Agricultural Land Preservation and Food Security in Sabah: A Content Analysis-Based Overview

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ABSTRACT

Agricultural land preservation has become an increasingly important concern in Sabah because of rapid urbanisation, development pressure, changing land-use priorities, and persistent food security challenges. This paper presents a targeted content analysis-based overview of academic literature, legal instruments, policy documents, official reports, and comparative preservation models. The final analytical corpus comprised 76 sources selected from a 92-record post-duplicate screening set using explicit subject, geographical, source-type, language, accessibility, and evidential relevance criteria; three additional official sources were added for legal and statistical clarification and excluded from the n = 76 thematic frequency calculations. Each source was assigned one primary theme for frequency calculation, while secondary themes were retained for interpretation without double counting. Four analytical themes emerged: land conversion pressure and governance vulnerability (12 sources; 15.8%), food security implication (14; 18.4%), policy and institutional gap (18; 23.7%), and preservation strategy (32; 42.1%). The findings indicate that Sabah's agricultural land problem is simultaneously spatial, institutional, tenure-related, and food-security-oriented. Verified administrative evidence also shows continuing conversion pressure, while recent official statistics indicate a limited paddy land base and a low rice self-sufficiency level. Comparative models from Japan, Shanghai, North Sumatera, Ontario, and Maryland offer useful instruments, but require adaptation to Sabah's state land authority, Native Title and customary tenure, institutional capacity, and farming conditions. The paper proposes three integrated policy pillars: spatial and legal protection of strategic food-producing land; coordinated governance and digital monitoring; and farmer-centred economic and infrastructure support for productive land retention.

Keywords: Agricultural Land Preservation, Food Security, Land Conversion, Sabah, Content Analysis, Land Governance, Policy Framework

INTRODUCTION

Food security remains a major global and regional concern because it is closely connected to poverty reduction, sustainable agriculture, public welfare, and long-term development. It is commonly understood through four key dimensions: food availability, access, utilisation, and stability (Barrett, 2010; Food and Agriculture Organization of the United Nations [FAO], 2009). These dimensions show that food security is not limited to the physical presence of food but also includes people's ability to obtain, consume, and rely on stable food supplies over time. In this context, agricultural land is a critical foundation of food security because it provides the physical space for food production, rural livelihoods, and domestic food supply (Viana et al., 2022; Godfray et al., 2010). At the global level, population growth, urban expansion, land degradation, climate change, and competing land-use demands have increased pressure on agricultural land (Seto et al., 2011; Godfray et al., 2010; King et al., 2023).

This issue is highly relevant to Malaysia and especially to Sabah. In Malaysia, land administration is largely a state matter, while food security policy is shaped through both federal and state-level institutions (Ismail, 2011; Ministry of Agriculture and Food Industries, 2021b). This creates a governance challenge because food security

goals may be set nationally, but land-use decisions are often made at the state or local level. In Sabah, the issue is further complicated by its distinctive land tenure system, Native Customary Rights, agricultural land classification, and the dominance of industrial crops such as oil palm (Nuar & Lunkapis, 2019; Salleh, 2021; Sabah Economic Development and Investment Authority [SEDIA], 2021). Although Sabah possesses land suitable for agriculture, not all agricultural land directly contributes to food crop production because a substantial share is allocated to industrial and commercial agricultural uses rather than food crops (SEDIA, 2021; Baharuddin et al., 2025).

Sabah's food security situation is particularly important because rice remains a staple food, yet the state's rice self-sufficiency level has remained low (Ministry of Agriculture and Food Industry Sabah, 2015; Tahir & Abd Talip, 2020; Wong et al., 2017). The decline in rice self-sufficiency has increased Sabah's dependence on food imports and made the state more vulnerable to external disruptions in food supply, global market fluctuations, and rising food prices. At the same time, agricultural land continues to face pressure from residential, commercial, infrastructure, and industrial development (Marzuki & Jais, 2020; Azizan & Hussin, 2015; Ahemad et al., 2026). Without stronger agricultural land preservation mechanisms, Sabah may face long-term constraints in strengthening domestic food production and improving food system resilience.

Existing instruments include the Third Sabah Agricultural Policy and Sabah Agriculture Blueprint (Ministry of Agriculture and Food Industry Sabah, 2015, 2021), the National Agrofood Policy 2.0 and National Food Security Policy Action Plan (Ministry of Agriculture and Food Industries, 2021a, 2021b), National Physical Plan 3 (Federal Department of Town and Country Planning Peninsular Malaysia, 2016), and the Land Ordinance (Sabah Cap. 68) (1930). However, these instruments are not always integrated, enforceable, or sufficiently focused on agricultural land preservation (Abdul Sani et al., 2022; Candel, 2014; Ahemad et al., 2026). The original contribution of this paper is to reposition agricultural land preservation in Sabah as a food security governance problem by linking land conversion pressure, rice self-sufficiency, institutional fragmentation, and preservation strategy through a structured content analysis. Therefore, this paper synthesises literature, policy documents, legal instruments, and comparative case studies into analytical categories that can inform a Sabah-sensitive preservation framework.

