

Agricultural resilience, collaborative governance, and local administrative organizations in Thailand



 Chairat
Nateprasittiporn¹

 Phattharawuth
Somyana²

 Mujalin
Nateprasittiporn^{3*}

¹Department of Public Administration Faculty of Humanities and Social Sciences, Rajabhat Chiang Mai University, Thailand.

²Email: chairat_nat@cmru.ac.th

²Department of Economics, Faculty of Management Sciences, Chiang Mai Rajabhat University, Thailand.

³Email: W.somyana@gmail.com

³Department of Public Administration, Faculty of Social Sciences and Liberal Arts, North Chiang Mai University, Thailand.

³Email: mujalin.natee@gmail.com



(+ Corresponding author)

ABSTRACT

Article History

Received: 14 July 2025

Revised: 16 October 2025

Accepted: 3 November 2025

Published: 17 November 2025

Keywords

Agricultural
Collaborative governance
External factors
Local administrative
organizations
Policy
Thailand.

This study examines how external factors influence agricultural policy implementation by local administrative organizations (LAOs) in Chiang Mai, Thailand, with collaboration modeled as a mediator. A mixed-methods design across 59 LAOs combines surveys, interviews, and document analysis. Statistical results indicate that social dynamics exert the strongest direct effect on policy outcomes ($\beta = 0.270$, $p = 0.007$), while political influences are marginally significant ($\beta = 0.151$, $p \approx 0.05$). Although economic and technological factors record lower means (3.34 and 3.03), their impacts become substantial when transmitted through collaborative mechanisms, accounting for approximately 54–70% of total effects. Qualitative cases illustrate farmer networks, community enterprises, and shared-equipment programs that increase household incomes by about 30% and reduce resource dependence. Building on these findings, a Collaboration-Mediated Participatory Development model is advanced, positing that multi-stakeholder collaboration should precede major technological investments. Despite the provincial scope, the evidence offers actionable guidance for the design of agricultural policy in resource-constrained Southeast Asian contexts.

Contribution/ Originality: This study contributes to collaborative governance theory by revealing how economic and technological factors, though initially weak, gain significant influence when mediated through community collaboration. The proposed Collaboration-Mediated Participatory Development model provides practical insights for strengthening agricultural resilience and offers policy guidance for resource-constrained regions across Southeast Asia.

1. INTRODUCTION

Global food security and climate change have increased the imperative for sustainable agriculture as one of the top agendas defined by the United Nations' Sustainable Development Goals, emphasized by SDG 2 (Zero Hunger) and SDG 11 (Sustainable Cities and Communities) (Beddington et al., 2012; Hanjra & Qureshi, 2010). In Thailand, agriculture persists as the foundation for economic growth, rural development, and sustainable community development (Pretty et al., 2020; Rigg, Salamanca, Phongsiri, & Sripun, 2020).

Northern Thailand's Chiang Mai Province exists as an economic center as well as an agricultural heartland, encompassing geographical diversity as well as multi-ethnic farm communities (Jepsen, Palm, & Bruun, 2019; Jiang, Kang, Schmidt-Vogt, & Schrestha, 2007). The local administrative institutions (LAOs) form the central actors in providing agricultural policy but struggle amidst rising external pressures. Politically, national instability as well as policy changes disrupt planning and budgeting (Barrett et al., 2020). Economically, smallholder farmers struggle amidst agri-food price variability affecting the global arena as well as market competition (Ricciardi, Mehrabi, Wittman, James, & Ramankutty, 2021). Socially, rural-urban migration as well as changing demographics lower the supply of labor and threaten the durability of agriculture (Zhang, Li, & Quan, 2023). Technologically, access to and use of agricultural innovations remain contributory factors toward limited smallholder productivity (Jokonya & Smidt, 2022).

Earlier research revealed that successful agricultural development of highland systems relies on the collaboration between government institutions, local governments, the private sector, and farm communities, especially in technology transfer, market development, and resource conservation (Klerkx & Leeuwis, 2009; Shiferaw, Okello, & Reddy, 2009). Further, effective policies must combine indigenous knowledge with the latest technologies by closing financial and market gaps (Asenso-Okyere & Davis, 2009; Aubert, Schroeder, & Grimaudo, 2012). The formation of farmer peer groups and the connection of producers with larger markets also ensure the stability of the agricultural system (Braun, Thiele, & Fernández, 2000).

Even though these understandings are out there, thus far, studies of collaborative governance of agriculture have been geared towards social and political drives, with fewer concerns with the intersection of economic and technological factors with collaborative processes at the local and regional levels. The paper bridges the gap by analyzing how external influences shape LAOs' policy deliverables in the agricultural development of Chiang Mai Province, with attention directed toward collaboration as a mediating factor. The study makes a contribution to public policy administration when confronted with questions of ecological as well as societal transformation while projecting indicative implications for the sustainable agricultural governance of Southeast Asia.

1.1. Research Objectives

1. To study and examine how external factors, encompassing political, economic, social, and technological factors, impact LAO agricultural policy implementation in Chiang Mai province.
2. In attempts to examine the interplay between such outside forces and LAOs' support systems of agricultural policy implementation, such as the networks of construction, capacity development of the staff, and plans for resource allocation.
3. To capture collaboration's mediating role between the exogenous environment and LAOs' capacity to implement their agriculture policy, examining the extent of collaborative processes supporting policy outcomes and implementation success.

1.2. Research Hypotheses

Hypothesis 1 (H₁): Political, economic, social, and technological external factors significantly influence LAO agricultural policy implementation in Chiang Mai province.

H₂: Positive correlations between exogenous political, economic, social, and technological forces and LAO's channels of support for cooperation exist regarding the implementation of agricultural policy, specifically in resource allocation, equipment provision, and networking among community organizations.

H₃: Collaboration is an intervening variable between environmental external variables and the agricultural policy implementation effect, in that collaborative processes enhance the implementing efforts of LAOs' agricultural policy in terms of being more effective and efficient.

2. LITERATURE REVIEW

Contemporary LAOs are expected to function within more complex and dynamic external environments. According to Gupta (2013), PEST analysis is a systematic process of evaluating the political, economic, social, and technological drivers of organizational activities. The tool allows LAOs to scan for possible opportunities and threats and develop strategies responsive to differing contextual issues. However, whereas PEST analysis may serve as a useful starting point in understanding external drivers, the complexity of government operations in developing economies often necessitates more advanced and inclusive theories.

The Collaborative Governance Theory, as highly influential as it is in public administration literature, has some flaws when utilized under the framework of developing countries. Ponte and Cheyns (2013) contend that the premise for an equal distribution of power among the stakeholders within the theory does not acknowledge the inherent power imbalances built into developing institutional environments. This is especially true in Thailand, where state bureaucratic frameworks still bear significant limitations on actual collaboration despite the strict application of decentralization rules (Marks & Lebel, 2016). To top it all off, conventional collaborative governance frameworks, which focus on official institutional arrangements (Ansell & Gash, 2008), easily ignore the critical role played by informal networks and customary modes of governance in policy execution. Tai (2015) demonstrates that, in the scenario of Southeast Asian agricultural societies, informal institutional arrangements are stronger in fostering cooperation compared to formal ones.

Within these limitations, Ostrom's Institutional Analysis and Development (IAD) Framework is a more nuanced framework for exploring governance dynamics in developing worlds. In its emphasis on "action situations" across different levels, the IAD Framework illustrates how local actors handle institutional complexity in such a manner as to coordinate common resources like agriculture and water systems (Ostrom, 2011). It emphasizes the interaction between rules, stakeholders, and context, and provides more insight into how the problems of governance are managed in practice.

