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Development of a mobile app for enhancing the performance of smallholder native chicken management and production

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Abstract

The purposes of this paper are: 1) to study farmers' demographic information, farm characteristics, and mobile phone usage patterns; 2) to develop a mobile app that can comprehensively address the needs of native chicken farmers through dissemination of proper information; and 3) to collect and analyze completed satisfaction surveys by Thai native chicken (TNC) mobile app users. Data was collected from 50 farmers through the use of semi-structured interviews and statistically analyzed using measurements of frequency, percentage, and mean. Most of the farmers were male (84%), with an average age of about 52 ± 9.40 years and with only a primary school education (40%). Most raised native chickens as a secondary career (92%) and had 5 years or less of farming experience (46%). Meanwhile, 34.06% raised chickens mainly for home consumption, 56% had medium-sized farms, and 90% reared in semi-intensive systems. Responses indicated that Android operating systems are more commonly in use than iPhone Operating System (iOS) (96% vs. 4%, respectively). The TNC mobile app is an Android-based app that serves as a tool for native chicken farmers in Thailand to improve their rearing methods and productivity. The key features of the app include information or guidance about Thai native chicken breeds, farm management, feed and feeding, and disease control. The users' completed satisfaction surveys, from a total of 48 respondents, demonstrated that the overall satisfaction score was 4.15, signifying native chicken farmers' satisfaction with the TNC mobile app in terms of functionality, aesthetics, and information quality.

1. Introduction

Thai native chicken rearing is favored by many smallholder farmers in Thailand and can be observed throughout the country. Although native chicken breeds have slow growth rates, low egg rates and less meat, they have various advantages over other breeds, including: disease resistance, heat tolerance, their adaptation to the tropical climate and their ability to scavenge for food. They are also not costly to raise, as the agricultural by-products commonly used for their feed are not expensive. Additionally, some consumers prefer the taste of native chicken meat to that of broiler chickens due to its unique taste and texture being more suitable for Thai traditional menus. Finally, native chicken meat is the healthier alternative in that it is low in fat and cholesterol. As a result, native chicken meat has a higher selling price than commercial broiler meat [1-3].

The agricultural industry is currently undergoing a fourth revolution, triggered by an exponential increase in the use of information and communication technologies (ICT) in agriculture [4-5]. Modern agricultural methods are being transformed on account of smart technologies, such as the Internet, Artificial Intelligence, sensors and robotics. The growing use of apps on mobile phone devices can be considered the most recent trend in information technology (IT) innovation and the number of mobile phone users in Thailand is continuously increasing, reaching 25.75 million, or approximately 40% of the population in 2018. This number is expected to reach 30.05 million by 2020 [6].

Mobile apps have the potential to connect farmers with agricultural information regarding weather, farm management, diseases, markets and other relevant issues [7]. Numerous free and paid-for apps are available via distribution platforms such as Play Store, Google Play and the App Store. However, there are currently few apps for farmers available for free. For example, in the livestock sector, apps developed for improving farm efficiency and helping farmers increase farm productivity can be divided into 5 groups: 1) Breeds and breeding-used to record breeding and identification information, e.g., iLivestock, Moocall Breed Manager and Mobile ID; 2) Feed and feeding-provide information on nutrition requirements and used for calculating feed intake of a herd or individual animals, e.g., InTouch Forage Budgeting and Feed Smart; 3) Farm management – used to record and keep track of the animal management process, e.g., Yagro, Herdwatch, FarmGRAZE, Body Condition Scoring and TNC farm manager; 4) Diseases-help farmers detect the onset of diseases or do preliminary diagnosis in the early stages and can recommend suitable treatment methods and controls, e.g., DD Check app, EMA-i and Veterinary Handbook; 5) Marketing-provide a variety of market information, e.g., AHDB Beef & Lamb Lite, CattleFax, Beef News and Markets [8-12].

Farmers in developing countries face several challenges, such as poor knowledge about ICT infrastructure and deficiencies in production information. Farmers can also face obstacles in understanding and accessing information technology, as they often find it too complicated. Other impediments may include lacking necessary equipment and having little or no infrastructure in the vicinity that supports access to information technology. Thus, insufficient personal media skills and inadequacies in the level of access to telecommunications infrastructure in rural areas are key challenges faced by Thai farmers. Smallholders require tools that are suitable for their farms, i.e., low-cost equipment, proper information, management strategies and dissemination of technology to agricultural farming areas [13].

