
Assessment of farmers' acceptance, satisfaction, and utilization of mobile application for rice production cost and return in Chachoengsao Province, Thailand

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Abstract Using descriptive analysis, the results revealed that the rice production database, accessible through the mobile application, incorporates critical variables encompassing plantation areas, variable and fixed costs, total costs, yields, selling prices, income, profitability or loss, and breakeven points. The assessment of acceptance across three dimensions included content, technical and physical attributes, and perceived ease of use, that the farmers consistently demonstrated the highest level of acceptance for the mobile application. In terms of satisfaction assessment, encompassing design, content, performance, and utility, the findings uniformly indicated that farmers expressed substantial satisfaction with the rice production database accessible via the mobile application. Farmers' feedback underscored the application's user-friendliness and its potential for aiding production planning in subsequent seasons. Moreover, the facilitating the adoption of innovative platforms, and policymakers can empower farmers with tools to enhance productivity and induce satisfaction and confidence in modern agricultural practices.

Keywords: Innovation, Satisfaction, Cost and return, Rice

Introduction

In the rapidly evolving landscape of the 21st century, where technological innovation intersects with traditional farming practices, it is important for agriculture to harness these advancements to optimize yields, efficiency, and sustainability (Bronson, 2018; Santiteerakul *et al.*, 2020). Traditional farming practices governed solely by intuition and generational knowledge are increasingly influenced by data-driven insights (Llonas and Suwanmaneepong, 2021b; Zhang *et al.*, 2020).

Rice production as a staple food for a significant portion of the global population demands consistent innovation to meet the ever-growing

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consumption needs (Bongiovanni and Lowenber, 2004; Tong *et al.*, 2019; Usman and Ahmad, 2018). However, rice farmers, especially in community enterprise setups, often face challenges related to access to timely and accurate information (Aker, 2011; Islam *et al.*, 2022). Whether it is about the cost and return dynamics, market trends, or best farming practices, the absence of a centralized information source can impede optimization and growth (Aker, 2011; Suwanmaneepong *et al.*, 2020).

In Thailand, Chachoengsao province is one of the country's leading rice-producing regions, but it faces various challenges, including shifts in climate patterns and fluctuations in market dynamics. (Guttormsen and Roll, 2014; Lee, 2021; Ministry of Agriculture and Cooperatives, 2013). Over the past decade, there has been a surge in mobile application developments aimed at various sectors, and agriculture is no exception (Llones *et al.*, 2022; Nakasone *et al.*, 2014). However, the real test of any application lies in its utility, user experience, and overall impact. The recent development of a mobile application tailored for rice farmers in Chachoengsao may potentially revolutionize rice farming practices in the region. The design as a comprehensive database encapsulated the cost and return dynamics of rice production, this application seeks to bridge the information gap, offering farmers real-time insights to inform their decisions.

Hence, this study evaluated how farmers in the region perceive, accept, and utilize the digital tool as a rice farming innovation. Using the information of farmers that perceived acceptance and satisfaction with the technology, user feedback, and expert opinions. The research aimed to assess the application's current standing and illuminate the adoption path, ensuring such innovation truly empower the farming community.

Materials and methods

Study area and data collection

The research investigation utilized the case of the "Safe Rice Community Enterprise Network" in Sanamchai Khet, which is the area recognized for its significance in rice cultivation and the presence of a structured community enterprise. The mobile application is envisioned as a cost and return database for rice cultivation, and it underwent testing among five distinct farmer groups during the cropping year 2019-2020.

In the testing phase, structured feedback forms were disseminated among the participant farmers. These surveys spanned multiple dimensions of the application, from aesthetics and content to functional efficiency and holistic benefits, and utilized a Likert scale for rating. Participants were prompted to rate their satisfaction across different application attributes to discern the

application's effectiveness and potential improvement zones. In addition, the focused group discussions were organized with selected farmers to dive deeper into their experiences, challenges, and suggestions for the mobile application. These discussions provided qualitative insights that cannot be captured through surveys alone.

Lastly, a panel of experts was organized, encompassing members from academia, NGOs, international partners, farmer groups, and extension workers. Their insights evaluated the application from diverse perspectives to ensure a holistic understanding of strengths, weaknesses, opportunities, and threats.