2.1. Political, Economic, Social, and Technological Dimensions Impacting LAOs

Politically, Parnell (2008) is concerned that political intentions play a key role in shaping the sustainability and scope of local policies. The implications can be observed in policy redrafts, fiscal systems, and administrative rules, which have immediate effects on agricultural development projects and public service delivery.

Economically, Altobelli and Henke (2024) outline that economic instability, such as inflation, market uncertainty, and unstable commodity prices, can greatly affect the budgetary allocation and practice of resource management among LAOs. National and international economic policies also influence policies employed for supporting agriculture, with an impact on farmers' competitiveness in world markets.

Socially, Pretty et al. (2020) provide strong evidence that local social interactions, beliefs, and cultural context exert significant influences on public participation and policy adoption in LAO projects. Under agricultural community development, intra-community collaboration and openness to innovation are key drivers of long-term project success.

Technologically, Herrero et al. (2020) contend that innovation is crucial for improving operational effectiveness in LAOs. Coupling high-tech information systems and new farm technology not only enhances product quality and reduces prices but also assists in closing the enduring technological gap between rural and urban communities.

2.2. Collaboration and Strategic Partnerships in Local Governance

Strategic collaboration and joint administration are the most effective ways to address such challenges. Ansell and Gash (2008) propose collaborative public management strategies that emphasize both external and internal collaboration, particularly in situations of resource limitations. This is in agreement with O'Flynn (2009) contention

that collaborative strategy minimizes redundancy, maximizes efficiency, and facilitates a broader response to different community requirements.

Provan and Kenis (2008) similarly propose that the use of several partnership arrangements allows LAOs to respond more adequately to environmental change. McGuire (2006) underscores the importance of capacity-building initiatives in developing management capacity, while Agranoff (2006) mentions the necessity of resource-sharing machinery for minimizing costs and enhancing the quality of service.

2.3. Collaborative Governance in Southeast Asia Contexts

In Southeast Asia, cooperative governance has been a critical instrument for driving the Sustainable Development Goals (SDGs) in agriculture and rural development. It has been crucial to enhance coordination among governments, non-governmental actors in the private sector, farmers, and research institutions in addressing critical issues such as poverty, food insecurity, and environmental degradation (Florini & Pauli, 2018). A good example is Vietnam's Small Farmer-Focused Governance model, a true representation of strategic coordination among the state, enterprises, farmers, and researchers. The model enhances farm efficiency and export capacity by mainstreaming marginalized smallholders into inclusive market systems (Dung, Schmied, & Van Chinh, 2022).

Collaborative governance in Thailand is effective based on a range of socio-economic determinants. They involve inequalities in access to the internet, economic behavioral patterns, and income inequalities. Denfanapapol, Setthasuravich, Rattanakul, Pukdeewut, and Kato (2024) observe that reducing the digital divide as well as ensuring adequate budgetary allocations to environmental initiatives are preconditions for efficient collaboration. These results emphasize the LAOs' duty to align agricultural and environmental policies with regional socio-economic conditions. Further, Myanmar's flood management experience provides lessons that also contribute even more to abandoning hierarchical in favor of participatory management.

As Aung and Lim (2021) propose, building trust among various actors is a sine qua non of achieving sustainable success in multi-actor collaboration, and that lesson applies just as much to agricultural as to other governance.

Decentralization is also important in influencing agricultural policy-making decisions. The decentralized state in Thailand has helped agrarian families, particularly in fast-developing urban provinces, to bargain livelihood and sustainability issues face-to-face with state institutions (Gullette & Singto, 2018). This local administration helps LAOs achieve a balance between the demands of urban development and the maintenance of agricultural livelihoods. In the Northeast, Promkhambut et al. (2023) emphasize a market-oriented collaborative governance system to facilitate continuous interaction among policymakers, scientists, and farmers. Based on their research, they demonstrate that sustainable agricultural outcomes are not solely dependent on the adoption of technology but also on ongoing farm practice adaptations to changing market trends.

Influence by stakeholders continues to be the impetus for the development of sustainable farming practices. Onbuddha, Ma, Chindavijak, and Ogata (2024) conclude that owners, employees, and competitors are some of the main drivers who compel farming firms to adopt sustainability initiatives. While their research focuses on private firms, the overarching principle that stakeholder interaction is central to sustainable development also applies to LAOs seeking inclusive rural development.

All these points function to create the fact that effective collaborative governance in developing contexts is more than the existence of formal institutional tools. It is the ability to address socio-economic disparities, digital disparities, and changing market forces.

In the context of LAOs in places like Chiang Mai, particularly, the possibility of designing participatory, inclusive, and market-sensitive governance institutions will be critical to building agricultural resilience alongside harvesting sustainable policy benefits.

2.4. Public Policy Management Frameworks

Good governance underpins many theoretical paradigms in policy-making and policy implementation. Dye (2012) and Hill and Hupe (2002) highlight the role of effective governance as pivotal in the incorporation of sound evaluation plans into systematic policy-making for effectiveness. Dunn (2018) also stresses the importance of interaction with real sources of data and subject-matter experts during the policy process. Early work by Pressman and Wildavsky (1984) emphasizes the importance of cross-agency coordination and continuous monitoring as critical factors in effective policy implementation. More comprehensively, Rossi, Lipsey, and Freeman (2004) promote that policy be assessed in terms of a multi-dimensional framework that includes economic, social, and community participation dimensions. Supportive of these perspectives, Lindblom (1959) reiterates the need to maintain adaptive flexibility while making policy in order to effectively respond to changing contextual realities.

3. METHOD

3.1. Research Methodology (*Mixed Method*)

This present research considers the role played by external mechanisms in the implementation of agricultural policy by Local Administrative Organizations (LAOs) in Chiang Mai province, specifically those LAOs that hold more than 20% of agricultural land within their overall territorial area. This selection criterion effectively characterizes contexts with extensive agricultural cultivation and significant economic reliance on agriculture. A mixed-methods design is employed, integrating both quantitative and qualitative data collection and analysis to provide a comprehensive understanding of the research problem. The study's scope and methodological framework are organized as follows:

3.1.1. Population Definition

The sample population consists of all 211 Local Administrative Organizations (LAOs) distributed across 25 districts in Chiang Mai province.

3.1.2. Sample Selection

Purposive sampling was used to select LAOs where agricultural land covers over 20% of the total area, reflecting intensive agricultural activity. Analysis of questionnaire data collected from LAOs throughout Chiang Mai province, supplemented by primary data extracted from official LAO websites, identified 80 eligible organizations. Of these, 59 LAOs participated in the study, representing a response rate of 73.75%, comprising 34 Sub-district Municipalities and 25 Sub-district Administrative Organizations (SAO). The selection of the 59 LAOs was based on both theoretical and contextual considerations. Chiang Mai province was chosen because it is one of Thailand's largest provinces and serves as the political, economic, and social center of the northern region. However, the majority of the population depends on agriculture for their livelihood. This paradox being a modernizing center with an agrarian society makes Chiang Mai an appropriate case study for analyzing how external pressures from political, economic, social, and technological domains interact with collaborative governance mechanisms during the implementation of agricultural policies.

