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The Impact of Science-Based Sufficiency Economy Immunity on Farmers' Practice of the Three Core Principles and Two Conditions in Chiang Rai Province

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Abstract

Background and Aim: Integrating the Sufficiency Economy Philosophy (SEP) with the Sustainable Livelihoods Framework (SLF) is essential for promoting sustainable development among Thai farmers. This study investigated how five Science-Based Sufficiency Economy Immunity dimensions, Mind, Economy and Society, Learning Culture, Natural Resources and Environment, and Technology, influence farmers' practice of Three Core Principles (Moderation, Rationality, and Immunity) and Two Conditions (Morality and Knowledge) in Chiang Rai Province.

Materials and Methods: A mixed-methods approach was employed, using qualitative data from documentary analysis, group discussions, and interviews, and quantitative data from structured questionnaires. The five-dimensional Science-Based Sufficiency Economy Immunity framework was used to assess internal factors affecting implementation.

Results: Findings revealed high levels of Science-Based Sufficiency Economy Immunity application, particularly in the Mind and Natural Resources and Environment dimensions. Regression analysis identified the Mind dimension as the strongest predictor ($\beta = .572$, $p < .001$), with the model explaining 49.7% of the variance in Science-Based Sufficiency Economy Immunity practice (Adjusted $R^2 = .497$).

Conclusion: Results highlight the importance of mental development, environmental stewardship, and lifelong learning. Policy recommendations emphasize community empowerment, participatory management, and capacity building. This integrated Science-Based Sufficiency Economy Immunity –SLF approach supports the SDGs by enhancing quality of life, income security, and sustainable self-reliance.

Keywords: Science-Based Sufficiency Economy; Three Core Principles and Two Conditions; Farmers' Practice; Sustainable Agriculture

Introduction

Thai society was characterized by simplicity and self-reliance. It was based on a subsistence economy where production was primarily for household and community consumption rather than market exchange. Natural surroundings served as the primary source of sustenance, and strong kinship ties and community affinity were expressed through shared rituals and beliefs that helped maintain social and ecological balance. These characteristics made Thai communities peaceful, interdependent, and capable of sustaining their identity across generations.

In recent decades, rapid industrialization and globalization have reshaped Thailand's economic and social landscape. The pursuit of continuous economic growth has intensified competition and increased dependence on global markets, technologies, and labor mobility. While these transformations have modernized Thai society and improved access to innovation, they have also contributed to increased inequality, debt accumulation, and a weakening of self-reliant practices, especially among farmers. The impacts of globalization are evident in the erosion of traditional farming practices, leading to

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overconsumption, reliance on formal and informal debt, and rising household vulnerability (Ministry of Social Development and Human Security, 2018).

As a result, Thai communities, both rural and urban, face growing challenges in maintaining resilience in the face of socio-economic volatility. In particular, the agricultural sector has experienced structural dislocation as modern practices are introduced without adequate social, moral, or environmental safeguards.

To address these concerns, the Thai government adopted the 20-Year National Strategy (2018–2037), which identifies "Security, Prosperity, and Sustainability" as the pillars of long-term development. At its core lies the Philosophy of Sufficiency Economy (SEP), introduced by His Majesty King Rama IX, which advocates for a balanced and ethical approach to development. SEP emphasizes three core principles, Moderation, Rationality, and Immunity, supported by two essential conditions: Morality and Knowledge.

The strategy promotes human resource development, equitable opportunity, and sustainable economic growth rooted in quality of life. It also calls for the application of SEP as a guiding philosophy to stabilize community livelihoods, reduce inequality, and build adaptive capacity for the future (Office of the Education Council Secretariat, 2018; Office of National Economic and Social Development Board and Crown Property Bureau, 2019).

Operationalizing SEP in today's complex world requires the application of its five key dimensions: Mind, Economy and Society, Learning Culture, Natural Resources and Environment, and Technology. These dimensions offer a holistic structure to support SEP implementation and enable communities to achieve self-reliance and resilience.

In recent academic discourse, these dimensions are increasingly interpreted through the lens of "science-based sufficiency economy immunity." This concept emphasizes the use of scientific reasoning, evidence-based decision-making, and integration of traditional wisdom with modern technology. It suggests that sustainable development is strengthened when SEP principles are applied not just philosophically but through practical and measurable approaches grounded in knowledge systems, innovation, and local participation.

Chiang Rai Province in Northern Thailand presents a particularly relevant case for examining this integrated SEP framework. The region is agriculturally rich and ethnically diverse, with community structures deeply embedded in traditional and cultural practices. However, many farming communities face increasing vulnerability due to market pressures, natural resource degradation, and social transformation.

Although numerous government and academic initiatives have supported SEP adoption in the North, most studies have focused on strong, already-successful farmers, often neglecting the broader patterns of SEP practice regarding science-based immunity. There remains a critical gap in understanding how the five SEP dimensions are applied in practice, particularly in shaping the Three Core Principles and Two Conditions that underpin SEP.

Given the evolving socio-economic context, the accelerating pace of globalization, and the recognized importance of SEP as a tool for sustainable rural development, it is crucial to understand how the five dimensions of SEP influence farmers' application of its foundational principles. There is a need to assess the extent to which science-based sufficiency economy immunity, as an operational framework, supports resilience and livelihood sustainability.

