รายงานการไปฝึกอบรม ดูงาน ประชุม / สัมมนา ตามระเบียบมหาวิทยาลัยสุโขทัยธรรมาธิราช ว่าด้วยการให้ทุนฝึกอบรม ดูงาน และประชุมทางวิชาการแก่บุคลากรของมหาวิทยาลัย

- ชื่อนายอนุชา .นามสกุล...ภูริพันธุ์ภิญโญ อายุ 59 ปี ตำแหน่ง...รองศาสตราจารย์ระดับ 9. สังกัดสาขาวิชาเกษตรศาสตร์และสหกรณ์ โทร 084225 6155 ไปประชุมวิชาการนานาชาติ เรื่อง The 16th Hatyai International Conference รูปแบบออนไลน์ ณ ประเทศไทย ตั้งแต่วันที่ 16 พฤษภาคม 2568 ถึงวันที่ วันที่ 16 พฤษภาคม 2568 รวมระยะเวลา (ปี เดือน วัน) ...1 วัน
- 2. รายละเอียดเกี่ยวกับการไปประชุมประชุมวิชาการนานาชาติ
 - 2.1 <u>รายงานการประชุมวิชาการนานาชาติ</u>
 - (1) หัวข้อเรื่อง และวัตถุประสงค์ของการประชุม/สัมมนา การประชุมวิชาการนานาชาติ The 16th Hatyai International Conference รูปแบบออนไลน์ ใน การประชุมวิชาการนานาชาติครั้งนี้มีวัตถุประสงค์ในการนำเสนอผลงานวิจัยในระดับนานาชาติ แลกเปลี่ยนเรียนรู้จากงานวิจัยและสร้างเครือข่ายวิชาการในระดับนานาชาติ
 - (2) ผู้เข้าร่วมประชุม/สัมมนา (ระบุจำนวนรวมและสังกัด เช่น เจ้าหน้าที่จากสถาบันการศึกษาทั้งใน ประเทศไทยและต่างประเทศ 5 คน ผู้เข้าร่วมประชุมประกอบไปด้วยอาจารย์ นักวิชาการ นักวิจัยจากประเทศต่าง ๆ ทั่วโลก 10 ประเทศ จำนวน 120 คน และนักศึกษาจากมหาวิทยาลัย หาดใหญ่ จำนวน 80 คน
 - (3) วิธีการประชุม/สัมมนา

สถาบันอุดมศึกษาเป็นแหล่งเรียนรู้ที่สำคัญของประเทศ นอกจากมีหน้าที่ในการผลิตบัณฑิต สู่ตลาดแรงงานของประเทศแล้ว ยังมีหน้าที่พัฒนาและรวบรวมองค์ความรู้ที่ทันสมัยถ่ายทอดสู่ สังคม โดยเฉพาะการผลิตผลงานวิจัยที่มีคุณภาพ เพื่อการใช้ประโยชน์และความก้าวหน้าทาง วิชาการภายใต้จุดเน้นของนโยบายแผนพัฒนาเศรษฐกิจและสังคมแห่งชาติ แผนกลยุทธ์การ พัฒนาบุคลากรวิจัยและนวัตกรรม และแผนพัฒนามหาวิทยาลัย

มหาวิทยาลัยหาดใหญ่ เป็นสถาบันการศึกษาระดับอุดมศึกษาเอกชน มีความมุ่งมั่นในการ พัฒนาศักยภาพของนักศึกษาและชุมชน โดยมีเป้าหมายในการสร้างบัณฑิตให้มีความรู้ ความสามารถ พร้อมทั้งมีคุณธรรมและจริยธรรมที่ดี ตลอดจนสนับสนุนการพัฒนาสังคมอย่าง ยั่งยืน โดยเน้นการนำเทคโนโลยีและนวัตกรรมมาใช้เพื่อสนับสนุนการเรียนการสอน และการ วิจัยสู่การพัฒนาที่ยั่งยืน (SDGs) โดยตระหนักถึงความสำคัญในการพัฒนาบุคลากรเพื่อผลิตผล งานวิจัยที่มีคุณภาพอย่างต่อเนื่อง เพื่อสร้างองค์ความรู้อันจะนำไปสู่การพัฒนาบุคลากรเพื่อผลิตผล งานวิจัยที่มีคุณภาพอย่างต่อเนื่อง เพื่อสร้างองค์ความรู้อันจะนำไปสู่การพัฒนาและสร้างสรรค์ สังคม ตลอดจนการจัดการเรียนการสอน การให้บริการทางวิชาการ เพื่อเป็นฐานความรู้แก่ ชุมชนและสังคมในการพัฒนาประเทศให้ก้าวทันต่อการเปลี่ยนแปลงของสังคมโลก มหาวิทยาลัย ฯ นอกจากนี้ยังมีนโยบายสร้างเครือข่ายการวิจัยร่วมกับหน่วยงานภายนอก เพื่อให้ได้ ผลงานวิจัยและงานสร้างสรรค์ที่มีคุณภาพ สามารถตอบสนองความต้องการของชุมชน สังคม และก่อให้เกิดประโยชน์แก่สาธารณชนในวงกว้าง ตลอดจนส่งเสริมสนับสนุนการเผยแพร่ ผลงานวิจัยที่ดำเนินการแล้วเสร็จให้ได้มีโอกาสเผยแพร่ในแวดวงวิชาการและขยายองค์ความรู้สู่ การนำไปใช้ประโยชน์ให้กว้างขวางขึ้น

มหาวิทยาลัยหาดใหญ่ จึงกำหนดจัดการประชุมหาดใหญ่วิชาการระดับชาติและนานาชาติ ครั้งที่ 16 ในวันศุกร์ที่ 16 พฤษภาคม 2568 เพื่อเป็นเวทีในการนำเสนอผลงานและเผยแพร่ ผลงานวิจัย การแลกเปลี่ยนองค์ความรู้และประสบการณ์การวิจัย จากนักวิจัย/นักวิชาการ อาจารย์ นิสิต/นักศึกษา และผู้สนใจทั่วไป เพื่อนำไปสู่ความร่วมมือ และเกิดการพัฒนา ความก้าวหน้าทางวิชาการ โดยบทความวิจัยที่นำเสนอในการประชุมหาดใหญ่วิชาการครั้งนี้จะ ได้รับการประเมินคุณภาพทางวิชาการจากผู้ทรงคุณวุฒิ จำนวน 3 ท่าน ที่มาจากหลากหลาย สถาบัน

วัตถุประสงค์

 เพื่อเป็นเวทีทางวิชาการให้กับคณาจารย์ นักวิจัย นักวิชาการ และนักศึกษา ได้มีโอกาส เผยแพร่ผลงานวิจัย ถ่ายทอดและแลกเปลี่ยนองค์ความรู้ ตลอดจนสร้างประสบการณ์ด้านการ วิจัย

2. เพื่อสร้างแรงกระตุ้นให้เกิดแนวคิดในการพัฒนาองค์ความรู้ด้านการวิจัย

3. เพื่อสร้างเครือข่ายความร่วมมือด้านการวิจัยระหว่างมหาวิทยาลัยกับหน่วยงานภายนอก

เพื่อเป็นการสร้างบรรยากาศการวิจัยให้เกิดขึ้นในภาคใต้

หน่วยงานที่รับผิดชอบโครงการ

สำนักวิจัยและพัฒนา มหาวิทยาลัยหาดใหญ่

กลุ่มเป้าหมาย

นักวิจัย นักวิชาการ อาจารย์ นิสิต นักศึกษา ผู้สนใจจากสถาบันการศึกษา หน่วยงานภาครัฐ และบุคคลทั่วไป

(4) เข้าประชุม/สัมมนาในฐานะวิทยากรบรรยาย (เดี่ยว/กลุ่ม) หรือผู้อภิปรายกลุ่ม หรือเป็นผู้เสนอ บทความทางวิชาการในที่ประชุม/สัมมนา (ในกรณีดังกล่าวโปรดจัดทำบทสรุปย่อในส่วนของ ท่านด้วย)

