Development of a Traceability System for Organic Eggs: A Case Study of Thankhun Organic Farm, Nakhon Pathom Province

Pawarisa Em-ot[1] and Sirion Son-ong[2]*

[1,2]College of Logistics and Supply Chain, Suan Sunandha Rajabhat University, Thailand

*Corresponding author

E-Mail: [1]pawarisa.em@ssru.ac.th, [2]sirion.so@ssru.ac.th

Abstract.

This study aimed to develop and evaluate a QR code–based traceability system for organic eggs at Thankhun Organic Farm in Nakhon Pathom Province. An applied research design was employed, combining qualitative research and descriptive evaluation methods. Semi-structured interviews were conducted with farm executives and staff to examine organic egg production practices, traceability requirements, and marketing perspectives. The qualitative findings were used to design a website-based traceability system linked to QR codes, allowing consumers to access verifiable information on product origin, production processes, certification standards, and animal welfare practices. User satisfaction with the traceability system was evaluated using a structured questionnaire administered to 30 users, and the data were analyzed using descriptive statistics. The results indicated a high level of overall satisfaction, particularly in terms of ease of use, information quality, and confidence in organic egg quality. The study demonstrates that QR code–based traceability systems can enhance transparency, consumer trust, and market competitiveness for small-scale organic farms, while supporting sustainable and ethical food production.

Keywords: Organic eggs; Traceability system; QR code; Consumer satisfaction; Organic farming

1. Introduction

In recent years, the global food industry has undergone a structural transformation driven by increasing consumer health consciousness and environmental awareness. These changes have led to a continuous rise in demand for organic food products, particularly organic eggs, which are widely perceived as a safe source of protein with superior nutritional value and minimal environmental impact. However, organic eggs fall into the category of credence goods, meaning that consumers are unable to verify product quality, organic authenticity, or animal welfare standards through visual inspection or consumption alone. This characteristic results in information asymmetry between producers and consumers and represents a significant barrier to building trust in the organic food market (Darby & Karni, 1973; Hobbs, 2019). Numerous studies have emphasized that food traceability systems play a crucial role in reducing food safety risks, enhancing supply chain transparency, and strengthening consumer trust, particularly when digital technologies such as Quick Response (QR) codes are employed. QR code-based traceability enables consumers to instantly access information regarding product origin, production processes, and certification standards, thereby supporting informed

purchasing decisions and increasing willingness to pay for premium organic attributes (Aung & Chang, 2014; Wongprawmas & Canavari, 2017; Zhang et al., 2023). In the context of Thailand, although demand for safe and organic agricultural products has grown substantially, the market remains fragmented with varying standards and inconsistent verification mechanisms. Consequently, consumers continue to question the credibility of organic labels, underscoring the importance of developing traceability systems that are appropriate for small- and medium-sized organic farms operating within the local context (Nuttavuthisit & Thøgersen, 2017).

Despite widespread recognition of traceability systems as a critical mechanism for improving food safety and supply chain transparency, the implementation of such systems among small-scale organic producers in Thailand remains limited. Small and medium-sized farms often face financial, technological, and human resource constraints, preventing them from adopting advanced traceability technologies such as blockchain or radio-frequency identification (RFID) systems (Bosona & Gebresenbet, 2013; Qian et al., 2020). Moreover, the organic food market continues to face challenges related to "greenwashing," where products claim organic or animal welfare attributes without reliable verification, thereby eroding consumer trust—particularly for high-value claims such as antibiotic-free production and ethical animal treatment (Darnall et al., 2018). A review of existing literature reveals that most studies focus either on the technical architecture of traceability systems or on general consumer acceptance of traceability information. However, limited empirical research has examined the development of low-cost, user-friendly traceability systems tailored specifically to small-scale organic farms within localized contexts. Furthermore, few studies integrate digital logistics solutions with the communication of social enterprise values, such as circular economy principles and shared value creation, through QR code-based interfaces that directly connect producers and consumers (Pantano et al., 2021). Consequently, a significant research gap exists regarding the design of farm-specific traceability systems and the evaluation of their impact on consumer satisfaction at the individual farm-brand level.

Based on the aforementioned significance, the researcher therefore aims to 1) study and systematically present comprehensive information about Thankhun Organic Farm, 2) develop and implement a QR code–based traceability system for organic eggs at Thankhun Organic Farm, and 3) evaluate user satisfaction with the QR code–based traceability system. This study seeks to design a system that transparently presents information regarding product origin, production processes, certification standards, and animal welfare practices while evaluating consumer satisfaction in terms of system usability and information quality. The expected outcomes of this research include enhancing the credibility and economic value of the case study farm and providing a practical traceability model applicable to other organic farms and social enterprises in Thailand. Ultimately, the findings are anticipated to contribute to the development of sustainable food logistics systems and to strengthen trust-based relationships between ethical producers and health-conscious consumers in the long term.

