

# AN ACADEMIC REVIEW OF RESEARCH IN LOCAL MARKETING COMMUNICATIONS

Kornkanok NINDUM<sup>1</sup>

1 Faculty of Management Science, Chiang Rai Rajabhat University, Thailand;  
n\_kornkanok@yahoo.com

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## ABSTRACT

This research aims to explore the knowledge of research on marketing communication of local agricultural products in Chiang Rai by using a documentary research method, reviewing research papers, theses, and independent studies in the fields of communication studies, mass communication, journalism, and communication technology in both public and private universities. The findings of the research can be summarized as follows: The development of research in this area between 2012-2014 showed no research on this topic. Between 2015-2018, there were three studies on this subject. From 2019-2023, there were 4 studies, indicating a continuous trend in research growth in this area. Most of the research conducted by academics from higher education institutions in Chiang Rai and other universities used qualitative research methods, particularly in-depth interviews with producers and consumers. The agricultural products studied included fruits such as hydroponic melons, processed fruits, Ngan Lae pineapple, Phu Lae pineapple, followed by agricultural learning centers like Rai Ruen Rom, and paper products made from agricultural waste materials. Marketing communication channels employed digital media, using integrated marketing communication approach through digital media, branding concepts, marketing mix, smart farming concepts, consumer satisfaction theory, and SWOT analysis.

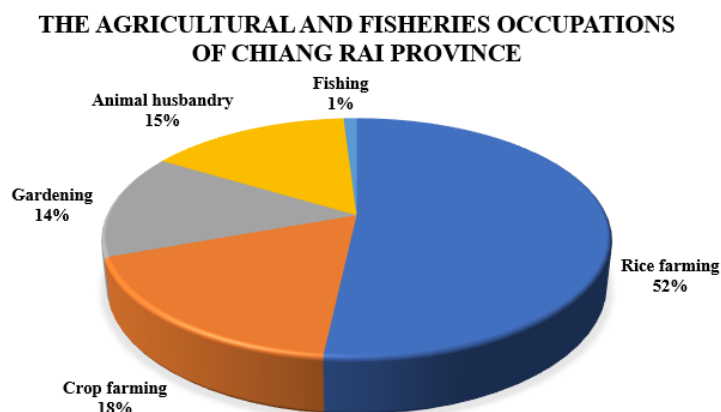
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## INTRODUCTION

In today's marketing world, both product manufacturers and service providers are fully dedicating themselves to creating unique identities for their products or services. The competition in every industry has become intense, which is one of the key responsibilities and challenges for marketers to differentiate their products or services and clearly define target audiences to create desire and make a lasting impression on customers (Felix, 2015). Marketing in each era constantly evolves with social, political, environmental, and economic development. The marketing concept is a process of activities involving the exchange of goods or services based on the needs and wants of consumers, aiming to maximize the satisfaction of the target audience (Dhavaputhalvi & Sornam, 2020). For localized marketing refers to a market with local buyers, where the products or services are tailored specifically for certain regional areas. Localized marketing is a small target market with limited production, as the products or services are unique and suitable only for shoppers in that specific locality (Bai et al., 2021). Localized marketing is a marketing strategy that both businesses and large brands prioritize.

Chiang Rai Province, located at the northern most of Thailand, is an area rich in resources due to its diverse landscapes of fertile plains and mountainous regions (Nindum, 2021). The Kok River flows through the province for a length of 130 kilometers, making it suitable for agricultural activities. Farming provides livelihood opportunities for the people in many sectors, earning it the nickname "Agricultural City of Chiang Rai." The area for agriculture in the Mueang Chiang Rai district is 282,898 rai, with 52.83% of farmers engaged in rice farming, while others focus on crop farming, gardening, animal husbandry, and fishing (Bosang, n.d.). Additionally, data from the Chiang Rai Provincial Statistical Office reported that in the third quarter, between July and September 2022, most people in Chiang Rai were engaged in agriculture and fisheries, accounting for 47.8% (Chiang Rai Provincial Statistical Report, 2023). This results in the majority of Chiang Rai's agricultural output being from economic crops such as rice, corn, longan, lychee, rubber, pineapple, tea, coffee, and santol, among others. From what has been mentioned, information on the agricultural occupations of the people in Chiang Rai can be presented as shown in figure 1. Given this, the researcher is particularly interested in studying the marketing communication of agricultural products and community-based goods as these are essential for human livelihood. Additionally, they contribute to generating income for the people of Chiang Rai and the national economic industrial system.



