DEVELOPMENT OF AN INFORMATION SYSTEM FOR UPGRADING POMELO ORCHARDS TO MEET GEOGRAPHICAL INDICATION STANDARDS IN NAKHON PATHOM PROVINCE

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ระบบสารสนเทศยกระดับสวนส้มโอสู่มาตรฐานสิ่งบ่งชี้ทางภูมิศาสตร์ จังหวัดนครปฐม

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ABSTRACT

The objective of this research is to develop an information system for recording and storing data in a digital format. The system is designed to simplify documentation processes and enhance preparedness for applications related to geographical indication registration. It comprises three core functions: data entry, storage, and display. The findings of this study indicate that if local farmers receive systematic support, particularly in areas such as technology adoption and structured data integration, their agricultural competitiveness can be significantly improved. Such progress would enable them to meet internationally recognized standards.

บทคัดย่อ

การวิจัยนี้มีวัตถุประสงค์เพื่อการพัฒนาระบบสารสนเทศสำหรับการบันทึกและจัดเก็บข้อมูลในรูปแบบดิจิทัล ช่วยลดความซับซ้อนของกระบวนการทางเอกสาร และส่งเสริมความพร้อมในการยื่นขอขึ้นทะเบียนสิ่งบ่งชี้ทางภูมิศาสตร์ ระบบประกอบด้วย การบันทึก การจัดเก็บ และการแสดงผล โดยผลการศึกษานี้ชี้ให้เห็นว่า หากเกษตรกรท้องถิ่นได้รับการสนับสนุนอย่างเป็นระบบ โดยเฉพาะด้านเทคโนโลยีและการบูรณาการข้อมูลอย่างเป็นระบบ จะสามารถยกระดับความสามารถในการแข่งขันของภาคการเกษตรได้ด้วยมาตรฐานที่ได้รับการยอมรับในระดับสากล

INTRODUCTION

Geographical Indication (GI) is a form of intellectual property protection that originated in 19th-century French legislation. It gained international recognition through agreements such as the Paris Convention (1883) and the Madrid Agreement (1891), and was later incorporated into the WTO's TRIPS Agreement in 1995 (*O'Connor, 2004; WIPO, 2020; Josling, 2006*). Thailand established its GI system in 2003 and enhanced its legal framework in 2016 to align with global standards (Department of Intellectual Property, 2019). GI standards provide significant commercial benefits, increasing product value by approximately 15–25 percent, and serve as a powerful marketing tool in high-end export markets where quality and authenticity are highly valued (*Bramley & Kirsten, 2007; Teuber, 2011*). Additionally, GIs foster consumer trust, safeguard against counterfeiting, and promote the preservation of local knowledge and cultural heritage (*Nakwachara, 2021*).

Thailand, as an agricultural country rich in natural resources, benefits from GIs by leveraging distinctive attributes and indigenous knowledge to enhance value across the agricultural supply chain (*Department of Intellectual Property, 2019*). Currently, 111 GI products from 71 provinces are registered, including the renowned Nakhon Chai Si Pomelo, which strengthens the credibility and global image of Thai GI products (*Department of Intellectual Property, 2020*). Nakhon Pathom Province is a key area for pomelo cultivation, with popular varieties such as Khao Namphueng, Thong Dee, and Khao Tangkwa (*Nakhon Pathom Provincial Office, 2021*). While pomelo production has been increasing in response to growing domestic and international demand, the documentation and procedural requirements for GI certification remain complex and burdensome for farmers (*Nakhon Pathom Provincial Office, 2021*).

This study addresses the challenge of complex GI certification procedures by developing an information system to support data recording for pomelo growers in Nakhon Pathom Province. The research seeks to streamline the application process, enable more efficient data management, and encourage broader participation in GI certification among pomelo producers. It is anticipated that integrating technology into agriculture will enhance farmers' capabilities and competitiveness, thereby creating sustainable value throughout the agricultural product value chain.

MATERIALS AND METHODS

The research methodology consisted of population and sample selection, the design and development of the information system, and data analysis. The objective was to ensure the accuracy, completeness, and consistency of data relevant to the GI registration process for pomelo orchards, thereby increasing the likelihood of certification and authorization for farmers to use the GI symbol.