การเข้าร่วประชุมครั้งนี้กระผมได้เข้าร่วมประชุมในฐานะผู้นำเสนอบทความวิจัยในหัวข้อเรื่อง

- The Organic Raw Milk Production Responding to the Bio Circular Green Economy Model in Saraburi Province, Thailand: From Beginning to Practice
- The Measurement of Technical and Scale Efficiency of Maize Production of Agricultural Cooperatives in Loei Province, Thailand
- (5) กรณีเข้าร่วมประชุม/สัมมนา ควรประมวลชื่อบทความทางวิชาการและเอกสารประกอบการ ประชุม/สัมมนา ที่เห็นว่าน่าจะเผยแพร่ให้ผู้อื่นได้ทราบ

เรื่องที่1 The Digital Technology in the Online High School Mathematics Classroom มี สาระสำคัญสรุปได้ดังนี้ In today's knowledge economy era, mathematics is moving from behind the scenes to the forefront. The combination of mathematics and computer technology has directly created value for society in many aspects and promoted the development of social productivity. Mathematics is an important component of human culture and has become a fundamental quality that citizens must possess. Mathematics plays a unique and irreplaceable role in the formation of human rational thinking. The research objectives were to 1) develop a quality digital technology in the online high school mathematics classroom, 2) compare the pre-test and post-test score of students after learning via the digital technology in the online high school mathematics classroom, and 3) study the satisfaction of students who learned via the digital technology in the online high school mathematics classroom. The samples of this study were 20 students in high school mathematics class who selected from students registered for the subject mathematics. The instruments consisted of digital technology, an evaluation form regarding the quality of media and contents, the pre-test and posttest assessment form, and an evaluation form regarding student's satisfaction towards the digital technology. Statistics used for data analysis were mean, standard deviation, and t-test for dependent samples. The results showed that 1) the digital technology achieved in media at an excellent level with the average score of 4.57 and quality of contents at an excellent level with the average score 4.93; 2) the students who learned via digital technology had an average the pre-test score of 64.75 points and post-test scores 79.70 points, respectively, when comparing the pre-test and post-test scores, so that the post-test scores were higher than pre-test scores with statistical significance at the level. 05; and 3) the students were satisfied with digital technology overall the students' satisfaction was found to be at a high level with the average score of 4.44. Teachers only pay attention to teaching, students can only passively receive relevant information, and the flow of information is unidirectional. The central activity of the whole class is "teaching" rather than "learning". Online teaching is to take advantage of the network platform as the carrier of teachers' teaching and students' learning, transcend space constraints, and carry out bilateral teaching activities. The online classroom teaching content mainly focuses on learning the knowledge points related to the chapter of "line plane parallelism" in solid geometry and training classroom exercises. The knowledge points mainly include the recognition of the spatial position of line plane parallelism, the determination and property theorems of line plane parallelism. Significant recommendations or research findings useful for mathematics teachers:

1. Utilization of digital technology in teaching mathematics: Teachers can utilize various applications and computer programs to enhance students' learning experiences in the classroom. Emphasis should be placed on making learning more engaging and effective.

2. Use of data and data analysis: Teachers can use data obtained from digital technology usage in teaching to improve their teaching methods. This data can be used to adjust lesson plans and respond to students' needs effectively.

3. Creation and sharing of learning content: Teachers can use digital technology to create engaging and effective learning content. They can also share this content with other teachers to serve as references and share best teaching practices within the mathematics teaching community.

4. Enhancement of technology skills for teachers: Teachers should receive training and support in using digital technology for teaching. Focus should be on developing skills and fostering creativity in using these technologies for teaching mathematics in the classroom.

เรื่องที่ 2 Exploring English Learning Preferences among Chiang Rai Rajabhat University Students: A Research Inquiry มีสาระสำคัญสรุปได้ดังนี้ In the dynamic tapestry of our contemporary global context, education assumes a pivotal role, orchestrating the metamorphosis, progression, and transmission of knowledge across generations. Responding to this challenge, the English language has ascended as a lingua franca, traversing cultural and geographical borders to serve as a global conduit for communication in realms such as politics, education, and cultural exchange. This study explores the dynamics of learners' learning styles in Chiang Rai Rajabhat University (CRRU) English language courses. Employing qualitative techniques such as surveys and interviews, it identifies common learning styles, differences in English proficiency levels, and efficient teaching approaches. The thematic analysis highlights connections between language proficiency and learning styles, revealing illuminating patterns about student preferences. The findings have applications for educators, emphasizing the necessity of customized strategies to address the heterogeneous nature of the learning environment. Furthermore, by providing comprehensive insights into learning patterns, this study significantly enhances English language instruction at CRRU. These discoveries can be leveraged by educators to craft inclusive and adaptable teaching methodologies that cater to diverse student preferences. The research underscores the necessity for Chiang Rai Rajabhat University to embrace a more efficient and responsive English language instruction paradigm which recognizing the importance of accommodating various learning styles. The research endeavors to provide insights into the dynamic relationship between students' educational backgrounds and their learning styles in English, anticipating implications for educational practices in our interconnected world.



This passage addresses the various learning styles of pupils from China, Shan, and Thailand. It highlights how important it is to comprehend these preferences, which are influenced by things like cultural background and educational history, to properly meet the unique demands of each student.

The results highlight the significance of teachers addressing the linguistic and emotional dimensions of language acquisition to establish safe spaces that reduce embarrassment. Furthermore, the study contrasts the learning techniques of Thai, Chinese, and Shan pupils, exposing a variety of cultural impacts on language learning. In 2019, Holliday and Amadasi made the argument that the growth of the student's learning process might be impacted by the community's variety in terms of culture, identity education (teaching methods), and consideration of cultural differentiation during the learning process. Similar findings to those of Yurtsever and Ozel (2021) indicate that while learning techniques vary due to cultural quirks and educational frameworks, there are also commonalities. This underscores the necessity for nuanced understanding to promote successful language instruction in various cultural contexts.

The findings from this research project offer valuable insights into the diverse learning styles of students from Myanmar, Thailand, and China at Chiang Rai Rajabhat University, particularly focusing on English language acquisition. By examining the interplay between cultural contexts and individual learning preferences, this study contributes to the existing literature on cross-cultural research in education. In conclusion, our study at Chiang Rai Rajabhat University highlights the complex interactions between cultural circumstances and personal preferences to offer a comprehensive view of students' English learning patterns. Students from China, Thailand, and Myanmar exhibit a wide variety of techniques, which highlights the necessity for specialized teaching approaches. Gupta (2023) highlights that the increasing demand for practical, communicative language skills, coupled with the evolving landscape of technology-driven learning, underscores the necessity for English language education to adopt a flexible and inclusive approach. According to DeCapua and Wintergerst (2016), effective cross-cultural education relies on an understanding of how cultural backgrounds influence learning, thereby providing crucial context to discussions surrounding inclusive language learning environments.