**Figure 1** The agricultural occupations of the people in Chiang Rai

From a search of academic resources in educational institutions and research works in various academic organizations in Northern Thailand, no research has been found on marketing

communication for local agricultural products in Chiang Rai. This study aims to review and synthesize research knowledge on local marketing communication in Chiang Rai over the past decade, propose recommendations for studying local marketing communication strategies in both agriculture and processed products or services. The aim is to plan policies and create marketing communication strategies for public and private organizations, ensuring effectiveness and efficiency (Ningsih et al., 2024). It also serves as a reflection of development and growth in research that will benefit the future development of marketing communication knowledge.

## **LITERATURE REVIEWS**

### **Marketing communication**

Marketing communication is a management process in which an organization creates and delivers information in a conversational or dialogue format to various target markets that have different characteristics. To achieve success, the organization must develop and present information tailored to each specific stakeholder group, which may vary. Additionally, it is necessary to evaluate the effectiveness of the information received and assess whether the recipients' behaviors align with the desired responses (Chris Fill, 2002). While Tom Duncan (2005) explain that marketing communication is a term that results from the compilation of various forms of information presentation that have been planned and created to build a product or brand identity. This includes Advertising, Public Relations, Sales Promotion, Direct Marketing, Personal Selling, Packaging, Events and Sponsorships, and Customer Service.

Therefore, it is consistent with the study of Simabur (2024) that is local marketing communication strategies play a crucial role in promoting cultural events, expanding market share, and enhancing brand visibility. Research has shown that incorporating local wisdom into marketing models can effectively engage communities and attract tourists in addition, research on the status of knowledge found studies of Brett Martin, (2005) reflecting that a comprehensive approach to marketing communications should cover various forms, including brand advertising, sales promotion, and personal selling.

### **Local products and agricultural products**

Local products refer to products that represent the unique way of life and local wisdom, produced by individual entrepreneurs or small and medium-sized enterprises (SMEs). (Parameswara et al., 2019; Sulasno et al., 2024). Agricultural products refer to the produce or products derived from agriculture, fisheries, livestock, or forestry, as well as by-products of such produce or products. Agriculture can be divided into four categories: 1) Agriculture refers to the cultivation of plants, such as rice farming, fruit orchards, crop farming, and soil-less planting, among others. 2) Livestock refers to the profession of raising land animals, such as livestock farming, dairy farming, pig farming, poultry farming, and sheep farming, among others. 3) Fisheries refers to the agricultural profession related to water, such as aquaculture or fishing, and harvesting aquatic animals and 4) forestry refers to professions related to forests, such as planting economic trees and processing forest products for practical use (Schwok, 2019; Zhang et al., 2019). From the above concept, it is consistent with the study of Batra and Keller (2016) found that as media landscapes evolve, integrating marketing communications becomes increasingly important for effective consumer engagement and also Martin (2005) reflecting that a comprehensive approach to marketing communications should cover various forms, including brand advertising, sales promotion, and personal selling. From the literature review, the conceptual framework can be drawn as shown in figure 2.

## RESEARCH METHODOLOGY

The population in the study consists of research papers, academic article, research article, theses, and independent studies related to marketing communication of local agricultural products in Chiang Rai province, available from government and private higher education institutions offering courses in communication, journalism, mass media, and communication technology related to marketing communication. The researcher explored online databases from northern universities, including other related databases, such as the Thai Library Integrated System (ThaiLIS) and data from the website <https://scholar.google.com>. The criteria used to select sources for study include titles or keywords related to "marketing communication of agricultural products."

The data analysis and presentation will involve analyzing the details of the research issues and communication context to identify the knowledge in marketing communication research in Thai educational institutions. The findings will then be used for content analysis, followed by summarizing and synthesizing the data according to the research objectives, ultimately producing an annotated bibliography.

## RESEARCH RESULTS

### **The development of research in local agricultural marketing communication**

An overview of the development of research in local agricultural marketing communication: In the initial phase, between 2012-2014, no research in this area was found due to 1) a lack of attention from professors in higher education institutions and graduate students, and 2) the presence of other interesting issues at the time, such as culture, management, etc., or urgent social development issues to address certain matters, such as the development of education.

