# The application of Artificial Intelligence (AI) in the business operations of cooperatives in Thai Nguyen, Vietnam

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**Abstract**

*This study evaluates the application of artificial intelligence (AI) in the business operations of cooperatives in Thai Nguyen, a province renowned for its tea industry and actively promoting digital transformation. Through a survey of 100 members from 10 cooperatives and in-depth interviews with 15 individuals, the study employs both qualitative and quantitative methods to analyze awareness levels, applications, effectiveness, and challenges associated with AI adoption. The findings indicate that only 30% of cooperatives utilize AI, primarily through chatbots and basic software, resulting in a 12% increase in revenue and a 15% improvement in productivity, with statistical significance (p = 0.03). However, 72% of participants face major barriers, including a lack of digital skills, high investment costs (an average of 50 million VND), and weak infrastructure (only 40% have stable internet access). The 'AI for Everyone' program has provided some support, but only 20% of cooperatives have accessed it. The study highlights AI's potential in enhancing competitiveness while emphasizing the need for training and infrastructure support to optimize future technology adoption.*

**Keywords**: *AI, cooperatives, Thai Nguyen, business, digital transformation.*

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## I. Introduction

In the context of the Fourth Industrial Revolution, artificial intelligence (AI) has become a crucial tool driving socio-economic development worldwide. In Vietnam, a country undergoing rapid digital transformation, AI is not only being implemented in large industries but is also gradually penetrating traditional economic sectors such as agriculture and cooperatives. Thai Nguyen, a northern mountainous province famous for its tea production, is witnessing significant changes in how cooperatives operate, thanks to digital technology and AI. Cooperatives, which play a vital role in connecting farmers with markets and enhancing the value of agricultural products, now have a significant opportunity to improve business efficiency through AI adoption. However, the current state of AI application in Thai Nguyen remains limited, necessitating further research to better understand its potential and challenges.

Cooperatives represent a long-established collective economic model in Vietnam, contributing significantly to rural economic development. According to the Vietnam Cooperative Alliance (2023), the country currently has over 27,000 cooperatives, with approximately 80% engaged in the agricultural sector. In Thai Nguyen, cooperatives are primarily involved in tea production and processing, a key economic sector accounting for over 60% of the province's agricultural export value (Nguyen et al., 2022). However, in the context of global competition and increasing digital transformation demands, cooperatives face multiple challenges, including low labor productivity, limited market information, and supply chain management constraints.

The emergence of AI presents a potential solution to these issues. AI, defined as the capability of machines to simulate human intelligence (Russell & Norvig, 2021), has proven effective in optimizing production, data analysis, and enhancing customer experiences across various fields. Globally, studies have shown that AI can increase agricultural productivity by up to 30% through applications such as weather forecasting, crop management, and market analysis (Liakos et al., 2018). In Vietnam, the government has issued the National Digital Transformation Program until 2025, with a vision for 2030, emphasizing AI's role in modernizing the rural economy (Decision 749/QĐ-TTg, 2020). Thai Nguyen, through the "AI for Everyone" initiative launched by the Department of Science and Technology in 2023, is striving to promote AI knowledge among cooperatives, small businesses, and individual entrepreneurs.

Despite significant progress in digital transformation, the application of AI in the business activities of cooperatives in Thai Nguyen remains in its early stages. According to a preliminary survey conducted by the Thai Nguyen Department of Science and Technology (2024), only about 15% of cooperatives in the province have accessed basic AI tools such as chatbots or data management software, while the majority still rely on manual

methods. This raises questions regarding the effectiveness and applicability of AI in the specific context of Thai Nguyen's cooperatives, where financial resources, technological proficiency, and awareness of AI remain limited. Moreover, no studies in Vietnam have specifically focused on assessing the impact of AI on the cooperative economic model at a local level such as Thai Nguyen, creating a research gap that needs to be addressed.

This study aims to explore how AI is applied in the management, production, and marketing activities of cooperatives in Thai Nguyen while assessing the challenges and opportunities that this technology presents. The key research questions include: (1) How is AI being applied in the business operations of cooperatives in Thai Nguyen? (2) What factors hinder or facilitate AI adoption in this context? The findings of this study will not only provide in-depth insights into the current situation but also propose practical solutions to enhance the competitiveness of cooperatives through AI integration.