METHODOLOGY

Research Design

This paper uses a targeted content analysis-based overview rather than claiming a fully systematic review. Content analysis is appropriate because it enables academic articles, legal instruments, policy documents, official reports, and comparative cases to be examined through a transparent coding framework and interpreted in relation to Sabah. Following Seuring and Gold (2012), the review proceeded through four stages: material collection, descriptive analysis, category selection, and material evaluation. Coding was undertaken within the material-evaluation stage and was informed by Mayring's (2000) deductive category-application approach. The unit of analysis was one complete document or source. The procedure also drew on White and Marsh (2006) and Hsieh and Shannon (2005), particularly their emphasis on explicit analytical units, category definitions, coding rules, and transparent interpretation.

Search Strategy and Review Boundaries

Sources were identified through Google Scholar and targeted searches of official Malaysian and Sabah government repositories, supplemented by backward reference searching from highly relevant articles and policy documents. Searches combined the core concepts of agricultural land, farmland, paddy land, preservation, protection, conversion, zoning, food security, rice self-sufficiency, land governance, Native Title, Native Customary Rights, farmer support, spatial monitoring, and Sabah. Illustrative Boolean combinations were: ("agricultural land" OR farmland OR "paddy land") AND (preservation OR protection OR conversion OR zoning); ("food security" OR "rice self-sufficiency") AND (Sabah OR Malaysia); ("Native Title" OR "Native Customary Rights") AND (agriculture OR "land use" OR conversion) AND Sabah; and ("farmland preservation" OR "agricultural land protection") AND (policy OR governance OR greenbelt OR easement OR zoning).

Additional targeted terms were used for GIS, remote sensing, smart farming, taxation, subsidies, rural infrastructure, and comparative preservation programmes.

The academic search covered January 2000 to June 2026 so that the review captured contemporary food-security and land-governance debates. Older legal instruments were retained where they remained operative or historically necessary for interpreting Sabah's land system. English- and Malay-language sources were eligible. The search was not restricted to peer-reviewed journal articles because Sabah's land-governance framework is also documented through legislation, official policy, administrative reports, and credible institutional publications.

Screening and Eligibility

The review was developed iteratively, and the original number of records before duplicate removal was not retained. The audit trail was reconstructed from the working bibliography, full source matrix, and archived source files. Duplicate checking by title, author, year, and DOI produced 92 unique records for the original content-analysis screening. All 92 records were screened by title and, where available, abstract, followed by full-document assessment against the eligibility criteria. Sixteen methodology-only, contextual, or statistical references were retained in the manuscript but were not treated as source-level analytical coding units, leaving 76 sources in the analytical corpus. After the thematic corpus had been finalised, three additional official sources were added specifically for statistical and legal clarification; Agriculture Census 2024 paddy report, the Sabah State Budget Speech 2025, and the Town and Country Planning Ordinance. These three sources were not added to the thematic denominator. The final bibliography therefore contains 95 references, while the source-level content analysis remains based on 76 sources.

Table 1. Eligibility Criteria for Source Selection

Criterion	Included	Excluded
Subject relevance	Agricultural land preservation or conversion, food security, paddy or rice production, land governance, tenure, preservation policy, farmer support, or spatial monitoring.	Sources without a meaningful connection to agricultural land, food security, governance, or a directly relevant preservation instrument.
Geographical relevance	Sabah and Malaysia; Southeast Asian evidence; global concepts; or international cases with a clear comparative lesson for Sabah.	External cases with no conceptual, institutional, or policy relevance to Sabah.
Source type	Peer-reviewed articles, scholarly books/chapters, theses with identifiable methods, legislation, official policies, government reports, and credible institutional publications.	Anonymous commentary, promotional pages, untraceable material, or documents without identifiable authorship or institutional authority.
Language	English or Malay.	Sources in other languages where an adequate English or Malay full text was unavailable.
Accessibility and evidence	Full text or sufficiently complete official documentation allowing the source to be coded reliably.	Abstract-only records, inaccessible documents, duplicates, or sources that could not support a coding decision.
Analytical contribution	At least one clear contribution to T1, T2, T3, or T4.	Methodology-only, general background, or statistical references used in the manuscript but not treated as thematic coding units.

Source: Authors' review protocol.