Population and Sample

A non-probability sampling method utilizing voluntary participation was employed. The sample comprised three groups:

- Fifteen (15) pomelo farmers who provided primary data regarding problems and needs.
- Fifteen (15) pomelo farmers with experience in the GI registration process for Nakhon Chai Si Pomelo who had already obtained certification.
- Ten (10) experts specializing in the registration of Geographical Indication (GI) products.

Design and development of the information system

The research team focused on designing an information system to support the upgrading of pomelo orchards in Nakhon Pathom Province to meet GI standards. The system was designed to ensure accuracy, completeness, and consistency of data related to the GI registration process. The aim was to increase the likelihood of certification and authorization for farmers to use the GI symbol. The development process was structured into defined phases, as illustrated in Fig. 1.

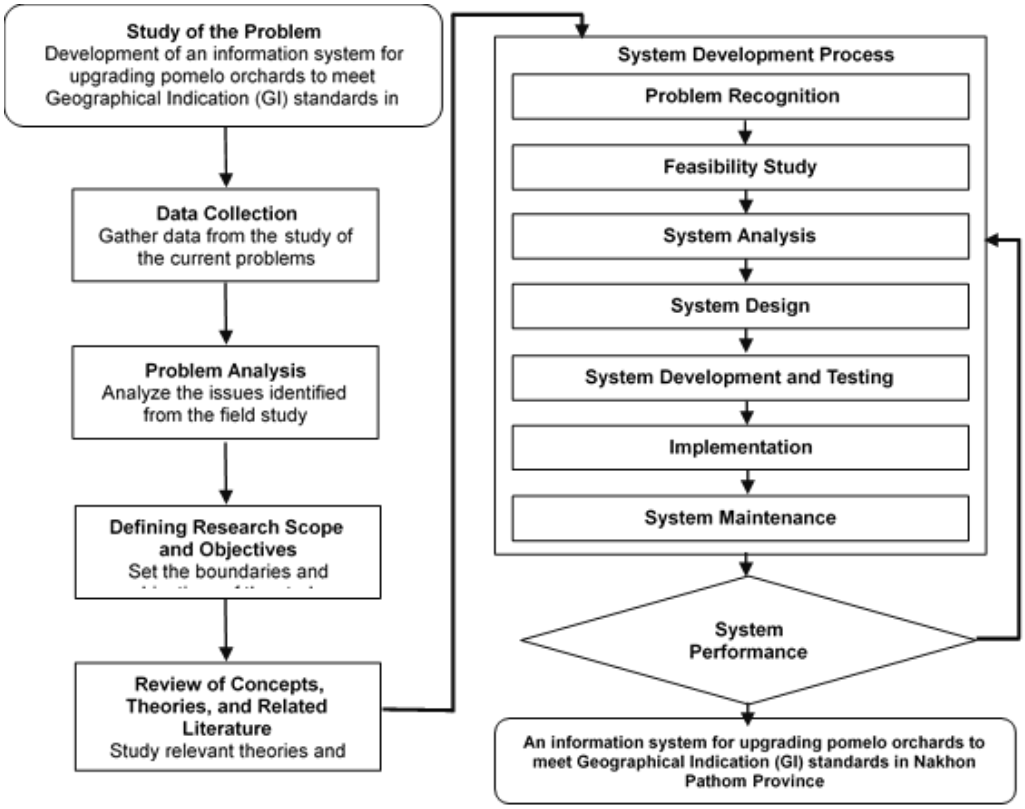

Fig. 1 - Research implementation process

The research team developed the system using the PHP programming language for application development and MySQL as the database management system for data storage. The design and implementation were guided by the System Development Life Cycle (SDLC) framework, drawing on theoretical models presented by *Kendall & Kendall (2011)* and *Whitten, Bentley, & Dittman (2001).* This structured approach encompassed the phases of analysis, design, implementation, testing, and maintenance, as illustrated in Fig. 2.

