Journal of Tropical Resources and Sustainable Science
Website : http://journal.umk.edu.my/index.php/jtrss/
eISSN : 2462-2389
Vol: 13 Issue 2, 2025, 303-309
DOI: https://doi.org/10.47253/jtrss.v13i2.1941

RESEARCH ARTICLE

A study on the collaborative governance constructs towards sustainable farming in Kelantan, Malaysia

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ARTICLE HISTORY
Received : 21 July 2025
Accepted : 17 October 2025
Online : 15 December 2025

KEYWORDS
sustainable farming,
collaborative governance,
stakeholder,
Kelantan

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ABSTRACT

Sustainable farming has become imperative to harmonize economic growth, environmental conservation, and social equity. Kelantan farming sector faces critical challenges, including land degradation, water scarcity, climate vulnerabilities, and technological gaps. While collaborative governance (CG) is touted as a transformative approach to multi-stakeholder alignment, empirical evidence on its drivers and operational constructs in developing agrarian economies remains limited. This study bridges this gap by identifying the critical CG constructs and their drivers for sustainable farming in Kelantan. Through stratified sampling of 117 farmers across ten districts, the results show joint action (3.65) as the most vital CG component, followed by shared motivation (3.55) and principled engagement (3.53). Consequential incentives (3.73) and leadership (3.69) emerged as primary drivers, outperforming interdependence (3.46) and uncertainty (3.37). These findings demonstrate how incentives participation and strong leadership can enhance agricultural resilience against climate threats and provide a governance framework to improve stakeholder engagement in sustainable practices. The study offers policy-relevant insights for strengthening Kelantan's agricultural productivity and its contribution to Malaysia's food security.

1. INTRODUCTION

Balancing the demands of social equity, environmental protection and economic growth has made sustainable farming increasingly important globally (Kasim et al., 2023; Abas et al., 2025). Addressing the complex issues facing contemporary agriculture requires an integrated approach, particularly in regions where farming is a major source of income and food security. Agriculture remains a vital component of the local economy in Malaysia, especially in the state of Kelantan, but the sector faces several sustainability challenges that threaten ecological balance and long-term productivity (Zeng et al., 2025).

Kelantan's farming sector is deeply embedded in the state's rural economy and plays a crucial role in food production and value creation. The sector contributes over 20% of Kelantan's Gross Domestic Product (GDP), underscoring the economic significance of crop and farm-based industries in the region (Nordin et al., 2024). In recent years, the state government has strengthened its commitment to transforming the agricultural and food sectors through targeted financial allocations and development programmes. For instance, allocations have been announced to enhance Kelantan's food industry via the establishment of rice and feed mills as well as the promotion of value-added packaging for local farm produce (Shukri et al., 2023; Nordin et al., 2024).

Within the agricultural sector, Kelantan features a mix of smallholder farms and emerging commercial operations cultivating paddy, vegetables, fruits and other crops (Nordin et al., 2022). Efforts to optimise agricultural land use have included converting idle lands into productive agricultural holdings. These initiatives demonstrate progress towards agricultural transformation but also highlight governance challenges related to resource management, environmental protection and adaptation to seasonal factors such as the northeast monsoon (Khalid et al., 2024). Collaborative governance among farmers, local agencies and policymakers is therefore essential to ensure the long-term sustainability and resilience of Kelantan's farming sector.

Land degradation is a major concern in Kelantan. Over-cultivation, deforestation and unsustainable land-management practices impair agricultural productivity by reducing soil fertility and increasing susceptibility to erosion (Rahman et al., 2022; Nordin et al., 2022). Water scarcity is another urgent issue, exacerbated by inconsistent rainfall patterns, inefficient irrigation systems and cross-sector competition for water resources (Fulazzaky et al., 2023).

Climate change further compounds these problems by increasing temperatures, intensifying weather variability and extending drought periods, all of which jeopardise crop yields and farmer livelihoods (Tan et al., 2021; Azahari et al., 2021).