Therefore, this study aims to examine how the five dimensions of Science-Based Sufficiency Economy Immunity contribute to the practical application of its Three Core Principles and Two Conditions among farmers in Chiang Rai Province.

Objectives

1) To examine how farmers in Chiang Rai perceive, experience, and apply the Science-Based Sufficiency Economy Immunity within their local agricultural, cultural, social, and environmental contexts.

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2) To analyze the relationship between the Five-Dimensional Science-Based Sufficiency Economy Immunity framework and the practical implementation of the Three Core Principles and Two Conditions by the community.

Conceptual Framework

Sustainable development has emerged as a central global paradigm, aiming to strike a balance between economic growth, social equity, and environmental preservation. It emphasizes a holistic and integrated approach to resource allocation that is both efficient and equitable within ecological limits (Chulalongkorn University, 2021). Sachs (2015) underscored the need to balance three core dimensions—economic, social, and environmental—to achieve sustainable outcomes. In support of this vision, the United Nations established the 17 Sustainable Development Goals (SDGs), organized under four key pillars: social inclusion, economic growth, environmental sustainability, and global partnership. These goals represent a collective commitment by nations worldwide to address complex and interconnected challenges and to enhance human well-being while protecting the environment.

Thailand's Sufficiency Economy Philosophy (SEP), initiated by His Majesty King Bhumibol Adulyadej, offers a development framework rooted in Thai cultural values while aligning with global sustainability discourse. SEP emphasizes resilience, moderation, and sustainable livelihoods, particularly in rural and agricultural contexts. The Chaipattana Foundation (2016) promotes self-reliance through five core values: knowledge, morality, reasonableness, immunity, and moderation—values deeply embedded in Thai society and cultural traditions. These principles position SEP as both a development philosophy and a practical framework for strengthening community resilience and self-sufficiency.

Recent research has explored the role of SEP in advancing the SDGs, especially within the Sustainable Livelihoods Framework (SLF). Both SEP and SLF stress adaptability, self-reliance, and efficient resource management as core strategies for achieving sustainable outcomes (Adenle & Agboola, 2011). In the agricultural sector, SEP aligns closely with key SDGs, including Goal 1 (No Poverty), Goal 2 (Zero Hunger), Goal 12 (Responsible Consumption and Production), and Goal 13 (Climate Action). SEP supports sustainable agriculture and local economic empowerment by promoting knowledge integration and resilience.

Empirical studies have demonstrated SEP's applicability across diverse contexts. For instance, research in rural Thailand found that SEP contributes significantly to promoting community-based agriculture, food security, and economic resilience (Charoenratana et al., 2021). A critical success factor is the integration of local wisdom with scientific knowledge, a key component of the SEP's "knowledge" condition, which enables farmers to effectively adapt to climate change and market fluctuations (Marks, 2011). Chanyapate (2011) further highlights the institutional role of SEP in promoting self-reliance and value-based development rooted in cultural norms and ethical practices.

Historically, Thailand's development strategies were heavily influenced by Western models focused on GDP growth, industrialization, and technological advancement (Suehiro, 2023). While this approach led to urban prosperity, it often marginalized rural communities and eroded traditional knowledge systems (Rigg, 2001; Unger, 2009). SEP emerged as an alternative development paradigm, advocating for a balanced approach that integrates human, social, and environmental dimensions (Wibulswasdi et al., 2006). This holistic model offers a localized strategy that contrasts with conventional growth-centric frameworks.

The Five-Dimensional Scientific-Based Sufficiency Economy Resilience Framework (Wibulswasdi et al., 2006) was designed to support the practical application of SEP in agricultural communities. It comprises the following dimensions:

1. **Mind:** Enhances psychological resilience and fosters moral integrity through self-awareness and ethical decision-making, reinforcing moderation and moral principles.
2. **Economy and Society**: Promotes economic security and social capital by fostering rational decision-making and protective networks through stable economic structures and strong community ties.

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3. Learning Culture: Encourages continuous development and adaptability through lifelong learning and the integration of local and scientific knowledge, aligning with the "knowledge" condition.

4. Natural Resources and Environment: Emphasizes conservation and efficient resource management to ensure ecological sustainability, consistent with rationality and immunity principles.

5. Technology: Supports the appropriate and efficient use of technology in agriculture to enhance productivity, inform decision-making, and mitigate external risks.

These five dimensions work synergistically to reinforce SEP's three core principles and two supporting conditions:

1. **Moderation**: Living within one's means based on actual needs and self-reliance.
2. **Reasonableness**: Making decisions based on rationality, justice, and long-term impact.
3. **Resilience/Immunity**: Preparing to cope with internal and external changes with awareness and prudence.
4. **Morality**: Upholding honesty, perseverance, and wisdom.
5. **Knowledge**: Integrating scientific and local knowledge for effective planning, analysis, and action (Wibulswasdi et al., 2006).

This conceptual framework aligns with multiple SDGs, such as food security, sustainable economic growth, and environmental preservation. It is also operationally applicable, particularly in the context of Chiang Rai Province (Suehiro, 2023; Rigg, 2001).

However, current research lacks a comprehensive model that systematically links these five dimensions to the core principles and conditions of the Three Core Principles and Two Supporting Conditions in a measurable and integrated way. There is also a paucity of empirical studies examining how these components interact to influence livelihood outcomes for farmers, especially in Northern Thailand.