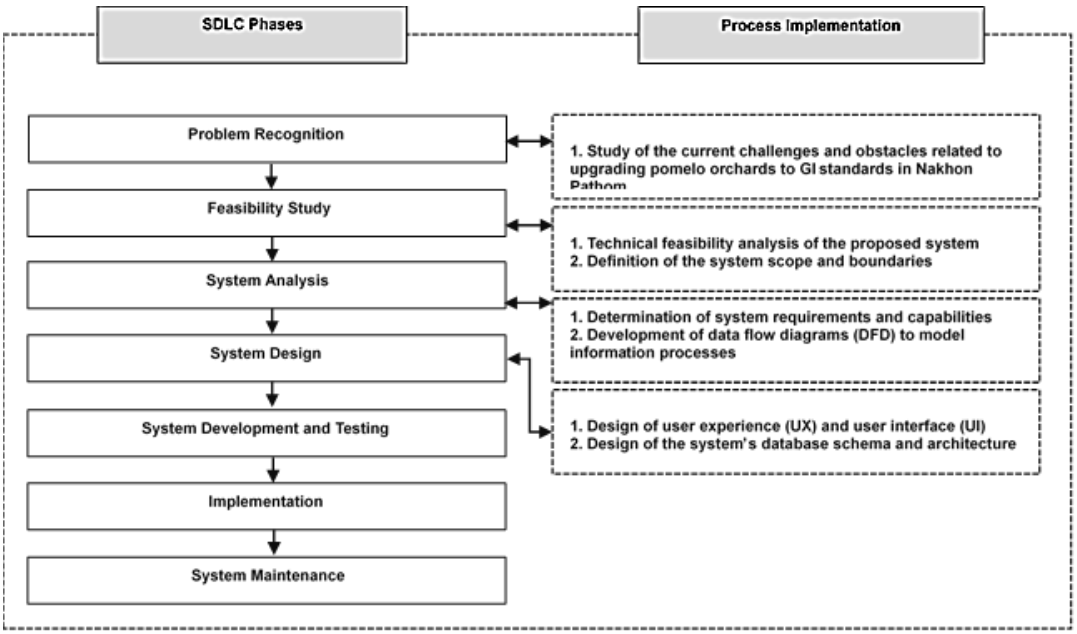

Fig. 2 - System development process

Programming

The Geographical Indications (GI) information management system was developed using PHP with a MySQL database on a LAMP architecture. The ArchitectUI Pro 2.0 framework and template were employed to design the user interface (UI) and user experience (UX), ensuring accessibility for all user groups, particularly elderly users. The system supports functionalities ranging from data entry through online forms, validation and storage in the database, to data presentation via dashboards and DataTables with search and export features for PDF and Excel files. During the development process, program code was implemented to support three key functions: data entry, data presentation for practical use, and secure data storage in the database (as illustrated in Fig. 3). All components were designed with a strong emphasis on both system security and user convenience.

a)

b)

```
// บันทึกข้อมูลลงฐานข้อมูล
$stmt = $pdo->prepare(query: "
    INSERT INTO gi_quality_checklist (
        id_request, id_card, prefix, customPrefix, fullname, houseNo, subDistrict,
        district, province, phone,
        1_gps, 2_productList, 2_variety, 2_shape, 2_flesh, 2_taste,
        3_sourceCriteria, 3_sourceLocation, 4_prepare, 4_plant, 4_care, 4_harvest,
        5_postHarvestPractices, 5_storageHygiene, 5_giSeparation,
        6_marketType, 6_domesticStem, 6_domesticPadding, 6_domesticArrangement,
        6_internationalStem, 6_internationalPadding, 6_internationalArrangement, 6_gap,
        7_registered, 7_marketType7, 7_domesticRegistered, 7_gap7
    ) VALUES (?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?)
");
// สร้าง id_request
$current_date = date(format: 'Ymd'); // YYYYMMDD
$stmt_id_request = $pdo->prepare(query: "SELECT id_request FROM gi_quality_checklist WHERE id_request LIKE ? ORDER BY id DESC LIMIT 1");
$stmt_id_request->execute(params: ["REQ{$current_date}%"]);
$last_request = $stmt_id_request->fetchColumn();

if ($last_request) {
    $last_number = (int) substr(string: $last_request, offset: -3); // ดึงตัวเลข 3 หลักสุดท้าย
    $next_number = str_pad(string: $last_number + 1, length: 3, pad_string: '0', pad_type: STR_PAD_LEFT); // เพิ่มเลขลำดับ
} else {
    $next_number = '001'; // เริ่มต้นที่ 001
}

$id_request = "REQ{$current_date}{$next_number}"; // สร้างรหัสคำขอ
```

C)

Fig. 3 - Components of the program

(a) Data entry, (b) Data presentation, (c) Data storage in the database.