เรื่องที่ 3 Graduation Probability Among Undergraduates at Ramkhamhaeng University: Using Data Analytics to Settle the Age-Old Question มีสาระสำคัญสรุปได้ดังนี Ramkhamhaeng University is a public, knowledge market university with open-door policy in Thailand. The flagship campus is located in Bangkok, Thailand. The main academic faculties of the University include Law, Business Administration, Humanities, Education, Science, Political Science, Economics, Mass Communication, and Human Resource DevelopmentUndergraduate education enrollment is growing worldwide. In 2021, there were approximately 220 million students enrolled in formal post-secondary education worldwide, and the number is projected to grow to 380 million by 2030. Difficulty is an inherently subjective construct with no standard approach to its measurement. Previous authors have used measures such as average self-reported hours of study and class preparation. Four-year graduation rates are often used to measure the performance of universities based on the notion that the higher graduation rate reflects the higher accountability of institutions. Undergraduate education enrollment is growing worldwide, and the question of "Is [insert field here] a "difficult" major?" still does not have a reliable answer. The objective of this study is to compare the difficulty of 4-years undergraduate programs at Ramkhamhaeng University, using the graduation rate as a proxy measure. The author extracted open-access data on enrollment of the 2017 cohort and the number of graduates in the 2021 commencement from the University's website and analyzed data using descriptive statistics. The author found that more than 32,000 enrolled in the 2017 cohort of undergraduates at Ramkhamhaeng University, with the highest enrollment in the Faculty of Political Science (nearly 10,000). At the 2021 commencement, there were more than 11,000 graduates (overall graduation probability = 36%). The Faculties of Science and Economics had the lowest graduation probabilities (less than 15% each), whereas the Faculty of Political Science had the highest graduation probability (approximately 54%). The low enrollment in the Faculty of Science might have reflected a gap in STEM education in Thailand. Science and Economics could be considered as the faculties with higher levels of difficulty within Ramkhamhaeng University, whereas the Faculty of Political Science could be considered as the opposite. However, the system for program transfers could have

introduced bias to the study findings, and the unique context of Ramkhamhaeng University limits the generalizability of the study findings. In the 2017 cohort at Ramkhamhaeng University, more than 32,000 students enrolled, three-fourths of whom were at the Main Campus in Bangkok (*Table 2*), the vast majority in the social sciences and humanities (Law, Political Science, Mass Communication, Humanities) and just over 3 percent at the Faculty of Science. At the 2021 commencement, there were more than 11,000 graduates, thus the overall graduation probability was 36 percent. There were wide variations in graduation probability by Faculty, as well as within each faculty. Science and Economics were the faculties with the lowest graduation probabilities, whereas Political Science was the faculty with the highest graduation probability.

เรื่องที่ 4 Using 5E Teaching Method to Improve Mathematics Learning Ability for Primary School Students มีสาระสำคัญสรุปได้ดังนี้ Teaching method is a strategy to develop learners' skills to match the demands of a changing society. According to the Outline of Curriculum Reform of Basic Education. Mathematics curriculum standards point out that mathematics learning should be an active and in-depth way of learning and cannot rely solely on imitation and memorization. On the contrary, students should truly understand and master the basic knowledge and skills of mathematics through hands-on practice, independent analysis and cooperative communication, and develop mathematical ideas and methods. Primary school is a key period to cultivate students' learning ability, including students' learning motivation, perseverance and ability, and students' learning efficiency, learning results and comprehensive quality are closely related. Adopting effective teaching methods is very important to improve students' learning ability in mathematics, and it is an important prerequisite to cultivate students' good learning habits, increase their knowledge and improve their learning quality. The objectives of this study were 1) to use 5E teaching method to improve mathematics learning ability for primary school students; 2) to compare mathematics learning ability before and after the implementation base on 5E teaching. The sample group consists of 50 students from 3/1 class of third grade students of Heyuan No. 4 Primary School, who were selected through the whole cluster random sampling method. The research instruments included 1) lesson plans for using the 5E teaching model and 2) mathematics learning ability measurement scales. The data were statistically analyzed using mean, standard deviation and t-test for dependent samples. The results showed that: 1) the study found that the 5E teaching method can improve mathematics learning ability; 2) after adopting the 5E teaching method, the mathematics learning ability of primary school students was significantly higher than before class, with statistical significance reaching the 0.01 level.

เรื่องที่ 5 Model for Optimizing Night Market Dynamics: A 4C Marketing Analysis of Seller and Buyer มีสาระสำคัญสรุปได้ดังนี้ Night markets in Bangkok, with kaleidoscope of colors, diverse offerings, and bustling energy, have become emblematic of the city's cultural and economic vibrancy. These markets serve as pivotal spaces where sellers and buyers converge in a dynamic exchange of goods, services, and cultural experiences. Night markets and flea markets have become integral components of Bangkok's cultural, economic, and social landscape, offering a unique blend of traditional and contemporary experiences. This literature review delves into key themes and insights from academic studies and research articles that explore the multifaceted aspects of night markets and flea markets in the vibrant city of Bangkok. This research aims to investigate the 4C marketing mix factors influencing both buyers and sellers in night markets in Bangkok and analyze their impact on destination loyalty intentions. Data were gathered through questionnaires administered to 385 buyers and 385 sellers across various night markets in Bangkok, encompassing Chatuchak Night Market, Srinakarin Train Market, Ratchada Train Market, Liap Duan-Ramintra Market, and Jod Fair Rama 9 Market. The results obtained from multiple regression analysis indicate that customer factors, price, convenience, and communication significantly influence loyalty in service utilization. These factors exhibit predictive coefficients of 43 percent (R²=0.433) for repeat travel and 40 percent (R²=0.395) for word of mouth among buyers. Similarly, the analysis of sellers' customer factors, price, convenience, and communication in relation to loyalty in service utilization reveals predictive coefficients of 36 percent (R²=0.364) for repeat sales and 45 percent (R²=0.453) for word of mouth at the market. Integration of the findings with the existing literature offers actionable insights for market owners seeking to enhance seller development and attract more buyers. Guided by the 4C concept, the recommended strategies include increasing buyer and seller participation, improving product quality, ensuring transparent pricing, providing special offers, enhancing transaction channels, creating systematic routes for convenience, and bolstering marketing communication channels while actively seeking customer feedback. These recommendations contribute to the ongoing scholarly discourse and provide practical directions for market owners in optimizing night market dynamics. From preserving tradition and fostering entrepreneurship to contributing to urban revitalization and addressing contemporary challenges, the literature underscores the multifaceted nature of these markets. As Bangkok continues to evolve, ongoing research in these areas is crucial for informing policies, fostering sustainable development, and ensuring the continued vibrancy of night

markets in the city.



This study investigates the 4C dimensions of buyers and sellers participating in night markets in Bangkok. The research aims to elucidate the buying behavior, preferences, and insights of buyers, an aspect that remains unexplored in the existing body of knowledge. Furthermore, the perspectives of sellers, inclusive of their opinions regarding market dynamics, have not been adequately addressed in scholarly discourse. Given the gap in the current understanding of these dynamics, interviews are proposed to be conducted.

The Organic Raw Milk Production Responding to the Bio Circular Green Economy Model in Saraburi Province, Thailand: From Beginning to Practice

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Abstract

Organic raw milk production is a key component of the Bio Circular Green Economy (BCG) Model in Saraburi Province, Thailand. The research objectives focused on factors affecting the technical efficiency and efficiency scales of the organic raw milk production in Saraburi province base area. The quantitative research was applied. The study population was 1,260 dairy farmers in Saraburi province. The purposive sampling technique was applied. With the inclusion criteria of farmers who operated their dairy product with BCG model, it turned out of 390 samples. The primary data were collected from dairy farmers applying the questionnaire as data collection tool. The Stochastic Production Frontier Analysis (SPFA) was exploited to determine the estimated parameters, factors affecting and Technical Efficiency (TE) of organic raw milk production. The findings showed that variable costs and fixed costs of organic raw milk production in the base area of Saraburi Province had a positive impact on organic raw milk output with statistical significance at the 99 percent and 95 percent levels respectively. This indicated that an increase in variable costs leads to an increase in organic raw milk production. The average technical efficiency (TE) score for organic raw milk production was 0.845, indicating a high level of efficiency. According to the results of the Stochastic Production Frontier model, efficiency scores ranged from high to very high. Specifically, 210 producers (53.846 percent) demonstrated high technical efficiency, while 146 producers (37.436 percent) achieved very high technical efficiency. The successfulness of organic raw milk production is driven by the adoption of technology and innovation and creating environmentally friendly farm practices for long-term sustainability.

Keywords: Organic Raw Milk, Bio Circular Green Economy Model, Technical Efficiency

Introduction

The inclusion of organic raw milk production within Thailand's Bio-Circular Green Economy (BCG) Model marks a strategic shift towards sustainable development, balancing economic growth, environmental protection, and social welfare. This initiative has evolved from concept to practice. The BCG Model in Thailand emphasizes efficient use of biological resources, promotes the circular economy and addresses environmental issues. It aligns with the country's commitment to sustainable

development and the United Nations' Sustainable Development Goals (SDGs). Organic raw milk production fits seamlessly into this framework, as it prioritizes natural farming methods, minimizes chemical use, and supports sustainable agricultural practices (National Economic and Social Development Council, 2024).