Though the survey of 59 LAOs generates robust insights, a few limitations must be emphasized. The findings are province-specific and reflect the distinctive character of the geography, ethnic composition, and governing structures of Chiang Mai. Generalizations cannot thus arise from the research for the total provinces of Thailand or other Southeast Asian provinces. Yet, as Chiang Mai also represents a large provincial center as well as an agriculturally concentrated province, the findings provide robust indicative lessons for other provinces that share the same structural features i.e., high dependence upon agriculture amidst a rapidly changing socio-economic context. For qualitative data collection through in-depth interviews, purposive sampling techniques were applied to select senior administrators or relevant departmental officials from 10 representative LAOs.

3.2. Data Collection

3.2.1. Primary Data

3.2.1.1. Quantitative Data

A 5-point Likert scale (ranging from 1.00 to 5.00) was used to assess LAOs' roles and collaborative practices in agricultural support initiatives.

Reliability Testing: Calculated Cronbach's Alpha coefficient of 0.87, indicating high internal consistency and acceptable reliability.

Content validity was verified through the Index of Item-Objective Congruence (IOC) methodology, with assessment by subject matter experts confirming that all questionnaire items achieved scores above the threshold value of 0.5.

3.2.1.2. Qualitative Data

Conducted in-depth interviews with LAO administrators and relevant officials using structured open-ended questions designed to explore conceptual understandings, practical experiences, and key factors influencing agricultural policy implementation.

3.2.2. Secondary Data

Collected and analyzed documentary evidence from LAO policy reports, statistical databases, and relevant peer-reviewed research publications.

3.3. Data Analysis

The analytical framework was designed to align precisely with the specified research objectives, encompassing a comprehensive assessment of external factors influencing LAOs' agricultural support functions and analyzing collaboration as a mediating variable in enhancing agricultural policy implementation effectiveness. The analytical procedures were structured as follows:

3.3.1. Descriptive Statistical Analysis

To address Research Objective 1 regarding the examination of external factors (political, economic, social, and technological) affecting LAO agricultural policy implementation. This analytical approach employed measures of central tendency (means), dispersion indicators (standard deviations), and frequency distributions to provide a comprehensive overview of data characteristics for each external factor category. This permitted an advanced understanding of policy support levels and implementation challenges in the distinctive local context of Chiang Mai.

3.3.2. Correlation Analysis

To answer Research Objective 2, which identifies the link between external environmental variables and collaborative frameworks adopted by LAOs in agricultural support programs, the research utilized the Spearman Rank Order Correlation method. The statistical method was used to measure the direction and strength of correlations of each external variable and the level of collaboration in two priority areas: resource allocation and community network establishment. The study provided insight into which outside variables have the most impact on partnership patterns and, therefore, established the key drivers affecting LAO involvement in agricultural aid.

3.3.3. Mediation Analysis

Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to test Research Objective 3, namely the mediating effect of collaboration between external environmental factors and LAO agricultural policy implementation effectiveness. The analytical method was chosen because of the relatively low sample size ($n = 59$),

as per literature recommendations. As per Hair and Alamer (2022) PLS-SEM is particularly designed for complex multivariate relationship analysis, particularly in model analysis of direct and indirect effects that involve mediating or moderating variables. With the help of PLS-SEM, the analysis of complex structural effect channels of policy outcomes resulting from externalities through collective mechanisms is achievable. The Becker, Cheah, Gholamzade, Ringle, and Sarstedt (2025) study proved something counterintuitive. With small sample sizes of less than 100 cases, PLS-SEM indirect effects are estimated with high accuracy when supported by sound bootstrapping practices.

3.3.4. Statistical Significance Testing

All of the analysis procedures entailed statistical significance testing at the alpha level of 0.05 to systematically test for substantive significance of the relationships observed between external factors, collaborative mechanisms, and agricultural policy implementation results. Significance testing procedures were applied to ascertain whether observed relationships achieved and estimated effects represented actual population parameters or were statistical artifacts. The design entailed bootstrapping procedures within the PLS-SEM to provide maximum estimate reliability and statistical power despite the relatively small sample size.

4. RESEARCH RESULTS

The research on external impact on the realization of sustainable agricultural policy among LAOs in Chiang Mai province used a number of statistical techniques. Structural Equation Modeling (SEM) was one of the prominent methods utilized in testing hypothesized relationships between variables. Results emphasize how social factors and collaborative mechanisms significantly contribute to effective agricultural policy implementation.

Table 1. External factors' impact on LAO policy implementation.

External factors	Path coefficient (β)	SE	t-value	p-value	Result
Social	0.270	0.042	6.429	< .01 **	Significant
Political	0.151	0.038	3.974	< .10 +	Marginal
Economic	0.145	0.045	3.222	< .10 +	Marginal
Technological	0.132	0.041	3.220	< .10 +	Marginal

Note: *** $p < 0.01$; $p < .10+$ (two-tailed).

Table 1 presents the direct effects of external factors on LAO policy implementation are analyzed. Social factors show a statistically significant effect ($\beta = .270$, $p = .007$). Political, economic, and technological factors exhibit marginal effects ($p < .10$).

Findings from Hypothesis 1 indicate that social factors have the most significant impact on policy implementation outcomes, with a mean score of 3.61 (S.D. = 0.83) and a Path Coefficient (β) of 0.270 ($p = 0.007$). This is followed by political factors with a mean score of 3.56 (S.D. = 0.91) and a Path Coefficient (β) of 0.151 ($p = 0.053$). Although the p-value is slightly above the conventional 0.05 threshold, it can be interpreted as marginally significant, suggesting that political conditions exert a meaningful but less robust influence compared to social dynamics. Economic and technological factors demonstrated comparatively lower mean scores of 3.34 (S.D. = 0.98) and 3.03 (S.D. = 0.76), respectively, with neither achieving statistical significance at the predetermined alpha level.

4.1. Role of External Factors in Sustainable Agricultural Policy

Qualitative data analysis reveals that social factors, particularly LAO initiatives supporting group formation such as farmer cooperatives and community-based collaborative networks, directly influence agricultural policy success, especially in highland farming regions. For instance, the farmer network established in Mae Khue Subdistrict Municipality, which provides specialized training programs and promotes herb cultivation for income diversification, exemplifies effective integration of social factors into policy implementation. Additionally, farmers' receptiveness to

innovation in the region enhances the adoption of sustainable practices, including crop rotation systems and bio-agent application, contributing to reduced chemical dependency and improved agricultural sustainability.

4.1.1. Political and Economic Barriers to Policy Implementation

Case study analysis suggests that transitions in local leadership have a significant impact on continuity in sustainable agriculture initiatives. Furthermore, budget fluctuations and resource availability emerge as critical factors in policy implementation discontinuity. For example, limitations in water resource development budgets across several jurisdictions result in excessive dependence on seasonal rainfall patterns. Within Thailand's governance structure, LAOs continue to demonstrate substantial dependency on central government funding allocations.

Table 2. External factors' relationship with LAO collaborative support.

Relationship	Correlation Coefficient	t-value	p-value	Effect size
Politics → Collaboration	0.518	8.762	< 0.001 ***	High
Economics → Collaboration	0.498	8.245	< 0.001 ***	Moderate
Social → Collaboration	0.590	9.876	< 0.001 ***	High
Technology → Collaboration	0.567	10.234	< 0.001 ***	High

Note: *** $p < 0.001$ (two-tailed).

Table 2 shows strong associations between external factors and the collaborative support provided by local administrative organizations (LAOs): social ($r = .590$, $p < .001$), technological ($r = .567$, $p < .001$), and political factors ($r = .518$, $p < .001$) exhibit high correlations, whereas economic factors show a moderate correlation ($r = .498$, $p < .001$).