In the second phase, between 2015-2018, three studies were conducted: in 2015, a study by a master's student from Silpakorn University; in 2017, an independent study by a master's student; and in 2018, a thesis by a master's student from Bangkok University.

In the final phase, between 2019-2023, research in this field became more continuous, with a total of four studies. In 2019, one study was found, a thesis from a master's student at the National Institute of Development Administration. In the following year, two studies were found: one from a scholar in the Faculty of Communication Arts at Chiang Rai Rajabhat University, and the other from a research output by a faculty member from the Faculty of Business Administration and Liberal Arts at Rajamangala University of Technology Lanna Chiang Rai. In 2022, only one study was found, from a faculty member in the Communication Arts Department at Chiang Rai Rajabhat University.

### **Types and Sources of research on local agricultural marketing communication**

In the field of marketing communication research, it was found that there are 21 studies in total, with most of them being research reports from scholars in higher education institutions. Research on local agricultural marketing communication has been ongoing and there is a trend of continuous research and academic work being produced in this field.

Regarding the types of research, there are 2 studies from scholars in higher education institutions in the Chiang Rai area, and 1 study from the National Institute of Development Administration in the fields of communication arts and management innovation. Additionally, there are 3 master's theses from private universities, including Bangkok University, and independent studies from master's students as well. Research from Rajamangala University of Technology Lanna Chiang Rai, in the form of a research report by a faculty member in the Faculty of Business Administration and Liberal Arts, is included as one study. There is also 1 study from a master's student in the Design Communication Arts program at Silpakorn University.

The sources of the marketing communication research were found to be the product of faculty members in the Faculty of Management Sciences, Communication Arts Program, who received research funding from Chiang Rai Rajabhat University. Other scholars received funding from government research budgets and the Thailand Research Fund. Nearly all research was in the fields of communication arts, journalism, or mass communication. Theses from master's students were also found at universities such as the University of Thai Chamber of Commerce in the field of management and the University of Phayao in tourism, both within the faculties of business administration and communication arts.

### **Research methods in agricultural marketing communication**

Most of the research used qualitative methods to seek knowledge, with a total of 4 studies. All of these used in-depth interviews, focus group discussions, and participant observation from entrepreneurs, group founders, brand owners, stakeholders, and target groups. However, the specific methods used to obtain the findings varied. These included the collection of secondary data from research documents and relevant theoretical concepts, as well as gathering and analyzing content from new media such as Facebook fan pages and YouTube. In-depth interviews were also conducted with structured questionnaires from the target group.

Additionally, a mixed-methods research approach was used in 3 studies. This approach combined with 1) in-depth interviews, focus group interviews, participant observation, and

content analysis with quantitative research methods using descriptive statistics such as frequency, percentage, and standard deviation to assess consumer satisfaction. Some studies used semi-structured questionnaires with academic groups, textual analysis and communicators (online media), and combined this with focus group interviews. There were also tests and participant observations mixed with quantitative methods, using descriptive statistics and interpreting the mean values. 3) group interviews, as well as testing and participant observation mixed with quantitative research methods with quantitative research methods to seek knowledge, such as analyzing data with descriptive statistics, including percentage, mean, and standard deviation. Only 2 studies conducted inferential analysis using T-tests and multiple regression analysis. Another study tested pairwise differences using the Scheffé statistic, with both studies conducting a one-way analysis of variance (ANOVA).

### **Issues and theoretical concepts used as the framework for the study**

Research related to agricultural marketing communication in local products focused on fruit production in 3 studies. These included melons grown hydroponically in the Mae Chan district, with one study covering both the marketing communication of the fruit and its processed products. Additionally, there was a study on marketing communication of the local agricultural product, the Nanglee pineapple, in the Nanglee sub-district of Mueang district, and another on the marketing of the Phula pineapple in the Mae Khao Tum sub-district of Mueang district. At the same time, there were 3 studies related to forest products or tree planting communication, including marketing communication of agricultural learning centers, which had considerable success. Two studies focused on Ruernrom farm, and one study covered paper products made from agricultural waste at Baan Khua Khrae.

When surveying marketing communication channels for agricultural products, it was found that all studies primarily used new media tools to reach target audiences, including Facebook, Line Add, e-commerce, YouTube, Instagram, and websites to promote product details and agricultural sales. However, while most studies emphasized online media communication with consumers, some still placed importance on offline media.