This study aims to address these gaps by developing a conceptual model and relevant indicators to analyze the impact of the five dimensions on farmers' adoption of the Three Core Principles and Two Supporting Conditions in Chiang Rai Province. It highlights the transformative potential of science-based sufficiency economy resilience as a development strategy that aligns with global SDGs while being deeply rooted in Thailand's cultural and ecological context.

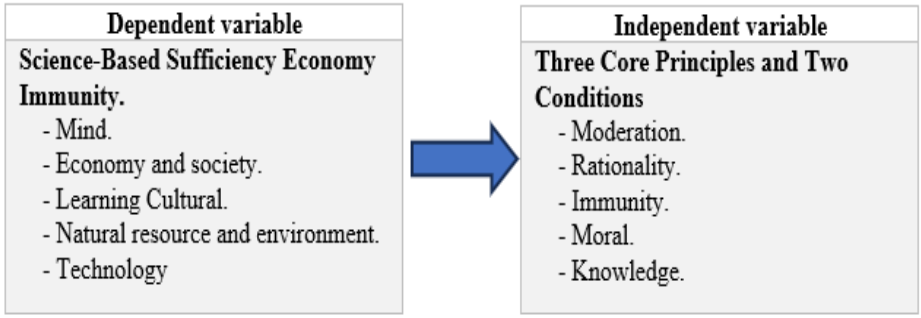

Figure 1 Research Framework of the Impact of Science-Based Sufficiency Economy Immunity on Farmers' Practice of the Three Core Principles and Two Conditions in Chiang Rai Province

Methodology

1. Research Design

The study employed a mixed-methods research design (Creswell, 2014), integrating both qualitative and quantitative approaches within the framework of Participatory Rural Appraisal for Learning and Development (PRAL&D). This design supports transformative learning and action research aimed at sustainable development.

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The qualitative component involved documentary synthesis, focus group discussions, and in-depth interviews with key informants, emphasizing multi-contextual and culturally grounded insights. The quantitative component utilized structured survey questionnaires to analyze causal relationships.

This methodology aligns with previous studies on the Five-Dimensional Sufficiency Economy Philosophy, which frequently use integrated methods to assess how Science-Based Sufficiency Economy Immunity influences the application of Moderation, Rationality, Immunity, Moral Integrity, and Knowledge in rural farming communities.

2. Research Objectives and Analytical Focus

This study aimed to analyze how the application of the Five-Dimensional Science-Based Sufficiency Economy Immunity, Mind (M), Economy and Society (ES), Learning Culture (LC), Natural Resources and Environment (NE), and Technology (TE), influences the practice of the Three Core Principles (Moderation: MO, Rationality: RA, Immunity: IM) and Two Conditions (Moral Integrity: MR, Knowledge: KN).

The analytical focus was on the relationships between these five input dimensions and the behavioral outcomes of the Three Core Principles and Two Supporting Conditions.

3. Research Area and Participants

The study was conducted in four communities within Chiang Rai Province, focusing on sub-district administrative organization (SAO) areas that represent diverse agricultural and socio-economic conditions.

Qualitative Participants: A total of 20 key informants were selected using purposive sampling. These included community leaders, sub-district administrative officers, and farmers engaged in rice farming, gardening, and livestock activities. They participated in focus group discussions, in-depth interviews, and community workshops.

Quantitative Sample: A total of 450 respondents were selected using multi-stage random sampling. Participants included local leaders, sub-district officers, farmers, and general residents within the selected Chiang Rai communities.

Research Instruments:

1) Structured Interview Guide: Used for qualitative exploration of the application of the Five-Dimensional SEP and the practice of its core principles. The tool had a content validity score (IOC) of 1.00.

2) Semi-structured Questionnaire (Form A): Five-point Likert scale assessing internal factors of the Five-Dimensional Science-Based Sufficiency Economy Immunity and their influence on principal practice. The instrument demonstrated a Cronbach's alpha of 0.87.

3) Semi-structured Questionnaire (Form B): Five-point Likert scale measuring the effectiveness of applying Science-Based Sufficiency Economy Immunity dimensions on practicing moderation, rationality, immunity, moral integrity, and knowledge. The instrument showed a reliability score of 0.89 (Hair et al., 2019).

4. Data Collection Methods

Data were collected in three structured phases, using both qualitative and quantitative approaches:

1) Qualitative Data Collection: This phase included documentary synthesis and semi-structured in-depth interviews with 20 purposively selected informants. The goal was to explore how farmers applied the Five Science-Based Sufficiency Economy Immunity Dimensions and how these informed their practice of the Three Core Principles and Two Conditions in specific cultural contexts.

2) Quantitative Data Collection: A structured questionnaire was administered to 450 respondents to assess causal relationships between Science-Based Sufficiency Economy Immunity dimensions and the behavioral outcomes of moderation, rationality, immunity, moral integrity, and knowledge.

3) Quantitative Data Collection, Relationship Analysis: The same structured questionnaires were used to examine the strength and direction of relationships between the Five-Dimensional Science-Based Sufficiency Economy Immunity and the practice of the Three Core Principles and Two Conditions.

5. Data Analysis Methods

The study applied both qualitative and quantitative data analysis techniques:

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1) Qualitative Analysis: Data were analyzed using triangulation across three steps: data reduction, data organization, and data interpretation. This process aimed to synthesize qualitative findings and identify key indicators related to Science-Based Sufficiency Economy Immunity behavior and impact.