Nowadays, Thailand's Bio-Circular Green Economy (BCG) Model aims for sustainability by incorporating biological, circular, and green principles into economic development. It focuses on efficient resource use, low-carbon initiatives, and minimizing waste, all in line with the country's commitment to the United Nations' Sustainable Development Goals (SDGs) (National Economic and Social Development Council, 2024). Organic raw milk production is a key component of the BCG Model, supporting eco-friendly farming practices, lowering greenhouse gas emissions, and promoting social well-being. This article explores the development of organic milk production in Thailand, tracing its origins and its integration into the BCG framework (National Economic and Social Development Council, 2024).

The beginning of organic raw milk production has been emerged with the health and sustainability trends of Thai people. In the past decade, Thai consumers have become more healthconscious, leading to a growing demand for organic and chemical-free food products, including milk (Kaewwongsa et al., 2022). This shift in consumer preferences has accelerated the adoption of organic farming practices. The Thai government, in partnership with NGOs and agricultural cooperatives, has supported organic farming initiatives. Policies from the Ministry of Agriculture and Cooperatives have focused on promoting sustainable livestock farming and providing certification programs (Ministry of Agriculture and Cooperatives, 2019). With the economic Potential, the export market for organic dairy products has created opportunities for farmers to transition to organic practices, driven by the potential for premium pricing and access to niche markets (Food and Agriculture Organization, 2024) The implementation in practice of Thai organic raw milk production has effectively been incorporated into the BCG Model through the following practices: 1) the organic farming practices which expressed as farmers adopted organic practices by removing the use of chemical fertilizers, antibiotics, and synthetic pesticides. The cows are provided with organic-certified feed and allowed to graze on free-range grass, promoting animal welfare (Kaewwongsa et al., 2020), 2) the circular economy integration explicated with the implementation of manure recycling. Cow manure is converted into organic fertilizers, minimizing waste and improving soil health (Ministry of Agriculture and Cooperatives, 2019). Biogas Production: Livestock waste is transformed into biogas, a renewable energy source, which is either used for farming activities or sold locally (United Nations Development, 2021), 3) community-based models was functioned as Cooperatives like the Thai Dairy Cooperative Federation (TDCF) assist farmers in accessing resources, exchanging knowledge, and consolidating organic products to improve market access (Food and Agriculture Organization, 2020), 4) organic raw milk production assessed to the certification and market development. Certified organic raw milk is sold under organic labels both locally and internationally, with certifications from

organizations such as the Organic Agriculture Certification Thailand (ACT). Niche markets, including health-conscious consumers and high-end exports, contribute to driving sales (National Economic and Social Development Council, 2024)

Despite its success, the production of organic raw milk faces several challenges of the high cost of production. Farmers faced significant expenses when shifting from conventional to organic farming including the costs of organic feed and certification (Kaewwongsa et al., 2020). Another issue was expressed as knowledge and skill gaps. Smallholder farmers often lacked the technical knowledge needed to adopt sustainable practices, making the transition difficult (Ministry of Agriculture and Cooperatives, 2024). Also, the organic sector struggles to compete with lower-priced conventional milk, hindering its growth.

To strengthen the synergy between organic raw milk production and the BCG Model with technology adoption. Farmers were introduced smart farming technologies to boost efficiency and lower production costs along with enhance subsidies, training programs, and financial support to assist farmers in transitioning to organic practices (United Nations Development, 2021). Also, the consumer awareness was launched public campaigns that emphasize the health and environmental advantages of organic milk.

At the present time, Thailand's organic raw milk production is in line with the principles of the Bio-Circular Green Economy (BCG) Model by promoting sustainable agricultural practices, aiding rural communities, and supporting environmental conservation. With targeted policy support and market expansion, organic milk production could be a key driver in Thailand's path toward sustainable development.Since, organic raw milk production was implanted and supported by the Royal Thai government in many places around Thailand. Saraburi province located in the central part of Thailand was one of several provinces of implemented area base. Bank for Agriculture and Agricultural Cooperatives (2025) reported that the growth of organic raw milk production in Saraburi Province, following the Bio-Circular-Green Economy model, has promoted sustainability within the raw milk sector. Farmers in the area have received assistance in adopting chemical-free and contaminant-free dairy farming practices, resulting in a monthly output of 129,600 kilograms of organic raw milk. This increase in production has also led to higher earnings for farmers, as they can sell their organic milk at a premium price compared to conventional milk. Saraburi Province is the leading dairy-producing region in Thailand, where some farmers have transitioned to organic practices.

The successfulness in this sector is driven by the adoption of technology and innovation in cattle breeding and rearing, prioritizing animal welfare, and creating environmentally friendly farm practices for long-term sustainability. Farmers are encouraged to enhance self-reliance, minimize dependence on imported materials, and focus on producing high-quality animal feed. Meanwhile, the government is urged to provide support and raise awareness about the benefits of consuming organic milk (Bank for Agriculture and Agricultural Cooperatives, 2025).

Addressing the research, the aim of this research paper attempted to measure the technical efficiency (TE) of organic raw milk production in Saraburi province base area to make sure that the organic raw milk production project supported by the Royal Thai Government obtained the technical efficiency (TE) for the project implementation which also made the confirmation that this project met the requirement of TE for the on-going project supporting by the Royal Thai Government. Theatrically, the stochastic production frontier was adopted as the tool for TE measurement. Technical efficiency (TE) refers to the ability of a production unit, such as a farm, to produce the maximum output (raw milk) from a given set of inputs such as feed, labor and capital. In the context of raw milk production, measuring technical efficiency helps identify whether dairy farmers are utilizing resources optimally and where improvements can be made to enhance productivity. (Kaewwongsa, P., et al, 2020).

The research results could be applied to support the organic raw milk production which offered several benefits of higher nutritional value, free from synthetic hormones, antibiotics, and pesticides lead to the sustainable farming practices. The integration of the Bio-Circular-Green (BCG) Economy Model into organic raw milk production obtained several advantages such as the enchantment of animal health, the research results would support and drive into probiotic-rich dairy products, bio-fermentation, and value-added organic dairy products. Cows in good health require fewer antibiotics, resulting in cleaner and safer milk. Transforms cow manure into organic fertilizer or biogas, creating a sustainable waste cycle.

Objectives

The research objective was focused on factors affecting the measurement of technical and scale Efficiency of the organic raw milk production in Saraburi province base area.

Hypothesis

Dairy farmers who performed organic raw milk production responding to BCG model achieved the technical efficiency.



Materials and Methods

The methodology was survey research applying the econometric methodology to estimate the organic raw milk production efficiency in Saraburi Province, Thailand exploiting the Stochastic Production Frontier Model to determine factors and the level of technical efficiency affecting the organic raw milk production efficiency.