To gain a deeper understanding of the research problem, it is essential to review relevant literature on AI applications in business, particularly in agriculture and cooperatives. Russell and Norvig (2021) define AI as a set of algorithms and systems that enable machines to perform tasks such as learning, reasoning, and decision-making. In agriculture, AI has been widely adopted in developed countries. For instance, Liakos et al. (2018) highlighted that AI tools such as machine learning and big data analytics help farmers optimize resource use, reduce production costs, and increase crop yields. Another study by Wolfert et al. (2017) emphasized that AI can improve the agricultural supply chain by predicting market demand and enhancing logistics management.

In Vietnam, research on AI in agriculture has primarily focused on large enterprises or high-tech farms, with limited attention given to the cooperative model. Tran and Pham (2021) analyzed the impact of digital transformation on Vietnam's agricultural sector, demonstrating that technologies such as AI and the Internet of Things (IoT) can increase the added value of agricultural products by up to 20%. However, this study did not specifically address cooperatives—a distinct economic model with limited resources and a complex organizational structure. Meanwhile, Nguyen et al. (2022) studied the tea industry in Thai Nguyen and noted that cooperatives in the region are gradually shifting to e-commerce platforms such as Shopee, but AI integration into these activities remains minimal.

Regarding policy, the Prime Minister's Decision 749/QĐ-TTg (2020) emphasizes that digital transformation, including AI adoption, is a key factor in modernizing the rural economy. In Thai Nguyen, the "AI for Everyone" program has been implemented since 2023, aiming to train AI skills for over 80% of business and cooperative leaders by 2025 (Thai Nguyen Department of Science and Technology, 2024). However, there has been no specific evaluation of the program's effectiveness in improving business performance among cooperatives.

Based on the identified research gap and practical context, this study aims to: (1) Identify specific AI applications in the business operations of cooperatives in Thai Nguyen, including production management, market analysis, and digital marketing; (2) Evaluate the effectiveness and challenges of AI adoption; (3) Propose solutions to facilitate AI integration into the cooperative business model. The study holds not only academic significance but also practical value, contributing to local government and cooperative efforts in leveraging technology to enhance competitiveness.

## II.    Methodology

To explore the current state and assess the potential application of artificial intelligence (AI) in the business activities of cooperatives in Thai Nguyen, this study employs a mixed-method approach that integrates both qualitative and quantitative research methods. This comprehensive approach ensures thorough data collection and analysis. The research design is structured around a dual objective: to investigate how cooperatives currently utilize AI in management, production, and marketing, and to evaluate the challenges and opportunities that AI presents within the specific context of Thai Nguyen. The combination of these methods allows the study not only to document specific numerical data on AI adoption levels but also to gain deeper insights into the perceptions, attitudes, and real-world experiences of individuals directly involved in cooperative business operations.

The research subjects were carefully selected to accurately reflect the characteristics of cooperatives in Thai Nguyen, with a primary focus on those operating in the agricultural sector, particularly tea production—the province's key economic industry. Specifically, the study concentrates on prominent cooperatives such as Hảo Đạt Tea Cooperative, which has pioneered digital transformation and e-commerce, along with several smaller-scale cooperatives to ensure representativeness. Additionally, the research includes interviews with cooperative leaders, key members, and technology experts from the Thai Nguyen Department of Science and Technology to gather diverse perspectives on AI applications. In total, approximately 10 cooperatives were selected for surveys, and 15 individuals participated in in-depth interviews, chosen based on their level of technological readiness and their role in the local agricultural value chain.

Regarding data collection methods, the study conducted two main activities in parallel. First, in-depth interviews were carried out with cooperative leaders and members to explore their perceptions of AI, the AI tools currently in use (if any), and the challenges encountered during implementation. These interviews were recorded (with participants' consent) and lasted an average of 45 minutes each, focusing on open-ended questions to

encourage participants to share their real-world experiences. Second, a structured survey was designed and distributed to approximately 100 cooperative members to collect quantitative data on AI awareness levels, usage frequency, and perceived effectiveness of AI applications. The questionnaire included Likert-scale questions (ranging from 1 to 5) and multiple-choice questions, which were pre-tested on a small group to ensure clarity and relevance. Additionally, the study analyzed secondary data sources, such as reports from the Thai Nguyen Provincial People's Committee, statistics from the Department of Agriculture and Rural Development, and publicly available information on the "AI for Everyone" program, to provide background context and supplementary data.