Many farming practices in Kelantan still rely heavily on conventional methods, with limited adoption of precision agriculture, smart-farming tools and other sustainable practices that could enhance productivity and environmental outcomes (Arifin et al., 2024). The implementation of innovative solutions is further constrained by a digital divide, gaps in technical knowledge and limited extension services (Barudin et al., 2021; Rahman et al., 2022).

In this context, collaborative governance models are increasingly necessary. Collaborative governance requires active involvement from a range of stakeholders, including governmental organisations, local communities, academic institutions and private-sector actors in the development, implementation and oversight of sustainable agricultural initiatives (Ansell & Gash, 2008; Cao & Tao, 2025). Such inclusive models can improve resource sharing and trust building and can generate more adaptive and context-specific solutions that are responsive to local needs.

Strengthening governance frameworks that encourage cooperation, knowledge exchange and equitable resource management is therefore as important as deploying technical interventions for sustainable farming in Kelantan. By working collaboratively and implementing integrated strategies, Kelantan's agricultural sector can more effectively navigate sustainability challenges and build resilience for future generations.

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted in Kelantan, a state in the northeastern region of Peninsular Malaysia (Figure 1). Kelantan borders Thailand to the north and the South China Sea to the northeast. The state has a strong agricultural base, with mixed crop and livestock farming forming a central part of the rural economy (Hanapiah et al., 2022). The survey targeted farmers across the main agricultural districts registered with the Department of Agriculture, Kelantan, ensuring coverage of areas where crop and livestock activities are concentrated.

2.2. Data collection and analysis

Primary data were collected using a structured questionnaire survey designed to examine stakeholders' perceptions of collaborative governance practices in sustainable agriculture. The questionnaire consisted of closed-ended items measured on a Likert scale and focused

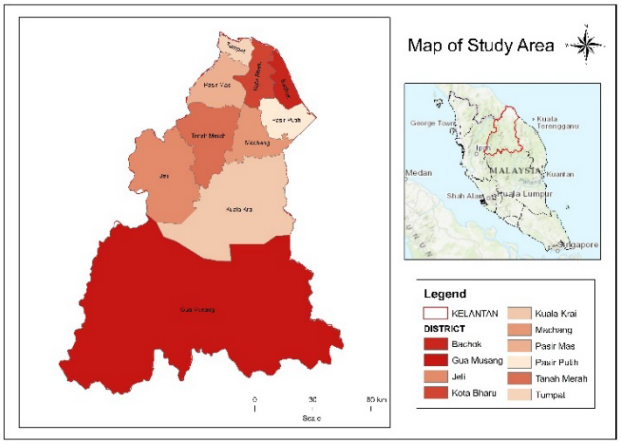

Figure 1: Map of the Study Area.

on dimensions such as collaborative governance constructs and its drivers. The survey was administered both online and in person to maximise participation and ensure inclusion of farmers from different demographic and geographic groups within Kelantan.

A stratified purposive sampling technique was employed to ensure the inclusion of participants with relevant expertise and involvement in agricultural activities (Creswell & Creswell, 2018; Ahmad & Wilkins, 2025). Stratification allowed the sample to reflect the diversity of roles and interests within the agricultural sector while focusing on respondents directly involved in decision-making and farming operations. The mixed-mode survey distribution (digital and physical) helped reach respondents in rural and semi-urban areas who may have limited internet access and increased the likelihood of obtaining complete responses.

The appropriate sample size was determined using the guidelines provided by Adam (2020). Based on an estimated population of approximately 160 individuals involved in collaborative agricultural activities in Kelantan, the recommended minimum sample size for a 95% confidence level and a 5% margin of error is 113 respondents. To account for potential non-responses or incomplete submissions, the target sample was set at 117 respondents. The collected data were analysed using IBM SPSS Statistics. Descriptive statistics were used to summarise demographic characteristics and explore the distribution of responses related to collaborative governance constructs and their perceived drivers in sustainable farming.