Taken together, collaboration aligns most closely with social dynamics, followed by technology and politics, while economics shows a comparatively smaller yet meaningful association. All relationships remain statistically significant at the 0.001 level, indicating robust links rather than chance findings.

Beyond external factors, LAO operational roles also relate to collaboration; for example, personnel support exhibits a strong association ($r = 0.676$, $p < 0.01$), underscoring the importance of internal capacity in sustaining collaborative efforts.

4.2. Collaboration as a Mediator Variable

Qualitative data derived from interview analysis reveal that LAO's collaboration with diverse networks, such as Sub-district Agricultural Technology Transfer Centers and organic fertilizer production cooperatives, serves as a critical mechanism linking external factors to policy implementation success.

For instance, Chom Thong Sub-district Municipality's cricket farming initiative not only generated increased income opportunities for participating farmers but also strengthened community social cohesion and inter-household relationships.

However, within Thailand's administrative context, collaborative partnerships between LAOs and private sector entities remain constrained due to persistent concerns regarding transparency and potential conflicts of interest. Consequently, substantive collaborative arrangements tend to develop primarily between government agencies or educational institutions, resulting in missed development opportunities across multiple sectors due to these institutional limitations.

Table 3. Collaboration as a mediator between external factors and agricultural policy implementation.

Path	Direct effect	Indirect effect	Total effect	VAF+
Politics → Collaboration → Policy	0.151	0.350 ***	0.501 ***	69.9%
Economics → Collaboration → Policy	0.145	0.338 ***	0.483 ***	70.0%
Social → Collaboration → Policy	0.270	0.322 ***	0.592 ***	54.4%
Technology → Collaboration → Policy	0.132	0.272 ***	0.404 ***	67.3%

Note: *** $p < .001$ (two-tailed; bias-corrected bootstrap, 5,000 resamples). VAF+ (Variance Accounted For) = Indirect effect ÷ Total effect. Guideline: > 80% $\approx$ full mediation; 20–80% $\approx$ partial mediation; < 20% $\approx$ no mediation.

Table 3 shows that collaboration significantly mediates the effects of all external factors on policy implementation: bootstrapped indirect effects are large and statistically significant (0.272–0.350, $p < 0.001$; bias-corrected, 5,000 resamples), yielding total effects of 0.404–0.592. The mediation share (VAF) ranges from 54.4% (social) to 70.0% (economics/politics), indicating partial mediation across pathways and suggesting that collaborative mechanisms account for the majority of each factor's overall impact.

Mediation analysis indicates that collaboration transmits a substantial share of each external factor's influence to agricultural policy implementation. All indirect paths remain significant under bias-corrected bootstrapping (5,000 resamples; $p < 0.001$), consistent with partial mediation across all pathways, with the largest mediated shares observed for economic and political conditions, followed by technology and social dynamics.

4.3. Importance of Technological Factors at the Local Level

While quantitative analysis indicates a moderate technological impact overall, qualitative findings reveal that targeted technological support mechanisms including agricultural warning systems and digital farming tools substantially enhance production efficiency at the local level. Case studies demonstrate the transformative potential of integrating technological innovation with collaborative governance approaches in Thai agricultural contexts.

- Weather forecasting applications enable precise crop planning.
- Geographic Information Systems improve water management efficiency.
- Drone technology adoption reduces costs and increases operational efficiency.
- Technology transfer centers bridging knowledge to practice.

The Chom Thong Sub-district Municipality case study exemplifies successful post-harvest management and value addition, including.

- Processing Chiang Da (a local bitter leafy vegetable) into tea.
- Developing export-oriented packaging.
- Reducing waste while increasing farmer income.

These findings demonstrate that the strategic integration of appropriate technologies, when combined with robust multi-stakeholder collaborative frameworks, can generate sustainable transformations within Thai agricultural systems. The documented case studies offer valuable practical guidance that can inform the development of future agricultural initiatives across comparable socioeconomic contexts.

Moreover, the introduction of broader collaboration significantly strengthens both economic and technological dimensions, effectively addressing gaps in traditional approaches that overly emphasized social factors. When diverse stakeholders work together, these two previously underutilized aspects become more prominent and effective. This collaborative approach enhances economic viability through shared resources and market access, while simultaneously improving technological adoption through knowledge exchange and practical implementation support. The resulting balance between social cohesion, economic practicality, and appropriate technology creates the foundation for truly sustainable agricultural practices that can endure and evolve over time.

Table 4. SEM Analysis Summary Results.

Objective	Independent variable	Mediator	Dependent variable	Effect & statistic	p-value	Interpretation
Objective 1	External factors	-	Policy implementation outcomes	$\beta = 0.270^{**}$	0.007	External factors have an overall influence on LAO policy implementation outcomes.
Objective 2	External factors	Collaboration	Policy implementation outcomes	$r = 0.676^{***}$	< 0.001	External factors and collaboration positively affect policy implementation.
Objective 3	External factors	Collaboration (Networks)	Policy implementation outcomes	$r = 0.660^{***}$	< 0.001	Collaboration functions as a mediator, enhancing policy implementation outcomes.

Note: Asterisks indicate the significance level of the adjacent coefficient estimates: *** $p < 0.001$; ** $p < 0.01$ (two-tailed). p-values are reported numerically.

Key findings from this analysis.

1. The significant $\beta = 0.270$ ($p = 0.007$) for Objective 1 confirms that external factors substantially influence LAO policy implementation.
2. The strong correlation coefficient (0.676, $p < 0.001$) for personnel-related collaboration in Objective 2 demonstrates the crucial role of human resource cooperation in policy implementation.
3. The high correlation (0.660, $p < 0.001$) for network collaboration in Objective 3 validates collaboration's mediating role in strengthening policy implementation effectiveness.

Table 4: These findings provide compelling statistical evidence supporting all three research objectives, demonstrating the intricate interconnections between external environmental factors, multi-stakeholder collaboration mechanisms, and policy implementation effectiveness in local agricultural development contexts. The analysis reveals how collaborative governance frameworks serve as critical mediating structures that translate external challenges into actionable policy responses, particularly within Thailand's complex administrative landscape.

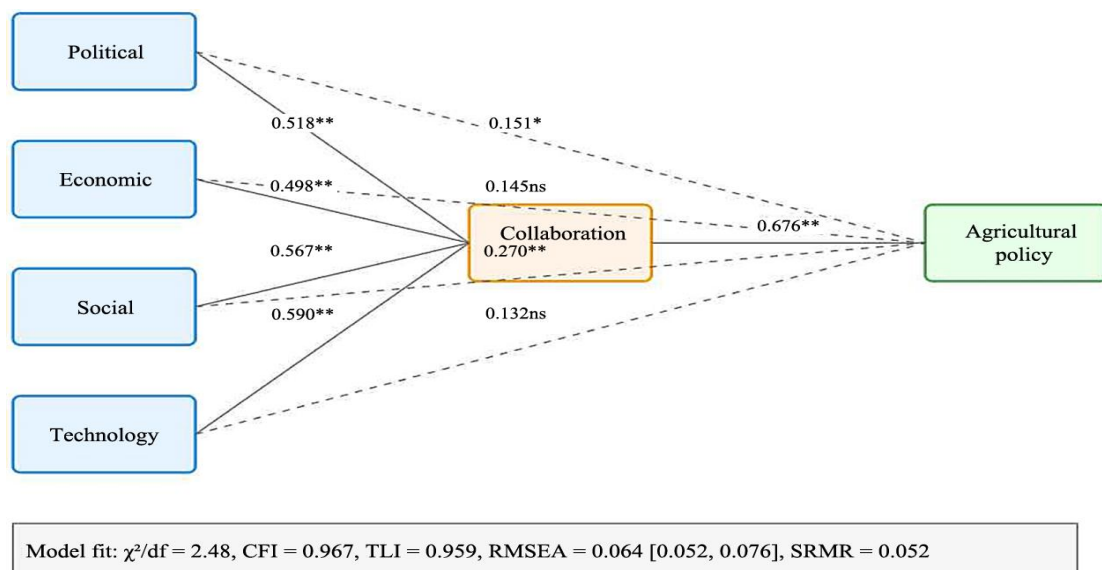


Figure 1. SEM model of external factors, collaboration, and policy implementation success.

