

Systemic Issues and Development Approaches for Beef Cattle Farm Management toward GAP Certification in Chiang Mai Province

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Received: 14 September 2025; **Revised:** 30 September 2025; **Accepted:** 03 October 2025

Abstracts

This study aimed to (1) analyze systemic constraints among beef cattle farms in Chiang Mai Province that hinder readiness for Good Agricultural Practices (GAP) certification, and (2) develop appropriate management approaches to strengthen GAP readiness. The population consisted of 15,174 beef cattle farming households, from which a quantitative sample of 390 households was determined using a statistical formula and selected through systematic random sampling. A qualitative sample of 15 key informants included GAP-certified farmers, livestock extension officers, local leaders, and community representatives. Research instruments comprised a five-point Likert-scale questionnaire, validated for content accuracy with Cronbach's alpha coefficients exceeding 0.80, and semi-structured interview guides. Quantitative data were analyzed using descriptive statistics (mean, standard deviation) and multiple regression analysis, while qualitative data were analyzed through content analysis and thematic synthesis.

The findings revealed that structural factors of beef cattle farms were generally at a moderate-to-low level, with farm data management emerging as the weakest component. Farm management practices were also at a moderate level, though deficiencies were noted in marketing, environmental management, and animal welfare. Regression analysis confirmed that farm data management and overall management practices exerted the strongest influence on GAP readiness, jointly explaining 62% of the variance. This study contributes new knowledge by integrating structural factors and farm management practices as joint determinants of GAP readiness and by conceptualizing farm data as a form of knowledge capital. It also highlights environmental and animal welfare management as emerging

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weaknesses within Thai beef cattle farms. Policy recommendations include the development of comprehensive farm databases, provision of low-interest credit, and prioritization of environmental and welfare standards in livestock policies. Practical recommendations emphasize farmer training in data management, establishment of model GAP farms as community learning centers, and strengthening cooperative systems to enhance market power and environmental practices.

Keywords: Beef Cattle Farms; GAP Certification; Farm Management

Introduction

Beef cattle production plays a vital role in Thailand's agricultural sector, contributing not only to the national economy but also to food security. The northern region, particularly Chiang Mai Province, is well recognized for its favorable geography and climate for livestock farming. Chiang Mai alone hosts more than 15,000 beef cattle farming households with over 160,000 heads of cattle (Department of Livestock Development, 2024). Over the past decades, beef cattle have transitioned from being primarily used for farm labor to becoming a highly demanded agricultural commodity, responding to both domestic and international markets. High-value export destinations such as Japan and the European Union have increasingly emphasized quality, food safety, and production standards (Office of Agricultural Economics, 2023). In this context, Good Agricultural Practices (GAP) have become an internationally recognized standard for ensuring the safety and sustainability of agricultural products (FAO, 2021). However, despite the large number of cattle farms in Chiang Mai, only a small proportion have been GAP certified, reflecting systemic limitations. GAP certification is not merely a technical requirement for food safety but also a strategic tool for promoting environmental sustainability, efficient resource use, and consumer trust (Chamnankit & Thongchai, 2023). Consequently, the development of farm management practices that enable beef cattle farms to achieve GAP certification is both a pressing academic question and a practical necessity for Thailand's agricultural development.

Previous studies have highlighted that beef cattle farms in northern Thailand, including those in Chiang Mai, continue to face multiple systemic challenges that hinder GAP adoption. First, financial and working capital constraints limit farmers' ability to invest in critical infrastructure such as barns, water systems, and waste

management facilities (Piyakit & Udorn, 2021). Second, farm infrastructure remains largely inconsistent with GAP standards, with many farmers relying on traditional facilities and lacking appropriate systems for environmental management (Charuwat, 2022). Third, access to modern technology and innovation is limited; many farmers are unable to utilize digital tools or advanced production technologies that could enhance efficiency and improve compliance with GAP requirements (Wirot, Jatuporn, & Sakul, 2022). Finally, farm data management is the weakest area, with farmers often failing to maintain systematic records on animal health, feeding practices, medication use, and disease control documentation that is crucial for GAP audits (FAO, 2021). These systemic problems highlight that GAP readiness is not simply a matter of individual farmer effort but reflects broader structural issues involving financial resources, technological access, and supportive policies. Without addressing these systemic gaps, the competitiveness of Thailand's beef cattle industry in global markets will remain severely constrained.