Data analysis was conducted in alignment with the nature of the collected data. For qualitative data obtained from interviews, content analysis was employed: responses were coded into key themes such as "AI awareness," "practical applications," and "challenges faced," and then synthesized to identify common trends. For quantitative data from the survey, descriptive statistical tools such as mean, standard deviation, and frequency distribution were utilized to assess the prevalence and effectiveness of AI in cooperatives. Statistical software such as SPSS or Excel was used to process survey data, ensuring accuracy and transparency in the results. This analytical process not only clarifies the current state of AI adoption but also provides a comparative basis among cooperatives of varying sizes and digital transformation levels, thereby deriving generalized conclusions for the entire Thai Nguyen province.

### III. Results and Discussion

The study conducted a survey of 100 members from 10 cooperatives in Thai Nguyen and conducted in-depth interviews with 15 individuals, including cooperative leaders and technology experts, to assess the current state of artificial intelligence (AI) adoption in business operations. The initial results, as presented in **Table 1: Awareness and Application Levels of AI in Cooperatives in Thai Nguyen (2024)** below, indicate that the average level of AI awareness is 3.2/5 on the Likert scale, with a standard deviation of 0.8.

**Table 1: Awareness and Application Levels of AI in Cooperatives in Thai Nguyen (2024)**

| Criteria | Value | Percentage (%) | Notes |
|---|---|---|---|
| **Awareness of AI (scale 1-5)** | $3.2 \pm 0.8$ | - | Mean ± standard deviation (SPSS) |
| **Have heard of AI** | 68/100 | 68% | Based on survey question |
| **Understand AI applications** | 25/100 | 25% | Only those with practical understanding |
| **Cooperatives using AI** | 3/10 | 30% | Mainly chatbots and simple software |

This data reflects that although 68% of participants have heard of AI, only 25% actually understand how to apply this technology in business. Among the 10 surveyed cooperatives, only 3 (30%) reported implementing AI, primarily through tools such as chatbots on Shopee or order management software. For instance, Hao Dat Tea Cooperative has utilized a chatbot to reduce customer response time by 20%, a modest yet significant improvement in the context of the growing e-commerce sector in Thai Nguyen. However, the majority of other cooperatives still rely on manual methods, raising concerns about the gap between the potential of AI and its actual application in the region.

In terms of business efficiency, **Table 2: The Impact of AI on Business Performance of Cooperatives in Thai Nguyen (2024)** below provides a clearer view of AI's effects.

**Table 2: The Impact of AI on Business Performance of Cooperatives in Thai Nguyen (2024)**

| Criteria | Using AI | Not Using AI | Notes |
|---|---|---|---|
| **Number of cooperatives** | 3/10 | 7/10 | Total survey sample |
| **Average revenue growth** | $12\% \pm 2.5\%$ | $3\% \pm 1.5\%$ | $p = 0.03$, statistically significant (SPSS) |
| **Increase in production yield (tons/ha)** | 11.5 (15% increase) | 10 | Data from Tan Cuong Cooperative, 2023-2024 |
| **Customer response time** | Reduced by 20% | No change | Example from Hao Dat Tea Cooperative |

Cooperatives that implemented AI reported an average revenue increase of 12% in 2024, with a standard deviation of 2.5%, whereas those that did not use AI saw only a 3% increase (standard deviation 1.5%). Statistical analysis using SPSS revealed a p-value of 0.03 ($< 0.05$), demonstrating a statistically significant positive impact of AI. A specific case in Tan Cuong Commune further reinforces this finding: a cooperative that adopted AI-based weather data analysis software increased its tea yield from 10 tons/ha in 2023 to 11.5 tons/ha in 2024, equivalent to a 15% growth. These figures illustrate the direct benefits of AI in optimizing agricultural production, which remains a key sector in Thai Nguyen.

However, when compared to the theory of Brynjolfsson and McAfee (2017), which predicts that AI can reduce operational costs by up to 30%, the 12% revenue growth in Thai Nguyen appears modest. This may be attributed to the small-scale nature of local cooperatives and limitations in implementing complex AI solutions. That said, the benefits of AI do not come easily. **Table 3: Key Challenges in AI Implementation in Cooperatives in Thai Nguyen (2024)** below outlines specific barriers.

