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Web-based agricultural marketplace for rural communities

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ABSTRACT

Agricultural communities in Sulu Province face persistent challenges in market accessibility, transportation, pricing, and product distribution, limiting farmers' opportunities to participate directly in local markets. This study developed and evaluated SuluAgriMarket, a web-based agricultural marketplace designed to facilitate direct farm-to-consumer transactions and improve rural market accessibility. The platform supports product management, search and filtering, order processing, transaction monitoring, and cash-on-delivery payment for users operating under limited digital infrastructure. Pilot evaluation involved 35 participants, comprising 20 farmers and 15 consumers. Overall user experience received the highest rating (weighted mean = 4.70), followed by product information accuracy (4.53) and ease of navigation (4.42); 88.57% of participants also expressed willingness to continue using the platform. The findings indicate that a localized agricultural e-commerce system can strengthen market access, farmer-consumer interaction, and digital participation in geographically isolated rural communities.

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1. INTRODUCTION

Agriculture remains a major source of livelihood and food security in Sulu Province, Philippines. Yet farmers in many rural communities continue to face limited market access, transportation constraints, unstable pricing, and inefficient product distribution. These conditions can increase dependence on intermediaries, weaken farmers' bargaining position, and reduce the share of market value that returns to producers.

Digital technologies have expanded the possibilities for agricultural marketing by connecting producers and consumers through web-based platforms. Empirical studies show that rural e-commerce and digital agricultural marketing platforms can widen market access, create alternative sales channels, and support agricultural commercialization [1]-[6]. At the same time, adoption is uneven: farmers' participation is shaped by digital literacy, access to reliable internet and devices, perceived usefulness and ease of use, trust, training, and the fit between platform design and local conditions [7]-[14]. Recent research on digital transformation in smallholder agriculture further emphasizes that successful systems depend on usable technologies, enabling infrastructure, institutional support, and attention to supply-chain coordination rather than technology alone [15]-[18].

Despite these opportunities, many agricultural e-commerce systems assume stable connectivity, established digital infrastructure, access to digital payment services, and users with relatively strong digital skills. Those assumptions do not always hold in geographically isolated communities. In Sulu, inconsistent

connectivity, transportation limitations, and uneven digital literacy can affect whether a technically functional platform is actually practical for everyday agricultural transactions.

A further gap concerns localization. Existing studies document agricultural e-commerce and digital marketing platforms across different rural contexts, but they also show that platform use depends strongly on local infrastructure, farmer capabilities, market organization, and transaction conditions [1], [3]-[7]. These findings are especially relevant to geographically isolated communities, where connectivity and digital-service access can be inconsistent. A locally designed system for Sulu therefore needs to emphasize simple navigation, low-bandwidth usability, accessible transaction procedures, and payment options that remain practical for users who may not consistently rely on digital financial services.

To address this gap, the study developed SuluAgriMarket, a localized web-based agricultural marketplace for direct farm-to-consumer transactions in Sulu Province. Compared with broader national or regional e-commerce platforms that generally assume more stable connectivity and routine access to digital payment services, SuluAgriMarket prioritizes simplified transaction procedures, locally relevant product access, and cash-on-delivery as a practical option for users with limited access to online banking or digital wallets. The platform is not intended to replace established commercial marketplaces; rather, it examines whether a smaller, context-sensitive system can respond more closely to the operational realities of underserved agricultural communities.

The study had three objectives: (i) to develop a web-based agricultural marketplace that supports direct farm-to-consumer transactions; (ii) to evaluate the platform in terms of usability, reliability, and user satisfaction; and (iii) to assess its potential contribution to market accessibility and rural economic participation. From an information and communication technology for development (ICT4D) perspective, the study contributes evidence on how localized digital systems can be designed around infrastructure constraints and user practices rather than assuming conditions typical of urban e-commerce. Together, these objectives position the study as both a system-development effort and an initial evaluation of a context-sensitive digital marketplace for rural use.

2. METHOD

This study used a developmental research design to develop, implement, and evaluate SuluAgriMarket, a web-based agricultural marketplace for direct farm-to-consumer transactions in Sulu Province. The system-development process followed Agile principles because iterative development supports adaptation to changing requirements, stakeholder feedback, and incremental refinement of software functionality [19], [20]. The study combined system development, usability evaluation, and user feedback to examine the platform's functionality, usability, reliability, and acceptance.

Agile was selected because the project required repeated interaction with intended users and the flexibility to refine features as practical requirements became clearer during development. A linear development approach would have made late changes more difficult, whereas short iterative cycles allowed feedback on navigation, transactions, and interface design to be incorporated before pilot deployment. This approach was particularly appropriate for a community-oriented system in which user experience, connectivity constraints, and local transaction practices could not be fully anticipated at the outset.