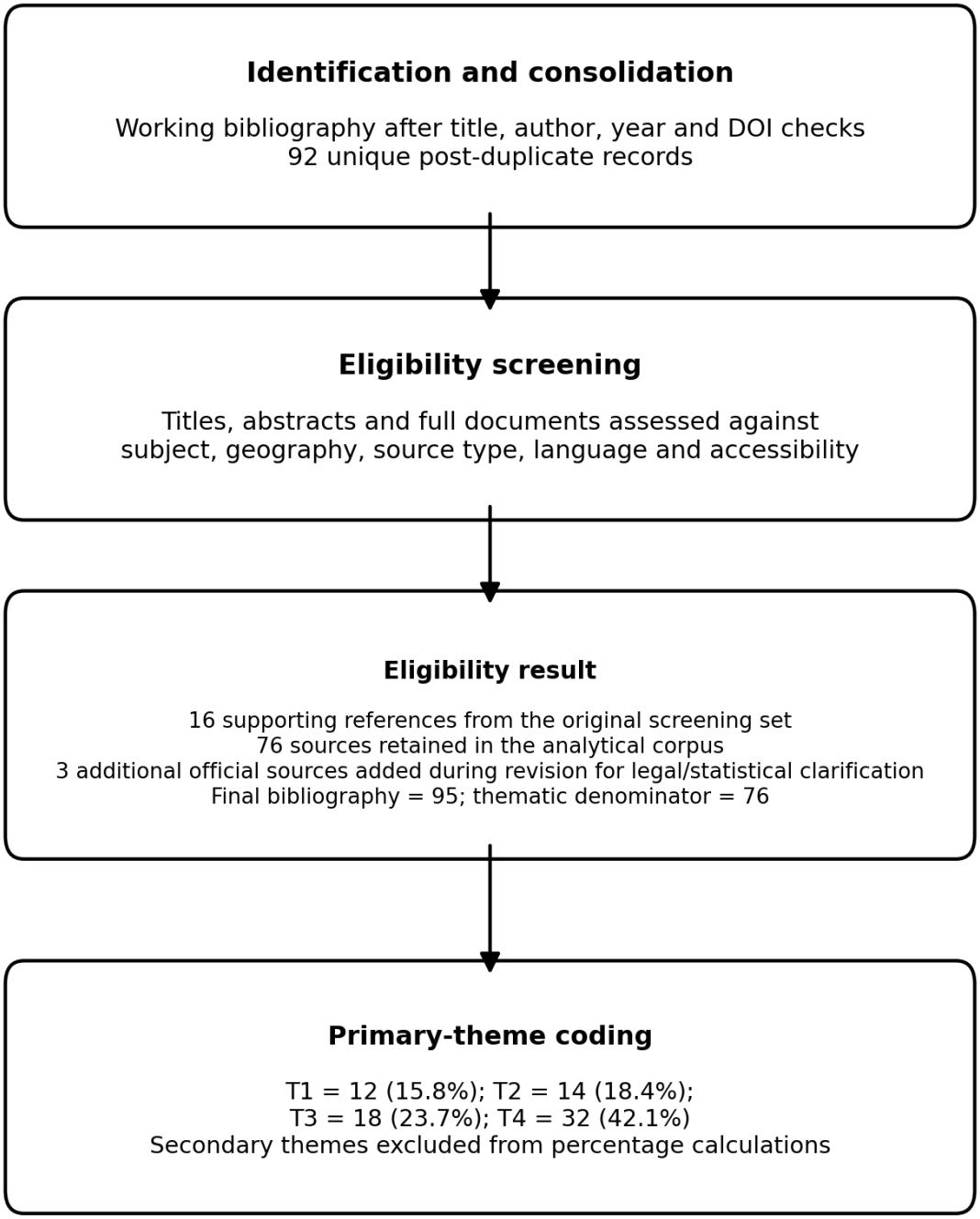

Figure 1. Source Identification, Screening and Analytical-Corpus Construction

Source: Authors' review protocol.

Descriptive Analysis

The descriptive stage profiled the 76 analytical sources by source type, geographical focus, and evidential role. The corpus combined peer-reviewed empirical studies, reviews, policy and legal analyses, official documents, reports, comparative cases, and selected theses. It also provided evidence at five levels: global conceptual literature; Southeast Asian land-use studies; Malaysian policy and governance literature; Sabah-specific agricultural, tenure, and food-security evidence; and international preservation models. Sabah-specific material

supplied the most direct evidence on land conversion, rice self-sufficiency, paddy cultivation, industrial crop dominance, Native Customary Rights, and institutional constraints. External sources were used only where they supplied a transferable concept, explanatory mechanism, or preservation instrument. This profile also revealed a continuing shortage of direct Sabah-specific empirical research, which explains the use of carefully selected regional and international comparisons.

Source-Quality Appraisal

Because the corpus combined heterogeneous evidence, one numerical appraisal tool was not imposed across all source types. Instead, a source-specific quality and authority check was applied. The appraisal was used to determine evidential weight and appropriate use: peer-reviewed empirical evidence and current official legal or statistical documents were given greater weight for factual claims, while weaker or indirect sources were used only for contextual or comparative support. No source was treated as equally authoritative merely because it appeared in the matrix.

Table 2. Source-Specific Quality Appraisal Framework

Source category	Quality and authority considerations
Academic empirical studies	Peer-review status; clarity of research design, data, analysis, and limitations; direct relevance to the coded claim.
Reviews and conceptual papers	Transparency of review or argument; quality of cited evidence; relevance to the analytical framework.
Legal instruments	Official text; jurisdiction; operative or revised status; direct relevance to land administration, planning, title, conversion, or appeal.
Policies and government reports	Issuing authority; policy period; implementation status; data source; relevance to Sabah or national-state coordination.
Grey literature, theses, and institutional publications	Identifiable author or institution; traceable evidence; methodological transparency; use limited to claims the source can reasonably support.
Comparative cases	Documented implementation or outcomes; institutional comparability; explicit limits on transferability to Sabah.

Source: Authors' appraisal framework, adapted to the mixed academic, legal, policy, and grey-literature corpus.

Category Selection and Coding Framework

The coding categories connect source description with analytical interpretation. Table 3 defines the fields used for every source.

The complete 76-source coding matrix is provided as Supplementary Material A, while the main manuscript retains the aggregate distribution and a shorter synthesis of the most influential Sabah-specific and comparative evidence. This arrangement preserves transparency without allowing the source-level matrix to dominate the paper.