Data Collection

The study population was composed of 1,260 dairy farmers in Saraburi province. The research in this study collects primary data obtained from the online questionnaire survey of organic raw milk producers in Saraburi province area base. The purposive sampling technique was applied as the inclusion criterions of dairy farmers who performed their or organic raw milk production over 2 years continuously. It turned out of 390 farmers which covered 13 districts in Saraburi province.

| Districts in Saraburi Province | Number of Samples (Dairy Farm | ers' | | | |
|--------------------------------|-------------------------------|------|--|--|--|
| | Households) | | | | |
| 1. Mueang Saraburi | 30 | | | | |
| 2. Kaeng Khoi | 30 | | | | |
| 3. Nong Khae | 30 | | | | |
| 4. Wihan Daeng | 30 | | | | |
| 5. Nong Saeng | 30 | | | | |
| 6. Ban Mo | 30 | | | | |
| 7. Don Phut | 30 | | | | |
| 8. Nong Don | 30 | | | | |
| 9. Phra Phutthabat | 30 | | | | |
| 10. Sao Hai | 30 | | | | |
| 11. Muak Lek | 30 | | | | |
| 12. Wang Muang | 30 | | | | |
| 13. Chaloem Phra Kiat | 30 | | | | |
| Total | 390 | | | | |

Table 1. Number of Samples of organic raw milk producers in Saraburi province area base

Source: The Researcher's Calculation



Figure 1. Map of Saraburi with 13 districts Source: https://en.wikipedia.org/wiki/Saraburi_province

According to figure 1, the geographic of Saraburi province is composed of 13 districts where the primary data were collected from. Theses 13 districts are: 1) Mueang Saraburi, 2) Kaeng Khoi, 3) Nong Khae, 4) Wihan Daeng, 5) Nong Saeng, 6) Ban Mo, 7) Don Phut, 8) Nong Don, 9) Phra Phutthabat, 10) Sao Hai, 11) Muak Lek, 12) Wang Muang, and 13) Chaloem Phra Kiat. The primary data were collected from 13 districts with equal numbers of 30 respondents. It turned out of the total numbers of 390 samples as sample size (Table1.)

Data Analysis

The research used cross-sectional primary data, analyzed to meet its objectives as follows:

Quantitative analysis

The study applied the Stochastic Production Frontier (SPF) method to evaluate the technical production efficiency of organic raw milk production in Saraburi Province. The analysis involved parameter estimation using the Maximum Likelihood method to determine their efficiency levels within the stochastic production model framework.

$$y_i = f(x_i; \beta).exp(v_i - u_i)$$
⁽¹⁾

Where:

 y_i is the output for the i^{th} firm in terms of the natural logarithm χ_i is a vector of inputs in terms of the natural logarithm

 β is a vector of parameters to be estimated.

 \mathcal{V}_i is the stochastic error term (assumed to be normally distributed).

 u_i is the inefficiency term (usually assumed to be non-negative).

In this research work the Stochastic Production Frontier could be expressed as follow: The output is expressed as:

 y_i is the maize output for the i^{th} household in terms of the natural logarithm The inputs are expressed as:

 $ar{\chi_1}$ is a vector input of concentrated feed cost in terms of the natural logarithm

 χ_2 is a vector input of labor cost in terms of the natural logarithm

 χ_3 is a vector input of roughage cost in terms of the natural logarithm

 $ar{\chi}_4$ is a vector input of milk transportation cost in terms of the natural logarithm

 $oldsymbol{\chi_5}$ is a vector input of consumable material costs in terms of the natural logarithm

 $oldsymbol{\chi_6}$ is a vector input of treatment and medical expenses in terms of the natural logarithm

 $oldsymbol{\chi_7}$ is a vector input of repair and maintenance costs in terms of the natural logarithm

 χ_8 is a vector input of water cost in terms of the natural logarithm

 χ_9 is a vector input of electricity costs in terms of the natural logarithm

 χ_{10} is a vector input of fuel costs in terms of the natural logarithm

 $oldsymbol{\chi_{11}}$ is a vector of miscellaneous and other expenses in terms of the natural logarithm

 $\pmb{\chi_{12}}$ is a vector input of opportunity cost of capitals in terms of the natural logarithm

 χ_{13} is a vector of insemination cost in terms of the natural logarithm

 $m{\chi_{14}}$ is a vector of depreciation cost of buildings and equipment in terms of the natural logarithm

 x_{15} is a vector of opportunity cost of buildings and equipment in terms of the natural logarithm

 x_{16} is a vector of land rental cost in terms of the natural logarithm β is a vector of parameters to be estimated.

 \mathcal{V}_i is the stochastic error term (assumed to be normally distributed).

 u_i is the inefficiency term (usually assumed to be non-negative).

Results

Part1 The estimation of factors affecting technical production efficiency of organic raw milk production in Saraburi Province, Thailand

The estimation of parameters based on the Stochastic Production Frontier equation using the Maximum-Likelihood method is Table 2 as follows:

 Table 2. Factors Affecting Technical Production Efficiency of Organic Raw Milk

 Producers in Phetchabun Province, Thailand

(n. = 390)

Dependent Variable (y): Organic Raw Milk Production

| | Esti | | t-value |
|--|----------------|--------------|-----------------------|
| Independent | mated | Coefficients | |
| Variables | Parameters | | |
| Stochastic Frontier | | | |
| Constant term | β _o | -236.860 | (39.252) |
| Concentrated feed $cost(x_1)$ | β_1 | 34.270 | (34.627)** |
| Labor cost (x_2) | β_2 | 54.670 | (23.425)** |
| Roughage cost (x_3) | β_3 | 29.290 | (18.602)** |
| Milk transportation $cost (x_4)$ | β_4 | 19.481 | (23.146)** |
| Consumable material (x_5) | β_5 | 11.546 | (22.462) [*] |
| Treatment and Medical expenses (x_6) | β_6 | 23.264 | (32.164) [*] |
| Repair and maintenance costs (x_7) | β ₇ | 16.412 | (24.126) [*] |
| Water Cost (x ₈) | β ₈ | 18.641 | (32.621) [*] |
| Electricity costs (x_9) | β, | 16.142 | (41.213)** |

| Fuel costs (x_{10}) | | | (19.143)** |
|---|--------------|--------|-----------------------|
| | β_{10} | 21.245 | |
| Miscellaneous and other expenses (x_{11}) | β_{11} | 24.168 | (22.463) [*] |
| Opportunity cost of capital (x_{12}) | β_{12} | 18.246 | (23.164)** |
| Insemination cost (x ₁₃) | β_{13} | 20.412 | (18.154) [*] |
| Depreciation cost of buildings and equipment (x_{14}) | β_{14} | 26.156 | (18.942) [*] |
| Opportunity cost of buildings and equipment (x_{15}) | β_{15} | 18.641 | (19.126)** |
| Land rental cost (x ₁₆) | β_{16} | 12.461 | (23.246)* |

**Statistical Significance at 99 percent

*Statistical Significance at 95 percent

Noted: Variables were expressed in a Natural logarithm form

According to table 2, the statistical results expressed that both variable costs and fixed cost of organic raw milk production in Saraburi province base area had positive impact on the organic raw milk production at the 99 and 95 percent Statistical Significance respectively. This indicated that the increase of all variable cost of organic raw milk would increase the organic raw milk production as well. In this research outcomes, the variable costs were comprised of 13 factors which were: concentrated feed, labor cost, roughage, milk transportation cost, consumable material costs, treatment and Medical expenses, repair and maintenance costs, water cost, electricity cost, fuel costs were composed of 3 factors which were depreciation cost of buildings and equipment, opportunity cost of buildings and equipment and land rental cost. Table 3. The level of technical efficiency of the organic raw milk in Saraburi Province, Thailand

| • | , | | | | | | | |
|------------|--------|-----------|----------|-----------|---|---------|--------|------------|
| Lev | el of | Technical | | Technical | | | Number | Percentage |
| Efficiency | | | Efficier | ncy Value | | of Farn | ners | |
| Ver | / low | | | (0.0000 | - | | 2 | 0.513 |
| | | | 0.5000) |) | | | | |
| Low | | | | (0.5001 | - | | 10 | 2.564 |
| | | | 0.6000) |) | | | | |
| Мос | lerate | | | (0.6001 | - | | 22 | 5.641 |
| | | | 0.8000) |) | | | | |
| Higl | ı | | | (0.8001 | - | | 210 | 53.846 |
| | | | 0.9000) |) | | | | |
| Ver | / High | | | (0.9001 | - | | 146 | 37.436 |
| | | | 0.9999) |) | | | | |
| Tota | al | | | | | | 390 | 100.000 |
| Мах | imum | | | 0.921 | | | | |
| Min | mum | | | 0.438 | | | | |
| Ave | rage | | | 0.845 | | | | |

Source: The Researcher's Calculation

According to table 3, the technical efficiency scores of organic raw milk production in Saraburi province of Thailand were ranged from 0.438 to 0.921. The average efficiency score expressed as 0.845 which was in the high technical efficiency score. The research findings from the Stochastic Production Frontier model revealed that the efficiency scores for organic raw milk production ranged from high to very high. There were 210 producers of organic raw milk production in the high level of Technical Efficiency which accounted for 53.846 percent. Also, there were 146 producers of organic raw milk production in the very high level of technical efficiency which accounted for 37.436 percent. In addition, there were 2, 10 and 22 producers of organic raw milk production in very low, low and moderate level of technical efficiency which accounted for 0.513, 2.564 and 5.641 percent respectively.