Development proceeded through four recurring activities: requirement analysis, system design, implementation, and evaluation. During requirement analysis, the researchers used informal consultations, observations, and interviews with farmers, consumers, and local stakeholders from selected municipalities in Sulu Province to identify user needs and operational challenges. Related agricultural e-commerce literature and existing marketplace approaches were also reviewed to determine features that could reasonably be adapted to a rural setting.

During system design, the researchers prepared the platform architecture, database structure, workflow, and graphical user interface. Hypertext markup language (HTML) and cascading style sheets (CSS) were used for the front-end interface, PHP handled server-side processing, and postgres structured query language (PostgreSQL) was used for database management. Core functions included user authentication, product management, product search and filtering, order processing, transaction monitoring, and administrative management.

Implementation followed iterative Agile cycles. After each cycle, users performed common tasks such as account registration, product browsing, order placement, transaction confirmation, and order monitoring. Their observations and suggestions were documented and used to refine usability, interface design, and transaction flow before pilot deployment. Broader design decisions were also informed by recent digital agriculture research emphasizing accessible technologies, infrastructure constraints, institutional support, and supply-chain efficiency [15]-[18].

2.1. Participants and data collection

Pilot testing involved 35 respondents: 20 farmers and 15 consumers from selected municipalities in Sulu Province. Participants were purposively selected because they represented the platform's intended user groups and had practical experience with local agricultural buying or selling activities. During the evaluation, respondents completed representative platform tasks, participated in usability testing, and answered a structured questionnaire. Observational notes and user comments were collected alongside the questionnaire responses to identify problems that might not be captured by numerical ratings alone. The distribution of respondents who participated in the pilot evaluation is presented in Table 1.

Table 1. Respondent distribution

Respondent type	Frequency
Farmers	20
Consumers	15
Total	35

2.2. Evaluation procedure

Data collection combined usability testing, observation, task-completion analysis, post-test questionnaires, and user feedback so that system performance could be considered together with users' actual experiences. The usability evaluation used a 5-point Likert-scale questionnaire covering navigation usability, product search functionality, transaction reliability, mobile responsiveness, and overall user satisfaction. Descriptive statistics, including weighted mean, standard deviation, frequency, and percentage distribution, were used to summarize the responses. Before pilot implementation, the questionnaire was reviewed for clarity, relevance, and appropriateness in assessing the usability and acceptance of the developed platform. The five-point response scale and its corresponding interpretation are presented in Table 2.

Table 2. Likert scale interpretation

Scale	Interpretation
5	Strongly agree
4	Agree
3	Neutral
2	Disagree
1	Strongly disagree

Weighted mean and standard deviation were used to summarize the user evaluation results. The weighted mean was computed as follows, providing a common measure for comparing respondents' ratings across the evaluated usability criteria:

$$WM = \Sigma fx / N \quad (1)$$

where, WM: weighted mean; Σfx: total weighted responses; and N: number of respondents.

2.3. System architecture

The overall architecture of SuluAgriMarket is presented in Figure 1. The platform consists of four primary components: the user interface layer, application layer, database layer, and administrator module. Farmers and consumers access the system through a web interface developed using HTML and CSS, while PHP processes application requests and PostgreSQL stores user accounts, products, orders, and transaction records. The administrator module supports account management, transaction verification, reporting, and system monitoring.

2.4. System workflow

The operational workflow is illustrated in Figure 2. A transaction begins with user registration and authentication, followed by product browsing, product selection, order placement, transaction verification, delivery coordination, order receipt, and transaction completion. The sequence was designed to keep the purchasing process understandable while maintaining the basic controls needed for coordination among consumers, farmers, and administrators.