Table 3. Analytical Categories Used in the Content Analysis

Main Category	Operational Definition	Coding Question	Examples from the Matrix	Coding Rule
Aim/focus of source	The principal objective, topic, or contribution of the article, policy, legal instrument, report, or case study.	What does the source mainly examine?	Food security dimensions; land conversion; land governance; preservation models; farmer support.	Code according to the explicitly stated objective or, where no objective is stated, the dominant issue addressed throughout the source.
Method/type of evidence	The research method, document type, or evidential basis used to support the source's findings.	What type of evidence does the source provide?	Empirical study; case study; literature review; policy document; legal instrument; statistical report.	Code using the source's stated methodology. Official policies, laws, and reports are classified by documentary type rather than as empirical studies.
Geographical context	The main country, region, or policy jurisdiction in which the evidence was produced or applied.	Where was the evidence produced or applied?	Global; Southeast Asia; Malaysia; Sabah; Japan; China; Indonesia; Canada; United States.	Assign the principal study or policy location. Multi-country sources are coded as international or global unless one location forms the main case.
Main issue addressed	The principal agricultural-land, governance, policy, or food-security issue discussed by the source.	What problem, effect, gap, or intervention is addressed?	Land conversion; urbanisation; rice production; policy gaps; zoning; farmer support.	Code the issue most directly connected to the source's objective and principal findings.
Primary content-analysis theme	The theme representing the source's dominant analytical contribution to the review.	Which of the four themes best represents the source's principal contribution?	T1, T2, T3, or T4.	Assign only one primary theme. The primary theme is determined from the source's objective, main findings, and dominant relevance to the overview paper.
Secondary content-analysis theme	An additional theme substantially supported by the source but not representing its dominant contribution.	Does the source provide substantial evidence for another theme?	T1/T3; T1/T2; T2/T4; T3/T4.	Assign a secondary theme only when the additional theme is substantively discussed. Secondary codes are excluded from percentage calculations.
Relevance to Sabah	The role of the source in interpreting agricultural land preservation and food security in Sabah.	How does the source improve the interpretation of Sabah?	Direct Sabah evidence; Malaysian policy support; regional comparison; conceptual support; strategy adaptation.	Prioritise direct Sabah evidence. External sources are classified according to whether they provide national support, regional comparison, conceptual explanation, or an adaptable policy instrument.

Source: Authors' analytical framework, adapted from Seuring and Gold (2012) and informed by Mayring's (2000) deductive category-application approach.

The primary thematic codes were applied using predefined operational boundaries. T1 was assigned when the main contribution concerned agricultural land conversion, land-use pressure, fragmentation or tenure-related vulnerability. T2 was assigned when the source mainly addressed food availability, paddy production, rice self-sufficiency, agricultural productivity or rural livelihood. T3 was assigned when the dominant contribution concerned legal, policy, governance, institutional, coordination or enforcement gaps. T4 was assigned when the source primarily proposed or evaluated preservation measures, such as zoning, farmer support, fiscal incentives, spatial monitoring, smart farming or infrastructure. Where a source substantially supported more than one theme, one dominant primary theme and one secondary theme were recorded. Only primary themes were included in the frequency and percentage calculations.

Coding Procedure, Primary and Secondary Themes, and Reliability

The first author coded all 76 sources. Each source received one primary theme representing its dominant analytical contribution. Where a source also made a substantial contribution to another domain, a secondary theme was recorded in parentheses. Only primary themes were used to calculate the frequencies and percentages in Table 4; secondary themes informed the qualitative interpretation and were excluded from percentage calculations to prevent double counting. Coding was completed in two passes. The second pass checked the full matrix against the codebook and reviewed borderline classifications. Ambiguous cases were discussed with the co-authors and resolved by returning to the source's research objective, main findings, and relevance to Sabah. Because one researcher performed the full coding, a formal intercoder coefficient was not calculated; this is reported as a limitation rather than being represented as intercoder reliability.

FINDINGS AND DISCUSSION

The findings of the content analysis show that agricultural land preservation in Sabah is shaped by four interconnected themes: land conversion pressure and governance vulnerability, food security implication, policy and institutional gap, and preservation strategy. Rather than functioning as separate themes, these findings form a causal sequence: land conversion and industrial crop dominance reduce the food-producing land base; weak zoning and fragmented governance allow this pressure to continue; declining paddy capacity and low rice self-sufficiency increase food security vulnerability; and preservation strategies become necessary to reconnect land-use control with food security planning. This structure gives the discussion its analytical direction, moving from drivers of risk to institutional constraints and then to policy response.

Table 4 shows the distribution of primary themes across the 76-source analytical corpus. Preservation strategy is the largest category, but frequency is interpreted as the prevalence of a topic in the reviewed corpus rather than as a direct measure of policy importance or causal effect. The percentages summarise the coding structure; they do not substitute for source quality, strength of evidence, or contextual interpretation.

Table 4. Distribution of Primary Content-Analysis Themes (n = 76)

Code	Theme	No.	%	Main sub-codes	Interpretation
T1	Land conversion pressure and governance vulnerability	12	15.8	Urbanisation; land-use change; fragmentation; competing land uses; tenure and zoning vulnerability	Agricultural land is exposed to development and governance pressure.
T2	Food security implication	14	18.4	Food availability; rice SSL; paddy productivity; rural livelihood; stability	Food-producing land is a strategic food-security asset.

Code	Theme	No.	%	Main sub-codes	Interpretation
T3	Policy and institutional gap	18	23.7	Coordination; enforcement; legal limitations; tenure; planning control	Preservation is constrained by fragmented and weakly enforceable governance.
T4	Preservation strategy	32	42.1	Zoning; monitoring; incentives; farmer support; infrastructure; smart farming	An effective framework must combine spatial, institutional, economic, and technical measures.