3. RESULTS

3.1. Demographic Profile

The demographic analysis shows that most respondents were male (76.1%), which reflects the pattern reported in previous studies where farming in rural Malaysia is dominated by men (Bidin et al., 2021). More than half of the

respondents (54.7%) were within the 45–64-year age bracket, indicating an ageing farming population. This trend is also observed in other developing countries where younger generations are less inclined to engage in agriculture due to perceptions of low profitability and limited career prospects (Consentino et al., 2023).

Ethnically, the respondent pool was overwhelmingly Malay (98.3%), which is consistent with the demographic composition of Kelantan. In terms of marital status, 92.3% of respondents were married, suggesting a socially stable farming community in which family labour may contribute to farm activities (Tay et al., 2024). Regarding education level, slightly more than half of the respondents (53.0%) had completed secondary education (SPM or equivalent), while only a minority had tertiary education. This education profile may influence the adoption of modern and sustainable farming practices, as higher education levels are often associated with greater receptivity to innovation (Rizzo et al., 2024).

An important finding is that 98.3% of respondents reported no prior involvement in conservation-related activities. This indicates a substantial gap in environmental awareness or participation, potentially due to limited exposure, incentives or institutional support for conservation initiatives within the local farming community (Savari et al., 2023). In terms of farming experience, 52.1% of respondents had between 1 and 5 years of experience, indicating a mix of relatively new entrants and more experienced farmers. Income data show that 72.6% of respondents were classified in the B1 income group within the national B40 category, reflecting widespread economic constraints among small-scale farmers in Kelantan. This economic vulnerability may constrain their capacity to invest in sustainable technologies or conservation practices (Kalogiannidis et al., 2023).

3.2. Descriptive Analysis

i. Collaborative Governance constructs in Sustainable Farming

The analysis of stakeholders' attitudes toward collaborative governance, guided by Emerson et al.'s (2012) integrative framework, reveals consistent support across three core dimensions such as principled engagement, shared motivation and capacity for joint action. These dimensions provide a basis for evaluating the effectiveness of collaborative governance in complex multi-stakeholder settings such as sustainable agriculture.

Capacity for joint action recorded the highest overall mean score (M = 3.65, SD = 0.53), indicating strong agreement on operational mechanisms that support collaboration. Items such as "flexible institutional arrangements" (M = 3.68, SD = 0.67), "open leadership" (M = 3.62, SD = 0.60) and "relevant knowledge of other stakeholders" (M = 3.67, SD = 0.49) were all rated highly. These findings suggest that respondents value institutional adaptability, participatory leadership and the sharing of expertise as key enablers of joint action. The relatively low standard deviation for knowledge recognition indicates robust agreement that leveraging stakeholder expertise is essential in collaborative settings (Scorrano et al., 2025).

Table 1: Demographic Profile.

Demographic Characteristics	Frequency (n)	Percentage (%)
Districts		
Bachok	10	8.5
Kota Bharu	12	10.3
Machang	14	12.0
Pasir Mas	10	8.5
Pasir Puteh	15	12.8
Tanah Merah	16	13.7
Tumpat	6	5.1
Rantau Panjang	2	1.7
Gua Musang	11	9.4
Kuala Krai	11	9.4
Jeli	10	8.5
Gender		
Male	89	76.1
Female	28	23.9
Age		
18-25 years	0	0
26-44 years	46	39.3
45-64 years	64	54.7
65-74 years	5	4.3
>75 years	2	1.7
Ethnicity		
Malay	115	98.3
Chinese	2	1.7
Marital Status		
Single	9	7.7
Married	108	92.3
Highest Education Level		
None	2	1.7
UPSR	3	2.6
SRP/PMR/LCE	16	13.7
SPM/SPMV/SMA/MCE	62	53.0
STU/STAM/STPM	8	6.8
High Certificate/Vocational	10	8.5
Diploma	8	6.8
Undergraduate	7	6.0
Doctor of Philosophy	1	0.9
Number of years/months in farming		
3-12 months	9	7.7
1-5 years	61	52.1
6-20 years	47	40.2
Gross Household Income		
Group B40		
B1 (<RM2 500)	85	72.6
B2 (RM2 501 - RM3 170)	17	14.5
B3 (RM3 171 - RM3 970)	5	4.3
B4 (RM3 970 - RM4 850)	4	3.4
Group M40		
M1 (RM 4 851 - RM5 879)	2	1.7
M2 (RM5 880 - RM7 099)	2	1.7
M3 (RM7 110 - RM8 699)	1	0.9
M4 (RM8 700 - RM10 959)	1	0.9