The needs described above motivated the researchers to develop a mobile app aimed at disseminating information in order to improve smallholder farmers' knowledge and increase their access to new technology relevant to Thai native chicken farming. Therefore, the purposes of the present study were to: 1) investigate Thai farmers' socio-demographic information, farm characteristics and mobile phone usage patterns; 2) develop a Thai native chicken mobile app useful in small-scale farming; and 3) assess satisfaction of the app through surveys completed by Thai native chicken mobile app users.

2. Materials and methods

2.1 Socio-demographic information about Thai native chicken farmers, farm characteristics and mobile phone usage survey

A survey was conducted from November to December in 2018. The study sample included a total of 50 selected smallholder farmers. All respondents were individuals who were small-scale rural Thai native chicken producers and the focus of data collection was on their socio-demographic characteristics, farm characteristics and mobile phones usage. Regarding questionnaire design, survey questions covered the following topics: 1) Under socio-demographic characteristics: gender, age and education level; 2) Under farm characteristics: the farmer's use of Thai native chickens as a source of income, farming background and experience, selected rearing system, flock size per household and rearing purpose; 3) Under mobile phone usage: operating system in use, mobile phone ownership, purposes for using mobile phone, enabled Internet capacity and downloaded apps; and 4) Under mobile app content needs, respondents evaluated their need for content and information on diseases, feed and feeding, breeds, farm management and various other topics.

2.2 Mobile app development

App design must aim to transform the idea for an app into a workable system. The app design phase in the present study consisted of coding and graphical user interface (GUI) design using Android Studio Framework with Kotlin Language for mobile devices. Figure 1 illustrates the conceptual framework for the development of the TNC mobile app. The main functionalities of the system include data collection, e.g., farm name, location, rearing conditions, chicken ages, breeds and making basic calculations to facilitate improvements in native chicken

farming activities. For example, the app is able to calculate feed quantities, other factors related to feeding and factors relevant to management, vaccine programs and deworming programs. The app also makes recommendations to the user and provides important information and solutions to the most common problems they might encounter. For example, farmers can select from a list of diseases to access related information in the database and the mobile app will offer solutions, such as treatments and methods of prevention and control. Implementation of the mobile app among farmers can improve access to important information and the portable nature of the app can help farmers to stay well-informed about native chicken production, management methods, feed and feeding and disease prevention with ease and accuracy. The app database consists of information collected from various sources, such as publications by the Department of Livestock Development, electronic journals and books.
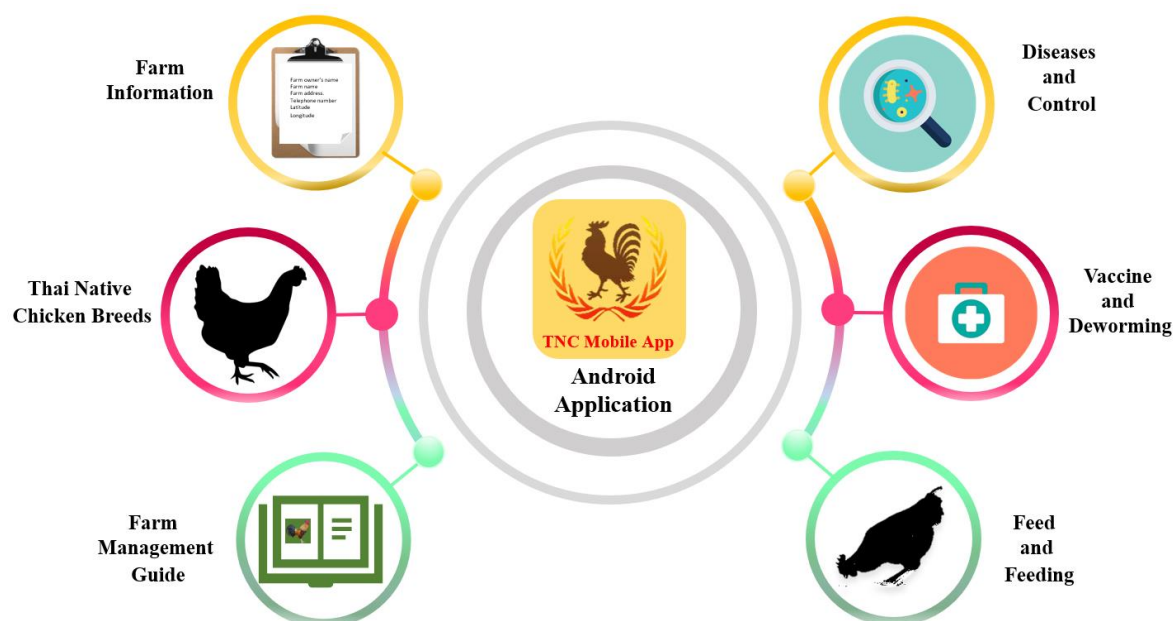

Figure 1 Conceptual framework for the TNC mobile app.