1.1 Objectives

This study aims to:

1. To examine and systematically present the organic egg production practices and farm-specific information of Thankhun Organic Farm, including production processes, organic certification standards, and animal welfare practices, as a foundation for traceability system development.

2. To design and develop a QR code–based traceability system for organic eggs at Thankhun Organic Farm, enabling consumers to access verifiable information related to product origin, production processes, certification, and farm practices through a website-based platform.

3. To evaluate user satisfaction with the QR code–based traceability system**,** focusing on ease of use, quality of information, user experience, and consumer confidence in the quality of organic eggs.

2. Literature Reviews

Existing research consistently emphasizes that product quality, transparency, and traceability are critical determinants of consumer behavior in the organic food sector. Bang-on Sawadeesuk et al. (2023) demonstrated that core product attributes—particularly nutritional value, certification labels, and packaging—together with price and distribution channels, significantly influence consumers' purchasing decisions for organic agricultural products. Their findings further indicate that consumers with higher levels of knowledge about organic agriculture and stronger environmental awareness exhibit greater repurchase intentions, underscoring the importance of cognitive and attitudinal factors in sustaining long-term demand for organic products.

Building upon the need for credible and accessible information, several studies have highlighted the role of digital traceability systems in enhancing transparency and trust across organic food supply chains. Warinsittikul, Lomlai, and Pantha (2024) reported that a QR-based traceability system integrated with Participatory Guarantee System (PGS) certification improved data accuracy, reduced inspection time, and facilitated information sharing among stakeholders. The system received strong approval from farmers and relevant actors, suggesting its effectiveness in strengthening value chain governance and competitiveness in the organic sector. Similarly, Guanqi and Husnain (2022) found that transparent and reliable traceability systems significantly enhance perceptions of food safety and consumer trust, which in turn increase overall satisfaction and indirectly promote brand loyalty and repurchase behavior. These findings suggest that traceability functions not only as a quality assurance mechanism but also as a strategic tool for relationship building between producers and consumers.

From a logistics and operational perspective, process clarity has been identified as a foundational element for effective traceability systems. Phunlarp et al. (2025) emphasized that clearly defined and consistently implemented procedures enable accurate recording, tracking, and verification of information throughout the supply chain. Their study demonstrated that process clarity was the strongest predictor of reverse logistics efficiency, as well-structured workflows and internal monitoring systems reduce errors and enhance the ability to trace activities backward. This insight highlights the importance of integrating digital traceability technologies with systematic operational processes to ensure data reliability and system effectiveness.

Focusing specifically on organic eggs, Medina-Cruz et al. (2024) reviewed the nutritional characteristics, production conditions, and market challenges associated with organic chicken egg production. The review revealed that organic eggs often contain higher levels of beneficial nutrients and are widely perceived by consumers as safer and more environmentally sustainable than conventional eggs. However, the authors noted that high production costs and structural market constraints limit broader accessibility, positioning organic eggs primarily within niche markets targeting health-conscious and sustainability-oriented consumers. Complementing

these findings, Caffa et al. (2025) emphasized that eggs play an essential role in healthy and sustainable diets due to their nutritional density and ecological efficiency, particularly when produced under organic systems. Importantly, the study highlighted that clear communication of production methods—supported by digital traceability technologies such as QR codes—significantly enhances consumer trust and acceptance of organic eggs.

Overall, the existing body of literature suggests that the successful development of the organic food market depends on the integration of credible information, ease of access, and effective digital traceability systems. By combining transparent production practices with user-friendly technological solutions, organic producers can strengthen consumer confidence, differentiate their products, and support sustainable market growth. Nevertheless, while prior studies provide valuable insights into traceability systems and consumer behavior, there remains a need for empirical research that examines localized, farm-specific implementations of QR code–based traceability systems and their implications for consumer satisfaction—particularly within small-scale organic farming contexts.

3. Research Methodology

This study adopted an applied research design with a mixed qualitative–descriptive evaluation approach, structured in accordance with the research objectives. The first objective, which aimed to study and systematically present comprehensive information about Thankhun Organic Farm, was addressed through a qualitative research method. Semi-structured interviews were conducted with key informants, including farm executives and staff members who were directly involved in organic egg production and farm operations. The interviews focused on gathering in-depth information regarding farm background, organic egg production processes, organic certification standards, animal welfare practices, and current challenges related to transparency and traceability. This qualitative approach enabled the researchers to obtain contextual and operational insights necessary for accurately representing farm-specific information within the traceability system.

