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Implementation of a Web-Based Agricultural Management Information System with Integration of Operational and Financial: A Case Study at Okazakki Farm

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Abstract

Operational management in small and medium-scale agricultural enterprises is commonly conducted manually, leading to inaccuracies in record-keeping, limited traceability of cultivation cycles, and inconsistencies in financial reporting. This study aims to develop a web-based agricultural management information system that integrates planting, harvesting, labor management, and financial processes at Okazakki Farm. The system was developed using the Rapid Application Development method with iterative prototyping, while system requirements were collected through observation, interviews, and documentation. The system was implemented using a web-based framework and a relational database. The implementation results demonstrate that the system is capable of validating field block availability, recording harvest activities along with associated labor, updating inventory levels, and automatically generating income and expense records. Black-box testing results indicate that all core system functionalities operate in accordance with user requirements. This research contributes to supporting the digitalization of agricultural enterprises through end-to-end integration of operational and financial processes.

Keyword: Agricultural Management Information Systems; System Integration; (RAD)

Abstrak

Pengelolaan operasional pada usaha pertanian skala kecil dan menengah umumnya masih dilakukan secara manual, sehingga berdampak pada rendahnya akurasi pencatatan, keterbatasan keterlacakan siklus budidaya, serta inkonsistensi laporan keuangan. Penelitian ini bertujuan untuk mengembangkan sistem informasi manajemen pertanian berbasis web yang mengintegrasikan proses penanaman, panen, pengelolaan tenaga kerja, dan keuangan pada Okazakki Farm*. Pengembangan sistem dilakukan menggunakan metode Rapid Application Development dengan pendekatan prototyping secara iteratif, sedangkan pengumpulan kebutuhan sistem dilakukan melalui observasi, wawancara, dan studi dokumentasi. Sistem dibangun menggunakan kerangka kerja berbasis web dan basis data relasional. Hasil implementasi menunjukkan bahwa sistem mampu melakukan validasi ketersediaan blok kebun, mencatat aktivitas panen beserta tenaga kerja yang terlibat, memperbarui stok hasil panen, serta menghasilkan pencatatan pemasukan dan pengeluaran secara otomatis. Pengujian menggunakan metode black-box menunjukkan bahwa seluruh fungsi utama sistem berjalan sesuai dengan kebutuhan pengguna. Penelitian ini berkontribusi dalam mendukung digitalisasi usaha pertanian melalui integrasi operasional dan keuangan secara menyeluruh.*

Kata-kata kunci*: sistem informasi manajemen pertanian; Integrasi Sistem; RAD*

1. Introduction

The agricultural sector is one of the main pillars of Indonesia's economy, but it still faces challenges in production efficiency and information management. Digitalization is a strategic step to improve resource management effectiveness, business productivity, and operational record accuracy. The use of information systems has been proven to support data-driven decision making and minimize recording errors that commonly occur in manual processes [1]. This shows that information technology-based modernization is an important requirement for the sustainability of agricultural businesses.

Although the principles of digitization are increasingly relevant, operational management practices in many agricultural businesses are still manual, including those at Okazakki Farm in Purbalingga Regency. The processes of harvest recording, garden block management, labor data collection, and financial management are carried out using simple notebooks and spreadsheets, resulting in data inconsistencies and difficulties in tracking production per garden or planting block. Operations in this study are defined as daily technical activities in the agricultural cultivation process, such as planting, harvest recording, and field labor management, which directly generate production data and operational costs. In addition, changes in block structure that are not systematically documented and the separation between harvest and financial data cause operational information to be inaccurate and make business evaluation difficult.

Much research has been conducted on agricultural information systems, but their scope is generally limited to production aspects. The monitoring system at PTPN III and the palm oil commodity production application, for example, only handle harvest recording and verification without integration with finance or labor [2] [3]. Meanwhile, system development at Gapoktan Lembang and the Aceh Agriculture Office focuses more on cultivation data collection and harvest reporting without providing location-based traceability or data connectivity between operational processes [4] [5]. Research at PT Pandawa for Indonesia shows the benefits of digitization in improving data accuracy and production evaluation, but it still focuses on harvest management without integrating financial and labor aspects [6].