Testing and deployment of the TNC mobile app: Before bringing the system into operation, the researchers conducted a test run to detect any errors, bugs, or unfulfilled requirements. The test run was a significant phase to ensure that the system worked well and as required. After modifying the system in its entirety, a functional test plan was developed and the researchers and testers ran the program using a given set of test data and with the same administrative privileges that a native chicken farmer would have. After testing, the TNC app entered the implementation phase. Users were allowed to install the app on their mobile phones via an Android Application Package (APK). The app was finally deployed through its integration with Google Play Store, making it available to all native chicken farmers.

2.3 Measurement and statistical analyses

To identify mobile app user satisfaction levels, a questionnaire was prepared and distributed. Multiple-subject surveys were carried out using face-to-face interviews with a total of 48 users. All respondents were owners of an Android-based smartphone. User satisfaction with respect to use of the TNC app was evaluated for functionality (performance, ease of use, navigation and gestural design), aesthetics (graphics, layout and visual appeal) and information quality (content, usefulness, visual information and credibility). An overall satisfaction score was then given. User satisfaction was measured using a five-point Likert scale (1=very unsatisfied, 2=unsatisfied, 3=neutral, 4=satisfied and 5=very satisfied). Descriptive statistics were used for data analysis, including frequency, percentage and average. Intervals for the Likert scale scores were defined to delineate app users' satisfaction (mean 1.00-1.80=very unsatisfied, 1.81-2.60=unsatisfied, 2.61-3.40=neutral, 3.41-4.20=satisfied and 4.21-5.00=very satisfied).

3. Results and discussion

3.1 Socio-demographics, farm characteristics and mobile phone usage

As shown in Table 1, demographics, personal information and data about farm rearing conditions were collected from the study's farmer participants. The results revealed more males (84%) than females (16%) and the largest proportion of farmer participants was middle-aged, with an average respondent age of 52. The largest percentage of respondents (30%) was between 51-60 years of age. Regarding the respondents' education levels: 40% had attained a primary school education and 36% a high school education, 8% had attained a high vocational certificate, 4% a vocational certificate and 2% a bachelor's degree or higher. Ten percent of the respondents had received no formal education at all. In terms of their use of Thai native chickens as a source of income, most of the respondents raised chickens only to supplement their income (92%), with just 8% using chicken rearing as their main source of income. As per farming background, the majority (46%) of the respondents had 5 years or less of farming experience. Approximately 56% of the respondents had medium flock sizes (100-200 head of chicken), with the average flock size per household being 175.90±160.13 head and only 5% of the respondents had a large flock size (>200 head). Most farmers raised chickens using a semi-intensive rearing system (90%). Farmers' major purposes for raising native chickens were as follows: 34.06% were rearing native chickens mainly for home consumption; 31.16% in order to sell fighting cocks; 17.39% for the selling of parent stock; 15.94% for personal use in sports and gaming and 1.45% indicated other reasons.

Table 1 Socio-demographic and farming characteristics of Thai native chicken farmers (n=50).

Characteristic	Frequency	%	Characteristic	Frequency	%
Gender			Farming experience		
Male	42	84.00	≤5 years	23	46.00
Female	8	16.00	6-10 years	17	34.00
Age			>10 years	10	20.00
≤30 years	4	8.00	Rearing system		
31-40 years	9	18.00	Intensive	3	6.00
41-50 years	10	20.00	Semi-intensive	45	90.00
51-60 years	15	30.00	Extensive	2	4.00
>60 years	12	24.00	Flock size per household		
Education level			Small (≤100 head)	17	34.00
No formal education	5	10.00	Medium (100-200 head)	28	56.00
Primary school	20	40.00	Large (>200 head)	5	10.00
High school	18	36.00	Purpose of rearing		
Vocational certificate	2	4.00	Home consumption	47	34.06
High vocational certificate	4	8.00	Selling of fighting cocks	43	31.16
Bachelor's degree or higher	1	2.00	Parent stock	24	17.39
Thai native chicken rearing as income source			Sports and games	22	15.94
Main income	4	8.00	Other	2	1.45
Supplemental income	46	92.00			