2) Quantitative Analysis: Data from the second-stage survey were analyzed using descriptive statistics (percentage, mean, standard deviation).

3) Quantitative Analysis: Data from the third-stage survey were analyzed using descriptive statistics and tested with Pearson's correlation coefficient (r) and stepwise multiple regression analysis to determine the strength of relationships between the Five-Dimensional Science-Based Sufficiency Economy Immunity and the level of practice of the Three Core Principles and Two Conditions.

Results

The research results on the application of the factors to science sufficiency economy base immunity and its impact on the practice of the three core principles and two conditions among farmers in Chiang Rai province are as follows:

1. Qualitative insights into the local agricultural context and Science-Based Sufficiency Economy Immunity implementation.

A field study conducted in Chiang Rai province revealed that most farmers primarily engage in traditional agricultural practices, such as rice cultivation, growing key cash crops (e.g., cassava, maize, and pineapple), and livestock farming. However, much of the area is characterized by sandy soils, insufficient water resources during the dry season, and inadequate irrigation systems. These limitations contribute to unstable yields and income. Farmers also face high production costs due to rising prices of fertilizers and seeds, while heavy reliance on middlemen further reduces their profit margins.

The social structure in these communities is predominantly agrarian, with a large proportion of the population being elderly. Many working-age individuals have migrated to urban areas or abroad in search of employment, resulting in various social issues such as family separation, malnutrition, poor health, and indebtedness. Furthermore, agricultural communities are affected by price instability, labor shortages, limited access to irrigation, and environmental degradation, particularly soil erosion and chemical contamination.

In terms of knowledge and capacity, there remains a need for more effective support mechanisms. Farmers require knowledgeable local leaders and community-based learning platforms. The development of large-scale farming models through cooperatives and community enterprises is also necessary to enhance bargaining power and increase income opportunities.

The study further analyzed and confirmed that farmers in Chiang Rai Province have concretely applied the Factors to science sufficiency economy base immunity, which has led to significant improvements in quality of life, occupational stability, and income security. The key dimensions can be summarized as follows:

1) Mind: Farmers have developed strong mental resilience, practicing moderation, patience, and moral integrity. These values contribute to psychological immunity, enabling them to better cope with economic and environmental risks.

2) Economy and Society: Farmers have strengthened their financial literacy and resource management skills. Through income planning, saving, investment, and collective action, they have reduced dependence on middlemen and enhanced community-level cooperation, leading to stronger grassroots economic resilience.

3) Learning Culture: The culture of shared learning is evident through knowledge exchange, farmer groups, and local training programs. Innovation and localized application of SEP and New Theory Agriculture are encouraged, enabling farmers to adapt knowledge to their specific cultural and environmental contexts.

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4) Natural Resources and Environment: Farmers increasingly prioritize soil and water conservation and adopt organic and integrated farming practices. These approaches help reduce environmental impacts and promote the long-term sustainability of agricultural resources.

5) Technology: Appropriate technology has been introduced to enhance productivity. This includes smart irrigation systems, modern agricultural tools, and information technologies that improve farm management and market connectivity, thereby increasing efficiency, reducing costs, and expanding marketing channels.

In conclusion, the findings highlight that farmers in Chiang Rai have effectively internalized and applied SEP principles across multiple dimensions. This has generated tangible benefits, including improved income, economic stability, stronger community cooperation, and the sustainable use of natural resources. The integration of SEP into daily life and livelihood activities illustrates its potential as a practical model for sustainable rural development in culturally diverse contexts.

2. Quantitative Analysis of the Impact of Factors on Science Sufficiency Economy base immunity on the practice of the three core principles and two conditions.

a) The factors to science sufficiency economy base immunity and its indicators for enhancing the practice of the three core principles and two conditions.

The research findings revealed that the application of factors to science sufficiency economy base immunity, based on the core principles of Moderation, Rationality, and Immunity, and the two accompanying conditions of Moral Integrity and Knowledge, consists of five key dimensions: Mind (M), Economy and Society (ES), Learning Culture (LC), Natural Resources and Environment (NE), and Technology (TE).

These dimensions collectively function as an integrated foundation to support and enhance the consistent practice of the three core principles and two conditions among farmers in Chiang Rai province. The results indicate that each dimension includes specific indicators that represent the capacity of farmers to internalize SEP principles and demonstrate the ability to adapt, respond to risks, uphold ethics, and apply knowledge in response to social, economic, and environmental challenges.

These findings demonstrate that factors related to science, sufficient economic base immunity play a crucial role in strengthening farmers' capacity to sustain quality of life, stable careers, and secure income through the continuous and balanced application of SEP principles.

Details of the indicators corresponding to each dimension are presented in Table 1.

Table 1 Factors of Science-Based Sufficiency Economy Immunity and Principles of the Three Core Principles and Two Conditions: The Five-Dimensional SEP and Their Indicators

Factors	Sub-factors	Indicators
Factors for a science-based sufficiency economy immunity.	1) Mind.	(1.1) Demonstrating contentment, modesty, and gratitude without greed. (1.2) Practicing self-initiative to build a strong mental foundation and healthy lifestyle through a middle-path approach. (1.3) Living with honesty, integrity, and continuously seeking useful knowledge.
	2) Economy and society.	(2.1) Promoting diligence and occupational perseverance to achieve self-reliance. (2.2) Striving to overcome poverty through productive livelihoods. (2.3) Applying inherited wisdom to practical, adaptive use in economic activities. (2.4) Fostering a compassionate society with mutual support, reduced spending, and increased income.