The shared motivation dimension recorded an average mean score of 3.55 (SD = 0.58), underscoring the importance of relational trust among stakeholders. Items relating to "trust" (M = 3.61, SD = 0.53), "mutual respect" (M = 3.51, SD = 0.54) and "acknowledgement of other stakeholders' actions" (M = 3.53, SD = 0.61) were positively evaluated. This pattern highlights the significance of social

capital in sustaining commitment and cooperation in collaborative arrangements (Ansell & Gash, 2008).

Principled engagement recorded an overall mean of 3.53 (SD = 0.59), indicating generally positive but slightly more varied perceptions of stakeholder engagement practices. The highest-rated item in this dimension was "identifying the tendencies and interests of stakeholders" (M = 3.62, SD = 0.55), followed by "discussing professionally with stakeholders" (M = 3.55, SD = 0.64). "Having a common understanding and goal with stakeholders" (M = 3.43, SD = 0.56) reinforces the importance of shared objectives in collaborative governance (Bryson et al., 2014).

Overall, the findings suggest that respondents value trust, mutual understanding, transparent communication and institutional flexibility as core elements of collaborative governance. High mean scores across most items indicate strong endorsement of these constructs, while variations in standard deviations point to specific areas, particularly communication and role clarity, where further capacity-building could strengthen collaborative processes (Emerson & Nabatchi, 2015).

ii. Collaboration drivers in Sustainable Farming

Collaborative governance drivers were grouped into four categories: consequential incentives, uncertainty, leadership and interdependence. The results indicate that all four drivers are perceived as important, but with different levels of emphasis. Consequential incentives recorded the highest average score (M = 3.73, SD = 0.60). The availability of financial resources (PSU1) had a mean of 3.81 (SD = 0.60), while the need to consolidate expertise and skills (PSU2) had a mean of 3.65 (SD = 0.61). These results highlight that respondents view financial backing and resource sharing as key enablers of collaborative efforts.

Leadership followed closely with an overall mean of 3.69 (SD = 0.57). Effective communication by leaders (PKE1) was rated at 3.72 (SD = 0.57), and leadership that integrates diverse perspectives and prioritises tangible results (PKE2) scored 3.67 (SD = 0.59). This reinforces the pivotal role of leadership in building trust, ensuring broad participation and steering collaborative initiatives.

Interdependence recorded an overall mean of 3.46 (SD = 0.59). Interdependence among public, private and community sectors (PDE1) had a mean of 3.45 (SD = 0.84), and trust between these sectors (PDE2) scored 3.47 (SD = 0.62). These findings suggest that respondents recognise cross-sectoral cooperation and trust as foundational to collaborative governance, although these relationships may still be uneven.

Uncertainty recorded the lowest mean score among the four dimensions but was still above the midpoint (M = 3.37, SD = 0.65). Access to reliable information (PUN1) achieved a mean of 3.63 (SD = 0.70), and effective communication to reduce uncertainty (PUN2) scored 3.62 (SD = 0.51). Reducing uncertainty through improved information sharing and communication remains an important precondition for fostering trust and collaborative behaviour.

Table 2: Collaborative Governance Constructs.