Conclusions and Discussion

(n=390)

Organic raw milk production plays a vital role in the BCG Model, fostering sustainable farming methods, reducing greenhouse gas emissions, and enhancing social welfare. This article delves into the evolution of organic milk production in Thailand, highlighting its origins and incorporation into the BCG framework.

This research aimed to evaluate the technical efficiency (TE) of organic raw milk production in the base area of Saraburi Province. The goal was to ensure that the organic raw milk production project, supported by the Royal Thai Government, achieved the required TE for effective project implementation. Additionally, the evaluation confirmed that the project met the necessary TE standards for its continued government support. To achieve this, the stochastic production frontier method was employed as the primary tool for measuring technical efficiency. The statistical analysis revealed that both variable costs and fixed costs of organic raw milk production in the base area of Saraburi Province had a positive impact on organic raw milk output, with statistical significance at the 99 percent and 95 percent levels respectively. This indicates that an increase in variable costs leads to an increase in organic raw milk production.

The research findings identified 13 factors contributing to variable costs: concentrated feed, labor costs, roughage, milk transportation costs, consumable materials, treatment and medical expenses, repair and maintenance costs, water costs, electricity costs, fuel costs, miscellaneous expenses, opportunity cost of capital, and insemination costs. Fixed costs were categorized into three components: depreciation of buildings and equipment, opportunity costs of buildings and equipment, and land rental costs. The research found that the average technical efficiency (TE) score for organic raw milk production was 0.845, indicating a high level of efficiency. According to the results of the Stochastic Production Frontier model, efficiency scores for organic raw milk production ranged from high to very high. Specifically, 210 producers (53.846 percent) demonstrated high technical efficiency, while 146 producers (37.436 percent) achieved very high technical efficiency.

The research findings were consistent with the study of Madau, F.A., Furesi, R. and Pulina, P. (2024) who studied technical efficiency and total factor productivity changes in European dairy farm sectors focusing the organic dairy farms. In according with Linehan, K., Patangia, D.V. Ross, R.P., and Stanton, C. (2024) found that milk is one of the most valuable products in the food industry with most milk production throughout the world being carried out using conventional management, which includes intensive and traditional systems. The intensive use of fertilizers, antibiotics, pesticides and concerns regarding animal health and the environment have given increasing importance to organic dairy and dairy products in the last two decades. The research findings were consistent with the study of Grodkowski, G. et al. (2024) who studied organic milk production and dairy farming constraints and prospects under the laws of the European Union who addressed that consumers are increasingly opting for organic farming products, driven by the belief that organic farming avoids the use of pesticides and antibiotics while ensuring optimal living conditions for animals. The differences between organic and conventional dairy cattle housing systems focused on welfare assessment, breed selection, and product quality. Their findings indicated that cows raised in organic systems generally experience better welfare compared to those in conventional systems. In addition, the research findings were consistent with Yu, Z. et al. (2023) who conducted their research on production efficiency of raw milk and its determinants: Application of Combining Data Envelopment Analysis and Stochastic Frontier Analysis. They found that raw milk production efficiency is significantly influenced by various factors, including the proportion of concentrate to roughage consumption, medical and epidemic prevention investment, the price of raw milk, the wage level, and fixed assets.

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The Measurement of Technical and Scale Efficiency of Maize **Production of Agricultural Cooperatives in Loei Province, Thailand** Anucha Wittayakorn-Puripunpinyoo^{1*}

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Abstract

Loei province contributes significantly to Thailand's total maize output with production primarily focused on feed maize. The research objectives focused on measuring the technical and scale efficiency of maize production of agricultural cooperatives in Loei Province. The study population was 35 agricultural cooperatives. The purposive sampling technique was applied. It turned out of 10 agricultural cooperatives as the sample size. Data were collected from the Cooperative Auditing Department from 2020 to 2024. Technical and scale efficiency were examined by the Data Envelopment Analysis (DEA) model. The findings expressed that 6 out of 10 agricultural cooperatives achieved the technical efficiency of maize production with an efficiency score of 1.00 which expressed these agricultural cooperatives operated their maize production with technical efficiency. On the other hand, there were 4 out of the agricultural cooperatives achieved the technical efficiency of maize production with an efficiency score of less than 1.00. This meant that these agricultural cooperatives operated maize production under the technical efficiency. There were 3 agricultural cooperatives, Tha Li Agricultural Cooperative Limited, Dan Sai Agricultural Cooperative Limited, and Na Duang Agricultural Cooperative Limited would decrease their inputs of maize production to get the maximum total revenue. On the other hand, there was only one agricultural cooperative, Tha Li Agricultural Cooperative Limited would increase their inputs of maize production to get the maximum total revenue. The findings would lead agricultural cooperatives to be the import area of maize production in Thailand.

Keywords: Technical Efficiency, Scale Efficiency, Maize Production, Agricultural Cooperatives

Introduction

Maize (Zea mays L.), also known as corn, is one of the most widely grown crops globally, with a crucial role in food security, livestock feed, and industrial applications. Research on maize production focuses on enhancing yield, combating pests and diseases, and mitigating the effects of climate change (Pingali, 2001). In addition, maize is a staple food for more than 1 billion people worldwide. Its adaptability to diverse agro-climatic conditions and high yield potential make it a key crop for ensuring food security. In addition, maize contributes significantly to the livestock feed industry and biofuel production (Pingali, 2001), (Farooq & Kadambot, 2009).

In Thailand, Maize is one of the major crops cultivated in Thailand, primarily used as animal feed, especially in the poultry and livestock industries. It ranks among the top export commodities for the country and plays a significant role in the agricultural economy. However, maize production in Thailand faces challenges related to land use, environmental sustainability, and global market competition (Food and Agriculture Organization, 2022). Maize contributes significantly to Thailand's agricultural sector, particularly as a feed crop for the growing poultry and livestock industries. In 2022, Thailand produced approximately 5 million tons of maize, with most of it consumed domestically to support the country's animal feed industry (Food and Agriculture Organization, 2022). Over 90% of maize produced in Thailand is used in animal feed industries. A smaller portion is exported to neighboring countries such as Vietnam and the Philippines. Maize starch is used in the production of food and beverages. (Rerkasem, 2016), (Food and Agriculture Organization, 2022).

The major maize-growing regions in Thailand are Chiang Mai, Chiang Rai, and Nan the Northern region of Thailand leads in maize cultivation due to favorable soil and climatic conditions. In the Northeastern region of Thailand, Loei and Nakhon Ratchasima are also significant contributors. Also in the Western region of Thailand, Kanchanaburi, and Tak are emerging regions for maize production (Rerkasem, 2016), (Food and Agriculture Organization, 2022).

Loei, a province in northeastern Thailand, plays a significant role in the country's maize production. Known for its mountainous terrain, diverse climate, and fertile soils, Loei has emerged as one of the key regions for growing maize, primarily for animal feed. The province's maize farming contributes to Thailand's broader agricultural economy, especially in meeting the increasing demand for livestock feed (Office of Agricultural Economics, 2022).