Data analysis

The evaluation was performed on the application's adoption, design, content, usability, efficiency, and overarching benefits. This comprehensive methodology is ensured through the assessment of the mobile application, considering both quantitative and qualitative feedback, thereby paving the way for refinement and widespread adoption.

Using the descriptive analysis and preliminary statistical analyses, which summarized mean and standard deviation, and interpreted the farmers' satisfaction metrics concerning the application features. Feedback ratings were linked to content attributes, which were processed to evaluate the application's capacity to render relevant information. Using feedback on design, accessibility, and application performance was used to determine the technical expertise and implications for wider adoption. Metrics linked to the application's value proposition, knowledge dissemination capability, and perceived utility were aggregated to infer a long-term potential in the sector.

Transcripts from the focused group discussions and expert panel sessions were qualitatively analyzed to identify recurring themes, potential recommendations, and overarching sentiments. Integrating feedback across the spectrum, broader implications for rice farming were deduced and extended a potential shift in agricultural practices, information flow, and community collaborations.

Results

Accessing database for costs and return of rice production

The mobile application designed for storing data related to the cost and return of rice production was demonstrated in Figure 1. Panel a showed the homepage of the mobile application. It introduced the users to the primary purpose of the app. The mobile application was tested among five groups of

farmers during the cropping year 2019-2020. This indicated a real-world trial to evaluate its functionality, usability, and relevance.



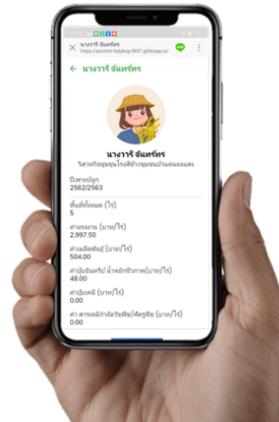
(a) Homepage of the mobile application for the cost and return database for rice production.



(b) Database information by community enterprise.



(c) Clicking the community enterprise allows users to access registered farmers' costs and return production information.



(d) An example of a farmer's cost and return data.

Figure 1. Panel (a) - (d) illustrated the process of accessing the cost and return data using the mobile application

Result showed the application's database information section as seen in Figure 1b. The users can access specific data which sorted by community enterprise. This layout ensured an easy navigation and quick retrieval of relevant information. The group for the application is focused on the "Safe Rice

Community Enterprise Network” located in Sanamchai Khet. This group provided significant feedback during the testing phase. The way users can access farm costs and return production information by clicking on community enterprise is shown in Figure 1c. It displayed the various profiles, presumably representing different members or segments of the enterprise.

The mobile application is versatile and developed to cater to various stakeholders including Rice Farming Community Enterprise, which allowed community enterprise members to register and access cost and return data (Figure 1c). Individual farmers can use this application to get insights, as seen in Figure 1 d, which showed an example of a farmer’s cost and return data. Government and academia showed that the application served as a tool for these entities to access grassroots-level data, helping formulate policy. Other Interested Agencies is concerned with the application’s extensive database which can be useful for agencies which involved in rice trade, pricing, and other related activities.

Overall implications of the mobile application are presented in Figure 1, which illustrated a well-thought-out mobile application designed for a specific target audience in the rice production industry. The design is comprehensive, user-friendly, and capable of catering to various stakeholders in the sector.

Perceived acceptance of the cost and return mobile application

The farmers’ perception of the mobile application across three key dimensions of content, ease of use, and physical attributes is shown in Figure 2. Evaluating farmers’ feedback was essential to understand how potential adopters viewed the application, pinpoint strengths, identify improvement areas, and inform future enhancements.

Results revealed that the content dimension witnessed high acceptability among the farmers. In terms of the intended use and value, a considerable majority found that the information met the target group’s intended use and offered valuable insights, underscoring the app’s relevance. While the reliability and accuracy aspects are related to and crucial for an application that serves as a knowledge hub, and strong acceptability. High accuracy ratings indicated a trust in the presented data, fostering confidence in decision-making. In addition, the application’s clarity and completeness reflected a comprehensive and easy-to-understand information display, which revealed important aspects for user engagement and comprehension. The positive reception of the content implies that the application’s foundation was robust. However, continuous updates, expansion and data validation are shown to be essential to maintain and enhanced a trust.