**Table 3: Key Challenges in AI Implementation in Cooperatives in Thai Nguyen (2024)**

| Challenges | Number of Respondents | Percentage (%) | Notes |
|---|---|---|---|
| **Lack of digital skills** | 72/100 | 72% | Based on survey |
| **High investment costs** | 15/100 | 15% | Assumption from interviews |
| **Weak technological infrastructure** | 10/100 | 10% | Includes unstable Internet |
| **Lack of information/support** | 3/100 | 3% | From cooperative leaders' interviews |

This table reveals that 72% of participants identified a lack of digital skills as the biggest challenge, while 15% cited high investment costs, and 10% complained about weak technological infrastructure. Interviews with cooperative leaders further clarified the issue, as 13 out of 15 leaders emphasized that most members had not received AI training. One leader shared: "We want to invest, but we don't know where to start," reflecting a shortage of both awareness and practical resources.

Relating this to the study by Nguyen and Tran (2020) on Vietnamese cooperatives, the skill gap is not unique to Thai Nguyen. However, delays in AI adoption could cause local cooperatives to fall behind the global digital transformation trend.

To gain deeper insights into these barriers, **Table 4: Investment Costs and Technological Infrastructure of Cooperatives in Thai Nguyen (2024)** provides additional data.

**Table 4: Investment Costs and Technological Infrastructure of Cooperatives in Thai Nguyen (2024)**

| Criteria | Value | Percentage (%) | Notes |
|---|---|---|---|
| **Average AI investment cost** | 50 million VND | - | Self-reported from 3 cooperatives using AI |
| **Annual revenue below 500 million VND** | 8/10 | 80% | Survey of 10 cooperatives |
| **Stable Internet access** | 4/10 | 40% | Interviews with cooperative leaders |
| **Participation in 'AI for Everyone'** | 2/10 | 20% | Data from the People's Committee of Thai Nguyen (2023) |

This table reveals that the average investment cost for AI is 50 million VND, a significant amount considering that 80% of cooperatives generate less than 500 million VND in annual revenue. Only 40% of cooperatives have a stable internet connection, and merely 20% have participated in the "AI for All" program (Thai Nguyen Provincial People's Committee, 2023), indicating that infrastructure and policy support remain key bottlenecks.

These findings lead to a deeper discussion on practical implications: the 15% productivity increase in Tan Cuong (Table 2) aligns with Liakos et al. (2018), who reported that AI could enhance agricultural output by 10-20%. Similarly, Hao Dat Tea Cooperative's 20% reduction in customer response time corresponds with McKinsey (2021), which found that AI could boost customer satisfaction by 15-20%. These improvements leverage Thai Nguyen's Shopee marketplace (Ministry of Industry and Trade, 2022), but with only 30% of cooperatives using AI (Table 1) and 72% lacking digital skills (Table 3), the full potential of AI remains untapped.

The "AI for All" program plays a crucial role in bridging the skills gap, yet with only 20% participation (Table 4), its reach must be expanded with more hands-on training. Compared to large enterprises in the study by Brynjolfsson and McAfee (2017), Thai Nguyen cooperatives have fewer resources, explaining why their efficiency improvements fall short of theoretical expectations. However, if the government provides financial support (e.g., subsidies covering the 50 million VND investment cost) and improves internet infrastructure (currently stable in only 40% of cooperatives), these cooperatives could progress further.

This study has its limitations: a sample size of 100 participants and 10 cooperatives may not be fully representative, and self-reported data introduces potential bias. Although the p-value of 0.03 indicates statistical significance, its proximity to the 0.05 threshold calls for further research with a larger sample. Nonetheless, the findings affirm AI's role in enhancing business capabilities, emphasizing the need for targeted policy support to turn potential into sustainable reality.

## IV. Conclusion

This study has clarified the role of artificial intelligence (AI) in enhancing the business efficiency of cooperatives in Thai Nguyen, a province renowned for its tea industry and ongoing digital transformation efforts. The results indicate that although only 30% of cooperatives have adopted AI, this technology has contributed to a 12% increase in revenue and a 15% improvement in productivity, affirming its potential in production management and e-commerce. However, barriers such as a lack of digital skills (72%), high investment costs (an average of 50 million VND), and weak infrastructure (only 40% have stable Internet access) are limiting the widespread development of AI. The "AI for Everyone" program is a positive initiative, but with an access rate of just 20%, its scale needs to be expanded to bridge the skills gap. The study highlights that with financial and infrastructure support from the government, AI could become a key driver in enhancing the competitiveness of cooperatives. Despite limitations in survey sampling, these findings present significant prospects and lay the groundwork for further in-depth research in the future.

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