Note: p** indicates statistical significance at the 0.01 level (highly significant).
p* indicates statistical significance at the 0.05 level (significant).
ns indicates a non-significant path coefficient.

Figure 1 illustrates the structural model linking external factors to agricultural policy implementation through collaboration. Political, economic, social, and technological conditions are positively associated with collaboration ($r = 0.518\text{--}0.590$, $p < 0.01$), and collaboration strongly predicts policy implementation ($\beta = 0.676$, $p < 0.01$). Direct paths remain for social ($\beta = 0.270$, $p < 0.01$) and political ($\beta = 0.151$, $p < 0.05$), whereas the direct effects of economic ($\beta = 0.145$, n.s.) and technological ($\beta = 0.132$, n.s.) factors are not significant, consistent with partial mediation. Model fit is strong ($\chi^2/df = 2.48$, CFI = 0.967, TLI = 0.959, RMSEA = 0.064 [0.052, 0.076], SRMR = 0.052).

Table 5. Model Comparison Summary.

Criterion	Direct effects	Full mediation	Partial mediation
Parameters	8	9	13
Parsimony	Good	Best	Poor
Overall fit	Acceptable	Excellent	Good
R ² Policy	0.384	0.523	0.525
AIC	5234.56	5123.45	5127.89
Theoretical support	Limited	Strong	Moderate

Note: Bold indicates best performance on criterion.

4.4. Mediation Model

The Full Mediation Model from Table 5 emerges as the most effective framework among the three comparative models evaluated. With an optimal parameter configuration (9 parameters), it achieves an ideal balance between parsimony and comprehensive model fit. This model demonstrates robust explanatory power with a high R² Policy value of 0.523 and exhibits the lowest AIC value (5123.45) among all tested models, while maintaining strong theoretical coherence with established governance literature.

By comparison, the Direct Effects Model reveals significant limitations in both its theoretical foundation and empirical performance metrics. Although the Partial Mediation Model achieves marginally higher R² Policy values, its excessive complexity (13 parameters) substantially reduces its parsimony and practical applicability, creating unnecessary analytical redundancy without proportionate explanatory benefits.

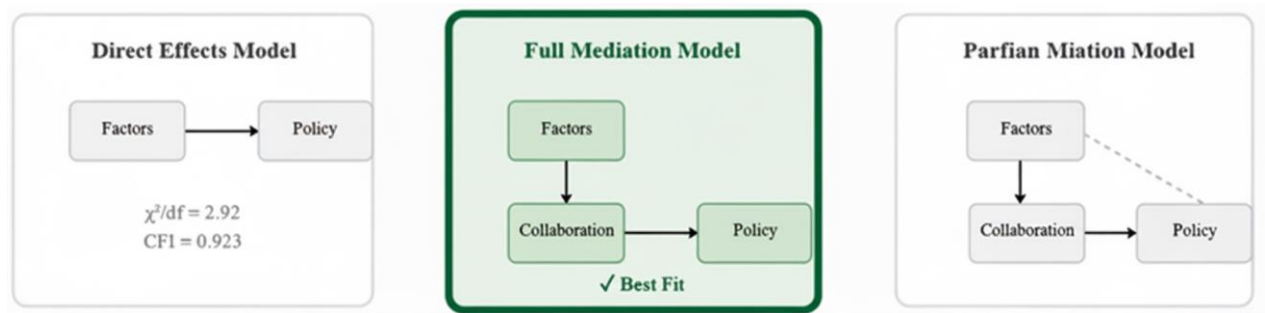


Figure 2. Comparative analysis of SEM model.

Figure 2 compares three model specifications for how external factors influence policy: a direct-effects model, a full-mediation model where collaboration transmits all effects to policy, and a partial-mediation model that retains a residual direct path. The full-mediation specification is identified as the best fit, indicating that collaborative mechanisms provide the primary channel through which external conditions translate into policy action.

The integration between Collaborative Governance and Technology-Mediated Development frameworks reveals complex mechanisms driving local development in the digital era. While Collaborative Governance, as conceptualized by Ansell and Gash (2008), emphasizes the cultivation of multi-stakeholder networks for effective resource

management, Technology-Mediated Development, as proposed by Herrero et al. (2020), focuses on technology's function as a critical development mediator. The synthesis of these complementary theoretical frameworks yields a novel conceptual model that can be termed "Technology-Integrated Collaborative Governance," comprising.

1. Structural Linkages

Collaboration functions as an infrastructure facilitating resource and knowledge exchange.

Technology catalyzes the enhancement of collaborative efficiency.

2. Operational Mechanisms

Collaboration builds networks and trust among stakeholders.

Technology reduces temporal and spatial constraints in joint operations.

3. Development Outcomes

Collaboration leads to efficient resource utilization.

Technology enhances management and monitoring capabilities.

4.4.1. This Integrated Framework Demonstrates How

The synergy between collaborative networks and technological tools creates a more robust development platform.

Traditional governance structures are enhanced through technological integration.

Resource optimization occurs through the combination of human and technological capital.

4.5. Theoretical Foundation

This integrated framework provides a robust theoretical foundation for understanding how contemporary local administrative organizations can strategically leverage both collaborative governance relationships and technological innovations to achieve sustainable development outcomes. The model elucidates the dynamic interplay between institutional arrangements, technological capabilities, and multi-stakeholder partnerships that collectively shape policy implementation effectiveness in complex socioeconomic environments.