Source: Authors' content analysis of 76 retained sources.

Note: Each source was assigned one primary theme. Secondary themes were recorded separately and excluded from the percentage calculation.

Following the category-selection and material-evaluation procedures outlined by Seuring and Gold (2012), and informed by Mayring's (2000) deductive category-application approach, each retained source was assigned one primary analytical theme. Primary-theme frequencies were then calculated to show the distribution of the reviewed materials.

Table 5 condenses the most influential evidence used in the main manuscript. Most entries are drawn from the 76-source analytical corpus, while selected official statistical and legal sources used for supplementary clarification are identified separately. Sabah-specific and Malaysian evidence was prioritised for direct empirical, legal, and policy relevance, while selected comparative cases illustrate instruments that may be adapted cautiously. Full coding details for the 76 analytical sources are provided in Supplementary Material A.

Table 5. Selected Influential Evidence Retained in the Main Manuscript

Source	Type/context	Main evidence	Relevant analytical theme	Analytical role
Ahemad et al. (2026)	Sabah empirical study	Verified conversion patterns, tenure vulnerability, weak zoning, and planning-process pressure.	T1	Direct evidence of land-conversion and governance risk.
Department of Town and Regional Planning Sabah (2024)	Administrative records	Annual agricultural land conversion area for 2022–2024.	T1	Quantifies recent verified conversion pressure.
Tahir & Abd Talip (2020)	Kota Belud case study	Paddy policy intervention and rice-production development.	T2	Links land, paddy support, and state food security.
Wong et al. (2017)	Sabah econometric study	Paddy self-sufficiency depends on land demand and production capacity.	T2	Directly connects the paddy land base with rice SSL.

Source	Type/context	Main evidence	Relevant analytical theme	Analytical role
Abdul Sani et al. (2022)	Sabah policy review	Food-security policy requires stronger agricultural and institutional alignment.	T3	Supports policy-coherence reform.
Land Ordinance (Sabah Cap. 68)	Sabah legislation	Land alienation, titles, dealings, and conditions.	T3	Defines land-administration powers but does not itself create a permanent food-security zone.
Town and Country Planning Ordinance (Sabah Cap. 141)	Sabah legislation	Planning permission, conformity with schemes, conditions, enforcement, and appeals.	T3	Identifies statutory levers and discretionary pathways relevant to preservation.
Nuar & Lunkapis (2019)	Sabah case study	Customary land supports indigenous livelihood and land-use practices.	T3	Shows why preservation must include Native and customary tenure safeguards.
Jamru et al. (2023)	Kota Belud GIS study	Remote sensing can monitor paddy cultivation change.	T4	Supports a digital agricultural-land monitoring system.
Wulan et al. (2022)	North Sumatera case	Legal protection combined with zoning, farmer empowerment, and local strategy.	T4	Regionally relevant hybrid preservation lesson.
Caldwell et al. (2022)	Ontario case	Urban-growth control and permanent farmland protection.	T4	Provides a spatial protection model with transferability limits.
Chen (2010)	Maryland case	Structured farmland preservation and programme selection.	T4	Provides lessons on incentive-based retention and programme design.

Source: Authors' synthesis. Full coding details for the 76 analytical sources are provided in Supplementary Material A.

Note: Department of Town and Regional Planning Sabah (2024) and the Town and Country Planning Ordinance (Sabah Cap. 141) are supporting sources outside the primary thematic frequency calculation and are not included in the 76-source coding matrix.

Direct Statistical and Administrative Evidence

The thematic findings are supported by direct administrative and statistical indicators. Department of Town and Regional Planning Sabah records report 513.35 acres of agricultural land conversion between 2022 and 2024:

157.37 acres in 2022, 238.08 acres in 2023, and 117.90 acres in 2024. The 2023 total comprised 36 verified cases analysed by Ahemad et al. (2026). The Agriculture Census 2024 reports 12,856.3 hectares of planted paddy area in Sabah for the 2023 reference year, of which Kota Belud accounted for 7,788.6 hectares (Department of Statistics Malaysia, 2025). Sabah's rice self-sufficiency level declined from 34% in 2000 to 26% in 2012, against a 60% policy benchmark in the Third Sabah Agricultural Policy, and the 2025 State Budget Speech reported an SSL of 22.6% (Ministry of Agriculture and Food Industry Sabah, 2015; Government of Sabah, 2024). These indicators should be interpreted carefully: conversion applications, approvals, verified conversion cases, rezoning decisions, and completed physical conversion are not identical measures. Nevertheless, together they show a limited food-producing land base, continuing land-use pressure, and persistent dependence on external rice supply.

Table 6. Selected Statistical and Administrative Indicators for Sabah

Indicator	Period	Evidence	Interpretive caution	Source
Agricultural land conversion	2022–2024	513.35 acres in total: 157.37 (2022), 238.08 (2023), and 117.90 (2024).	Verified administrative conversion records; not a complete cadastral land-loss time series.	Department of Town and Regional Planning Sabah (2024)
Verified conversion cases	2023	36 cases involving 238.08 acres.	Case-based evidence on conversion outcomes and tenure exposure.	Ahemad et al. (2026)
Planted paddy area	2023 reference year	Sabah: 12,856.3 ha; Kota Belud: 7,788.6 ha.	Shows concentration of the state's planted paddy base in Kota Belud.	Department of Statistics Malaysia (2025)
Rice self-sufficiency level	2000; 2012; reported for 2025 budget context	34% (2000); 26% (2012); 22.6% reported in the 2025 State Budget Speech; SAP3 benchmark: 60%.	Shows persistent rice-supply vulnerability; figures should be read according to their stated reference periods.	Ministry of Agriculture and Food Industry Sabah (2015); Government of Sabah (2024)

Source: Authors' synthesis of official statistics, administrative records, and Sabah-specific empirical evidence.