Regarding the ease of use, the application’s usability directly impacts its broader adoption and regular use. An overwhelming majority found the app convenient, with uncomplicated steps that enhanced the user experience. While the application displayed screen was found to be easy to use, the relatively mixed feedback on self-learning suggested some users faced challenges navigating certain features. While the application is found to be mainly user-friendly, further simplification or interactive tutorials might enhance the user experience to ensure those less tech-savvy can harness their full potential.

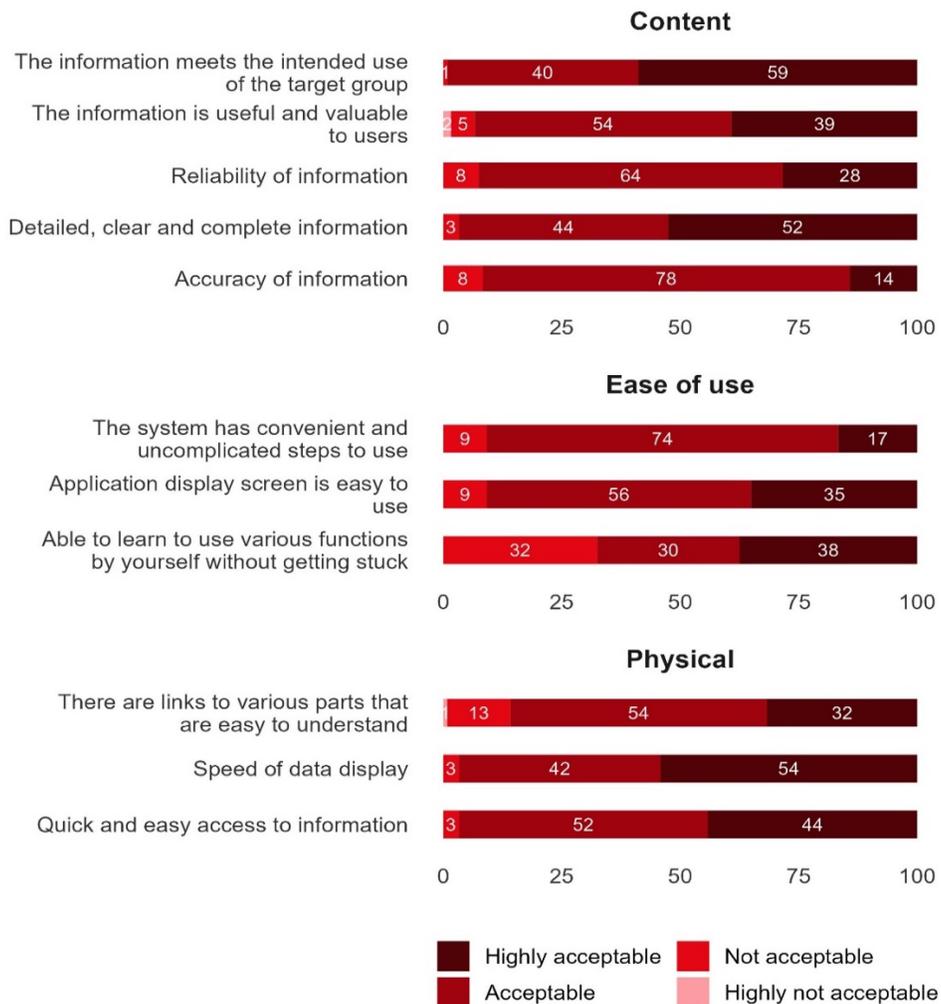


Figure 2. Farmers’ rating of their perceived acceptance of the mobile application features

Moreover, the physical attributes are largely concerned the app's interface and navigation. Regarding the links and navigation, most farmers found the in-app links easy to understand, suggesting a coherent design. However, there was a room for improvement to ensure seamless navigation. The mixed feedback regarding the data is displayed, and the speed indicated in varied experiences potentially influenced by device specifications or network speeds. While quick and easy access to information found to be paramount. The received feedback was mostly positive, indicating minimal barriers to accessing the desired data.