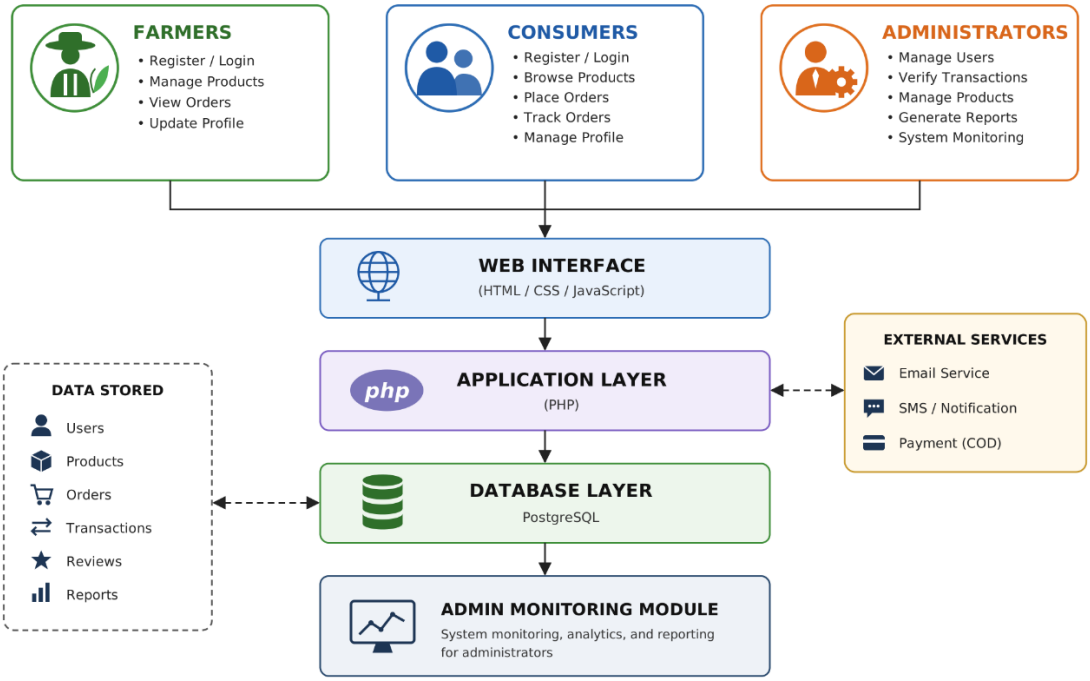


Figure 1. System architecture of the SuluAgriMarket platform



Figure 2. Operational workflow for farm-to-consumer transactions in SuluAgriMarket

2.5. Use case analysis

Figure 3 shows the principal interactions among farmers, consumers, and administrators. Farmers manage profiles, product listings, and orders; consumers search products, place orders, track transactions, and confirm receipt; and administrators verify transactions, manage users, generate reports, and monitor the system. Separating these roles helped define access privileges and reduced ambiguity in the transaction process.

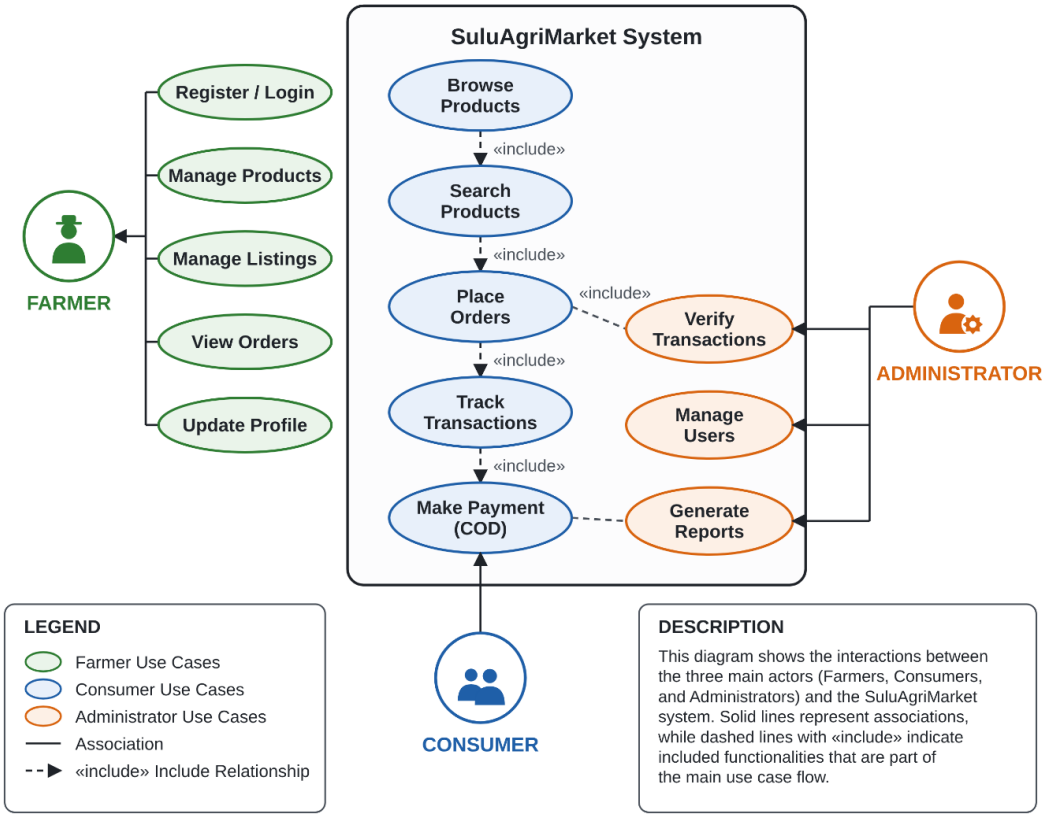


Figure 3. Use case diagram showing farmer, consumer, and administrator interactions in SuluAgriMarket