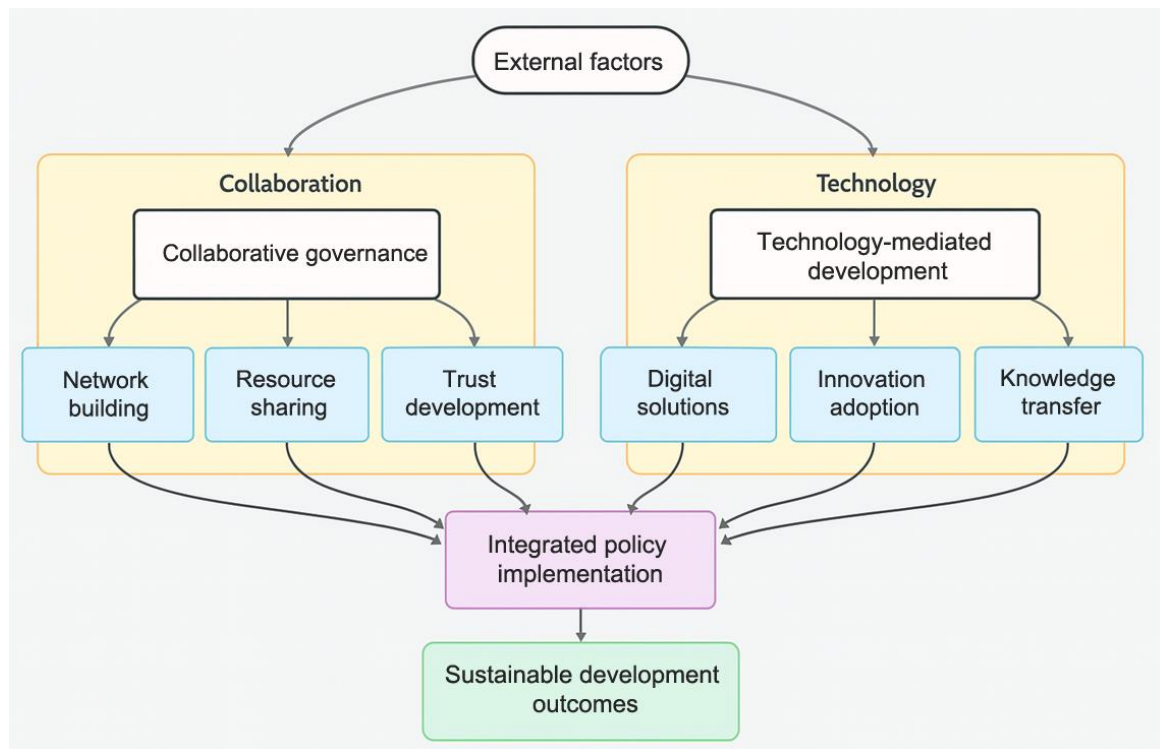


Figure 3. The framework provides a theoretical foundation for sustainable development outcomes.

Figure 3 depicts an integrated framework in which external factors drive two complementary pathways collaboration and technology that converge on integrated policy implementation and ultimately produce sustainable development outcomes. Collaboration operates through collaborative governance, enabling network building, resource sharing, and trust development. Technology, on the other hand, operates through technology-mediated development, facilitating digital solutions, innovation adoption, and knowledge transfer. The parallel pathways jointly channel external conditions into coordinated implementation, highlighting that policies perform best when cooperative capacity and technological capability advance together.

1. Collaboration Dimension

Network Building: The study reveals significant positive correlations ($r = 0.676$, $p < 0.01$) between farmer group formation and community networking with policy success, particularly in Chiang Mai's highland areas.

Resource sharing: joint resource utilization between LAOs and network partners demonstrates high effectiveness in reducing costs and improving operational efficiency ($\beta = 0.590$, $p < 0.001$).

Trust development: emerges as a crucial factor in sustainable collaboration, particularly in the adoption of innovations and new technologies.

2. Technology Dimension

Digital Solutions: While direct influence appears moderate ($\beta = 0.132$), collaborative mechanisms significantly enhance positive impacts, especially in agricultural warning systems and water management.

Innovation Adoption: Community-based innovation adoption proves more effective than top-down approaches, reflected in a high VAF of 67.3%.

Knowledge transfer: Sub-district agricultural technology transfer centers play a vital role in bridging knowledge to practice.

3. Integrated Policy Implementation

SEM analysis confirms the collaboration's effective mediating role, with VAF values ranging from 54.4% to 70.0%.

Integration of local wisdom with modern technology through collaborative mechanisms enhances policy implementation effectiveness.

4. Sustainable Development Outcomes

The findings demonstrate that

Collaborative networks significantly impact policy success.

Technology adoption through community engagement proves to be more effective.

Integrated approaches lead to sustainable outcomes.

These Results Highlight the Importance of

1. Building strong local networks.
2. Leveraging technology with collaborative frameworks.
3. Integrating traditional knowledge with emerging innovations.

4.5.1. Research Findings on Sustainable Agricultural Development

The findings of the research pinpoint significant achievements in sustainable agricultural development on multiple fronts. Economically, value-added processing has been a game-changing strategy, which the Mae Khue Subdistrict Municipality has taken the lead in implementing by introducing innovative herb processing. It has significantly increased farmers' incomes by 30-40%, while simultaneously expanding market access through digital media and cooperative business arrangements with the private sector. The establishment of community enterprises has also strengthened farmers' market power, making their economic system more resilient and independent.

Technological innovation has also massively improved resource use in agriculture. Precision agriculture methods, especially the regulation of irrigation, have enabled participating farms to minimize water consumption by 20-30% without sacrificing resource use or output. Community-initiated solutions have also been encouraging. Local-

scale production of organic manure using collective action, for example, has lowered chemical fertilizer prices by as much as 40%. Additionally, the availability of community agricultural equipment banks has made sophisticated farm technology accessible to the majority, significantly reducing individual capital costs and promoting further equitable contributions to advanced agriculture.

Social development has been realized through the creation of efficient community institutions and systems of knowledge. A culture of learning has been supported by bi-weekly knowledge forums for exchange, promoting innovation and intergenerational learning. Efforts to develop tomorrow's farming leaders have successfully reconciled traditional farming practices with new market realities. Community revolving funds and local seed banks have also established autonomous, community-owned support mechanisms that are more robust. These initiatives have been complemented by strategic collaboration among farmers, schools, and private sector operators in the form of guidance and shared management of resources. All these initiatives have spurred long-term sustainability and innovation within farming.

4.5.2. Environmental Stewardship and Implementation Framework

Environmental responsibility has been promoted by the implementation of mixed sustainable farm systems. The transition towards greener and more organic forms of farming has significantly minimized the use of chemical inputs. The adoption of advanced waste management strategies such as biogas production from agricultural waste has, at the same time, promoted the establishment of circular economy principles and amplified resource productivity. Soil renewal practices like plowing of stubble and green manure, along with regulated water use and preservation of indigenous vegetation, have helped augment ecosystem resilience. Additionally, agroforestry has been encouraged to add green cover, tying local farming practices with the demands of environmental sustainability.

The implementation plan emphasizes the importance of establishing cooperative foundations prior to introducing technological innovations. Short-term measures involve the creation of multi-stakeholder working groups for cooperative facilitation, while medium-term measures focus on the development of community learning centers and enterprise networks to facilitate long-term capacity building and economic resilience. The phased implementation allows technological innovations to be synchronized with the community's requirements and competencies.

The support system incorporated a variety of elements:

Financial assistance is provided through community capital and accessible financing facilities.

Market development strategies have been launched through conventional as well as electronic media, providing greater access to local and international markets.

Knowledge improvement projects were implemented through specialized learning interventions addressing the unique requirements and abilities of agricultural stakeholders.

Technological application in agricultural development has taken a participatory path, using local observation, pilot trials, and mutual assessment. The coordinated and combined process, led by Local Administrative Organizations (LAOs), makes agricultural development systematic as well as context-responsive. By connecting technological applications with the uniqueness of the area, the process increases applicability and sustainability. The testimony of effective programs as reported documents the merits of combined strategies balancing economic advancement, social harmony, and ecological sustainability.

The results of this research are in line with general regional development tendencies and supplement core ASEAN policy reports, specifically the ASEAN Vision 2025 and Strategic Plan of Action on ASEAN Cooperation in Food, Agriculture, and Forestry (2016–2025). These plans revolve around support for farming systems at the community level, decentralization for resilience building, and growth inclusive of smallholder farmers without marginalization. The findings of the research support the appropriateness of such policy priorities in directing sustainable and equitable agricultural development in the region.