Perceived satisfaction with the mobile application

Farmers' satisfaction levels regarding various facets of the mobile application are presented in Figure 3. This feedback is served as a guide to measure the application's strengths and potential areas for enhancement. The application's practical benefits were evident in the positive reception. Most recognized the content as directly helpful and applicable regarding the utility and application, underlining the tool's practical relevance. The app's role as an information dissemination medium and a knowledge source also received notable approval. Content is explained as the backbone of any informational tool, and the feedback is largely promised. The information's interestingness and clarity highlight the app's user-centric design, which was satisfied. The positive data accuracy and volume feedback underscored the tool's comprehensive nature and reliability. While the content is well-received, regular validation and updated possibly incorporate dynamic formats, and enhancing user engagement.

Whereas the application's efficiency determines how seamlessly users can interact with the application. Most users were satisfied with the quick access to information and the application's overall performance. There was a segment indicating potential room for improvement. At the same time, the design and user interface played a pivotal role in ensuring user retention and regular engagement. Most farmers are appreciated the app's color schemes and topic categorization, indicating an intuitive design approach. In addition, the imagery and font size were largely well-received, but some areas, like the composition of elements, witnessed a mixed response. The overarching positive feedback on the application underscored its potential as a game-changer in the agricultural landscape. The mobile tool resonates with farmers' needs. However, continuous refinements based on feedback, technological advancements, and emerging agricultural trends would be crucial to ensure long-term success and wider adoption.