Data Analysis

The analysis of the information system's performance in supporting the enhancement of pomelo farms to meet the Geographical Indication (GI) standard in Nakhon Pathom Province was conducted across five aspects:

1. Functional Requirements,
2. Functional Capability,
3. Usability,
4. Performance, and
5. Data Security.

The analysis was divided into two parts: (1) evaluation of system performance by domain experts, and (2) assessment of user satisfaction by sample users. Descriptive statistics—mean and standard deviation (SD)—were employed to analyze and interpret the data. The results were presented in tables along with narrative descriptions based on the statistical values.

A 5-point rating scale questionnaire was used as the assessment tool, with the following criteria:

5 = highest performance or most satisfied
4 = high performance or very satisfied
3 = moderate performance or moderately satisfied
2 = low performance or less satisfied
1 = lowest performance or least satisfied

The interpretation of mean scores was categorized into five levels:

4.50 – 5.00 = very high performance or very high satisfaction
3.50 – 4.49 = high performance or high satisfaction
2.50 – 3.49 = moderate performance or moderate satisfaction
1.50 – 2.49 = low performance or low satisfaction
1.00 – 1.49 = very low performance or very low satisfaction

Interpretation of the standard deviation (SD) values was as follows:

1.50 or higher = low consistency among respondents
1.01 – 1.50 = moderate consistency
0.00 – 1.00 = high consistency

RESULTS

This section presents the findings from the development and evaluation of the information system designed to support the elevation of pomelo farms in Nakhon Pathom Province to Geographical Indication (GI) standards.

1. Development of the Information System

The information system, a web-based platform registered under the domain https://gi-pomelo.npru.ac.th/ , was successfully developed. It consists of five main modules:

- Personal Information
- Quality Assessment Items
- Authorization Requests
- Summary Reports
- Password Change

The system is compatible with both web browsers and smartphones, enabling users to manage data and generate reports directly within the platform.