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Factors	Sub-factors	Indicators
		(2.5) Building community cooperation and fairness, while discouraging exploitation.
	3) Learning about culture.	(3.1) Cultivating a sustainable and economical lifestyle. (3.2) Leading a simple life free from materialism and consumerism. (3.3) Applying knowledge to adapt occupational results for self-reliance. (3.4) Utilizing sufficiency economy principles in practical activities. (3.5) Integrating education with local wisdom to reduce costs and make use of community resources. (3.6) Diversifying distribution channels for resilience and market access.
	4) Natural resources and the environment.	(4.1) Conserving and managing natural resources to align with farmers' livelihoods and production systems. (4.2) Achieving ecological balance to support self-reliance and quality of life. (4.3) Focusing on environmental sustainability and respecting agro-ecological systems. (4.4) Using natural processes to enhance productivity. (4.5) Integrating crop and livestock systems to optimize efficiency cyclically.
	5) Technology.	(5.1) Applying appropriate and integrated technology in agricultural production. (5.2) Leveraging digital and learning technologies to enhance productivity. (5.3) Building networks for knowledge sharing and innovation. (5.4) Presenting and utilizing information effectively for production and marketing.
Three Core Principles and Two Conditions of science science-sufficient economy.	1) Moderation.	(1.1) Ability to develop and manage local resources to generate household income and savings. (1.2) Practice of conserving natural resources and living in harmony with nature. (1.3) Capacity to apply community, human, and natural capital to sustain livelihoods amid changing circumstances.
	2) Rationality.	(2.1) Performing tasks based on cost-effectiveness and professional work processes. (2.2) Encouraging participation and reasoned decision-making in occupational practices. (2.3) Applying natural remedies and rational approaches to daily life and careers.
	3) Immunity.	

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Factors	Sub-factors	Indicators
	4) Moral.	(3.1) Practicing the middle path, being economical and non-greedy in career conduct, and developing self-awareness. (3.2) Maintaining diligence and continuous professional effort, and developing self-awareness. (3.3) Using appropriate technologies to increase efficiency and reduce costs, and finding ways to minimize expenses and avoid extravagant living. (4.1) Leaders and members of farmer groups demonstrate ethical behavior and unity, upholding strong responsibility, honesty, and ethical commitment to duties. (4.2) Fostering participation and cooperation within occupational groups. (4.3) Leaders serve as role models for collaboration and ethical professional practices
	5) Knowledge.	(5.1) Pursuing lifelong learning and applying knowledge confidently in professional life, while gaining hands-on knowledge (5.2) Developing broad knowledge and technical skills for professional competence. (5.3) Building learning processes through collaboration within and across communities.

The five key dimensions of the Science-Based Sufficiency Economy Immunity, Mind, Economy and Society, Learning Culture, Natural Resources and Environment, and Technology- collectively function as the independent variables that influence the practice of the Three Core Principles and Two Conditions: Moderation, Rationality, Immunity, Moral Integrity, and Knowledge.

Each dimension contributes uniquely to strengthening these core principles and conditions: (1) Mind cultivates psychological resilience, ethical consciousness, and emotional discipline, reinforcing Moderation in consumption and behavior, Immunity to cope with adversity, and Moral Integrity grounded in ethical farming practices. (2) Economy and Society enhances self-reliance and community-based economic cooperation, supporting Rationality in financial planning, Moderation in production, and Immunity against economic shocks. (3) Learning Culture fosters lifelong learning, integration of local wisdom, and innovation, factors which enhance Knowledge, adaptive capacity (Immunity), and context-based Rationality. (4) Natural Resources and Environment emphasizes ecological stewardship, which instills Moderation in resource use, Rationality in ecosystem-based decisions, and Immunity through sustainable land and water management. (5) Technology improves productivity and efficiency through appropriate innovations, directly enhancing Knowledge acquisition, Rational decision-making, and systemic Immunity via digital tools and smart agriculture.

These dimensions collectively strengthen the farmers' practice of Moderation through mindful resource use and balanced living, Rationality via informed, cost-effective decisions, Immunity by enhancing risk management and self-awareness, Moral through ethical leadership and social responsibility, and Knowledge by fostering lifelong learning and technical competence.

The research confirms that the application of Factors to a science-based economy-based immunity significantly impacts the consistent and effective practice of the three core principles and two conditions among farmers in Chiang Rai province, thereby improving their quality of life, occupational stability, and income sustainability.

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b) Levels and Descriptive Statistics of factors to Science-Based Sufficiency Economy Immunity and the practice of the three core principles and two conditions among farmers in Chiang Rai province

This section provides a descriptive analysis of Factors in the science-based sufficiency economy-based immunity framework alongside the practice levels of its three core principles and two conditions. The analysis emphasizes the mean scores, standard deviations, and corresponding application levels for each dimension and principle. The findings reveal the degree to which farmers have incorporated SEP into their daily lives, demonstrating their dedication to sustainable living, ethical behavior, and resilience against social, economic, and environmental challenges. The summary of these results is presented in Tables 2 and 3.

Table 2 Mean, standard deviation, and levels of factors Influencing Science-Based Sufficiency Economy Immunity among Farmers in Chiang Rai Province.