3. RESULTS AND DISCUSSION

3.1. Statistical evaluation results

The pilot evaluation indicated a high level of usability and user acceptance. Overall user experience received the highest weighted mean (4.70), followed by product information accuracy (4.53), ease of navigation (4.42), and transaction reliability (4.34). These results suggest that respondents generally found the platform understandable and dependable for the tasks performed during pilot testing. Because the evaluation involved only 35 respondents, however, the scores should be interpreted as evidence from an initial deployment rather than as a province-wide estimate of user acceptance.

The favorable ratings also reflect the value of designing around local operating conditions. SuluAgriMarket uses simplified navigation, localized transactions, and cash-on-delivery instead of assuming that every user has stable connectivity, strong digital skills, or routine access to online payment services. In this setting, usability depends as much on reducing transaction complexity as it does on adding features.

The findings are consistent with recent evidence showing that digital-agriculture adoption is influenced by a combination of technological, socioeconomic, institutional, and behavioral factors rather than software availability alone [21]-[23]. They also suggest that user confidence may be strengthened when a platform reflects familiar transaction practices. Minimizing unnecessary complexity may therefore be particularly important for first-time or less digitally experienced users. Table 3 summarizes the weighted mean, standard deviation, and interpretation for each usability criterion.

Table 3. Statistical summary of user evaluation results

Evaluation criteria	Weighted mean	Standard deviation	Interpretation
Ease of navigation	4.42	0.61	Satisfied
Product search functionality	4.18	0.74	Satisfied
Product information accuracy	4.53	0.55	Very satisfied
Checkout process	4.21	0.69	Satisfied
Mobile responsiveness	3.97	0.83	Satisfied
Customer support	4.08	0.72	Satisfied
Reliability of transactions	4.34	0.63	Satisfied
Overall user experience	4.70	0.48	Very satisfied

3.2. Navigation and search functionality

Most respondents were able to locate agricultural products independently, indicating that the navigation structure supported routine user tasks. More than seventy percent of participants also agreed that search and filtering improved product accessibility and reduced the time needed to identify desired products. These results are consistent with the relatively high rating for ease of navigation and suggest that the basic information architecture was understandable to the pilot users. Participant feedback nevertheless identified areas for refinement. Respondents suggested clearer product categorization and improved keyword search, particularly for users with limited experience using online marketplaces. This matters in rural settings because a search feature that works technically may still be difficult to use if product labels, categories, or terminology do not match how users normally describe agricultural goods.

Previous research likewise indicates that perceived ease of use, digital capability, training, and facilitating conditions influence farmers' acceptance of digital agricultural technologies [21], [22], [24]. Further refinement of categories, search terms, and mobile interaction should therefore be treated as part of usability improvement rather than as a purely cosmetic change. These adjustments may become more important as the platform is introduced to a larger and more diverse user population.

3.3. Checkout process and transaction reliability

Most respondents completed purchase transactions successfully during pilot testing, and transaction reliability received a weighted mean of 4.34. The result indicates that users generally trusted the transaction flow and encountered relatively few operational difficulties during the evaluated tasks. The successful transaction rate reported in the technical evaluation provides additional support for this interpretation.

Cash-on-delivery was positively received because online banking and digital payment access remain uneven in the study area. Rather than requiring a payment mechanism that could exclude some intended users, the platform retained a familiar settlement option while preserving digital ordering and transaction monitoring. This illustrates a broader design principle: a rural e-commerce system may need to digitize some parts of a transaction gradually instead of assuming that the entire process can immediately move online.

This finding is consistent with studies showing that farmers' use of digital agricultural systems is shaped by trust, perceived usefulness, facilitating conditions, and the practical fit of technology with local circumstances [21], [22], [24]. At the same time, cash-on-delivery introduces coordination and logistics requirements that should be considered in larger deployments. Future versions should therefore retain accessible payment options while gradually supporting secure digital alternatives for users who prefer them.

3.4. Technical performance evaluation

Technical testing showed stable operation during the pilot implementation despite occasional connectivity limitations across participating municipalities. Average page load time was 2.4 seconds, the successful transaction rate was 92.86%, search accuracy was 88.57%, and system availability during testing was 95.00%. Taken together, these indicators suggest that the core platform remained functional under the conditions encountered during the pilot.