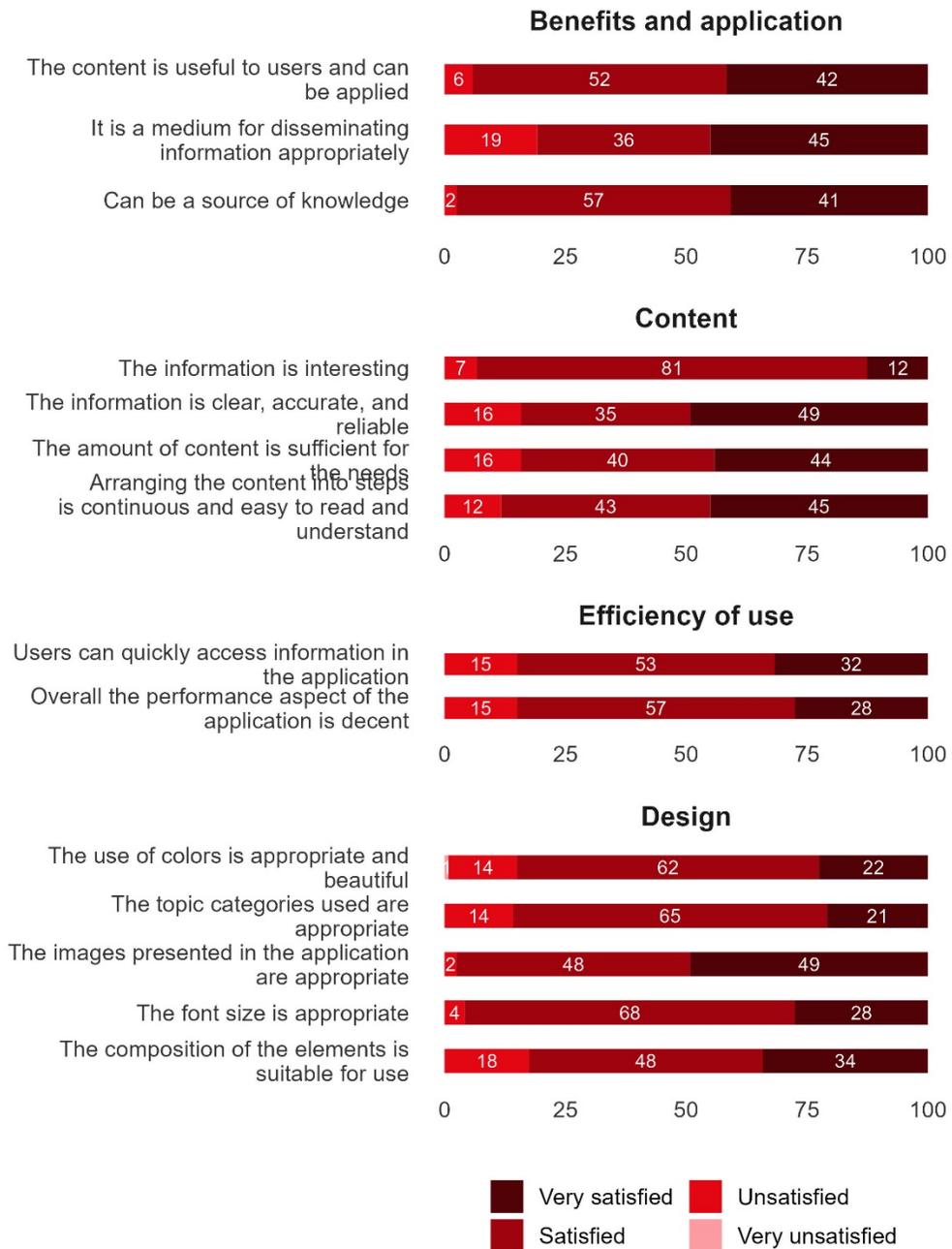


Figure 3. Farmers' rating on their perceived satisfaction with the mobile application features

Association between acceptance and satisfaction of the mobile application

An analytical representation of how farmers' acceptance of various facets of the mobile application correlated with their overall satisfaction is shown in Table 1. The Spearman correlation values shed light on the strength and direction of these relationships. A strong positive correlation (0.633) existed between the acceptance of content and satisfaction with the design. This implies that when farmers found the content suitable, they tended to be more satisfied with the app's design. However, the relationship between content acceptance and other satisfaction aspects like efficiency of use (0.265) and benefits and application (0.444) were moderate but still significant.

On the other hand, the physical attributes showed a weak and sometimes negative correlation with the satisfaction categories. Particularly, there was a weak negative correlation with content satisfaction (-0.226). While physical attributes might not be the most vital determinant of satisfaction, negative correlations indicated the areas of potential improvement. The focus was on refining physical aspects to elevate the user experience further.

Moreover, a significant positive correlation with design (0.382) indicated that farmers who found the app easy to use also appreciated its design. However, the other correlations were relatively weak. User-friendly navigation and intuitive design go hand-in-hand. Simplifying complex features or providing guidance can enhance the ease of use, indirectly boosting satisfaction with design. The highest correlations with satisfaction is laid in content and ease of use, emphasizing the need for an app that was both informative and user-friendly. While design aesthetics were crucial, the primary focus should be delivered a reliable and valuable content in an easily navigable format that would be shown. Some weak and negative correlations provided an opportunity for introspection and refinement.

Table 1. Spearman correlation of farmer's acceptance and perceived satisfaction of the mobile application

		Satisfaction			
		Design	Content	Efficiency of use	Benefits & application
Acceptance	Content	0.633***	0.169	0.265**	0.444***
	Physical	0.17	-0.226	-0.071	0.07
	Ease of use	0.382***	-0.109	0.201	0.285**

* p < 0.10, ** p < 0.05, *** p < 0.01

Discussion

Given the advancement in agricultural production, the significance of technology and data-driven decision-making in farming is crucial (Gunavathie *et al.*, 2023; Pongnumkul *et al.*, 2015; Roslin *et al.*, 2021). The mobile application designed for rice farmers in the Sanamchai Khet region was an example of this evolving agricultural innovation. The advent of this application could mark a significant shift from traditional, experience-based decision-making to a more data-driven approach. When real-world, current data inform decisions about planting, harvesting, and selling, it increases the likelihood of positive outcomes, reduces risks, and can lead to more consistent yields and profits (Llones and Suwanmaneepong, 2021a; Roslin *et al.*, 2021).