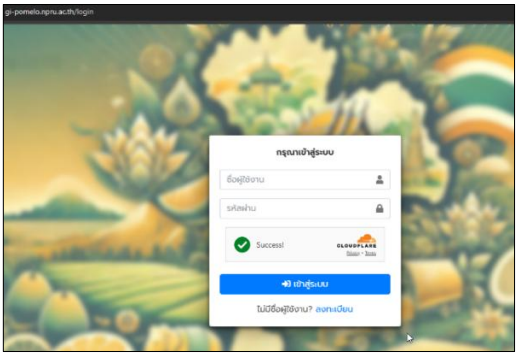

Fig. 4 - System login interface

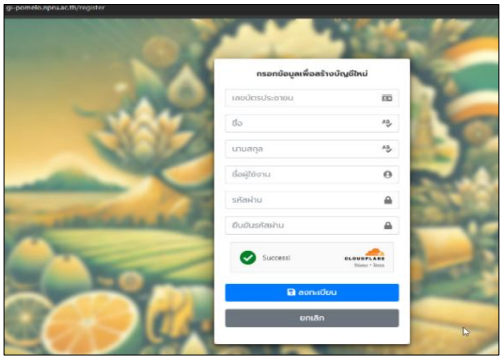

Fig. 5 - Account registration for system access

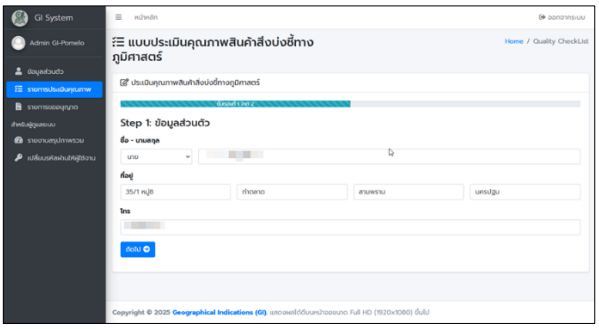

Fig. 6 - Display of personal information for product quality assessment

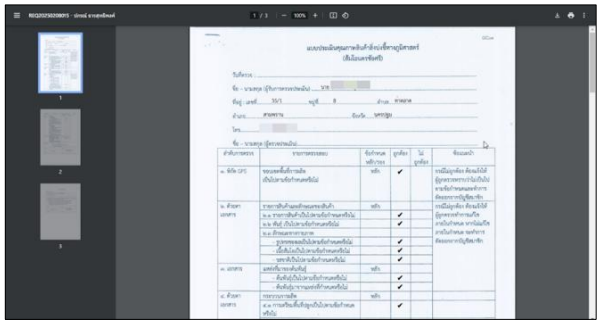

Fig. 7 - Geographical Indication report generated upon completion of data entry

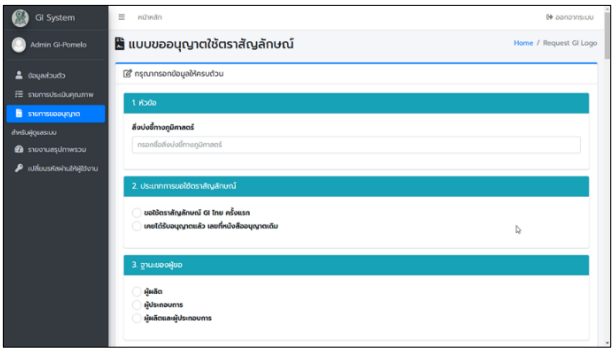

Fig. 8 - Application form for trademark usage authorization (data entry stage)

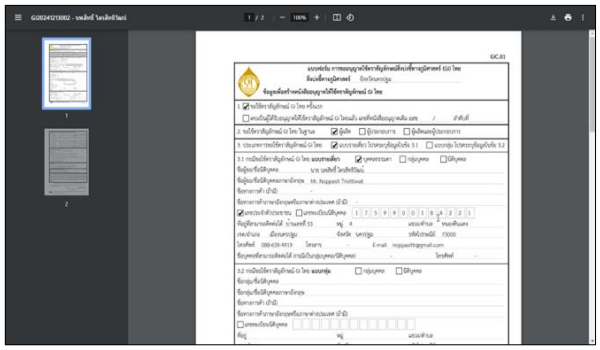

Fig. 9 - Application form for trademark usage authorization (completed form)

2. Evaluation Results of the Information System for Elevating Pomelo Farms to Geographical Indication Standards in Nakhon Pathom Province

The performance of the system was evaluated by 10 experts and agricultural extension academics. The assessment focused on five key aspects, as summarized in Table 1.

Table 1

Performance evaluation results of the information system across five aspects

Evaluation Aspect	$\overline{x}$	S.D.	Interpretation
Function Requirement	4.63	0.55	Very High
Functional Capability	4.54	0.61	Very High
Usability	4.70	0.56	Very High
Performance	4.57	0.59	Very High
Data Security	4.56	0.58	Very High
Overall Average	**4.60**	**0.58**	Very High

The overall performance evaluation by experts yielded a “Very High” average score of 4.60 with a standard deviation of 0.58. Among the five aspects assessed, usability received the highest rating, with an average score of 4.70 and a standard deviation of 0.56.

For the actual deployment of the system among target farmers, the initial sample group was set at 15 participants; however, actual participation reached 16 users. The results of the user satisfaction evaluation regarding the information system developed to elevate pomelo farms to GI standards in Nakhon Pathom Province are presented in Table 2.

Table 2

User satisfaction evaluation of the system's performance across five aspects

Evaluation Aspect	$\overline{x}$	S.D.	Interpretation
Function Requirement	4.40	0.79	High
Functional Capability	4.29	0.83	High
Usability	4.29	0.74	High
Performance	4.42	0.66	High
Data Security	4.38	0.77	High
Overall Average	**4.35**	**0.77**	High

The overall user satisfaction evaluation by farmers yielded a "High" average score of 4.35, with a standard deviation of 0.77. Among the five evaluated aspects, performance received the highest satisfaction rating, with an average score of 4.42 and a standard deviation of 0.66.

3. Strategic Utilization of Information from the System

The strategic application and further development of information obtained from the system can be implemented through three approaches to enhance farmer capabilities:

3.1. Supporting Geographical Indication (GI) Registration

The information system assists farmers by simplifying data entry, reducing paperwork, and enabling efficient document upload, storage, retrieval, and search. Following system implementation among the sample group, seven farmers were identified as ready to proceed with GI registration. It was therefore recommended that they form a cooperative group and jointly submit their applications.