Collaborative Governance Constructs	Statements	Frequency (n), Percentage (%)					Mean	SD
		0	1	2	3	4		
Principle Engagement	TLU1: Identifying the tendencies and interests of stakeholders is important in principled engagement.	-	-	4 (3.4%)	36 (30.8%)	77 (65.8%)	3.62	0.553
	TLU2: Having a common understanding and goal in a matter with stakeholders is important in principled engagement.	-	1 (0.9%)	1 (0.9%)	62 (53.0%)	53 (45.3%)	3.43	0.562
	TLU3: Discussing professionally with stakeholders in important in principled management.	-	2 (1.7%)	3 (2.6%)	41 (35.0%)	71 (60.7%)	3.55	0.636
Shared Motivation	TPM1: Trust is important for stakeholders to shared motivation together.	-	-	2 (1.7%)	42 (35.9%)	73 (62.4%)	3.61	0.525
	TPM2: The understanding with respects towards each other is important for stakeholders to shared motivation together.	-	-	2 (1.7%)	53 (45.3%)	62 (53.0%)	3.51	0.535
	TPM3: Validation/Acknowledgement of other stakeholders' action is important to shared motivation together.	1 (0.9%)	-	1 (0.9%)	49 (41.9%)	66 (56.4%)	3.53	0.610
Capacity For Joint Action	TBB1: Flexible institutional arrangement is important for stakeholders to joint action.	2 (1.7%)	-	1 (0.9%)	28 (23.9%)	86 (73.5%)	3.68	0.667
	TBB2: Open leadership is important for stakeholders to joint action.	1 (0.9%)	-	1 (0.9%)	39 (33.3%)	76 (65.0%)	3.62	0.600
	TBB3: Relevant knowledge of other stakeholders is important for joint action.	-	-	1 (0.9%)	37 (31.6%)	79 (67.5%)	3.67	0.491

(0= Not Sure, 1=Strongly Disagree, 2=Disagree, 3=Agree, 4=Strongly Agree)

Table 3: Collaborative Governance Drivers

Collaborative Governance Drivers	Statements	Frequency (n), Percentage (%)					Mean	SD
		0	1	2	3	4		
Consequential Incentive	PSU1: Financial resources requirements are important in influencing organization/individual to collaborate with other parties.	2 (1.7%)	-	-	14 (12.0%)	101 (86.3%)	3.81	0.601
	PSU2: The need for expertise and skills resources is important in influencing organization/individual to collaborate with other parties.	1 (0.9%)	-	2 (1.7%)	33 (28.2%)	81 (69.2%)	3.65	0.606
Uncertainty	PUN1: The ability to access/obtain information organization/individual is important in influencing organization/individual to collaborate/cooperate with other parties.	1 (0.9%)	2 (1.7%)	3 (2.6%)	27 (23.1%)	84 (71.8%)	3.63	0.702
	PUN2: Effective communication between organizations/other parties is important in influencing organization/individual collaboration/cooperate with other parties.	-	-	1 (0.9%)	43 (36.8%)	73 (62.4%)	3.62	0.506
Leadership	PKE1: Effective communication between organizations/other parties is important in influencing organization/individual collaboration/cooperate with other parties.	1 (0.9%)	-	1 (0.9%)	27 (23.1%)	88 (75.2%)	3.72	0.570
	PKE2: Leadership that prioritizes results (comprehensive with consideration of various perspectives) is important in influencing organizations/individuals to collaborate/cooperate with other parties.	1 (0.9%)	-	1 (0.9%)	33 (28.2%)	82 (70.1%)	3.67	0.587
Interdependence	PDE1: Interdependence between the public-private-community sector is important in influencing organizations/individuals to collaborate/cooperate with other parties.	1 (0.9%)	5 (4.3%)	5 (4.3%)	35 (29.9%)	71 (60.7%)	3.45	0.836
	PDE2: Trust between the public-private-community sector is important in influencing organizations/individuals to collaborate/cooperate with other parties.	-	2 (1.7%)	2 (1.7%)	52 (44.1%)	61 (52.1%)	3.47	0.624

(0= Not Sure, 1=Strongly Disagree, 2=Disagree, 3=Agree, 4=Strongly Agree

4. DISCUSSION

This study shows that strong values and perceived enablers coexist with uneven interdependence. This pattern is consistent with recent collaborative governance literature, which finds that collaboration improves pro-environmental behaviour only when incentives and information flows are explicit and shared, for example through contract or benefit linkage models that combine price certainty, training and market access (Seow et al., 2022; Abas et al., 2025).