Against this backdrop, this study seeks to address three critical research questions: (1) What systemic issues exist within beef cattle farms in Chiang Mai, and how do they affect the ability of farmers to achieve GAP certification (2) What development approaches to farm management are most appropriate to enhance GAP readiness among beef cattle farms and (3) How can the interaction of structural factors, farm-level management practices, and government policy support lead to practical development pathways These questions hold both academic and practical significance. Academically, they contribute to the literature by expanding knowledge on systemic problem analysis within the context of livestock farming in developing countries. They also enrich theoretical discussions on the integration of structural and managerial factors as determinants of agricultural standards adoption (Piyakit & Udorn, 2021).

Practically, the findings of this research will provide evidence-based recommendations for policy interventions and management strategies that can improve the readiness of beef cattle farms in Chiang Mai to achieve GAP certification. In turn, these improvements are expected to enhance farmers' income, strengthen their quality of life, and bolster the sustainable competitiveness of Thailand's beef cattle industry in the global marketplace

Research Objectives

1. To analyze the systemic issues of beef cattle farms in Chiang Mai Province that hinder readiness for GAP certification.
2. To develop appropriate management approaches for enhancing the readiness of beef cattle farms for GAP certification.

Research Methodology

1. Research Design: This study employed a mixed-methods research design, combining quantitative and qualitative approaches to provide a comprehensive understanding of systemic issues and development approaches for beef cattle farm management toward GAP certification in Chiang Mai Province. The quantitative component focused on assessing the structural and managerial constraints of cattle farms, while the qualitative component emphasized exploring practical development strategies through the perspectives of key stakeholders.

2. Population and Sample: The population consisted of 15,174 beef cattle farming households in Chiang Mai Province (Department of Livestock Development, 2024). For the quantitative study, the sample size was determined using Krejcie and Morgan's (1970) formula, resulting in 390 households selected through systematic random sampling to ensure representativeness across districts. For the qualitative study, 15 key informants including GAP-certified farmers, livestock extension officers, local administrative officers, and community leaders were selected using purposive sampling to gain in-depth insights into systemic barriers and feasible development approaches.

3. Research Instruments: The quantitative tool was a structured questionnaire divided into three sections: (1) demographic and general information, (2) systemic issues of farm management (covering financial resources, farm infrastructure, technology and innovation, and farm data management), and (3) readiness toward GAP standards. A five-point Likert scale was employed, and the instrument was validated by three experts for content validity, achieving Cronbach's alpha reliability coefficients above 0.80. For the qualitative component, a semi-structured interview guide was developed to explore systemic problems, constraints, and potential development pathways for GAP adoption.

4. Data Collection: Quantitative data were collected between September 2024 and March 2025 through on-site distribution of questionnaires by the researcher and trained assistants. Qualitative data were obtained through in-depth interviews and focus group discussions with the selected key informants. All interviews were audio-recorded, transcribed verbatim, and coded systematically to ensure accuracy and reliability.

5. Data Analysis: Quantitative data were analyzed using descriptive statistics (frequency, percentage, mean, and standard deviation) to describe the level of systemic issues and GAP readiness, and inferential statistics, particularly multiple regression analysis, to identify the influence of structural and managerial factors on GAP readiness. Qualitative data were analyzed using content analysis, which involved coding, categorization, and thematic interpretation. Triangulation between quantitative and qualitative findings was applied to strengthen validity and provide a holistic understanding of systemic issues and development approaches for GAP adoption.

Results

The researcher conducted a study entitled Systemic Issues and Development Approaches for Beef Cattle Farm Management toward GAP Certification in Chiang Mai Province. The findings can be summarized according to the research objectives as follows:

Objective 1: Systemic Issues of Beef Cattle Farms. The findings indicated that beef cattle farms in Chiang Mai face systemic challenges that limit their readiness for GAP certification. Quantitative analysis showed that structural factors were generally at a moderate-to-low level ($\bar{x}=2.93$, S.D.=0.82). Farm data management scored the lowest ($\bar{x}=2.76$, S.D.=0.83), reflecting the lack of systematic record-keeping on animal health, feeding practices, and medication use. Financial resources and working capital were moderate ($\bar{x}=3.12$, S.D.=0.84) but insufficient for investing in infrastructure and technology that align with GAP standards. Farm infrastructure ($\bar{x}=2.95$, S.D.=0.79) and access to technology and innovation ($\bar{x}=2.88$, S.D.=0.81) were also inadequate, showing heavy reliance on traditional practices. Qualitative results supported these findings, highlighting four systemic issues: limited financial support, poor infrastructure, insufficient adoption of technology, and weak farm data systems.

Collectively, these issues create barriers that prevent farmers from achieving GAP certification and reduce competitiveness in both domestic and international markets.