This study offers an integrated approach through the implementation of a web-based agricultural management information system that connects cultivation processes, harvest recording, labor management, and finance in a single platform. The novelty of this study lies in the application of location-based operational integration for farms or planting blocks and the provision of a direct link between production and finance, which has not been discussed in previous studies. This study aims to: (1) design and develop an integrated agricultural information system; (2) provide a more accurate and consistent mechanism for recording harvests and finances; (3) provide farm- or block-based production traceability; and (4) support business performance evaluation through more structured data.

2. Method

2.1. Research Process

This study uses a software engineering approach with a systematically structured workflow to ensure that the process of problem identification, requirements formulation, and information system development as a solution is carried out in a targeted manner and in accordance with the operational conditions at Okazakki Farm. The research stages began with a literature study to review previous research and obtain a conceptual basis related to management information systems and software development methods [7].

The next stage involved collecting field data through observation of operational processes, documentation of harvest and financial records, and interviews with business owners. The data obtained was analyzed and reduced into functional and non-functional requirements for the system, which became the basis for development.

The system design and implementation process was carried out using the Rapid Application Development (RAD) method, which emphasizes rapid development through prototyping and active user involvement. In this method, the system is developed in stages through prototype iterations to validate the requirements and system flow before full development [8] [9] [10].

The final stage of the research involved testing the system using the Black-Box Testing method to verify the suitability of the system output against the predetermined usage scenarios. This testing was focused on the final evaluation of the system development results, while functional testing during the development process was carried out internally in accordance with RAD principles. The entire research process is arranged sequentially as a conceptual framework, but still allows for adaptive improvements [11]. The research flow becomes the framework for conducting the research, while the details of the system development stages are described further in Subchapter 2.2. The research flow diagram is shown in **Figure 1**.

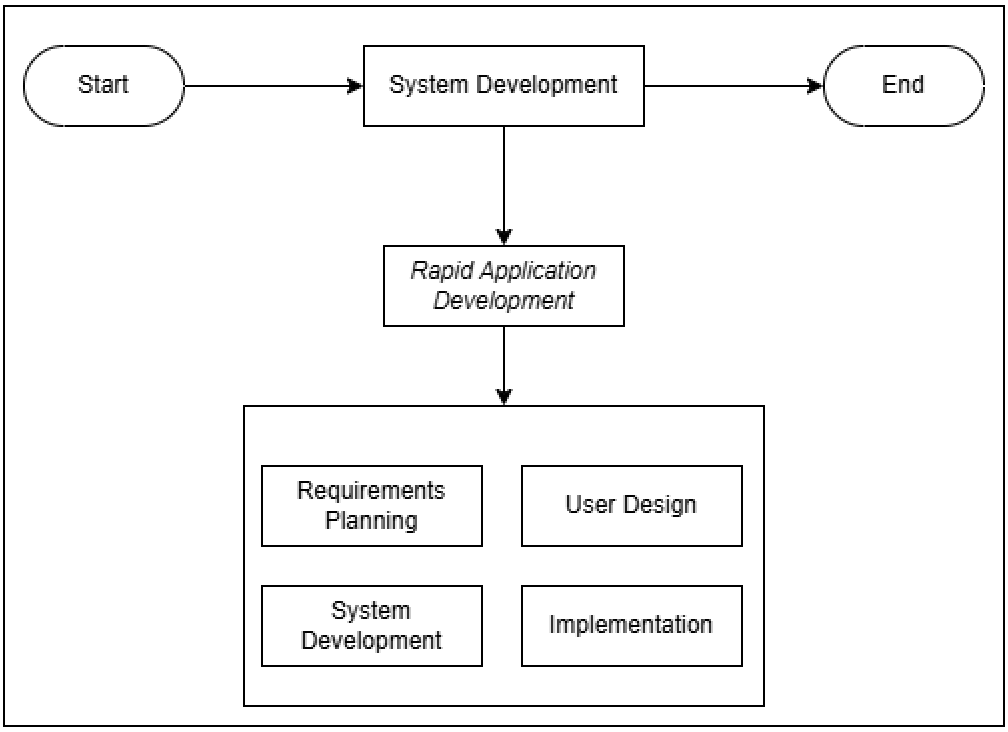

Figure 1. Research Process

2.2. System Development Method

The system development method used in this study is Rapid Application Development (RAD). The RAD method was chosen because it supports system development in a relatively short time while still actively involving users through prototyping and iteration processes [10] [12] . This approach allows user requirements to be validated from an early stage so that the resulting system is more in line with ongoing operational processes. [13] [12]. The stages of system development using the RAD method in this study include Requirements Planning, User Design, Construction, and Cutover, as shown in **Figure 2**.