The marketing communication for local agricultural products predominantly utilized integrated marketing communication through digital media and branding concepts. The marketing mix, which included communication tools for product communication, pricing, promotion, and distribution channels, was often mentioned. Tools such as public relations, sales by sales personnel, advertising, and promotion were commonly used. Some studies also highlighted marketing through digital media, incorporating retail outlets and booth displays. Concepts related to smart agriculture, consumer satisfaction theory, and SWOT analysis to analyze strengths, weaknesses, opportunities, and threats were applied to evaluate and improve local agricultural products.

## **DISCUSSION & CONCLUSION**

### **The development of research in local agricultural marketing communication**

The development of research on agricultural marketing communication in the early stages did not show any studies in this area due to 1) a lack of attention from professors in higher education institutions and graduate students, and 2) the presence of other interesting issues at the time, such as culture, management, etc., or urgent social development issues to address certain matters, such as the development of education.

In the second stage, some studies emerged from master's degree students in Bangkok and Silpakorn University, who either originated from or worked in Chiang Rai, so they had an interest and proximity to conducting research in that area. However, there was clear development and progress in this field of study, with growing interest over time.

In the final stage, research in this field increased significantly compared to earlier periods, with a more continuous flow of outputs (Abdullah et al., 2023). In 2019, one study was found, a

thesis by a master's student from the National Institute of Development Administration (NIDA). The following year, two studies were found on agricultural marketing communication in local products, one by scholars from Chiang Rai Rajabhat University and another by a scholar from the Faculty of Business Administration and Arts, Rajamangala University of Technology Lanna Chiang Rai. In 2022, there was only one study, a thesis by a lecturer from the Faculty of Communication Arts, Chiang Rai Rajabhat University.

This growing interest from graduate students and scholars aligns with the Chiang Rai Province Development Plan 2023-2027, specifically in the area of promoting production and developing innovations to elevate agricultural products under the sustainable development goals (SDGs). This has led to both students and scholars focusing on agricultural products, aiming to generate academic work that can benefit farmers to the fullest (Office of Provincial Administration Development and Promotion, 2021). Consequently, there has been clear progress and continuous development, with an increasing trend in research on this subject.

### **Types and Sources of research on local agricultural marketing communication**

The types of research on local agricultural marketing communication are studies conducted by scholars from the Faculty of Management Science, the Communication Arts Program at Chiang Rai Rajabhat University, and research from Rajamangala University of Technology Lanna Chiang Rai, which are research reports from faculty members of the Faculty of Business Administration and Arts. This is because the research output on agricultural marketing communication comes from educational institutions located in the area, supporting the policy of public higher education institutions to provide academic services to the community. This aligns with the strategy of Chiang Rai Rajabhat University, which includes the “Local Development Strategy” to promote learning that focuses on developing 21st-century skills and improving the quality of life for local people (University Development Strategic Plan (2022-2026)).

The research results can be fully utilized and expanded by the researchers, who have gone into the field to survey and collect data. The types of research output from the National Institute of Development Administration (NIDA) include master's theses in Communication Arts and Innovation Management. Additionally, research output includes master's theses in Digital Marketing Communication from Bangkok University, as well as independent studies from master's students. Research from Silpakorn University, from master's students in the Communication Arts Design program, also contributes to this field.

It can be concluded that research on agricultural marketing communication conducted by master's students from the fields of communication innovation or digital marketing aligns with the scope of marketing communication concepts. These studies focus on the development process and the application of various elements of marketing communication to persuade the target audience to change their behavior, following invitations from promotions, while using all types of media effectively (Taan, 2018).

### **Research methods in agricultural marketing communication**

Most of the research uses qualitative research methods to seek answers. All studies apply in-depth interviews with entrepreneurs, group founders, brand owners, stakeholders, and target groups, which aligns with the philosophy of qualitative research, which is used to explore and reach conclusions. It should be research related to individuals' lives, stories, phenomena, or social processes to obtain deep truths (Freeman & Given, 2011). However, there are some variations in the methods used to reach these findings, such as collecting secondary data from relevant documents, gathering and analyzing content from new media such as Facebook fan pages and YouTube, in-depth interviews with structured questionnaires from entrepreneurs, group founders, brand owners, stakeholders, and target consumers. This is consistent with the philosophy of qualitative research, which focuses on interviewing individuals with specific characteristics. Typically, small sample sizes are used, but with the aim of obtaining very