To support the qualitative data collection, a semi-structured interview instrument was developed following a systematic process. First, an interview framework was designed and organized into three main topics: (1) organic egg production and farm practices, (2) the use of QR codes and website-based traceability systems, and (3) customer behavior and marketing perspectives related to organic eggs. Second, the interview questions were reviewed and tested for content validity to ensure clarity, relevance, and alignment with the research objectives, and revisions were made accordingly. Third, the revised interview guide was submitted to the thesis advisor for further review and refinement before data collection. The interview data were analyzed using content analysis to synthesize key themes and operational requirements for the development of the traceability system.

The second research objective, which focused on developing and implementing a QR code–based traceability system for organic eggs, was addressed by integrating findings from the qualitative interviews into the system design process. Based on the extracted information, a website-based traceability system was developed to present verifiable data related to product origin, production processes, organic certification, and farm practices. QR codes were generated and linked to the system, allowing users to access traceability information by scanning the code on organic egg packaging. This development-oriented approach ensured that

the traceability system was tailored specifically to the operational context and information needs of Thankhun Organic Farm.

The third research objective, which aimed to evaluate user satisfaction with the QR code–based traceability system, employed a descriptive survey method. A structured questionnaire was developed and administered to 30 users of the Thankhun Organic Farm website in Nakhon Pathom Province. The questionnaire consisted of two sections: (1) general information about the respondents and (2) satisfaction assessment of the organic egg traceability system. The satisfaction assessment covered six key aspects: ease of use, quality of information, design and user experience of the website-based traceability system, confidence in the quality of organic eggs, knowledge and understanding of organic eggs, and overall satisfaction with the traceability system. The collected data were analyzed using descriptive statistics, including frequency, percentage, mean, and standard deviation, to evaluate user satisfaction and support the interpretation of research findings.

4. Results

4.1 To study and systematically present comprehensive information about Thankhun Organic Farm

The findings related to the first research objective were derived from qualitative data collected through semi-structured interviews with executives and workers at Thankhun Organic Farm. The results indicate that the farm's organic egg production possesses several distinctive characteristics that differentiate it from conventional egg production. Interviewees emphasized that the farm adopts free-range rearing practices and uses organic feed that is free from hormone enhancers and antibiotics. These practices were consistently highlighted as key contributors to improved egg quality, higher nutritional value, and enhanced food safety. In addition, the farm strictly adheres to organic production standards and has received certification from relevant authorities, with regular inspections conducted to monitor chicken health, feed quality, and overall production conditions. These measures ensure that the organic eggs produced meet safety and quality requirements.

4.2 To develop and implement a QR code–based traceability system for organic egg

The results related to the second research objective indicate that the implementation of a QR code–based traceability system is a key strategy for enhancing transparency and consumer confidence at Thankhun Organic Farm. Interview findings revealed that QR codes and a website-based system were designed to provide consumers with comprehensive traceability information, including egg collection dates, chicken coop details, product origin, and nutritional information. In addition to traceability, the system serves as a communication and promotional tool by allowing the farm to present images and videos of production processes, thereby reinforcing credibility and demonstrating compliance with organic standards.

However, the qualitative findings also identified several challenges associated with the implementation of the QR code traceability system. These include potential barriers for customer groups with limited technological familiarity, as well as costs related to system development and ongoing maintenance. Despite these challenges, the farm perceives the traceability system as a valuable marketing instrument, particularly for health-conscious consumers who place a high value on food origin transparency and ethical production. The interviews further indicated that consumers prefer a simple and user-friendly system that

enables immediate access to information without complex steps. Overall, the results demonstrate that the QR code–based traceability system has strong potential to enhance product differentiation, support marketing activities, and increase consumer trust, provided that system usability and long-term maintenance are carefully managed.

The findings of this study demonstrate that the QR code–based traceability system effectively enhances transparency and consumer confidence by providing accessible and verifiable information on organic egg production. This result is consistent with Warinsittikul et al. (2024), who found that QR-based traceability systems improve data accuracy, reduce inspection time, and strengthen transparency across the organic value chain. The present study also supports the findings of Guanqi and Husnain (2022), who emphasized that transparent traceability systems reinforce perceptions of food safety and trust. Furthermore, the integration of farm images, production details, and certification information aligns with Caffa et al. (2025), who argued that digital traceability tools are essential for communicating organic production values and increasing market acceptance. Overall, the findings suggest that QR code technology serves not only as a logistics tool but also as a strategic mechanism for value communication and brand differentiation in the organic egg market.