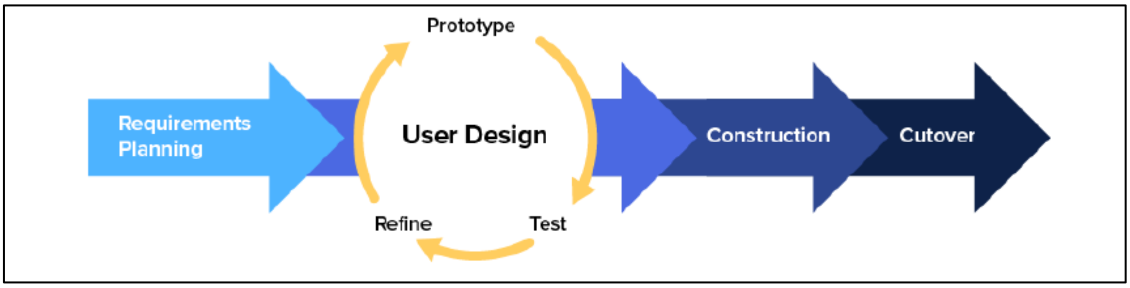

Figure 2. RAD stages [10]

a. Requirement Planning *(Perencanaan Kebutuhan)*

The Requirement Planning stage focuses on identifying and analyzing system requirements. Activities carried out include direct observation of agricultural operational processes, interviews with business owners, and analysis of harvest, labor, and financial records. The outcome of this phase is a structured list of functional and non-functional system requirements, which includes harvest recording processes, garden block management, labor management, and income and expenditure recording. These requirements form the basis for system design in the next phase [12].

b. User Design *(Desain Pengguna)*

In the User Design stage, system design is carried out iteratively in accordance with the Rapid Application Development (RAD) principle, which emphasizes active user involvement and gradual design refinement [10]. This stage aims to ensure that the system flow, interface design, and functional requirements are in line with the operational processes at Okazakki Farm as the basis for the Construction stage.

The prototype iteration process is carried out in stages, starting from the simplest representation of the system to prototypes with higher levels of functionality. This approach aims to ensure that all user feedback can be systematically accommodated before the system is fully developed in the Construction stage [10].

The User Design process in this study was carried out through two prototype iterations. The first iteration was conducted by developing a simple wireframe (low-fidelity prototype) to visualize the page structure, navigation flow, and main system processes. This wireframe was used as a medium for initial discussions with users to reach an agreement on the basic requirements of the system and the general flow of use.

The second iteration produced a high-fidelity prototype in the form of an interactive interface design that was implemented through limited coding. This prototype was used to test user interactions, key system functions, and navigation flows. Improvements were made based on user feedback until a validated prototype was obtained as the basis for development.

Coding in the high-fidelity iteration not only covers the user interface, but also the partial implementation of the system logic needed to validate the workflow and main functions. Full development and comprehensive integration are carried out in the Construction stage.

c. Construction *(Pengembangan)*

The Construction phase is the full development and refinement of the system based on a validated prototype [12]. Activities carried out include consolidating the database structure, developing all key features, integrating modules, and optimizing system performance.

At this stage, functional testing is conducted internally to ensure the stability and consistency of each module. The development process is iterative and adaptive in accordance with RAD principles until the system is ready for implementation [12].

d. Cutover *(Implementasi)*

The cutover phase is the phase of implementing the system in the operational environment. Activities carried out include system installation, initial database preparation, and user training. After the system is in use, initial monitoring is carried out to ensure that the system is running properly and in accordance with user needs [14].

3. Results and Discussion

3.1. Requirement Planning *(Perencanaan Kebutuhan)*

This stage began with a system requirements analysis conducted through observation of Okazakki Farm operations and semi-structured interviews with the business owner. The observations showed that attendance recording, planting, harvesting, and financial processes were still being carried out manually, making it difficult to trace activity histories and impacting the accuracy of operational data. Based on these findings, core system requirements were compiled to represent the main needs of the actors involved. These requirements were then formulated in the form of user stories to ensure that the developed system was in line with the actual workflow in the field, namely:

a. As an employee, I want to record operational activities such as attendance, planting, and harvesting so that the entire cultivation process is systematically documented and traceable.

b. As an administrator, I want to manage harvest data and record sales transactions so that business income is automatically recorded and integrated with the financial system.

c. As an administrator, I want to see financial summaries that include income, planting costs, harvesting costs, and employee salaries so that I can monitor the overall performance of the business.