NO.	FACTORS TO SCIENCE-BASED SUFFICIENCY ECONOMY IMMUNITY	MEAN	STD.	LEVELS
1.	Mind.	4.37	0.49	Very High
2.	Economy and society.	4.03	0.52	High
3.	Learning about culture.	4.16	0.51	High
4.	Natural resources and the environment.	4.30	0.49	Very High
5.	Technology.	3.98	0.52	High
	Totals	**4.17**	**0.29**	**High**

Table 2 summarizes the mean, standard deviation, and engagement levels across the five dimensions of science-based sufficiency economy immunity among farmers in Chiang Rai Province. The overall mean of 4.17 (SD = 0.29) indicates a high level of SEP immunity application across the sample.

The most notable finding is the exceptionally high score in the Mind dimension (Mean = 4.37, SD = 0.49), reflecting deep-rooted ethical consciousness and emotional resilience among farmers. This suggests that values such as contentment, moderation, honesty, and continuous learning are well-integrated into their daily lives, serving as a moral foundation for SEP application.

The Natural Resources and Environment dimension also scored very highly (Mean = 4.30, SD = 0.49), highlighting a strong commitment to ecological balance, sustainable resource use, and integrated farming practices. This demonstrates that environmental stewardship is not only valued but actively practiced in ways that align with sufficiency economy principles.

Meanwhile, Learning Culture (Mean = 4.16, SD = 0.51) and Economy and Society (Mean = 4.03, SD = 0.52) reflect substantial efforts in fostering knowledge exchange, local innovation, and community cooperation. These findings support the idea that social capital and knowledge adaptation are critical enablers of SEP resilience.

Although the Technology dimension received the lowest score (Mean = 3.98, SD = 0.52), it remains within the high category, suggesting that while digital tools and innovations are being adopted, there remains room for growth in this area. This could be due to barriers in access, training, or infrastructure, especially in more remote communities.

In summary, the consistently high scores across all five dimensions, especially in Mind and Environmental Stewardship, confirm that farmers in Chiang Rai have meaningfully internalized and operationalized the SEP framework. These dimensions collectively foster psychological, ecological, and social resilience, reinforcing the practical relevance of science-based sufficiency economy immunity for sustainable rural development.

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Table 3 Mean, Standard Deviation, and Levels of the practice of the three core principles and two conditions of the sufficiency economy philosophy.

NO.	THREE CORE PRINCIPLES AND TWO CONDITIONS OF THE SUFFICIENCY ECONOMY PHILOSOPHY.	MEAN	STD.	LEVELS
1.	Moderation.	4.45	0.91	Very High
2.	Rationality.	4.39	0.42	Very High
3.	Immunity.	4.44	0.43	Very High
4.	Moral.	4.48	0.44	Very High
5.	Knowledge.	4.43	0.47	Very High
	Totals	**4.44**	**0.34**	Very High

Table 3 presents the mean, standard deviation, and levels of practice for the Three Core Principles and Two Conditions of the Sufficiency Economy Philosophy among farmers in Chiang Rai Province. The overall mean was 4.44 (SD = 0.34), indicating a consistently very high level of application across all five components.

Among these, "Moral" received the highest score (Mean = 4.48, SD = 0.44), underscoring the central role of ethical leadership, social responsibility, and cooperative group behavior in sustaining SEP-based livelihoods.

Closely following were "Moderation" (Mean = 4.45, SD = 0.91) and "Immunity" (Mean = 4.44, SD = 0.43), which together reflect farmers' emphasis on resource efficiency, prudent living, resilience, and the use of cost-saving innovations to mitigate risks.

"Knowledge" (Mean = 4.43, SD = 0.47) highlights active lifelong learning, technical skill development, and collaborative knowledge-sharing systems. Although "Rationality" had the lowest score (Mean = 4.39, SD = 0.42), it still indicates a very high level of thoughtful decision-making based on participation, professionalism, and contextual reasoning.

These results suggest that SEP principles are not only internalized as abstract values but are actively translated into daily decision-making and collective practices. The strong performance in "Moral" and "Moderation" particularly reflects the communities' ethical foundation and sustainable mindset, which strengthen rural resilience and reinforce the practical relevance of the SEP framework in local development.

c) Relationship Matrix of factors influencing science-based sufficiency economy immunity and the three core principles and two conditions.

The relationship between Factors to science sufficiency economy base immunity Mind (M), Economy and Society (ES), Learning Culture (LC), Natural Resources and Environment (NE), and Technology (TE) and the Three Core Principles (Moderation, Rationality, and Immunity) as well as the Two Conditions (Moral Integrity and Knowledge). These dimensions represent the foundation of SEP-based immunity, while the principles and conditions reflect the outcomes of sustainable practice, as shown in Table 4.

Table 4. Relationship matrix of factors influencing science-based sufficiency economy immunity and the three core principles and two conditions.

Variable	M	ES	LC	NE	TE	MO	RA	IM	MR	KN
M	1									
ES.	.462**	1								
LC.	.009	.052	1							
NE	.113*	.072	.440**	1						
TE	.055	.005*	.387**	.302**	1					

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Variable	M	ES	LC	NE	TE	MO	RA	IM	MR	KN
MO	.346**	.238**	.026	.050	.009	1				
RA	.275**	.199**	.297**	.437**	.193**	.062	1			
IM	.587**	.348**	.255**	.341**	.201**	.211**	.403**	1		
MR	.343**	.058	.285**	.368**	.351**	.058	.310**	.372**	1	
KN	.606**	.426**	.034	.071	.025	.277**	.242**	.604**	.217**	1

The correlation matrix reveals several statistically significant and practically meaningful relationships between the five dimensions of science-based sufficiency economy immunity and the practice of the Three Core Principles and Two Conditions among farmers in Chiang Rai Province.