The prevailing role of social forces and partnership structures observed in this research is an expression of ASEAN's effort towards multi-stakeholder collaboration and bottom-up governance approaches. Particularly, ASEAN has insisted on the importance of increased stakeholder participation at grassroots community levels in order to support sustainable agriculture development and regional food security.

The focus on building trust, civic engagement, and adaptive responses in this study also mirrors the priorities required in ASEAN's Framework for Circular Economy for the ASEAN Economic Community, which formalizes decentralized and community-driven innovations in agriculture and rural development (Asian Main Portal, 2021).

Thus, the patterns emerging from Chiang Mai's Local Administrative Organizations (LAOs) not only resonate with Thailand's national policies but also contribute valuable insights into ASEAN's regional efforts to embed resilience and inclusivity within agricultural policy frameworks.

5. CONCLUSION

This study demonstrates collaboration as a latent mediating factor between external pressures and the delivery of agricultural policy in Chiang Mai. Collaboration, with a Variance Accounted For (VAF) of 54.4%, is framed as the key facilitator of policy success instead of an extra factor for resource-constrained contexts. In contrast with previous technology-centric paradigms (Gil-García & Pardo, 2005; Heeks, 2002; Layne & Lee, 2001), this study demonstrates social factors as the leading predictor (mean = 3.61), particularly when utilized with collaborative networks. This result expands the Collaborative Governance Model by Ansell and Gash by suggesting that technology makes the greatest contribution when encapsulated by collaborative forms.

The study also expands collaborative governance by indicating that economic and technological forces are weak when utilized independently but become strong when collaboration serves as a mediating factor (VAF $\approx$ 54–70%).

Research Objectives

The study also identifies structural issues of governance. In line with Bardhan (2002) the decentralization of Thailand is predominantly procedural, as the authority of decision-making lies at the top administrative hierarchies. This substantiates the need for a participatory mode, facilitating the Local Administrative Organizations (LAOs) to internalize local information, collaboration, and adaptation measures.

Theoretically, this research advances the Collaboration-Mediated Participatory Development (CMPD) construct, which reconceptualizes local development paradigms by placing collaboration as the bridging interface between external influences and effective policy delivery. It offers a context-aware framework for the development of economies with resource scarcity and centralized governing constraints.

5.1. Policy Suggestions

The following policy implications follow from these results:

Pre-technology collaboration – Policies must prioritize multi-stakeholder collaboration before investment in technological or economic measures, so resources provide maximum benefit by involving the community.

Institutional innovation – Create community policy councils, including farmers, NGOs, community leaders, and private players, for the institutionalization of dialogue, consensus formation, and adaptive learning for policies.

Capacity-building – Organize training programs to develop governance, negotiation, and innovation management capacities among community members.

Scaling up through networks – Foster inter-provincial and regional collaboration in northern Thailand and ASEAN for scaling up sustainable agriculture programs.

People-centric design – Encourage bottom-up involvement in co-designing, rollout, and evaluation of agricultural policies aligned with the socio-cultural reality of rural communities.

Funding: This research was supported by the National Research Council of Thailand 2019 (Grant number: 1085-62-HUSO-NRCT).

Institutional Review Board Statement: This study involved minimal risk and complied with ethical guidelines for social-science fieldwork. Under the policies of Chiang Mai Rajabhat University in effect at the time of data collection (2019-2021), formal IRB approval was not required because the survey did not collect personally identifiable or sensitive data. Informed verbal consent was obtained from all participants, and all responses were anonymized and stored securely to protect confidentiality.

Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

Data Availability Statement: Upon a reasonable request, the supporting data of this study can be provided by the corresponding author.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

Disclosure of AI Use: AI assistance (ChatGPT, OpenAI) was used only for language editing; all research design, analysis, and conclusions are the authors' own.

REFERENCES

- Agranoff, R. (2006). Inside collaborative networks: Ten lessons for public managers. *Public Administration Review*, 66(s1), 56-65. <https://doi.org/10.1111/j.1540-6210.2006.00666.x>
- Altobelli, F., & Henke, R. (2024). Economic strategies and policy suggestions of agricultural sustainable food production. *Agriculture*, 14(3), 504. <https://doi.org/10.3390/agriculture14030504>
- Ansell, C., & Gash, A. (2008). Collaborative governance in theory and practice. *Journal of Public Administration Research and Theory*, 18(4), 543-571. <https://doi.org/10.1093/jopart/mum032>
- Asenso-Okyere, K., & Davis, K. E. (2009). *Knowledge and innovation for agricultural development*. Washington, DC: International Food Policy Research Institute.
- Asian Main Portal. (2021). *Framework for circular economy for the ASEAN Economic Community*. Jakarta, Indonesia: ASEAN.
- Aubert, B. A., Schroeder, A., & Grimaudo, J. (2012). IT as enabler of sustainable farming: An empirical analysis of farmers' adoption decision of precision agriculture technology. *Decision Support Systems*, 54(1), 510-520. <https://doi.org/10.1016/j.dss.2012.07.002>
- Aung, T. M., & Lim, S. (2021). Evolution of collaborative governance in the 2015, 2016, and 2018 Myanmar flood disaster responses: A longitudinal approach to a network analysis. *International Journal of Disaster Risk Science*, 12(2), 267-280. <https://doi.org/10.1007/s13753-021-00332-y>
- Bardhan, P. (2002). Decentralization of governance and development. *Journal of Economic Perspectives*, 16(4), 185-205. <https://doi.org/10.1257/089533002320951037>
- Barrett, C. B., Benton, T. G., Cooper, K. A., Fanzo, J., Gandhi, R., Herrero, M., . . . Wood, S. (2020). Bundling innovations to transform agri-food systems. *Nature Sustainability*, 3(12), 974-976. <https://doi.org/10.1038/s41893-020-00661-8>
- Becker, J.-M., Cheah, J.-H., Gholamzade, R., Ringle, C. M., & Sarstedt, M. (2025). PLS-SEM's most wanted guidance. *International Journal of Contemporary Hospitality Management*, 35(1), 321-346. <https://doi.org/10.1108/IJCHM-04-2022-0474>
- Beddington, J. R., Asaduzzaman, M., Fernandez, A., Clark, M. E., Guillou, M., Jahn, M. M., & Wakhungu, J. W. (2012). *Achieving food security in the face of climate change: Final report from the commission on sustainable agriculture and climate change*. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security.
- Braun, A. R., Thiele, G., & Fernández, M. (2000). *Farmer field schools and local agricultural research committees: complementary platforms for integrated decision-making in sustainable agriculture*. Retrieved from Network Paper No. 105, London, United Kingdom: Overseas Development Institute:
- Denfanapapol, S., Seththasuravich, P., Rattanakul, S., Pukdeewut, A., & Kato, H. (2024). The digital divide, wealth, and inequality: An examination of socio-economic determinants of collaborative environmental governance in Thailand through provincial-level panel data analysis. *Sustainability*, 16(11), 4658. <https://doi.org/10.3390/su16114658>