4.3 To evaluate user satisfaction with the QR code–based traceability system

The evaluation of user satisfaction with the QR code–based traceability system was conducted using a structured questionnaire administered to a sample of 30 users of the Thankhun Organic Farm traceability website in Nakhon Pathom Province. Descriptive analysis of the respondents' general characteristics indicated that the majority of participants were female (60.0%), while male respondents accounted for 40.0%. In terms of age, most respondents were between 31–40 years old (36.7%), followed by those aged 41–50 years (30.0%), 21–30 years (20.0%), and 51 years and above (13.3%). Regarding experience related to farming or agricultural activities, the respondents showed varied backgrounds. Approximately 33.3% reported having less than 5 years of experience related to farming or agricultural involvement, 30.0% had 5–10 years of experience, 23.3% had 11–15 years of experience, and 13.4% reported more than 15 years of experience. This distribution suggests that the evaluation included users with diverse levels of familiarity with agricultural practices, which is beneficial for assessing the usability and clarity of the traceability system for different user groups.

Table 1*:* Satisfaction of Users using the QR code–based traceability system

Aspect of Satisfaction	Mean	SD	Interpretation
Ease of Use	4.03	0.72	High
Quality of Information	3.93	0.78	High
Design and User Experience of the Traceability System on the Website	3.87	0.82	High
Confidence in the Quality of Organic Eggs	4.03	0.89	High
Information about Knowledge and Understanding of Organic Eggs	3.83	0.83	High
Overall Satisfaction	3.97	0.67	High
Overall	3.94	0.66	High

The results of the satisfaction evaluation indicate that users expressed a high level of satisfaction with the QR code–based traceability system overall ($\bar{x}$ = 3.94, S.D. = 0.66). Among the evaluated aspects, Ease of Use and Confidence in the Quality of Organic Eggs received the highest mean scores ($\bar{x}$ = 4.03), suggesting that users found the system easy to navigate and

perceived that the traceability information enhanced their trust in the quality of organic eggs. The Quality of Information and Overall Satisfaction also received high ratings, reflecting that the content provided through the system was clear, useful, and relevant to users' information needs. Although Design and User Experience and Information about Knowledge and Understanding of Organic Eggs showed slightly lower mean scores compared to other aspects, both remained at a high satisfaction level. This suggests that while the system design and educational content were generally well received, there remains potential for further enhancement, such as improving visual presentation or expanding informational content. Overall, the findings demonstrate that the QR code–based traceability system effectively supports transparency, user understanding, and consumer confidence, aligning with the objectives of the study. The results indicate a high level of user satisfaction with the QR code–based traceability system, particularly regarding ease of use and increased confidence in organic egg quality. These findings align with Bang-on Sawadeesuk et al. (2023), who reported that product attributes, certification information, and consumer knowledge significantly influence purchasing decisions and repurchase intentions for organic products. The positive satisfaction outcomes also support Guanqi and Husnain (2022), who found that reliable traceability systems enhance consumer trust, satisfaction, and loyalty. Moreover, the ease of accessing information through QR codes reflects the importance of process clarity and structured information flow, as highlighted by Phunlarp et al. (2025) in logistics and tracking systems. Collectively, these findings suggest that user-friendly traceability systems can effectively enhance consumer understanding, trust, and overall satisfaction with organic food products.

5. Conclusion

This study provides significant practical and academic benefits by demonstrating how a QR code–based traceability system can be effectively developed and applied within a small-scale organic egg farm context. The findings highlight that integrating verified farm information, production processes, and organic standards into a digital traceability platform enhances transparency, strengthens consumer trust, and supports informed purchasing decisions. From a practical perspective, the developed system offers Thankhun Organic Farm a low-cost and user-friendly technological tool to communicate product quality, animal welfare practices, and certification credibility, thereby increasing brand differentiation and market competitiveness. The positive user satisfaction results further indicate that such systems can improve consumer confidence and understanding of organic eggs, which is essential for sustaining long-term demand in health-conscious markets. From an academic standpoint, this research contributes empirical evidence to the limited body of literature on localized, farm-specific traceability systems tailored for small and medium-sized agricultural enterprises. By linking digital traceability with consumer satisfaction outcomes, the study extends existing knowledge on how transparency mechanisms function as both logistics tools and strategic marketing instruments. Moreover, the research provides a practical prototype that can be adapted by other organic farms and social enterprises in Thailand, supporting sustainable food systems, ethical production, and trust-based producer–consumer relationships in the organic agriculture sector.