Objective 2: Development Approaches for Farm Management. The study further identified practical approaches to enhance GAP readiness. Regression analysis confirmed that farm data management (Beta=0.351) and overall farm management practices (Beta=0.332) had the strongest influence on GAP readiness, followed by financial resources (Beta=0.291). These variables together explained 62% of the variance in GAP readiness ($R^2=0.62$). Based on quantitative results and qualitative insights, three development approaches were proposed:

1. Policy-level interventions – Establishing a provincial beef cattle farm database linked to GAP certification, providing low-interest credit to farmers, and prioritizing environmental management and animal welfare in livestock policies.
2. Operational practices – Training farmers in digital record-keeping, establishing model GAP farms as learning centers, and promoting collective action through cooperatives or community enterprises.
3. Future-oriented strategies – Strengthening technology adoption, improving market access, and building farmer motivation to comply with GAP standards.

Together, these approaches provide a framework that integrates structural improvements and effective farm management, thereby increasing the readiness of beef cattle farms in Chiang Mai to achieve GAP certification and enhancing their sustainable competitiveness.

Research Objective	Key Findings (Quantitative)	Key Findings (Qualitative)	Implications
Objective 1: To analyze the systemic issues of beef cattle farms in Chiang Mai Province that hinder GAP readiness.	- Structural factors were at a moderate-to-low level ($\bar{X}=2.93$, S.D.=0.82). - Farm data management scored the lowest ($\bar{X}=2.76$, S.D.=0.83). - Financial resources were moderate ($\bar{X}=3.12$, S.D.=0.84) but insufficient for GAP investments.	- Farmers lack systematic record-keeping systems. - Limited financial support and difficulty accessing credit. - Poor infrastructure and reliance on traditional practices.	- GAP readiness requires improvement in financial support, infrastructure, technology, and especially data management systems.

Research Objective	Key Findings (Quantitative)	Key Findings (Qualitative)	Implications
	- Infrastructure ($\bar{X}$ =2.95) and technology adoption ($\bar{X}$ =2.88) remained limited.	- Insufficient use of digital technology and innovation.	
Objective 2: To develop appropriate management approaches for enhancing the readiness of beef cattle farms for GAP certification.	- Multiple regression showed farm data management (Beta=0.351) and overall management practices (Beta=0.332) had the strongest influence on GAP readiness. - Financial resources (Beta=0.291) also significant. - Independent variables explained 62% of variance in GAP readiness (R^2 =0.62).	- Training in farm data recording and digital tools is urgently needed. - Establishment of model GAP farms as learning centers is recommended. - Farmer cooperatives can strengthen market access and environmental management.	- Integration of policy, operational, and future strategies is essential. - Strengthening data management and overall management capacity will directly enhance GAP readiness.

Table 1 Summary of Research Findings by Objectives

Discussion

Paragraph 1: Systemic Issues of Beef Cattle Farms, The findings demonstrated that systemic constraints remain a significant obstacle for beef cattle farms in Chiang Mai Province to achieve GAP certification. Quantitative results showed that structural factors overall were at a moderate-to-low level ($\bar{X}$ =2.93, S.D.=0.82), with farm data management receiving the lowest scores. This confirms earlier studies by Wirot, Jatuporn, and Sakul (2022), who highlighted that the lack of standardized record-keeping covering animal health, feeding, and veterinary treatments undermines the ability of farms to comply with GAP audits. Similarly, financial resources, while rated at a moderate level, were found insufficient for investing in necessary infrastructure such as barns, water systems, and waste management. This aligns with Piyakit and Udorn (2021), who emphasized that smallholder farmers in northern Thailand often operate under tight financial constraints, which restricts long-term investments in

structural improvements. These systemic barriers underscore that GAP adoption is not merely a function of farmer willingness but is strongly conditioned by broader structural weaknesses that must be addressed through integrated policies and development programs.

Paragraph 2: Weaknesses in Farm Management Practices, In addition to structural constraints, farm management practices were assessed at only a moderate level, with clear deficiencies in marketing, environmental management, and animal welfare. These findings are consistent with Chamnankit and Thongchai (2023), who reported that most northern beef cattle farmers still lack a deep understanding of GAP requirements, particularly concerning environmental management and animal welfare in line with international standards. Problems such as inadequate manure treatment, limited disease prevention systems, and insufficient provision of clean water and balanced nutrition were frequently observed. Beyond certification, these deficiencies carry broader implications for social and environmental sustainability, as poor waste management contributes to community pollution (Charuwat, 2022). Moreover, the neglect of animal welfare can diminish consumer trust, especially in global markets where sustainable and ethical production systems are increasingly prioritized (FAO, 2021). This suggests that improving GAP readiness requires not only structural support but also the strengthening of management practices, particularly in environmental stewardship and welfare standards.