3.2. System Design *(Desain Sistem)*

The system design is based on user requirements. Several diagrams are used in the design process, such as use case diagrams, activity diagrams, and entity relationship diagram (ERD).

a. Use Case Diagram

Use Case Diagrams are used to illustrate the relationship between users and the core features of the system. There are two main actors, namely Admin and Employees. Admin has access to manage master data, monitor attendance, manage harvest results, record sales transactions, and view financial reports. Meanwhile, employees use the system to record daily attendance, record planting, and record harvests based on the active cycle. This model provides an initial overview of the functional scope of the system before delving into more detailed process flows. The use case diagram can be seen in **Figure 3**.

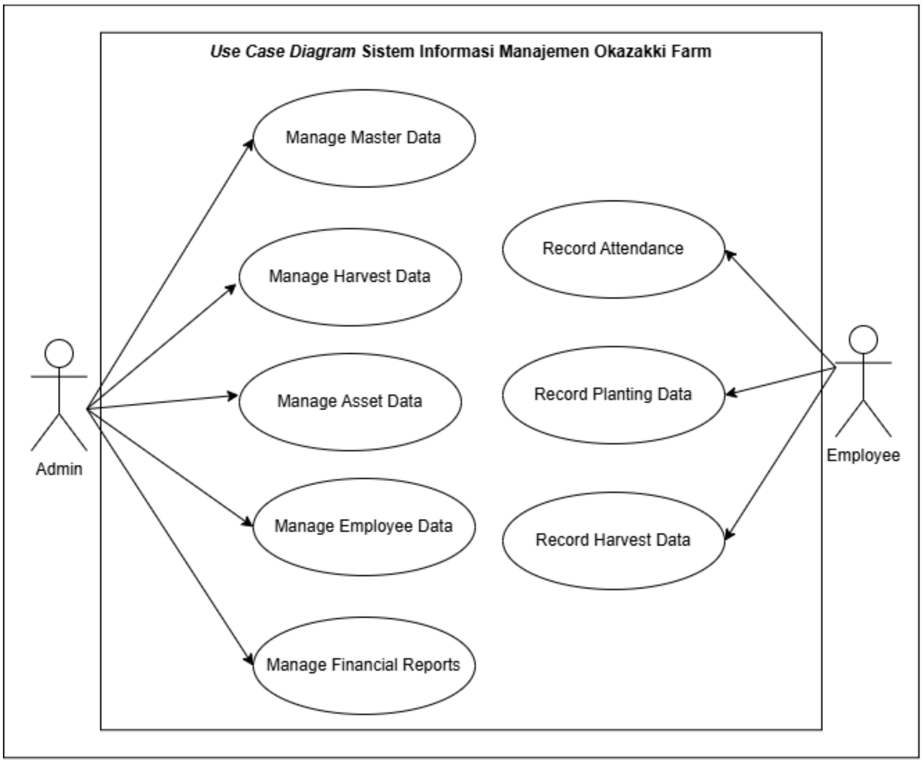

Figure 3. Use Case Diagram Okazakki Farm Management Information System

b. Activity Diagram

The Activity Diagram is designed to illustrate the flow of activities in the process that is the focus of the study, namely harvest recording by employees. The flow begins with the selection of a plantation, checking blocks that have an active planting cycle, filling in harvest details (date, harvest weight, failure weight, and workers involved), to storing data in the harvest and harvest_worker tables. The system then automatically generates harvest cost expenditure entries into the financial_transactions table. This diagram shows how the system automatically integrates field operational flows with financial recording. The Activity Diagram for the harvest recording process is shown in **Figure 4.**