The Mind (M) dimension exhibited the strongest and most consistent positive correlations, particularly with Knowledge (KN) (r = .606**), Immunity (IM) (r = .587**), and Moderation (MO) (r = .346**). These findings suggest that a strong internal mindset, characterized by ethical awareness, emotional resilience, and self-initiative, is crucial to promoting resilience, informed living, and lifelong learning, which are central to SEP practice.

Similarly, Natural Resources and Environment (NE) correlated significantly with Rationality (RA) (r = .437**) and Moral Integrity (MR) (r = .368**), highlighting how environmental stewardship supports rational decision-making and ethical behavior. These results emphasize that sustainable resource management is not only an ecological priority but also a moral and cognitive one in the SEP framework.

Economy and Society (ES) showed positive correlations with Knowledge (KN) (r = .426**) and Immunity (IM) (r = .348**), reinforcing the idea that economic self-reliance and community cooperation strengthen adaptive capacity and knowledge application in farming practices.

Although the Technology (TE) dimension showed relatively lower correlation coefficients, it was still significantly associated with Moral Integrity (MR) (r = .351**) and Rationality (RA) (r = .193**), indicating that appropriate technological integration may support ethical and rational farm management, though its impact is emerging.

In summary, the Mind and Natural Resources and Environment dimensions appear to have the most substantial influence on farmers' SEP-based practices. These correlations support the theoretical assertion that internal values and ecological awareness are foundational to sustainable and ethical development in rural communities.

d) Multiple regression analysis of the influence of factors on science, the sufficiency economy, based immunity on the practice of the three core principles and two conditions among farmers in Chiang Rai province.

Table 5 Multiple Regression analysis of the influence factors on science sufficiency economy based on the practice of the three core principles and two conditions among farmers in Chiang Rai province.

Variable	Unstandardized Coefficient		Standardized Coefficient	t	Sig.	Collinearity Statistics	
	b	S.E.	β			Tolerance	VIF
Constant.	1.415	0.161		8.767	0.000**		
Mind: M	0.397	0.026	0.572	15.124	0.000**	0.764	1.308
Economy and society: ES	0.085	0.025	0.128	3.369	0.001*	0.753	1.327
Learning culture: LC	0.340	0.260	0.095	2.443	0.015*	0.724	1.381
Natural resource and environment: NE	0.940	0.260	0.133	3.533	0.000**	0.775	1.290

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Variable	Unstandardized Coefficient		Standardized Coefficient	t	Sig.	Collinearity Statistics	
	b	S.E.	β			Tolerance	VIF
Technology: TE	0.690	0.240	0.106	2.849	0.005*	0.795	1.258

Adjusted R^2 of 0.497, F-Value of 91.823, Sig of .000**

The results from the multiple regression analysis reveal that all five dimensions of science-based sufficiency economy immunity, Mind (M), Economy and Society (ES), Learning Culture (LC), Natural Resources and Environment (NE), and Technology (TE), have a statistically significant influence on the practice of the Three Core Principles and Two Conditions of the Sufficiency Economy Philosophy.

Among these, the Mind (M) dimension stands out with the highest standardized coefficient (β = .572, $p < .001$), confirming its dominant role in shaping farmers' ethical orientation, resilience, and capacity to internalize and practice SEP values. This finding reinforces earlier correlations and descriptive trends, suggesting that mindset development is the cornerstone of SEP-based behavior change.

The Natural Resources and Environment (NE) dimension also shows a significant effect (β = .133, $p < .001$), indicating that environmental stewardship is not only practiced but also serves as a catalyst for broader SEP adoption. Farmers who actively conserve resources and maintain ecological balance are more likely to make rational decisions and live in moderation.

Economy and Society (ES) (β = .128, $p = .001$) and Technology (TE) (β = .106, $p = .005$) also contribute positively, suggesting that socioeconomic stability and appropriate technological use play supporting roles in sustaining SEP-aligned livelihoods. Meanwhile, Learning Culture (LC), though statistically significant (β = .095, $p = .015$), has the smallest effect, indicating its influence is present but relatively modest compared to other dimensions.

The model demonstrates a solid overall fit, with an Adjusted R^2 of 0.497, meaning that approximately 49.7% of the variance in SEP practice can be explained by these five dimensions. The F-value of 91.823 ($p < .001$) confirms the model's statistical significance.

In summary, the findings highlight Mind as the most critical predictor, followed by environmental awareness and socioeconomic support. These dimensions collectively strengthen rural resilience and sustainable development through the consistent application of the Sufficiency Economy Philosophy.

Discussion

Science sufficiency economy base immunity, grounded in the principles of the Three Core Principles and Two Conditions, is applied through five key dimensions: Mind, Economy and Society, Learning Culture, Natural Resources and Environment, and Technology. Farmers in Chiang Rai Province reported a high overall level of SEP base immunity, with particularly strong performance in the Mind and Natural Resources and Environment dimensions. The practice of the Three Core Principles and Two Conditions was also at a very high level, with Moral Integrity scoring the highest.