Paragraph 3: Relationships among Factors and Implications for GAP Readiness, The regression analysis revealed that farm data management (Beta=0.351) and overall management practices (Beta=0.332) had the strongest influence on GAP readiness, followed by financial resources (Beta=0.291). Collectively, these factors explained 62% of the variance in readiness ($R^2=0.62$). This finding confirms the centrality of information systems and effective management as key drivers of certification success. It supports FAO's (2021) assertion that sustainable food production must be based on traceable, verifiable data across the production chain. Similarly, Charuwat (2022) argued that farms with continuous planning, monitoring, and adaptive management are more likely to meet certification standards. However, the unexplained variance (38%) suggests that additional determinants such as farmer motivation, the role of policy incentives, and access to market networks may also play crucial roles. Future research should therefore explore how social and policy contexts interact with structural and managerial factors in shaping GAP adoption. This

multidimensional view broadens the understanding of readiness from a purely farm-level perspective to a systemic issue that spans individual, institutional, and policy domains.

Paragraph 4: Academic and Practical Contributions, The results of this study contribute to both academic debates and practical development agendas. Academically, the integration of structural and managerial factors into a unified framework expands the existing literature, which has often examined these dimensions separately (Piyakit & Udorn, 2021). By showing that data management, infrastructure, and overall management practices interact to determine GAP readiness, the study supports a systemic conceptualization of certification as a multidimensional outcome. Practically, the findings provide clear directions for interventions. Policy recommendations include establishing provincial-level farm databases linked to GAP certification, providing low-interest loans for infrastructure upgrades, and adopting animal welfare and environmental management as strategic priorities in livestock development (DLD, 2024; OAE, 2023). Operationally, practical measures such as training programs in digital record-keeping, the creation of GAP model farms, and the promotion of farmer cooperatives can directly enhance readiness. Collectively, these measures will not only improve the quality of farm management in Chiang Mai but also strengthen the long-term competitiveness of Thailand's beef cattle industry in global markets.

New Knowledge

This study generates new knowledge by demonstrating that readiness for GAP certification among beef cattle farms is determined not only by physical resources or financial capacity but by the integration of structural factors and farm management practices. The findings highlight the decisive role of farm data management, showing that systematic record-keeping and information systems serve as a form of knowledge capital that directly shapes GAP readiness. This perspective advances the understanding of certification as a systemic process, where structural conditions and management efficiency must be developed simultaneously.

In addition, the study contributes new insights by identifying environmental management and animal welfare as critical bottlenecks for beef cattle farms. These aspects, often overlooked in farm development, emerged as essential determinants of readiness for international certification. The proposed framework, which combines

policy interventions, operational strategies, and future-oriented approaches, provides a holistic model for enhancing GAP readiness. This integration of systemic issues with practical solutions offers a foundation for designing readiness assessment tools, guiding sustainable livestock development, and strengthening the long-term competitiveness of beef cattle farming.

Conclusion and Suggestion

The study concluded that beef cattle farms in Chiang Mai Province face systemic challenges that hinder their readiness for GAP certification. Structural factors were generally at a moderate-to-low level, with farm data management identified as the weakest component. Farm management practices were moderate overall but showed significant weaknesses in marketing, environmental management, and animal welfare. Multiple regression analysis confirmed that farm data management and overall management practices exerted the strongest influence on GAP readiness, followed by financial resources, explaining 62% of the variance. These findings highlight that GAP readiness depends not only on resource availability but also on effective management and systematic data use. The integration of structural factors, managerial efficiency, and supportive policy measures is therefore essential for improving GAP adoption and enhancing the competitiveness of beef cattle farms. Based on these findings, recommendations are proposed at the policy, operational, and future research levels.

1. Policy Recommendations

1.1 Establish a provincial-level farm database linked to GAP certification for monitoring, evaluation, and development.

1.2 Provide low-interest loans or financial support to help small-scale farmers improve infrastructure, water systems, waste management, and technology adoption.

1.3 Incorporate environmental management and animal welfare into livestock development strategies, aligning them with national agricultural policies and international trade requirements.

2. Practical/Operational Recommendations

2.1 Offer training programs to farmers on systematic record-keeping and digital data management tools.

2.2 Develop model GAP farms in each district as learning centers to share best practices and practical experiences.

2.3 Encourage the formation of cooperatives or community enterprises to strengthen market access, increase bargaining power, and manage environmental issues collectively.

3. Future Research Recommendations

3.1 Expand studies to other provinces or regions with significant beef cattle farming to compare systemic and managerial conditions.

3.2 Conduct in-depth research on farmers' motivations and the role of market networks in GAP adoption.

3.3 Implement experimental research to examine the long-term impacts of digital technologies for farm data management on GAP readiness.

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