As shown in Table 2, Android, rather than iOS, was the most widely used mobile phone operating system (96% vs. 4%). This is consistent with a 2018 Statista report on the worldwide market share for mobile phone operating systems, which identified Android as the most popular (88%) and iOS the least (accounting for only approximately 11.9% of all users worldwide). Thailand is no exception, with Android being far more popular and accounting for 76.37% of Thai users compared to the 23.43% that choose to use iOS [14]. About 60% of the farmers had had their mobile phones for more than five years. Their main purposes for using their mobile phones included making and receiving calls, entertainment, chatting, educational purposes and other (31.69%, 25.35%, 21.83%, 16.19% and 4.93%, respectively). In terms of Internet access capacity, 74% of the farmers were able to access the Internet through their phones. Websites that farmers often visited were: YouTube, Line, Facebook, Google and Instagram (36.89%, 23.77%, 21.31%, 16.39% and 1.64%, respectively). About 52% of the respondents had never downloaded a livestock app before, suggesting that farmers used their phone for entertainment more than for its educational features. Knowledge of this pattern in mobile phone usage was advantageous to the development of the app as an educational tool, as it led to the integration of VDO and infographic formats in order to relay information and agricultural knowledge in an attractive way. Many studies

have suggested that dissemination approaches using VDO or infographics as educational tools have the potential to enhance learning efficiency to a higher degree than those that solely use plain text [15-17].

Table 2 Mobile phone usage characteristics of respondents (n=50).

Characteristic	Frequency	%	Characteristic	Frequency	%
Mobile phone operating system			Internet access enabled		
Android	48	96.00	Yes	37	74.00
iOS	2	4.00	No	13	26.00
Mobile phone ownership			Which websites do you visit often on your mobile phone?		
<2 years	5	10.00	Facebook	26	21.31
2-5 years	15	30.00	Google	20	16.39
6-10 years	18	36.00	YouTube	45	36.89
>10 years	12	24.00	Line	29	23.77
Purposes of mobile phones use			Instagram	2	1.64
Making or receiving calls	45	31.69	Have you used any livestock apps on your mobile phone?		
Educational purposes	23	16.19	Yes	24	48.00
Entertainment	36	25.35	No	26	52.00
Chatting	31	21.83			
Other	7	4.93			

The questions most pertinent to the researchers in terms of the functionality of the app developed in this study were: Will the app's content meet the farmers' demands and will the app provide informative content that is interesting enough? In order to answer these questions, the farmers' mobile app content needs were surveyed. Findings from the survey are presented in Figure 2. As shown, content needs related to diseases, feed and feeding, farm management, breeds and other (34%, 30%, 18%, 12% and 6%, respectively). These responses were in line with results from other studies that have surveyed farmers' needs for agricultural knowledge content. Such studies have found a need for content on market information, financing, logistics, crops and livestock husbandry, irrigation, pests and diseases, weather, fertility management and other topics. [18-22].
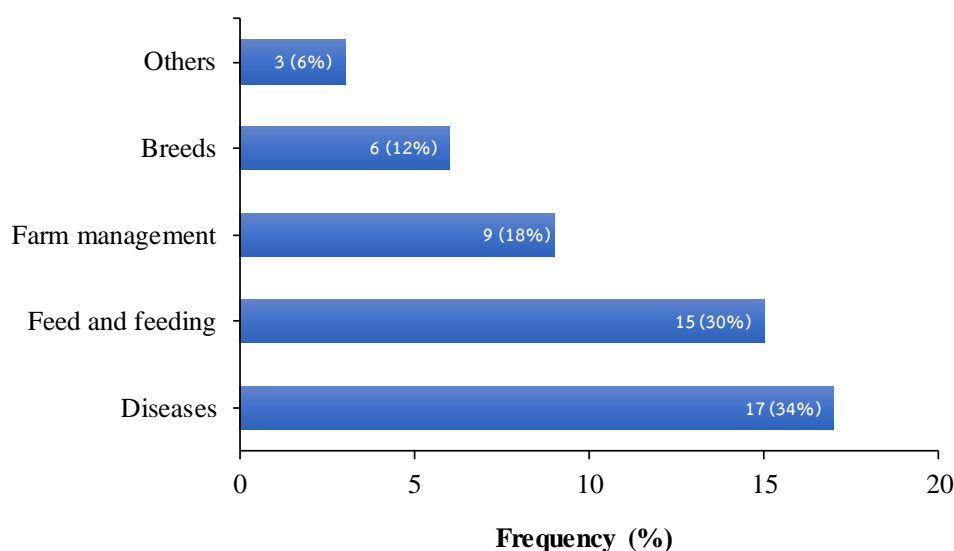

Figure 2 TNC App content needs for Thai native chicken app.