Land Conversion Pressure and Governance Vulnerability

The first major finding is that agricultural land in Sabah is exposed to pressure from urbanisation, infrastructure, housing, commercial development, and shifts toward non-food agricultural uses. The administrative evidence in Table 6 confirms that conversion is not merely theoretical: 513.35 acres were recorded across 2022–2024, including 36 verified cases covering 238.08 acres in 2023. These figures do not represent every form of agricultural land loss, but they demonstrate that conversion approvals and outcomes are continuing within a state that already has a limited paddy land base. This finding is consistent with global and Malaysian evidence that urban expansion, rising land values, and competing development priorities place peri-urban and strategically located agricultural land at risk (Seto et al., 2011; King et al., 2023; Marzuki & Jais, 2020; Azizan & Hussin, 2015).

In Sabah, land conversion pressure is more complex because it is not only driven by urban expansion but also by land tenure conditions, zoning weaknesses, and agricultural land-use priorities. Ahemad et al. (2026) show that agricultural land conversion in Sabah is influenced by urban expansion, speculative development, housing demand, weak tenure safeguards, and insufficient zoning enforcement. This is significant because agricultural

land may appear protected through land status or planning documents, but in practice it may still remain vulnerable to rezoning, subdivision, appeal processes, or development-oriented land-use decisions.

The content analysis also shows that Native Title and customary land issues are central to agricultural land preservation in Sabah. Native Title lands are often linked to smallholder agriculture and local livelihood, but they may also be exposed to conversion pressure due to market incentives, leasing arrangements, and weak land-use safeguards (Nuar & Lunkapis, 2019; Salleh, 2021). This creates a governance vulnerability because the protection of agricultural land cannot be separated from land tenure, customary rights, and state land administration. Therefore, agricultural land preservation in Sabah must consider not only physical land availability, but also the legal and institutional conditions under which agricultural land is retained, transferred, leased, or converted.

The findings further indicate that conversion pressure is not limited to direct urban encroachment. Agricultural land may also be indirectly weakened when food crop land is displaced by industrial crops or when agricultural policy prioritises commercial agriculture over food crop production. Baharuddin et al. (2025) highlight that agricultural land in Sabah has been affected by a shift from food crops to industrial crops, which can reduce the land base available for local food production. This suggests that land preservation should not simply protect "agricultural land" in general, but should specifically safeguard food-producing agricultural land, especially paddy and other strategic food crop areas.

Food Security Implication

The second finding is that agricultural land preservation is directly connected to food availability, rice self-sufficiency, paddy production, rural livelihood, and supply stability. Agricultural land supplies the physical base of the availability dimension of food security, but this relationship becomes especially important where domestic production is already limited (Barrett, 2010; Viana et al., 2022).

Recent official statistics reinforce this relationship. Sabah recorded 12,856.3 hectares of planted paddy area for the 2023 reference year, with 7,788.6 hectares located in Kota Belud (Department of Statistics Malaysia, 2025). This concentration means that the loss, fragmentation, underuse, or rezoning of strategic paddy areas can have effects beyond the individual parcel. It can reduce the continuity of irrigation systems, farm access, mechanisation efficiency, and the economic viability of surrounding cultivation.

The rice self-sufficiency trend also shows why preservation matters. Sabah's SSL declined from 34% in 2000 to 26% in 2012, substantially below the 60% benchmark identified in SAP3, while the 2025 State Budget Speech reported an SSL of 22.6% (Ministry of Agriculture and Food Industry Sabah, 2015; Government of Sabah, 2024). Although SSL is affected by yield, imports, consumption, inputs, and farm management as well as land area, a secure and productive paddy land base remains a necessary condition for increasing local production.

Tahir and Abd Talip (2020) show that public intervention in Kota Belud can improve paddy production, whereas Wong et al. (2017) demonstrate the structural relationship between paddy land demand, production capacity, and self-sufficiency. The implication is that production support and land protection should not be designed separately. Policies that raise yields without safeguarding strategic cultivation areas may generate only temporary gains; conversely, zoning without irrigation, finance, machinery, extension, and markets may leave land idle or vulnerable to later conversion.

Agricultural land preservation also supports rural livelihoods and local resilience. Farming land provides income, employment, intergenerational knowledge, and community continuity, particularly for smallholders and Native landholders. Therefore, the policy objective should not be the preservation of agricultural labels alone, but the retention of viable, accessible, and productively used food-producing landscapes.

Policy and Institutional Gap

The third finding is that Sabah's preservation problem is produced not only by policy absence, but by the way existing land, planning, agricultural, and food-security instruments interact. National policies set food-security and agricultural-modernisation objectives, while land administration and planning decisions are principally implemented through Sabah's state institutions. This division creates a translation problem: national or sectoral food-security goals do not automatically become binding parcel-level land-protection rules (Ismail, 2011; Abdul Sani et al., 2022).