Figure 1. Map of Loei Province, Thailand Source: https://en.wikipedia.org/wiki/Loei_province

Figure 2. Map of 14 Districts in Loei Province, Thailand Source: https://en.wikipedia.org/wiki/Loei province

According to figure 2, Loei province is comprised of 14 districts which are: 1) Mueang Loei, 2) Na Duang, 3) Chiang Khan, 4) Pak Chom, 5) Dan Sai, 6) Na Haeo, 7) Phu Ruea, 8) Tha Li, 9) Wang Saphung, 10) Phu Kradueng, 11) Phu Luang, 12) Pha Khao, 13) Erawan, and 14) Nong Hin.

Loei's geography and climate make it well-suited for maize farming. The province experiences a tropical savanna climate, characterized by a pronounced rainy season and a cooler dry season. Most maize in Loei is grown during the rainy season from May to October which provides the necessary water supply for crop growth. Due to its hilly topography, maize fields in Loei often utilize terrace farming to minimize soil erosion and improve water retention. Farmers predominantly cultivate hybrid maize seeds for higher yields, improved pest resistance, and suitability to Loei's environment. The province's soil, predominantly sandy loam, is ideal for maize cultivation, though consistent use of fertilizers and soil conditioners is needed to maintain fertility (Office of Agricultural Economics, 2022).

Loei contributes significantly to Thailand's total maize output, with production primarily focused on feed maize. The yield in Loei averages around 3.5 to 4 tons per hectare, depending on weather conditions and farming practices (Office of Agricultural Economics, 2022), (Suwankiri & Pannangpetch, 2021).

This research evaluated the technical efficiency of maize production in Loei Province, Thailand, using Data Envelopment Analysis (DEA). DEA, a non-parametric linear programming method, is employed to estimate the efficiency levels of maize farms based on their input-output data. The study identifies the scale efficiency, pure technical efficiency, and overall technical efficiency of maize production through the agricultural cooperatives in Loei province of Thailand.

In this research paper with the information mentioned, the researcher conducted the research paper of the measurement of technical and scale efficiency of maize production of agricultural cooperatives in Loei province, Thailand. This would give a better understanding of the technical efficiency of maize production in Loei province which is crucial for addressing production gaps and improving overall output. Technical efficiency refers to the ability of farmers to maximize output given a specific set of inputs and technologies (Farrell, 1957). The research results would be applied for the maize production guideline for agricultural cooperatives to improve their maize production with technical applied for the utilizing resources optimally to maximize output while minimizing waste of agricultural cooperatives performances. The maize production cost reduction which streamlined their processes of waste reduction and lowering production and operational expenses on maize production to achieve the maximum output level along with existing resources enhances maize production efficiency.

Objectives

The research objectives were to measure the technical and scale efficiency of maize production of agricultural cooperatives in Loei province, Thailand.

Hypothesis

Agricultural cooperatives in Loei province operated their maize production with the technical efficiency expressing their scale efficiency of 1.00.

Concept theory framework

Conceptual framework

Research Methodology

The methodology was quantitative research applying the Data Envelopment Analysis (DEA) Model to measure the technical and scale efficiency of maize production of Agricultural Cooperatives in Loei Province, Thailand.

Data Collection

The study focused on a population of 35 agricultural cooperatives in Loei Province, Thailand. A purposive sampling method was used to select cooperatives that had been continuously producing maize for five years. Based on these criteria, 10 agricultural cooperatives were selected: Muang Loei Agricultural Cooperative Limited, Wang Saphung Agricultural Cooperative Limited, Phu Ruea Agricultural Cooperative Limited, Phu Kradueng Agricultural Cooperative Limited, Tha Li Agricultural Cooperative Limited, Dan Sai Agricultural Cooperative Limited, Na Duang Agricultural Cooperative Limited, Phu Luang Agricultural Cooperative Limited, Pha Khao Agricultural Cooperative Limited, and Erawan Agricultural Cooperative Limited.

Secondary data were obtained from the Cooperative Auditing Department's database for the period 2020–2024. The dataset included the following financial indicators: (1) total revenue, (2) core business costs, (3) operating expenses, (4) inventory, (5) total current assets, (6) long-term investments, (7) total liabilities, (8) share capital, and (9) total cooperative equity. With five consecutive years of time-series data from 10 agricultural cooperatives, the study comprised a total of 50 observations.

Data Analysis

To evaluate the technical and scale efficiency of maize production among agricultural cooperatives in Loei Province, Thailand, the Data Envelopment Analysis (DEA) model was utilized as the analytical tool. The assessment included: (1) technical efficiency based on the Constant Returns to Scale (CRS) DEA (CRSTE), (2) technical efficiency based on the Variable Returns to Scale (VRS) DEA (VRSTE), and (3) Scale Efficiency (SE).

Results

In line with the research objectives, the technical and scale efficiency of maize production among agricultural cooperatives in Loei Province, Thailand, were measured as follows:

| Order | Cooperatives Name | CRSTE | VRSTE | Scale | Explanation |
|-------|--|-------|-------|-------|-------------|
| 1 | Muang Loei Agricultural Cooperative | 1.000 | 1.000 | 1.000 | - |
| | Limited | | | | |
| 2 | Wang Saphung Agricultural Cooperative | 1.000 | 1.000 | 1.000 | |
| | Limited | | | | |
| 3 | Phu Ruea Agricultural Cooperative | 1.000 | 1.000 | 1.000 | - |
| | Limited | | | | |
| 4 | Phu Kradueng Agricultural Cooperative | 0.959 | 0.960 | 0.999 | DRS |
| | Limited | | | | |
| 5 | Tha Li Agricultural Cooperative Limited | 0.917 | 0.928 | 0.988 | IRS |
| 6 | Dan Sai Agricultural Cooperative Limited | 0.894 | 1.000 | 0.894 | IRS |
| 7 | Na Duang Agricultural Cooperative | 0.981 | 1.000 | 0.981 | IRS |

Table1. The technical and scale efficiency of maize production among agricultural cooperatives in Loei Province, Thailand

| | Limited | | | |
|----|---|-------|-------|---------|
| 8 | Phu Luang Agricultural Cooperative | 1.000 | 1.000 | 1.000 - |
| | Limited | | | |
| 9 | Pha Khao Agricultural Cooperative | 1.000 | 1.000 | 1.000 - |
| | Limited | | | |
| 10 | Erawan Agricultural Cooperative Limited | 1.000 | 1.000 | 1.000 |
| | Average | 0.975 | 0.989 | 0.986 |

Source: Calculation

Note: CRSTE = technical efficiency from CRS DEA

VRSTE = technical efficiency from VRS DEA

Scale = scale efficiency = CRSTE/ VRSTE

According to Table 1, there were 6 out of 10 agricultural cooperatives in Loei province achieved the technical efficiency from Constant Return to Scale (CRS), technical efficiency from Variable Return to Scale (VRS), and Scale Efficiency (SE) of 1.00. The 6 agricultural cooperatives were comprised of 1) Muang Loei Agricultural Cooperative Limited, 2) Wang Saphung Agricultural Cooperative Limited, 3) Phu Ruea Agricultural Cooperative Limited, 4) Phu Luang Agricultural Cooperative Limited, 5) Pha Khao Agricultural Cooperative Limited, and 6) Erawan Agricultural Cooperative Limited.

There were 4 out of 10 agricultural cooperatives achieved technical efficiency from Constant Return to Scale (CRS), technical efficiency from Variable Return to Scale (VRS), and Scale Efficiency (SE) less than 1.00 which comprised 1) Phu Kradueng Agricultural Cooperative Limited, 2) Tha Li Agricultural Cooperative Limited, 3) Dan Sai Agricultural Cooperative Limited and 4) Na Duang Agricultural Cooperative Limited.