detailed insights, allowing interviewees to share their opinions or provide information freely. Next in sequence, for the mixed-method approach, techniques include in-depth interviews combined with descriptive statistics and content analysis to assess consumer satisfaction. This aligns with the philosophy of quantitative research, which emphasizes scientific methods that focus on observable phenomena and measurable behaviors (Hasan, 2024). Methods include group interviews with semi-structured questionnaires with scholars, textual analysis and message sender in the online world, combined with surveys and 3) group interviews, as well as testing and participant observation mixed with quantitative research methods using descriptive statistics like percentages and averages, comparing differences in means, standard deviations, and interpreting average values with quantitative research methods for seeking answers in the studies include analyzing data with descriptive and inferential statistics to study the relationships between independent and dependent variables in marketing factors, customer demand, or satisfaction with products (Danliti, 2024).

### **Issues and theoretical concepts used as the framework for the study**

The research on marketing communication for agricultural products related to fruit production includes hydroponic melons and processed fruits in the Mae Chan area, marketing communication research for agricultural products like Nang Lae pineapple in the Nang Lae subdistrict, and marketing communication research for Phulae pineapple in the Mae Khao Tom subdistrict. At the same time, marketing communication for forest products or tree planting focuses on successful agricultural learning centers, such as the Rai Ruen Rom farm, and paper products made from agricultural waste materials at Ban Khua Khae. This will cause government agencies responsible for addressing the occupational issues of various professional groups to adjust their policies in promoting and supporting farmers appropriately, as well as lead to the development of the community's brand identity.

The marketing communication channels for agricultural products used in all the studies apply digital communication tools to reach target groups, including platforms like Facebook, Line, e-commerce, YouTube, Instagram, and websites for product sales. However, offline channels, such as in-store sales, are still emphasized. This aligns with the increasing internet usage across all age groups, as reflected in data from the Information and Communication Technology (ICT) household survey (National Statistical Office Thailand) This shows that the internet is a convenient and quick communication tool for farmers to connect with consumers, though some research still pays attention to offline sales or in-store and booth-based product displays (Grewal et al., 2010). Therefore, it is consistent with the study "Guidelines for agritourism of fish farming learning center: A case study of Chiang Rai, Thailand" by Nindum et al. (2024). Local farmers promote community products through various channels, including on-site, online, and on-ground. This demonstrates that although communication technology has developed rapidly in society, promoting through participatory experiences for the target group by setting up booths remains important.

The marketing communication of local agricultural products uses the Integrated Marketing Communications (IMC) concept through digital media or brand concepts, as these are central to studies in this field. This concept encompasses tools for communicating about products, their features, pricing, promotional strategies, and distribution channels from producers to consumers, such as public relations, sales by salespeople, advertising, and events. Digital marketing concepts are central, as all studies focus on distributing agricultural products through online platforms due to the current global social context and changing consumer behaviors. The smart farming concept is relevant because the study areas include agricultural learning centers and farms that develop agricultural practices from upstream to downstream, serving as models for others to learn from and exchange knowledge.

Other key concepts include the Consumer Satisfaction Theory to measure consumer perceptions and satisfaction with agricultural products or services and SWOT Analysis, used



by producers to explore and develop marketing strategies, such as creating brands and designing media to suit agricultural products, while aligning with the current environment and target audiences.

