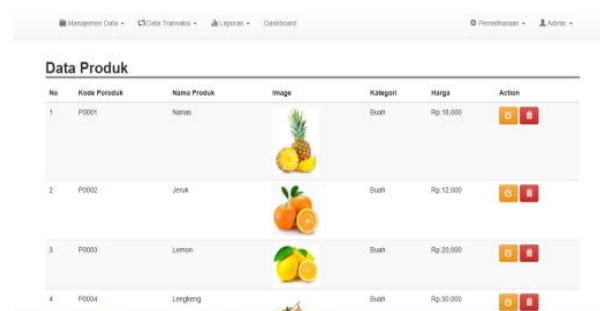


Figure 12. Manage Product Data Page

Based on Figure 12 is the product data management page on the Agromart system. This page displays complete agricultural product data in the form of a table that makes it easy to add, edit, and delete products. In addition, there is an add product button to create or add new products, and edit and delete features to manage existing products. The product data management page will support product marketing operations by farmers.

h. Manage Product Stock Page

The product stock management page is a page for admins to manage the amount of product inventory for sale. On this page, admins can update the stock amount based on the harvest or product availability in *real-time*. The appearance of the product data management page can be seen in Figure 13.

No	Kode Produk	Nama	Stok	Satuan	Harga	Action
1	P0001	Nanas	0	kg	15.000/kg	[Edit] [Delete]
2	P0002	Jeruk	97	kg	12.000/kg	[Edit] [Delete]
3	P0003	Lemon	100	kg	20.000/kg	[Edit] [Delete]
4	P0004	Lenggang	100	kg	30.000/kg	[Edit] [Delete]
5	P0005	Anggur	100	kg	25.000/kg	[Edit] [Delete]
6	P0006	Mangga	100	kg	15.000/kg	[Edit] [Delete]
7	P0007	Suka	95	kg	12.000/kg	[Edit] [Delete]
8	P0008	Pepaya	100	kg	10.000/kg	[Edit] [Delete]

Figure 13. Manage Product Stock Page

Based on Figure 13 is the product stock management page on the Agromart system. This page functions as stock management to prevent stock running out and help admins fill stock according to market demand. This page is very important to maintain the smooth running of sales and purchase transactions in the Agromart agricultural product marketing system.

3.4 System Testing

In this stage, the results of the system development are tested to ensure that the developed system is in accordance with expectations and can meet all the needs that have been set. System testing uses the *blackbox testing method* to test the system against the output produced [22]. Testing using *blackbox* is different from *whitebox* because it does not see and test the program code directly but from the functional side of the application which includes checking the function, *input*, and *output* of the program. The results of blackbox testing can be seen in Table 3.

Blackbox Testing of Agromart System			
No	Test Scenario	Testing Steps	Expected results
1	Register features	Enter data on the registration form	Succeed
2	Login feature	Enter <i>username</i> and <i>password</i>	Succeed
3	Product detail features	Show product details	Succeed
4	Product search feature	Search for products with valid names,	Succeed

No	Test Scenario	Testing Steps	Expected results
		displays a <i>list of</i> searched products.	
5	Shopping cart features	Add products to cart, remove products from cart	Succeed
6	<i>Checkout</i> features	Check <i>out</i> your order with a valid shipping address.	Succeed
7	Product management features	Add products with valid data and delete products	Succeed
8	<i>User</i> management features	View <i>user</i> account <i>list</i> and delete <i>user</i> data	Succeed
9	Transaction list feature	View order list, accept, reject and view order details	Succeed
10	Product stock management features	View product stock, edit stock, and delete stock	Succeed
11	Report features	View sales reports, profits, order cancellations, and stock of goods	Succeed
12	Dashboard features	Displays a summary of new orders, canceled orders, and received orders.	Succeed
13	Logout feature	Log out of your account and return to the login page.	Succeed

Based on the results of the system testing above, the Agromart system can be used for registration, login, viewing products and their details, putting products in the shopping cart and *checking out* products, as well as reporting features and other features. In this system, there is no *real-time* order *tracking* feature and product assessment and *review* features. Therefore, the Agromart system can be developed sustainably by building an Android and IOS-based *platform* to make it easier for users to access Agromart,

4. Conclusion

Based on the research results, the Agromart system to meet the needs of Toapaya village in Bintan Regency has been successfully developed. The design and modeling of the system uses *the waterfall* and UML methods. The system that was built was then tested using *blackbox* testing with a focus on testing thirteen functions and obtaining valid test results for each function in the system. With this Agromart system, it can make it easier for farmers to market agricultural products directly to *customers* and can improve the economy of farmers in Toapaya village. For further research, a *multi-platform based system can be developed* by focusing on Android and IOS based applications.

Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	W
Rifaldi Herikson	✓	✓			✓	✓		✓	✓
Berta Erwin Slam		✓				✓			✓
Ferry Irawan	✓		✓				✓		
Nolan Efranda				✓	✓				

Conflict of Interest Statement

Authors state no conflict of interest.

Informed Consent

We have obtained informed consent from all individuals included in this study.

Data Availability

The data that support the findings of this study are available from the corresponding author, [R], upon reasonable request.

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