The mobile application's overwhelmingly positive reception highlighted the farming community's readiness and eagerness to incorporate digital tools into their farming practices. This is particularly evident from the high satisfaction ratings about the application's features and contents, which suggested that farmers value accurate, reliable, and pertinent information. In an era where precision agriculture becomes vital, such platforms bridge the information gap, facilitating optimized, data-backed farming methods (Roslin *et al.*, 2021). In addition, with accessible data on costs and returns, farmers might move towards standardized practices that have proven effective, reducing the trial-and-error approach (Pongnumkul *et al.*, 2015). This can lead to be a better rice quality, higher yields, and a more sustainable approach to farming, benefiting not just individual farmers but the entire community (Llones *et al.*, 2021; Pongnumkul *et al.*, 2015; Roslin *et al.*, 2021).

Results revealed that the design elements of the application, from its aesthetics to its navigability, played crucial roles in its adoption. While aspects like font size and imagery received commendations, areas like topic categorization presented potential avenues for refinement. An intuitive design not only ensures broader usage but also minimizes the learning curve, which is especially vital in communities where technology updates might be limited, such as in the field of agricultural production (Adamsone-Fiskovica and Grivins, 2021; Cadger *et al.*, 2016; Tsouvalis *et al.*, 2000). The application's high scores in content were accuracy, reliability, and arrangement, highlighting its user-centric approach. Delivering clear, concise, and actionable insights can revolutionize farming decisions (Pinsard and Accatino, 2022). However, the slightly lower score on the content's interestingness indicated a possible enhancement area. Incorporating dynamic content formats, like videos or interactive tutorials, might augment user engagement (Lee *et al.*, 2022).

While the application received satisfactory ratings in terms of its performance and efficiency, continuous technological upgrades and

optimizations can further bolster its appeal. Ensuring seamless, glitch-free user experiences is paramount to retaining user trust and promoting regular usage (Ali *et al.*, 2020; Koutsou *et al.*, 2014; Suwanmaneepong *et al.*, 2023). One of the standout features of the mobile application is its dual role as a practical tool and an educational resource. Feedback from the focus group discussions and expert panels emphasized its potential as a central knowledge repository for rice farming. This transformative aspect can bridge generational knowledge gaps, fostering a culture of continuous learning and innovation (Gunavathie *et al.*, 2023; Lorente *et al.*, 2012). The younger generation, typically more tech-savvy, might find the app appealing and engage more with farming, leading to smoother knowledge transfer from older farmers. This can help in bridging the technological gap often observed in farming communities.

The elicitation from experts, spanning academicians to NGOs and international partners, highlighted the application's multifaceted utility. Beyond being a tool for farmers, it can serve as a data source for researchers, a policy influencer for governmental bodies, and a collaboration platform for international partners. Its potential to democratize access to agricultural data can level the playing field, empowering even the most marginalized farmers (Tantalaki *et al.*, 2019; Wolfert *et al.*, 2017). The mobile application's success and positive reception hint at a promising future. As more farmers adopt this tool, there is potential for a community-driven feedback loop where user experiences drive application refinements.

Moreover, the app's success could catalyze the development of similar platforms for other crops, setting new standards in agricultural technology (Lorente *et al.*, 2012; Pongnumkul *et al.*, 2015). In conclusion, the mobile application for rice farmers was a beacon of modern agricultural practices. Its adoption and feedback reflected the shifting paradigms in farming, with technology and data taking center stage (Bartlett *et al.*, 2015; Lorente *et al.*, 2012) and moving forward as the tools will undoubtedly play an instrumental role in shaping the future of agriculture, promoting sustainability, efficiency, and community collaboration (Lorente *et al.*, 2012).

Given the positive trajectory of the app, there was an evident need for strategies and policies to further its adoption. For government and extension services, workshops and training sessions, especially in rural areas, to enhance digital literacy and application usage among farmers are very important, particularly since most farmers have received a lower literacy rate regarding technological advancement. Extension workers should provide farmers with hands-on training and troubleshooting support, ensuring they benefit from the app. Extension workers were a bridge between farmers and developers, ensuring real-time challenges were addressed. The mobile application signified a

paradigm shift in agricultural practices. Its success offers a glimpse into a future where technology and data become the mainstay. The onward journey is marked by continuous innovation and holistic collaborations, which show the potential to redefine the contours of global agriculture.

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