## REFERENCES

- A summary on the current use of the internet. (2024). *National Statistical Office Thailand*. Retrieved from <https://www.nso.go.th>.
- Abdullah, K. H., Muzawi, R., Gazali, N., & Abd Aziz, F. S. (2023). Digital marketing: A scientometric review. *Contemporary Management Research*, 19(1), 55-79.
- Bai, H., McColl, J., & Moore, C. (2022). Luxury fashion retailers' localised marketing strategies in practice—evidence from China. *International Marketing Review*, 39(2), 352-370.
- Batra, R., & Keller, K. L. (2016). Integrating marketing communications: New findings, new lessons, and new ideas. *Journal of marketing*, 80(6), 122-145.
- Bosang, S. (n.d). *Asian Cities Climate Change Resilience Network - ACCCRN*. Retrieved from <https://www.tei.or.th/thaicityclimate/public/research-38.pdf>.
- Danliti, I. M. (2024). The Impact of Marketing Research on Distribution Channels and Merchandizes Activities. *World Journal of Economics and Business Research*.
- Dhavaputhalvi, A. C., & Sornam, A. (2021). Marketing of Library Management Software Products. In *Research Anthology on Collaboration, Digital Services, and Resource Management for the Sustainability of Libraries* (pp. 337-349). IGI Global.
- Duncan, T. (2002). *IMC: Using Advertising and Promotion to Build Brands*. Boston: McGraw Hill Irwin.
- Felix, E. (2015). Marketing Challenges of Satisfying Consumers Changing Expectations and Preferences in a Competitive Market. *International Journal of Marketing Studies*, 7(41).
- Fill, C. (2002). *Marketing Communications: Contexts, Strategies, and Applications*. Financial Time Prentice Hall.
- Freeman, M., & Given, L.M. (2011). *The SAGE encyclopedia of qualitative research methods*. Retrieved from <https://api.semanticscholar.org/CorpusID:142417507>.
- Grewal, D., Janakiraman, R., Kalyanam, K., Kannan, P. K., Ratchford, B., Song, R., & Tolerico, S. (2010). Strategic online and offline retail pricing: a review and research agenda. *Journal of interactive marketing*, 24(2), 138-154.
- Hasan, K. M. (2024). Quantitative Methods in Social Science Research: Systematic Review of Content Analysis, Survey and Experiment Methodologies. *SSRN Electronic Journal*.
- Local Development Strategy. (2024). *University Development Strategic Plan (2022-2026)*. Retrieved from [https://crru.ac.th/strategic\\_plan/](https://crru.ac.th/strategic_plan/).
- Martin, B. A. (2005). Book Review: Marketing Communications: Theory and Applications. *Australasian Marketing Journal*, 13, 77-80.
- Nindum, K. (2021). Innovative Storytelling to Add Value to Homestay Tourism (January 1, 2021). *PSAKU International Journal of Interdisciplinary Research*, 10(1).
- Nindum, K., Nindum, S., & Paripan, K., (2024). Guidelines for agritourism of fish farming learning center: A case study of Chiang Rai, Thailand. *The 4<sup>th</sup> International Joint Conference on Hospitality & Tourism 2024* (September 2024). Thai Binh Duong University.
- Ningsih, G. M., Rasyid, H., Ningsih, N., Pujotomo, D., & Suseno, G. P. (2024). Agricultural marketing strategies in the digital era: Improving the competitiveness of local products. *Journal of Social Science (JoSS)*, 3(9), 1756-1764.

- Parameswara, A., Wulandari, A., & Giri, R. (2019). The Analysis of Productivity and Labor Absorption in Creative SMEs Base on Local Wisdom Kamasan Village, Bali, Indonesia. *International Journal of Business, Economics and Law*, 18(5), 330-340.
- Schwok, R. (2019). Agriculture. *The Restless and Relentless Mind of Wes Jackson*. Retrieved from <https://doi.org/10.1002/9781119579748.ch31>.
- Simabur, L. A. (2024). Exploring Local Wisdom-Based Marketing Communication Models in Tomalou Fishermen's Village Festival. *PROCURATIO: Jurnal Manajemen & Bisnis*, 3(1), 22-29.
- Sulasno, S., Rifai, A., & Rostiyana, A. (2024). Local Wisdom and Product Competition Model of MSMEs Rambutan Tangkue Based on Intellectual Property in Curugbitung Sub-District, Lebak District. *Devotion: Journal of Research and Community Service*, 5(8), 1017-1033.
- Sustainable Development Goals-SDGs. (2021). *Office of Provincial Administration Development and Promotion*. Retrieved from <https://gdcatalog.go.th/dataset/gdpublish-planning>.
- Taan, H. (2018). Design and Manage Integrated Marketing Communication. *Journal of International Conference Proceedings*, 1(2), 423474.
- The occupations of the people of Chiang Rai. (2023). *Chiang Rai Provincial Statistical Report*. Retrieved from <https://chiangrai.nso.go.th/>.
- Wynd, C. A., Schmidt, B., & Schaefer, M. A. (2003). Two quantitative approaches for estimating content validity. *Western journal of nursing research*, 25(5), 508-518.
- Zhang, Y., Zhang, J., & Simpson, B. K. (2019). An Introduction to agricultural and fishery wastes. *Byproducts from Agriculture and Fisheries: Adding Value for Food, Feed, Pharma, and Fuels*, 1-17.

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