Empirical studies report that farmer's collaboration through structured arrangements such as contract farming significantly increases the adoption of environmental practices, with information access and expected returns acting as key mediators (Liang et al., 2025). Similarly, cross sector partnerships among government, agribusiness and research organisations help align short term livelihood goals with longer term ecological outcomes when trust and common goals are translated into joint training and market-based incentives (Miao et al., 2025). The high scores on financial and communication drivers in this study mirror these findings and indicate priority areas for intervention. Predictable finance, including buy back mechanisms, input support and micro credit, together with skills brokerage and reliable information channels, should be strengthened.

The demographic profile sharpens the design logic for intervention. The older and B40 or B1 leaning profile indicates liquidity constraints and risk aversion. Malaysian and regional studies show that age, education, access to credit and membership in organisations systematically shape the adoption of sustainable intensification and smart farming options (Chang et al., 2024; Kamaruddin et al., 2025). In settings where conservation participation is historically low, as in this sample, trust building and low friction information delivery are crucial. ICT enabled extension and transparent

communication help reduce uncertainty costs and support collaborative uptake (Mulungu et al., 2025; Lynch, 2025). Malaysia specific work also shows that many farmers are willing to change but face financial constraints, and that programme credibility increases when incentives such as transparent price boards and input finance are paired with simple compliance pathways and practical training (Hassan et al., 2023).

Overall, the findings point to a clear implementation pathway. Strong norms of principled engagement and perceived capacity for joint action can be leveraged by, first, formalising consequential incentives through price certainty, small grants or credit and input support. Second, two-way information flows can be institutionalised through local ICT and extension touchpoints together with consistent communication by recognised leaders. Third, interdependence can be deliberately strengthened through co-operatives or contractual arrangements that clearly specify roles, shared standards and benefit sharing. These steps are consistent with recent evidence that collaboration delivers measurable environmental behaviour when trust, information and material incentives are designed together and made transparent.

5. CONCLUSION

This study examined collaborative governance constructs and drivers for sustainable farming among farmers in Kelantan, Malaysia. The results indicate high levels of principled engagement, shared motivation and capacity for joint action, alongside strong perceptions of consequential incentives and leadership as key drivers of collaboration. At the same time, interdependence across public, private and community actors remains weaker, and uncertainty about information and market conditions continues to constrain behaviour.

The findings suggest several practical implications. First, programmes aimed at promoting sustainable farming in Kelantan should formalise incentives by pairing price certainty (for example, through transparent buy-back schemes) with input support and accessible micro-credit. Second, two-way information flows should be institutionalised through a combination of local leadership and ICT-enabled extension services, with predictable feedback loops between farmers and implementing agencies. Third, interdependence should be deliberately engineered through co-operative structures or contract arrangements that codify roles, shared standards, benefit-sharing and simple dispute-resolution mechanisms.

These measures address both the strongest drivers and the weakest relational links identified in the data and align with broader policy agendas such as SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDGs 16 and 17 (Peace, Justice and Strong Institutions; Partnerships for the Goals).

Future research could move beyond cross-sectional perceptions to consider longitudinal or quasi-experimental designs that follow households before and after the implementation of collaborative interventions. Mixed-methods approaches that combine survey data with qualitative insights, administrative records and cost-effectiveness analyses would further strengthen the evidence base and support replication in other districts and states.

ACKNOWLEDGEMENT

The authors gratefully acknowledge financial assistance from the Ministry of Higher Education Malaysia through the Fundamental Research Grant Scheme (FRGS), FRGS/1/2022/SS02/UMK/02/1. The authors also appreciate the internal funding from Universiti Malaysia Kelantan (UMK): R/STA/A0800/01698A/007/2204/01331 and R/TSF/A0800/00793A/007/2025/01402.

The authors thank the Faculty of Earth Science, Universiti Malaysia Kelantan (UMK), for providing technical support and research facilities during the study. Special thanks are extended to the Department of Agriculture, Kelantan, for sharing data on registered farmers and facilitating questionnaire administration.

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