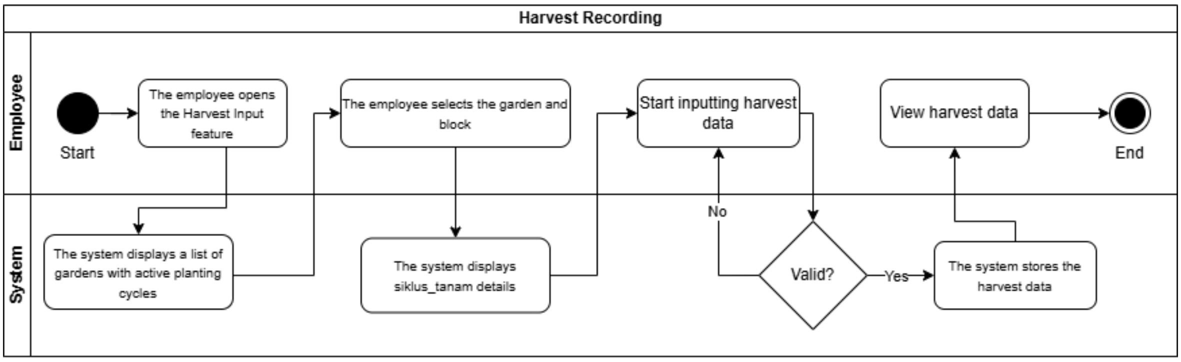

Figure 4. Activity Diagram harvest recording process

c. Entity Relationship Diagram (ERD)

ERD is used to design the database structure that forms the main foundation of the system. The tables designed cover the entire operational domain, ranging from plantation management, planting cycles, harvesting activities, casual workers, employee attendance, to financial transactions. Entities such as plantation, plantation_commodities, planting_cycle, harvest, and sales are connected in a relationship that describes the actual flow of the cultivation process and the distribution flow of the harvest. In addition, the entities of attendance, salary, and financial_transactions support the integration of operational and financial aspects. This model ensures data integrity and facilitates operational analysis through the system dashboard. The ERD can be seen in **Figure 5.**

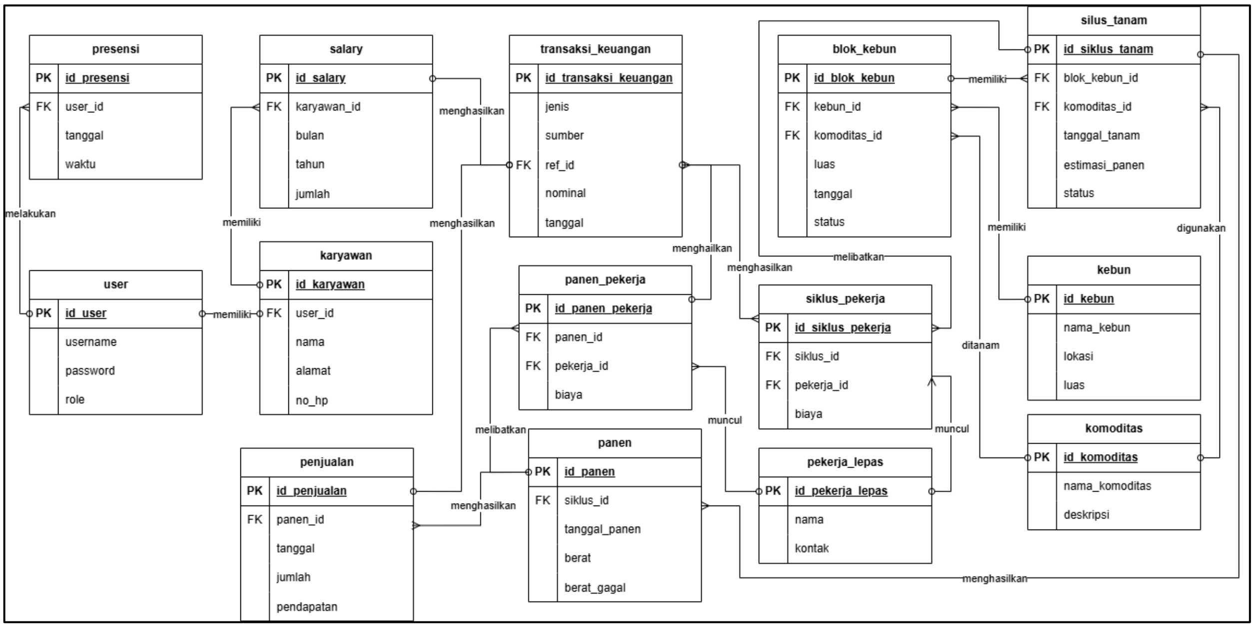

Figure 5. Entity Relationship Diagram (ERD)

3.3. System Development *(Pengembangan Sistem)*

The system development phase was carried out by applying the RAD principle, in which development was carried out in stages through prototype iterations and continuous refinement based on user feedback. Documentation at this stage focused on the harvest recording feature as a representation of the implementation of design iterations to full system development.