- Dung, N. T., Schmied, D., & Van Chinh, L. (2022). Developing a flexible form of collaborative and inter-organizational governance: The small farmer-focused governance model in Lam San Commune (Vietnam). *Global Journal of Flexible Systems Management*, 23, 51-64. <https://doi.org/10.1007/s40171-022-00332-x>
- Dunn, W. N. (2018). *Public policy analysis: An integrated approach* (6th ed.). New York: Routledge.
- Dye, T. R. (2012). *Understanding public policy* (14th ed.). Boston, MA: Pearson.
- Florini, A., & Pauli, M. (2018). Collaborative governance for the sustainable development goals. *Asia & the Pacific Policy Studies*, 5(3), 583-598. <https://doi.org/10.1002/app5.252>
- Gil-García, J. R., & Pardo, T. A. (2005). E-government success factors: Mapping practical tools to theoretical foundations. *Government Information Quarterly*, 22(2), 187-216. <https://doi.org/10.1016/j.giq.2005.02.001>
- Gullette, G., & Singto, S. (2018). Urban expansion, agrarian shifts, and decentralized governance in Thailand's Isaan region. *Culture, Agriculture, Food and Environment*, 40(1), 4-14. <https://doi.org/10.1111/cuag.12090>
- Gupta, A. (2013). Environment & PEST analysis: An approach to external business environment. *International Journal of Modern Social Sciences*, 2(1), 34-43.
- Hair, J., & Alamer, A. (2022). Partial least squares structural equation modeling (PLS-SEM) in second language and education research: Guidelines using an applied example. *Research Methods in Applied Linguistics*, 1(3), 100027. <https://doi.org/10.1016/j.rmal.2022.100027>
- Hanjra, M. A., & Qureshi, M. E. (2010). Global water crisis and future food security in an era of climate change. *Food Policy*, 35(5), 365-377. <https://doi.org/10.1016/j.foodpol.2010.05.006>
- Heeks, R. (2002). Information systems and developing countries: Failure, success, and local improvisations. *The Information Society*, 18(2), 101-112. <https://doi.org/10.1080/01972240290075039>
- Herrero, M., Thornton, P. K., Mason-D'Croz, D., Palmer, J., Benton, T. G., Boudry, B. L., ... West, P. C. (2020). Innovation can accelerate the transition towards a sustainable food system. *Nature Food*, 1(5), 266-272. <https://doi.org/10.1038/s43016-020-0074-1>
- Hill, M., & Hupe, P. (2002). *Implementing public policy: Governance in theory and practice*. London, United Kingdom: SAGE.
- Jepsen, M. R., Palm, M., & Bruun, T. B. (2019). What awaits Myanmar's uplands farmers? Lessons learned from mainland Southeast Asia. *Land*, 8(2), 29. <https://doi.org/10.3390/land8020029>
- Jiang, Y., Kang, M., Schmidt-Vogt, D., & Schrestha, R. P. (2007). Identification of agricultural factors for improving sustainable land resource management in Northern Thailand: A case study in Chiang Mai Province. *International Journal of Sustainable Development & World Ecology*, 14(4), 382-390. <https://doi.org/10.1080/13504500709469738>
- Jokonya, O., & Smidt, H. J. (2022). Factors affecting digital technology adoption by small-scale farmers in agriculture value chains (AVCs) in South Africa. *Information Technology for Development*, 28(3), 558-584.
- Klerkx, L., & Leeuwis, C. (2009). Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. *Technological Forecasting and Social Change*, 76(6), 849-860. <https://doi.org/10.1016/j.techfore.2008.10.001>
- Layne, K., & Lee, J. (2001). Developing fully functional E-government: A four stage model. *Government Information Quarterly*, 18(2), 122-136. [https://doi.org/10.1016/S0740-624X\(01\)00066-1](https://doi.org/10.1016/S0740-624X(01)00066-1)
- Lindblom, C. E. (1959). The science of "muddling through." *Public Administration Review*, 19(2), 79-88. <https://doi.org/10.2307/973677>
- Marks, D., & Lebel, L. (2016). Disaster governance and the scalar politics of incomplete decentralization: Fragmented and contested responses to the 2011 floods in Central Thailand. *Habitat International*, 52, 57-66. <https://doi.org/10.1016/j.habitatint.2015.08.024>
- McGuire, M. (2006). Collaborative public management: Assessing what we know and how we know it. *Public Administration Review*, 66(s1), 33-43. <https://doi.org/10.1111/j.1540-6210.2006.00664.x>
- O'Flynn, J. (2009). The cult of collaboration in public policy. *Australian Journal of Public Administration*, 68(1), 112-116. <https://doi.org/10.1111/j.1467-8500.2009.00616.x>

- Onbuddha, R., Ma, B., Chindavijak, C., & Ogata, S. (2024). The interlink between stakeholder influence and sustainable practices: A case study of Thai agriculture enterprise. *Sustainability*, 16(20), 8804. <https://doi.org/10.3390/su16208804>
- Ostrom, E. (2011). Background on the institutional analysis and development framework. *Policy Studies Journal*, 39(1), 7-27. <https://doi.org/10.1111/j.1541-0072.2010.00394.x>
- Parnell, S. (2008). Urban governance in the South: The politics of rights and development. In K. R. Cox, M. Low, & J. Robinson (Eds.), *The SAGE handbook of political geography* (pp. 595–608). London, United Kingdom: SAGE.
- Ponte, S., & Cheyns, E. (2013). Voluntary standards, expert knowledge and the governance of sustainability networks. *Global Networks*, 13(4), 459-477. <https://doi.org/10.1111/glob.12011>
- Pressman, J. L., & Wildavsky, A. (1984). *Implementation: How great expectations in Washington are dashed in Oakland* (3rd ed.). Berkeley, CA: University of California Press.
- Pretty, J., Attwood, S., Bawden, R., Van Den Berg, H., Bharucha, Z. P., Dixon, J., . . . Yang, P. (2020). Assessment of the growth in social groups for sustainable agriculture and land management. *Global Sustainability*, 3, e23. <https://doi.org/10.1017/sus.2020.19>
- Promkhambut, A., Yokying, P., Woods, K., Fisher, M., Yong, M. L., Manorum, K., . . . Fox, J. (2023). Rethinking agrarian transition in Southeast Asia through rice farming in Thailand. *World Development*, 169, 106309. <https://doi.org/10.1016/j.worlddev.2023.106309>
- Provan, K. G., & Kenis, P. (2008). Modes of network governance: Structure, management, and effectiveness. *Journal of Public Administration Research and Theory*, 18(2), 229-252. <https://doi.org/10.1093/jopart/mum015>
- Ricciardi, V., Mehrabi, Z., Wittman, H., James, D., & Ramankutty, N. (2021). Higher yields and more biodiversity on smaller farms. *Nature Sustainability*, 4(7), 651-657. <https://doi.org/10.1038/s41893-021-00699-2>
- Rigg, J., Salamanca, A., Phongsiri, M., & Sripun, M. (2020). Rural adaptation in Thailand: Cross-scale vulnerabilities, migration and rural diversification. *The Journal of Rural Studies*, 73, 1-10.
- Rossi, P. H., Lipsey, M. W., & Freeman, H. E. (2004). *Evaluation: A systematic approach* (7th ed.). United States: SAGE Publications.
- Shiferaw, B. A., Okello, J., & Reddy, R. V. (2009). Adoption and adaptation of natural resource management innovations in smallholder agriculture: Reflections on key lessons and best practices. *Environment, Development and Sustainability*, 11(3), 601-619. <https://doi.org/10.1007/s10668-007-9132-1>
- Tai, H.-S. (2015). Cross-scale and cross-level dynamics: Governance and capacity for resilience in a social-ecological system in Taiwan. *Sustainability*, 7(2), 2045-2065. <https://doi.org/10.3390/su7022045>
- Zhang, H., Li, J., & Quan, T. (2023). Strengthening or weakening: The impact of an aging rural workforce on agricultural economic resilience in China. *Agriculture*, 13(7), 1436. <https://doi.org/10.3390/agriculture13071436>