References

Aung, M. M., & Chang, Y. S. (2014). Traceability in a food supply chain: Safety and quality perspectives. *Food Control, 39*, 172–184.

Bang-on Sawadeesuk, B., Sawadeesuk, K., Phasuk, S., Rattanasanguanwong, K., & Pruengsawanon, P. (2023). Factors influencing consumer purchasing decisions for organic agricultural products in Phayao Province. *Chiang Rai Rajabhat Journal of Management*, *18*(2), 203–216.

Bang-on, S., Sawadeesuk, B., Phasuk, S., Rattanasanguanwong, K., & Pruengsawanon, P. (2023). Factors influencing consumer purchasing decisions for organic agricultural products in Phayao Province. *Chiang Rai Rajabhat Management Journal*, *18*(2), 203–216.

Bosona, T., & Gebresenbet, G. (2013). Food traceability as an integral part of logistics management. *Food Control*, *33*(1), 32–48.

Caffa, I., Spagnolo, P., Righetti, C., & Soldi, S. (2025). Nutritional aspects of eggs for healthy and sustainable consumption: A narrative review. *Food Science & Nutrition*, *13*(1), e70285.

Caffa, I., Spagnolo, P., Righetti, C., Soldi, S., & Et al. (2025). Nutritional aspects of eggs for healthy and sustainable consumption: A narrative review. *Food Science & Nutrition*, *13*(1), e70285.

Darby, M. R., & Karni, E. (1973). Free competition and the optimal amount of fraud. *Journal of Law and Economics*, *16*(1), 67–88.

Darnall, N., Ji, H., & Vázquez-Brust, D. A. (2018). Third-party certification, sponsorship, and consumers' ecolabel use. *Journal of Business Ethics*, *150*(4), 953–969.

Guanqi, Z., & Husnain, M. (2022). Assessing the role of organic food supply chain traceability on food safety and consumer wellbeing: A mediated-moderation investigation. *Frontiers in Psychology*, *13*, 1073376.

Hobbs, J. E. (2019). Information asymmetry and the role of traceability systems. *Agribusiness*, *35*(1), 1–13.

Nuttavuthisit, K., & Thøgersen, J. (2017). The importance of consumer trust for the emergence of a market for organic food: The case of Thailand. *Food Quality and Preference*, *57*, 134–145.

Medina-Cruz, M. F., Zárate-Contreras, D., Pérez-Ruiz, R. V., Aguilar-Toalá, J. E., Rosas-Espejel, M., & Cruz-Monterrosa, R. G. (2024). Nutritional aspects, production and viability in the market of organic chicken eggs: A review. *Food Chemistry Advances*, *4*, 100595.

Pantano, E., Pizzi, G., Scarpi, D., & Dennis, C. (2021). Competing during a pandemic? Retailers' ups and downs during the COVID-19 outbreak. *Journal of Business Research*, *116*, 209–213.

Phunlarp, U., Chaitorn, T., Boonmalert, W., Phoothong, B., & Jaiyen, W. (2026). Factors Affecting the Efficiency of Reverse Logistics in E-commerce Warehouses in Nakhon Pathom Province. *International Journal of Sociologies and Anthropologies Science Reviews*, *6*(2), 217-230.

Qian, J., Ruiz-Garcia, L., Fan, B., et al. (2020). Food traceability system from governmental, industry, and consumer perspectives. *Trends in Food Science & Technology*, *99*, 402–412.

Warinsittikul, P., Lomlai, P., & Pantha, J. (2024). Application of product traceability systems and PGS organic certification to enhance the value chain of organic farming networks in Ubon Ratchathani Province. *Journal of Industrial Technology Surindra Rajabhat University*, *9*(2), 15–28.

Warinsittikul, P., Lomlai, P., & Pantha, J. (2024). Application of product traceability systems and PGS organic certification to enhance the value chain of organic farming networks in Ubon Ratchathani Province. *Journal of Industrial Technology Surindra Rajabhat University*, *9*(2), 15–28.

Wongprawmas, R., & Canavari, M. (2017). Consumers' willingness-to-pay for food safety labels in an emerging market. *Food Policy*, *69*, 25–34.

Zhang, G., & Husnain, M. (2022). Assessing the role of organic food supply chain traceability on food safety and consumer wellbeing: A mediated–moderation investigation. *Frontiers in Psychology*, *13*, 1073376.