The initial iteration of development was carried out by creating a simple wireframe (low-fidelity prototype) to visualize the harvest recording flow and the main interface structure. This wireframe was used to validate the system flow logic and the suitability of the recording process with the operational conditions at Okazakki Farm. The evaluation results showed the need to adjust the input sequence and simplify the interface display. The wireframe can be seen in **Figure 6**.

Figure 6. Wireframe harvest recording

Based on the results of the initial iteration, development continued in the second iteration in the form of a high-fidelity prototype implemented through limited coding. This prototype allows users to simulate harvest data entry and test the navigation flow. In addition to the interface, at this stage, the system logic was also partially implemented to validate the main workflow before full development was carried out. The high-fidelity prototype can be seen in **Figure 7**.

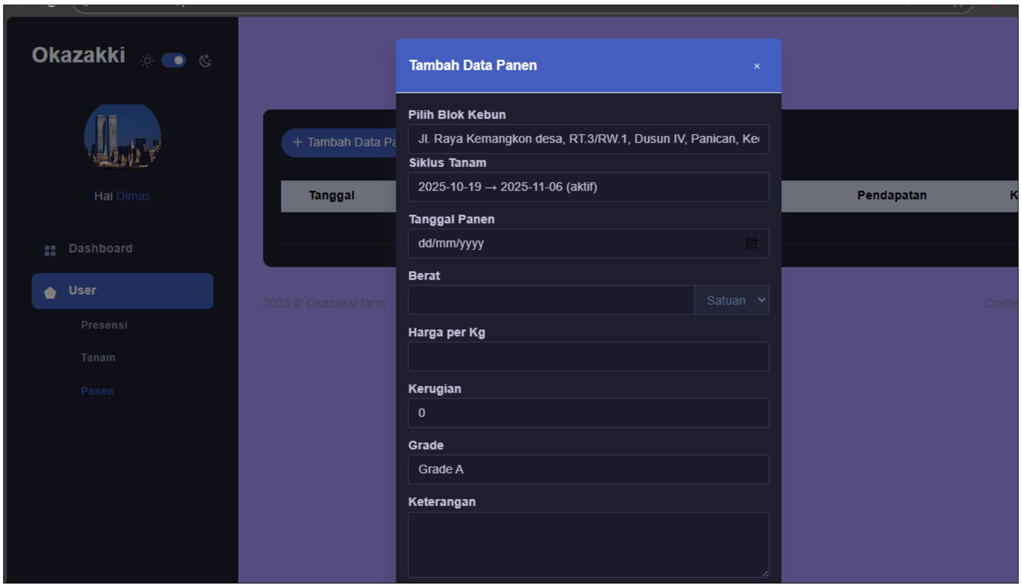

Figure 7. Prototype High-Fidelity Harvest Recording Feature

After the high-fidelity prototype was validated, the system was fully developed in the Construction phase. At this stage, all functions in the harvest recording feature were fully implemented by integrating the user interface, application logic, and database. Development included stabilizing the harvest database structure, linking it to garden block and commodity data, and integrating it with the financial recording module. Documentation of the harvest recording feature development can be seen in Figure 8.

The result of the Construction phase is a web-based agricultural management information system capable of managing harvest data in a structured and consistent manner. This final system is then used as the basis for functional testing in the next phase.