1. The Mind dimension emerged as the most influential factor, both in terms of mean scores and regression coefficients (β = .572, p < .001). This suggests that internal values, such as ethical awareness, mindfulness, contentment, and emotional resilience, form the moral and psychological foundation necessary for sustainable SEP practices. These findings align with Tangthong (2018), who emphasized the importance of cultivating inner values and self-awareness in enhancing moderation and resilience, and Sukwattanapong (2014), who highlighted the role of moral development in transforming behavior. The strong correlations between Mind and SEP outcomes, such as Immunity, Knowledge, Moderation, and Moral Integrity, support the notion that mental preparedness is a catalyst for behavioral change and community adaptation.

2. The Natural Resources and Environment dimension (β = .133, p < .001) also significantly contributed to SEP practice. Farmers demonstrated a high commitment to resource conservation, ecosystem balance, and sustainable agricultural techniques. This finding is consistent with Chuenpagdee & Jentoft

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(2015), who noted that environmental sustainability is intricately linked to community ethics and resilience. The fact that environmental factors are embedded in daily practice suggests that agro-ecological awareness is not only strategic but culturally internalized.

3. The dimensions of Learning Culture ($\beta = .095$, $p = .015$) and Economy and Society ($\beta = .128$, $p = .001$) play supporting yet meaningful roles in SEP implementation. These dimensions emphasize knowledge transfer, local innovation, and collaborative networks, all of which are vital for sustaining the SEP framework. According to Tantivejkul (2014), these systems reflect SEP's multi-dimensional nature, where learning, participation, and economic stability are mutually reinforcing.

4. Although Technology had the lowest standardized coefficient ($\beta = .106$, $p = .005$), its positive impact indicates emerging efforts to integrate digital tools, innovation, and data into agricultural practices. This supports the findings of Chetri et al (2021) and Adenle & Agboola (2011), who argue that technological inclusion enhances adaptive capacity and productivity in rural areas. However, challenges such as limited digital access, low literacy, and inadequate support systems may slow this transition and require further investment.

5. The relative strength of each dimension may reflect cultural familiarity and accessibility. Mind and Environmental factors resonate deeply with Buddhist ethics and rural traditions, making them easier to internalize. In contrast, dimensions such as Technology and Learning Culture often require external intervention, capacity-building, and sustained infrastructure, which may explain their lower impact. This disparity highlights the importance of contextualizing SEP implementation to match community readiness.

6. The model's Adjusted R^2 of 0.497 suggests that nearly half of the variance in SEP principal practice is explained by the five dimensions, evidence of a robust and integrative framework. This echoes His Majesty King Bhumibol Adulyadej's philosophy, which positions inner development as the foundation of all other forms of growth (United Nations Development Programme, 2007).

Limitations

Despite these promising results, several limitations must be acknowledged. First, the study focused exclusively on Chiang Rai Province, which may not fully reflect conditions in other provinces or regions. Second, the cross-sectional nature of the study means that changes over time were not captured. Third, self-reported data may introduce bias, especially in subjective areas such as morality and rationality. Future studies should incorporate longitudinal designs to triangulate findings and explore causal relationships more deeply.

Recommendations

To strengthen the application of science-based sufficiency economy immunity, the following recommendations are proposed: 1) Policies should focus on mental and ethical development, including programs in mindfulness, values education, and emotional intelligence in agricultural communities. 2) Encourage the adoption of sustainable farming models and community-based natural resource management, particularly those that promote equity, cooperation, and interdependence. 3) Expand access to digital infrastructure, agricultural technology, and localized training, especially for underserved rural areas, to bridge the innovation gap. 4) Develop community-led platforms for decision-making that integrate local wisdom, practical experience, and collaborative learning to strengthen institutional trust and legitimacy.

Conclusion

This study confirms that farmers in Chiang Rai Province apply the science-based sufficiency economy immunity at a very high level, particularly in dimensions related to mindset, moral integrity, and knowledge application. These findings reflect a solid ethical and cognitive foundation for achieving sustainable livelihoods aligned with the Three Core Principles and Two Conditions.

Among the five dimensions assessed, the Mind dimension emerged as the most influential predictor, showing the strongest correlations and highest standardized coefficient about the Three Core Principles (Moderation, Rationality, Immunity) and the Two Conditions (Moral Integrity and Knowledge). Environmental stewardship and social capital also played meaningful roles, reinforcing the multi-

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dimensional and integrated nature of science-based sufficiency economy immunity as a practical development framework.

Rather than merely reiterating the empirical results, these insights emphasize that internal mental resilience and ethical orientation are not just complementary but central enablers of behavioral change, sustainability, and adaptability in rural livelihoods. The findings also validate existing theories on sufficiency-based development while contributing new empirical evidence from the context of Northern Thailand.

In terms of practical application, this research offers policy-relevant guidance. Programs designed to promote science-based sufficiency economy immunity in agricultural communities should prioritize inner development, lifelong learning, and environmental management, alongside the strategic deployment of appropriate technology. Capacity-building and participatory mechanisms can further amplify the impact of these initiatives.

Future research could build on these findings by exploring longitudinal effects, expanding the geographic scope, or integrating qualitative methods to gain deeper insights into cultural and contextual influences on the Three Core Principles and Two Conditions. Such efforts would help refine both theoretical understanding and implementation strategies for sustainable development grounded in sufficiency economy principles.

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