3.2. Enhancing Market Potential and Export Readiness

GI certification serves as a quality assurance symbol that increases market value. The study recommends that farmer groups strengthen product presentation by incorporating GI logos on packaging and sharing their production story through online platforms. In addition, participation in international trade fairs and business-matching activities is encouraged to expand both domestic and international market opportunities.

3.3. Knowledge Development and Network Building for Farmers

To fully leverage the GI mark, knowledge transfer and network formation are essential. New applicants are encouraged to join existing GI-certified farmer groups, such as the Nakhon Chai Si Pomelo Network, to facilitate knowledge sharing, capacity building, and expanded market access. This includes opportunities in online sales and export strategies.

DISCUSSION

The study and development of the information system for upgrading pomelo orchards to GI standards in Nakhon Pathom Province underscores the importance of integrating information technology to support the GI registration process for pomelo growers. Although many farmers are highly skilled in pomelo cultivation, they often face limitations in document handling and navigating complex administrative procedures. The developed information system helps address these challenges by simplifying documentation, facilitating data entry, and promoting readiness for GI application among small-scale farmer groups. These findings align with studies indicating that developing countries face challenges in GI protection due to limited resources, insufficient understanding of the process, and ineffective legal enforcement (*Ngokkuen & Grote, 2012; Das, 2010*). They also reinforce evidence that GI certification adds to the technical complexity of exporting agricultural products (*Xu, Feng, & Wei, 2022*).

If the information system can be integrated with relevant agencies—such as the Provincial Agriculture Office and the Department of Intellectual Property—it could significantly increase application review efficiency, reduce processing time and costs, and expand opportunities for farmers to benefit from GI in both national and international markets. Systematic support, particularly in technology and data integration, has the potential to enhance the competitiveness of the agricultural sector and generate sustainable positive impacts on the local economy.

The evaluation of system performance and user satisfaction further validates its effectiveness. Experts rated the system's overall performance as very high (average score of 4.60), while farmers rated their satisfaction as high (average score of 4.35). Usability received the highest score from experts, whereas performance was the most satisfying aspect for farmers. These results are consistent with prior studies on information systems supporting agricultural product quality standards and farmer database management (*Klongdee & Promphut, 2021; Khanja, 2019; Tharapitakwong, 2021*). They also correspond with findings on GIS quality and user satisfaction (*Rahman et al., 2022*), which demonstrate that attributes such as reliability, usability, and performance are strongly correlated with user satisfaction and positively influence work performance.

The strategic utilization of information from the system can further enhance farmer capabilities through three main approaches: supporting GI registration, strengthening market and export potential, and fostering knowledge development and network building among farmers. Developing and adding value to pomelo products—especially varieties with strong global demand—presents substantial opportunities for market expansion and improved competitiveness (*Ningsih et al., 2024*). Moreover, brand development and storytelling represent promising strategies for creating psychological value and product differentiation (*Jinai & Borisut, 2022*). Finally, promoting GI registration for indigenous pomelo varieties, raising intellectual property awareness, and encouraging the formation of producer groups are essential government policies to strengthen the global position of Thai agricultural products (*Li & Ouyang, 2025*).

CONCLUSIONS

The research successfully studied and developed an information system for recording and managing data to support Geographical Indication (GI) certification for pomelo growers in Nakhon Pathom Province. When tested with a sample group, the system achieved a "Very High" overall performance rating and a "High" overall user satisfaction score.

The study also identified three key strategies for empowering farmers:

1. Supporting GI registration for smallholder farmers.
2. Enhancing market and export potential through GI certification.
3. Developing knowledge and networks among farmers.

These findings underscore the critical role of information technology in supporting the GI registration process, particularly for farmers who possess strong cultivation skills but encounter challenges with documentation. The system addresses these limitations by simplifying paperwork, streamlining data entry, and promoting readiness for GI application among small-scale farmer groups.

Overall, the developed system provides a foundational model that can be further expanded to support GI registration for other agricultural products in the future.