The Land Ordinance (Sabah Cap. 68) is the principal legal instrument governing alienation, land titles, dealings, and conditions of use. It provides the state with important land-administration powers, but an agricultural title or condition does not by itself amount to a permanent food-security designation. Land conditions, dealings, and administrative decisions must therefore be considered together with planning controls. This legal distinction is important because preserving land classified broadly as agricultural does not necessarily ensure that it remains under paddy or another strategic food crop.

The Town and Country Planning Ordinance (Sabah Cap. 141) provides the more direct statutory pathway for development control. Under section 28C, a local authority may approve, refuse, or conditionally approve an application for planning permission, and permission must conform to the relevant approved scheme. Section 28E permits planning conditions, while section 28H establishes offences for unauthorised or non-compliant development. The Ordinance also provides appeal pathways against refusals or imposed conditions. These provisions can constrain conversion where approved schemes clearly protect agricultural land and agencies enforce them consistently; however, discretion, scheme amendment or rezoning, conditional approval, and appeal procedures can also create pathways through which preservation objectives are reconsidered.

The legal issue is therefore not that Sabah has no planning authority, but that food-producing land is not always identified through sufficiently precise, durable, and enforceable planning designations. A paddy conservation label, agricultural title condition, local plan designation, departmental objection, and food-security target may carry different legal and administrative weight. Where these instruments are poorly aligned, development decisions can proceed without a single binding test that requires decision-makers to demonstrate that conversion will not materially weaken strategic food-production capacity.

Native Title and customary land require additional safeguards. Customary land supports livelihood, identity, inheritance, and community stewardship, but preservation rules that simply prohibit conversion may unfairly transfer the cost of food-security protection to landholders. A defensible framework should combine clear conversion criteria with voluntary retention incentives, procedural participation, compensation or benefit mechanisms where appropriate, and protection against speculative or coercive conversion (Nuar & Lunkapis, 2019; Salleh, 2021).

Institutionally, land administration, town and regional planning, agriculture, local authorities, irrigation, infrastructure, and food-security agencies operate through different mandates and data systems. The central gap is therefore policy coherence and enforceable coordination. Sabah needs a mechanism that requires agricultural and food-security evidence to be considered before strategic food-producing land is rezoned or released, records the reasons for decisions, and monitors cumulative land loss rather than assessing applications only as isolated parcels.

Agricultural Land Preservation Strategy

The fourth finding is that the reviewed literature provides a wide range of preservation strategies that may inform Sabah's policy direction. This theme is the most frequently coded in the content analysis, suggesting that many sources are solution-oriented. The strategies identified include zoning and land protection, spatial planning, GIS and remote sensing monitoring, farmland preservation models, fiscal incentives, land taxation, smart farming, subsidies, rural infrastructure, farmer support, and market access. Comparative models from Asia and Western countries provide useful lessons, but the findings show that these models cannot be transferred directly to Sabah. Japan's farmland consolidation and institutional reforms demonstrate the importance of structured land

administration and support for agricultural productivity, but Sabah's customary land context and Native Customary Rights make direct replication difficult (OECD, 2023).

Shanghai's land policy model highlights the role of strong regulatory control and compensation mechanisms, but its centralised governance system differs significantly from Sabah's pluralistic land governance structure (Zhou et al., 2022). North Sumatera provides a more comparable regional example because it combines juridical measures, spatial zoning, farmer empowerment, and market support to protect sustainable food agricultural land (Wulan et al., 2022). Western preservation models also offer important lessons. Ontario's Greenbelt model demonstrates how planning instruments can be used to control urban expansion and protect agricultural land (Caldwell et al., 2022). Maryland's farmland preservation model shows how conservation easements and structured preservation programmes can encourage landowners to retain agricultural land (Chen, 2010).

However, these approaches need careful adaptation because Sabah's land market, customary tenure, institutional capacity, and land administration system differ from those in Canada and the United States. The content analysis suggests that Sabah requires a hybrid preservation strategy rather than a single imported model. Zoning and land protection are important, but they must be supported by incentives, enforcement, monitoring, and farmer-level support. Anggono et al. (2023) emphasise the importance of spatial planning in sustainable land-use change, while Wulan et al. (2022) demonstrate the value of combining legal protection with local strategies and farmer support. Similarly, Sahari et al. (2020) and Abd Hamid et al. (2023) indicate that fiscal tools and land taxation may influence land-use behaviour and encourage productive land retention.

Technical strategies are also relevant. GIS, remote sensing, UAV, and smart farming tools can support better land-use monitoring and agricultural productivity. Jamru et al. (2023) show that paddy cultivation change in Kota Belud can be assessed using GIS and remote sensing, while Mohidem et al. (2024) highlight the potential of UAV and multispectral sensors for paddy growth monitoring. Walter et al. (2017) further argue that smart farming can improve agricultural efficiency and sustainability. These sources suggest that agricultural land preservation should be supported by a digital monitoring system that can identify land-use change, track paddy areas, and support evidence-based planning.

Overall, the findings show that agricultural land preservation in Sabah should be understood as a multi-dimensional food security governance issue. The central analytical link is that development pressure and weak land-use control may reduce the availability and security of food-producing land, which can constrain paddy production, weaken rice self-sufficiency, and increase dependence on external food supply. The content analysis therefore supports the need for an integrated and state-sensitive agricultural land preservation framework that links land-use governance directly with food security planning, especially for strategic paddy and food crop areas.