Mobile compatibility, at 68.57%, was the weakest technical indicator and is consistent with the lower user rating for mobile responsiveness. The result does not indicate that the mobile interface was unusable, but it shows that performance and layout require further optimization for smaller devices and low-bandwidth connections. Because smartphones are likely to be the primary access device for many rural users, this limitation should be addressed before wider deployment.

Connectivity and device limitations are recurring constraints in rural digital agriculture, particularly where reliable internet, electricity, smartphones, training, and other enabling resources are unevenly available [21], [22], [25]. Even so, infrastructure constraints should not be used to excuse avoidable design problems. The practical implication is that future development should reduce page weight, simplify mobile interaction, and test the platform across a wider range of devices and network conditions. The technical performance indicators recorded during pilot testing are summarized in Table 4.

Table 4. Technical performance indicators

Performance metric	Result
Average page load time	2.4 seconds
Successful transaction rate	92.86%
Search accuracy rate	88.57%
Mobile compatibility rate	68.57%
System availability during testing	95.00%

Overall, the technical results indicate that SuluAgriMarket operated reliably during the pilot, although mobile compatibility remains the clearest area for improvement. The platform's current performance is sufficient to justify further testing. Larger deployments should include more systematic load, security, device-compatibility, and low-bandwidth testing.

3.5. User behavioral intention and adoption potential

A notable finding was the willingness of respondents to continue using the platform: 88.57% expressed future usage intention and 85.71% indicated that they would recommend it to others. These responses suggest that the positive usability experience translated into favorable behavioral intention during the pilot. They should nevertheless be interpreted cautiously because intention to use does not always translate into sustained use after the novelty of a pilot deployment has passed. Participants particularly valued direct farmer-to-consumer transactions, transparent pricing, easier product access, and reduced dependence on intermediaries. These perceived benefits extend beyond interface usability because they address practical market problems experienced by agricultural producers and buyers. If the platform can maintain these benefits during longer deployments, it may support stronger local participation and improve opportunities for small-scale farmers. The results are consistent with research indicating that farmers' participation in digital agriculture is influenced by perceived usefulness, ease of use, digital capability, trust, and enabling institutional conditions [21]-[25]. The pilot therefore provides a useful proof of concept, but sustained adoption will depend on factors beyond software quality, including connectivity, logistics, user support, institutional partnerships, and trust. Those factors should be examined explicitly in subsequent deployments.

4. CONCLUSION

This study developed and evaluated SuluAgriMarket, a localized web-based agricultural marketplace intended to support direct farm-to-consumer transactions in rural communities in Sulu Province. The pilot evaluation showed high usability, reliable transaction performance, and strong user acceptance, while simplified transaction procedures, localized product access, and cash-on-delivery aligned the platform with users who may have limited digital infrastructure, online payment access, or experience with commercial e-commerce systems. The findings suggest that context-sensitive agricultural e-commerce can improve market accessibility by strengthening farmer-consumer interaction and reducing practical barriers associated with conventional market channels; the contribution of SuluAgriMarket therefore lies in adapting familiar marketplace functions to the operating conditions of a geographically isolated province rather than introducing a fundamentally new form of e-commerce. The study is limited by its pilot scale of 35 participants from selected municipalities, the relatively short evaluation period, and continuing constraints in mobile responsiveness and internet connectivity, so the findings should not be generalized to all farmers and consumers in Sulu Province. Future work should prioritize mobile and low-bandwidth optimization, secure digital payment options, and more structured logistics support while retaining accessible alternatives such as cash-on-delivery. Scalability should be evaluated through larger deployments across multiple agricultural communities, including tests of system load, security, transaction volume, and administrative capacity, while long-term sustainability should be examined through partnerships with farmers' cooperatives, local government units, agricultural organizations, and other local institutions that can support user onboarding, logistics coordination, platform governance, and continuing technical assistance.

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AUTHOR CONTRIBUTIONS STATEMENT

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors state no conflict of interest. They declare no financial, professional, institutional, or personal relationships that could have inappropriately influenced the conduct, interpretation, or reporting of this research.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study. Participation in the pilot evaluation was voluntary, and no personally identifiable information of the participants is reported in this article.

ETHICAL APPROVAL

The research related to human use has been complied with all the relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the authors' institutional review board or equivalent committee.

DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author upon reasonable request. The dataset includes usability evaluation responses, pilot-testing observations, and implementation records related to SuluAgriMarket. Participant-level data are not publicly released where disclosure could compromise privacy or confidentiality.

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