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REFERENCES

[1] Bramley, C., & Kirsten, J.F. (2007). Exploring the economic rationale for protecting geographical indicators in agriculture. *Agrekon*, 46(4), 462–487.

[2] Das, K. (2010). Prospects and challenges of geographical indications in India. *The Journal of World Intellectual Property*, 13(2), 148–171.

[3] Department of Intellectual Property, Ministry of Commerce. (2019). *Geographical Indications Products of Thailand (GI THAILAND)*. Bangkok: Onpa Co., Ltd.

[4] Department of Intellectual Property, Ministry of Commerce. (2020). *Annual Report 2020*. Bangkok: Ministry of Commerce.

[5] Jinai, T., & Borisut, Y. (2022). Value creation of agricultural products: Guidelines for small-scale entrepreneurs. *Journal of Research and Development in the Greater Mekong Subregion (Online)*, 1(2), 66–79. Retrieved from https://so14.tci-thaijo.org/index.php/RDGMSJournal/article/view/734/494.

[6] Josling, T. (2006). The war on terroir: Geographical indications as a transatlantic trade conflict. *Journal of Agricultural Economics*, 57(3), 337–363.

[7] Kendall, K. E., & Kendall, J. E. (2011). *Systems analysis and design* (9th ed.). Upper Saddle River, NJ: Pearson Education.
[8] Khanja, P. (2019). Development of farmer potential database system in the long-Laplae durian market mechanism in Uttaradit Province. *Uttaradit Rajabhat University Academic Journal*, 14(1), 13–26. Retrieved from https://ph01.tci-thaijo.org/index.php/uruj/article/view/159384/137741.
[9] Klongdee, S., & Promphut, S. (2021). Information system to support the certification of good agricultural practices for mangosteen. *Journal of Applied Information Technology*, 7(1), 18–28. Retrieved from https://ph02.tci-thaijo.org/index.php/project-journal/article/view/242207/165788.
[10] Li, X., & Ouyang, Z. (2025). Does certification lead to satisfaction? Agro-product geographical indications and subjective well-being of farmers. *BMC Psychology*, 13(532). https://doi.org/10.1186/s40359-025-02844-4.
[11] Nakhon Pathom Provincial Office. (2021). *Five-Year Provincial Development Plan (2023–2027)*. Retrieved January 22, 2024, from https://www.nakhonpathom.go.th/files/com_news_develop_plan/202206_b10963fe21a2c6a.pdf.
[12] Nakwachara, W. (2021). *Development of geographical indications for trade promotion*. Bangkok: Chulalongkorn University Press.
[13] Ningsih, G. M., Rasyid, H., Ningsih, N., Pujotomo, D., & Suseno, G. P. (2024). Strategies to improve the competitiveness of local agricultural products through product certification and standardization. *International Journal of Religion*, 5(11), 5869–5875.
[14] Ngokkuen, C., & Grote, U. (2012). Challenges and opportunities for protecting geographical indications in Thailand. *Asia-Pacific Development Journal*, 19(2), 93–118.
[15] O'Connor, B. (2004). *The law of geographical indications*. London: Cameron May Ltd.
[16] Rahman, M. S., Shuhidan, S. M., Masrek, M. N., & Baharuddin, M. F. (2022). Validity and reliability testing of Geographical Information System (GIS) quality and user satisfaction towards individual work performance. *Proceedings*, 82, 68. https://doi.org/10.3390/proceedings2022082068.
[17] Teuber, R. (2011). Consumers' and producers' expectations towards geographical indications: Empirical evidence for a German case study. *British Food Journal*, 113(7), 900–918.
[18] Tharapitakwong, J. (2021). *Development of an information system for off-season longan production process management*. Retrieved May 9, 2024, from http://cmruir.cmru.ac.th/handle/123456789/2178.
[19] Whitten, J. L., Bentley, L. D., & Dittman, K. C. (2001). *Systems analysis and design methods* (5th ed.). New York, NY: McGraw-Hill.
[20] World Intellectual Property Organization. (2020). *World intellectual property indicators 2020*. Geneva: WIPO Press.
[21] Xu, Z., Feng, Y., & Wei, H. (2022). Does geographical indication certification increase the technical complexity of export agricultural products? *Frontiers in Environmental Science*, 10, Article 892632. https://doi.org/10.3389/fenvs.2022.892632.