Phu Kradueng Agricultural Cooperative Limited achieved technical efficiency from Constant Return to Scale (CRS), technical efficiency from Variable Return to Scale (VRS), and Scale Efficiency (SE) of 0.959, 0.960, and 0.999 respectively. The result expressed that Phu Kradueng Agricultural Cooperative Limited would increase the use of maize production inputs which were 1) increasing in share capital, 2) total cooperatives equity, and 3) long-term investments. The share capital was expressed as the total amount of money that the agricultural cooperatives raised by issuing shares to its members or investors. It represents the financial contribution made by shareholders in exchange for ownership stakes in the organization. The total cooperatives equity functioned as the overall financial ownership value of agricultural cooperatives which included members' share capital, retained earnings, and other reserves. It represented the cooperative's net worth after deducting total liabilities from total assets. In addition, **long-term investments** indicated to assets or financial investments that a cooperative or business holds for an extended period, typically longer than one year. These may include stocks, bonds, real estate, or other investments intended to generate returns over time rather than for immediate use or resale.

The Li Agricultural Cooperative Limited achieved technical efficiency from Constant Return to Scale (CRS), technical efficiency from Variable Return to Scale (VRS), and Scale Efficiency (SE) of 0.917, 0.928, and 0.988 respectively.

Dan Sai Agricultural Cooperative Limited achieved technical efficiency from Constant Return to Scale (CRS), technical efficiency from Variable Return to Scale (VRS), and Scale Efficiency (SE) of 0.894, 1.000, and 0.894 respectively.

Na Duang Agricultural Cooperative Limited achieved technical efficiency from Constant Return to Scale (CRS), technical efficiency from Variable Return to Scale (VRS), and Scale Efficiency (SE) of 0.981, 1.000, and 0.981 respectively.

The 3 above agricultural cooperatives in Loei province would decrease the inputs of maize production which were 1) core business cost, 2) operating expenses, 3) inventory, 4) total current assets, and 5) total liabilities.

The decrease in the core business cost indicated the total expenses directly related to the agricultural cooperative's main operations. This included costs such as raw materials, production expenses, labor, and other essential expenditures necessary to sustain the primary business activities.

The decrease in operating expenses was expressed to the costs incurred in the dayto-day operations of agricultural cooperatives. These expenses included salaries, rent, utilities, administrative costs, and other overhead expenses necessary to maintain business activities but were not directly tied to production.

The decrease in inventory indicated the goods, raw materials, and products that agricultural cooperatives hold for production, resale, or daily operations. It included finished products ready for sale, work-in-progress items, and raw materials used in production.

The decrease in total current assets included the sum of all short-term assets that a cooperative can convert into cash or use within one year. These typically included cash and bank deposits, accounts receivable (money owed by customers), inventory (raw materials, work-in-progress, and finished goods), Short-term investments, prepaid expenses (payments made in advance for future expenses), total current assets were crucial for assessing a cooperatives' liquidity and ability to meet short-term financial obligations.

Conclusions and Discussion

Maize (*Zea mays* L.), commonly known as corn, is one of the world's most extensively cultivated crops, playing a vital role in food security, animal feed, and various industrial uses. Studies on maize production primarily aim to improve yield, manage pests and diseases, and address the challenges posed by climate change.

In Thailand, maize is a key agricultural crop primarily grown for use as animal feed, particularly in the poultry and livestock industries. It is also one of the country's major export commodities, contributing significantly to the agricultural sector and overall economy.

Loei, a province in northeastern Thailand, is an important hub for maize production. With its mountainous landscape, diverse climate, and fertile soil, the region has become a key area for cultivating maize, mainly for use as animal feed.

The were 6 out of 10 agricultural cooperatives in Loei Province achieved a technical efficiency score of 1.00 across all three efficiency measures: Constant Returns to Scale (CRS) technical efficiency, Variable Returns to Scale (VRS) technical efficiency, and Scale Efficiency (SE). The 6 agricultural cooperatives were comprised of 1) Muang Loei Agricultural Cooperative Limited, 2) Wang Saphung Agricultural Cooperative Limited, 3) Phu Ruea Agricultural Cooperative Limited, 4) Phu Luang Agricultural Cooperative Limited, 5) Pha Khao Agricultural Cooperative Limited, and 6) Erawan Agricultural Cooperative Limited.

There were 4 out of 10 agricultural cooperatives that demonstrated technical efficiency below 1.00 in Constant Return to Scale (CRS), technical efficiency in Variable Return to Scale (VRS), and Scale Efficiency (SE). These cooperatives include: 1) Phu Kradueng Agricultural Cooperative Limited, 2) Tha Li Agricultural Cooperative Limited, 3) Dan Sai Agricultural Cooperative Limited, and 4) Na Duang Agricultural Cooperative Limited.

The result indicated that Phu Kradueng Agricultural Cooperative Limited should enhance its use of maize production inputs. The Li Agricultural Cooperative Limited, Dan Sai Agricultural Cooperative Limited, and Na Duang Agricultural Cooperative Limited would decrease core business costs, operating expenses, inventory, and total current assets in order to get the maximum total revenue for agricultural cooperatives.

The research results were consistent with Phuphisith, S., Gheewala, S.H. and

Sampattagul, S. (2022) who conducted their study on the promotion of sustainable maize production in Northern Thailand, the country's largest maize-producing region, is crucial to securing the supply of the nation's feed manufacturing, as well as protecting environmental resources, enhancing social welfare, and improving the livelihoods of farmers and communities. According to Chaovanapoonphola, Y, and Somyana, W. (2020) who studied the production efficiency of maize farmers under contract farming in Laos PDR found that the efficiency of contract maize farmers in Lao PDR was on average 0.85 and that the main factors affecting maize production efficiency were the age and education level of the farmer and area of planted land. This research outcomes also were consistent with Khongdee, N., Hilger, T., Pansak, W., and Cadisch, G. (2022) who conducted their works on optimizing maize sowing under irregular rainfall distribution in northern Thailand: A model approach for improved decision-making. Also, the research findings were consistent with Charoenratan, S., Anukul, C, and Rosset, P.M. (2021) found that Northern Thailand was the center of several controversies surrounding changing cropping patterns, in particular related to deforestation driven by the expansion of maize mono-cropping by peasant farmers.

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 - (7) ประโยชน์ที่ได้รับ
 - 7.1 การแลกเปลี่ยนเรียนรู้จากาเข้าร่วมประชุมและการนำเนอผลงานวิจันในระดับนานาชาติ7.2 การสร้างเครื่อข่ายทางวิชาการกับต่างประเทศ เช่น ประเทศเยอรมันนี ประเทศตุรกี เป็นตัน
 - (8) ข้อเสนอแนะ มหาวิทยาลัยสโขทัยธรรมาธิราขควรสนับสนุนการเข้าร่วมประชุมวิชาการนานาชาติแก่ บุคคลากรเพื่อเป็นเวทีในการนำเสนอผลงานวิจัยและการสร้างเครือข่านทางวิชาการในระดับ นานาชาติ

<u>หมายเหตุ</u> 1. กรณีไปฝึกอบรม ดูงาน ประชุม/สัมมนา เป็นหมู่คณะโปรดระบุชื่อผู้ไปร่วมกิจกรรมดังกล่าว ทั้งหมด

และเสนอรายงานในชุดเดียวกัน

2. รายงานควรมีความยาวประมาณ 5 - 10 หน้า และถ้ามีรายงานต่างหากเพิ่มเติมก็ให้แนบไป

ด้วย ทั้งนี้

- เพื่อที่ผู้สนใจซึ่งมิได้ไปฝึกอบรม ดูงาน ประชุม/สัมมนา จะสามารถหาความรู้จากเนื้อหาสาระ ดังกล่าวได้ตามสมควร
- 3. ให้ผู้ที่ได้รับทุนส่งรายงานการฝึกอบรม หรือดูงาน หรือประชุมทางวิชาการ จำนวน 1 ชุด

ใบประกาศบทความวิจัยดีเด่น

The 16" Hatyai National and International Conference

On May 16, 2025

This Certificate is Presented to

Anucha Wittayakorn-Puripunpinyoo

For your participation as Oral Presentation titled

The Measurement of Technical and Scale Efficiency of Maize Production of Agricultural

Cooperatives in Loei Province, Thailand

refe

(Assistant Professor Dr. Wittawat Didyasarin Sattayarak)

President, Hatyai University

ใบประกาศการนำเสนอบทความวิจัยที่ 2