3.2 User interface of TNC mobile app

The researchers produced an online-offline Android-based app that has the capacity to serve as a learning tool for native chicken farmers in Thailand in order to improve their raising methods and productivity. The TNC app can be downloaded from Play Store or Google Play and employs the search terms "TNC mobile app." Figures 3-

5 show the user interface of the TNC mobile app. Figure 3 shows the splash screen that appears when the user opens the app on their mobile device. Figure 4 shows the homepage that appears when the user accesses the main page of the TNC app. The homepage displays various menu options to provide assistance in native chicken farming, such as "Thai native chicken breeds", "farm management guide", "feed and feeding" and "diseases and control." Figure 5 shows information about the common diseases that may be contracted by native chickens and suggests treatment and control methods. As previously mentioned, the app content was refined according to findings from the survey. Therefore, an infographic format was designed to make the content more attractive to learners than plain text. On the basis that the content was short, concise, refined and simple, the researchers believed that the knowledge presented in the app would be appropriate and adaptive for users [23].

Figure 3 Screenshot of TNC app splash screen.

Figure 4 TNC app home page.

Figure 5 Common diseases in native chickens.

3.3 User satisfaction survey

The participants recruited for the user satisfaction survey were in total 48 farmers, all of whom had smartphones with an Android operating system**.** Table 3 shows the satisfaction scores given by the respondents under the various criteria and in reference to user engagement with the developed mobile app**.** The user satisfaction survey was useful as both a preliminary evaluation of the potential of the app and as an indicator of how to improve its effectiveness and quality. The results showed that users were very satisfied with the aesthetics and information quality of the app, giving these categories average scores of 4.21 and 4.25, respectively. Users were satisfied with the app's functionality, which received an average score of 4.03. The overall satisfaction score was 4**.**15, indicating that users were satisfied overall with the TNC mobile app and implying that the respondents would be willing to try this new technology to help them with Thai native chicken production in the future**.**

Table 3 Summary of user satisfaction scores for TNC mobile app **(**n=48**)**.

Criterion category	Mean	SD	Evaluation
Functionality			
Performance	4.23	0.72	Very satisfied
Ease of use	3.98	1.04	Satisfied
Navigation	3.90	1.04	Satisfied
Gestural design	4.02	0.86	Satisfied
Average functionality score	4.03	0.92	Satisfied
Aesthetics			
Graphics	4.00	0.97	Satisfied
Layout	4.38	0.67	Very Satisfied
Visual appeal	4.25	0.91	Very satisfied
Average aesthetics score	4.21	0.85	Very satisfied
Information quality			
Content usefulness	4.46	0.71	Very satisfied
Visual information	4.15	0.95	Satisfied
Credibility	4.13	0.82	Satisfied
Average information score	4.25	0.83	Very satisfied
Overall satisfaction score	4.15	0.86	Satisfied

4. Conclusion

Mobile technology brings with it many advantages beyond making or receiving calls, including opening up educational opportunities through the dissemination of appropriate information to farmers. In order to meet the potential of mobile technology, this research has proposed a TNC mobile app that can provide information and guidance on good management practices. The app can help to improve production efficiency of farms and is suitable for Thai native chicken farmers, who can use it to search for information anywhere and anytime.

This paper described data collected from small-scale Thai native chicken farms, including socio-demographic data and farm and mobile phone usage characteristics. The information was used for the development of a mobile app that would be suitable as a learning tool for farmers. User satisfaction survey results showed an overall satisfaction score of 4.15, indicating that Thai native chicken farmers were satisfied with the TNC mobile app in terms of its functionality, aesthetics and information quality. Furthermore, the app was shown to be capable of providing comprehensive information and farming guidance to native chicken farmers, helping them to optimize productivity of their small-scale farm. However, farmers are still limited by a lack of digital technology skills and by poor Internet access. In terms of future studies, the researchers plan to develop the app to include market information functionality. This would increase smallholder farmers' access to marketing channels and disease outbreak alerts.

5. Acknowledgements

6. References

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