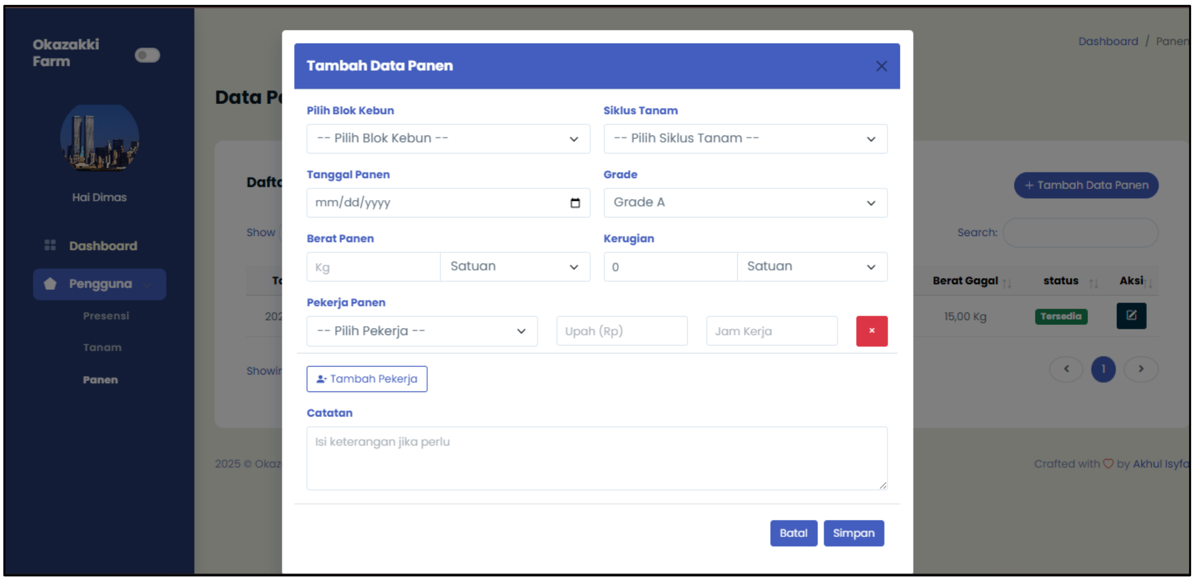

Figure 8. Final Implementation of Harvest Recording Feature

The system that has been fully developed in the Construction phase is then tested using the Black-Box Testing method to ensure the functionality of the system meets the specified requirements.

3.4. System testing *(Pengujian Sistem)*

System testing was conducted to ensure that each of the system's main functions—including planting, harvest recording, crop sales, and financial transaction recording—worked according to user requirements. The Black-Box Testing method was used to evaluate the suitability of system functions based on usage scenarios without involving examination of the internal structure of the program code.

Black-Box testing in this study was conducted by business owners as system administrators and employees as operational users, with researchers assisting in running the test scenarios. This approach aimed to ensure that each system feature functioned in accordance with the actual workflow at Okazakki Farm and reflected the operational needs of users.

The test results showed that all core system scenarios ran correctly, including updating the status of garden blocks, automatically recording operational costs, adjusting harvest stocks, and synchronizing income and expenses in the financial module. Several minor errors in input validation were found and corrected in the final stage of development. A summary of the test results is presented in **Table 1**.

Table 1. Black-Box Testing Results

Process	Actor	Action	Results
Planting Records	Employee	Select available garden plots and save planting data	The system stores data in the siklus_tanam and rejects blocks with active status.
Planting Worker Input	Employee	Add freelancers and calculate costs automatically	The cost is recorded as an expense in the financial transaction.
Harvest Recording	Employee	Selecting active garden blocks, inputting harvest and crop failure weights	System stores data to table panen dan panen_pekerja
Harvest Stock Validation	Admin	Adding sales with quantities exceeding stock	The system rejects the transaction and displays an error message.
Harvest Sales Transactions	Admin	Storing sales data with sufficient stock	Data recorded in sales and income is added to transaksi_keuangan

Process	Actor	Action	Results
Employee Attendance	Employee	Employees take attendance	Data is stored in the attendance table and can be accessed by the admin.
Master Data Management	Admin	add/change data on farms, blocks, employees, commodities	The system saves changes and data appears in all related modules.
Financial Recapitulation	Admin	Automatic income-expense calculation system	Balances and financial statements updated according to transactions

The integration of planting, harvesting, labor, and financial features into a single web-based system has proven to be effective through the RAD approach and Black-Box testing. All operational processes can be recorded consistently and traced, thereby achieving the research objective of providing an integrated, accurate, and operationally relevant agricultural management system for Okazakki Farm.

4. Conclusion

This research successfully developed a web-based agricultural management information system that integrates planting, harvest recording, labor management, and financial recording processes into a single platform centered on Okazakki Farm. This system is able to overcome manual recording problems by providing more consistent, structured, and easily traceable operational and financial data based on orchards and planting blocks.

The application of the Rapid Application Development (RAD) method enabled iterative system development with active user involvement from the design stage. Prototype iterations at the User Design stage played an important role in validating the system flow and key functions before full development was carried out. Black-Box testing results showed that all core system functions ran in accordance with user operational needs.

The contribution of this research lies in the application of end-to-end operational-financial integration in the context of small to medium-scale agricultural businesses, thereby supporting improved management efficiency, production traceability, and data-based business performance evaluation. The developed system can serve as a reference for the application of integrated agricultural management information systems in similar contexts.

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