Proposed Policy Direction For Sabah

For analytical clarity, the interventions identified through the content analysis are consolidated into three mutually supporting policy pillars, each comprising a broader set of implementation instruments.

Pillar 1: Spatial and Legal Protection of Strategic Food-Producing Land

Sabah should identify strategic food-producing land through a state spatial inventory that distinguishes paddy, other essential food crops, supporting irrigation systems, and contiguous production landscapes from agricultural land used primarily for industrial commodities. Priority areas should be incorporated into approved planning schemes through clear food-production zones, paddy conservation areas, or equivalent designations. Comparative evidence shows that agricultural zoning, Greenbelt planning, and stronger spatial controls can help limit urban expansion and protect strategically important farmland (Wulan et al., 2022; Caldwell et al., 2022; Han & Go, 2019). Conversion applications affecting these areas should therefore be subject to an explicit food-security impact test, cumulative-loss assessment, and a higher evidential threshold before rezoning or planning permission is granted. This pillar should align land administration under the Land Ordinance (Sabah Cap. 68), planning schemes under the state planning system, agricultural policy, and food-security targets. Land

administration is largely exercised at the state level, while development control in Sabah is implemented through state land and planning institutions, requiring stronger alignment between land-use decisions and agricultural objectives (Ismail, 2011; Rabe et al., 2011; Land Ordinance [Sabah Cap. 68], 1930). The objective is not an absolute prohibition on all development, but a transparent hierarchy in which avoidance is considered first, exceptional conversion must be justified, and mitigation or replacement cannot be used casually for high-value paddy landscapes. Native Title and customary food-producing land should also be protected through participatory mechanisms, safeguards against speculative conversion, and voluntary retention or stewardship arrangements that respect ownership and community decision-making. Customary and Native land systems in Sabah are closely connected to livelihood, community stewardship, inheritance, and indigenous land-use practices; therefore, they require context-sensitive preservation mechanisms rather than direct adoption of external models (Nuar & Lunkapis, 2019; Salleh, 2021).

Pillar 2: Coordinated Governance, Transparent Decisions, and Digital Monitoring

Sabah should establish a permanent inter-agency agricultural land preservation mechanism involving land administration, town and regional planning, agriculture, local authorities, irrigation, infrastructure, and food-security agencies. Food-security governance depends on policy coherence, institutional capacity, and coordination across sectors, while Sabah's current food-security arrangements require stronger integration between agricultural policy, land administration, and natural-resource planning (Candel, 2014; Abdul Sani et al., 2022). The mechanism's functions should include reviewing proposals affecting strategic land, reconciling conflicting technical positions, recording reasons for approval or refusal, monitoring cumulative conversion, and reporting progress against food-security indicators. It should use clear decision criteria rather than relying only on ad hoc consultation. A shared geospatial monitoring system should integrate land title and conditions, approved zoning, paddy and food-crop boundaries, conversion applications, approvals, appeals, completed development, idle land, irrigation assets, and agricultural productivity. GIS and remote sensing have already been applied to assess changes in paddy cultivation in Kota Belud, while UAV and multispectral technologies can support paddy monitoring and agricultural management (Jamru et al., 2023; Mohidem et al., 2024). Smart-farming and digital information systems can also improve the efficiency, sustainability, and evidence base of agricultural decision-making (Walter et al., 2017; Amiri-Zarandi et al., 2022). GIS, remote sensing, and periodic field verification can therefore identify land-use change and provide an auditable basis for enforcement and policy evaluation. Public reporting should distinguish applications, approved conversions, verified conversion cases, and completed physical land-use changes so that trends are neither overstated nor obscured.

Pillar 3: Farmer and Economic Support for Productive Land Retention

Land protection will not be durable if farming is economically unviable. Sabah should therefore link preservation status with irrigation and drainage improvements, farm roads, machinery access, storage and collection facilities, extension services, input support, finance, market access, and succession support. Rural infrastructure, transportation, financial capacity, subsidies, machinery support, and farmers' socioeconomic conditions influence agricultural productivity and whether farming remains a viable land use (Abdulraheem et al., 2021; Daud et al., 2018; Alam et al., 2011; Mohd Shafiai & Moi, 2015; Ranathilaka & Arachchi, 2019; Priyanto et al., 2023). The aim is to maintain active cultivation and reduce the incentive to sell, subdivide, or convert land because of low returns or infrastructure constraints. Economic instruments may include targeted land-retention payments, grants, tax or rent relief, infrastructure priority, and outcome-based support for owners and farmers who keep strategic land in food production. Previous studies indicate that taxation, subsidies, and other fiscal instruments can influence land-use decisions, agricultural productivity, and the economic attractiveness of retaining land for agricultural purposes (Sahari et al., 2020; Abd Hamid et al., 2023; Ranathilaka & Arachchi, 2019; Priyanto et al., 2023).

Conversion charges or stricter conditions may discourage avoidable loss, but these measures should be calibrated so that smallholders are not penalised disproportionately. Incentives should be tied to transparent eligibility, active or recoverable production potential, and monitoring rather than being applied uniformly to all land classified as agricultural.

Integrated Sabah-Sensitive Framework

The three pillars form a hybrid Sabah-sensitive framework. Spatial and legal protection secures the agricultural land base; coordinated governance and monitoring make land-use decisions more consistent and accountable; and farmer-centred support helps ensure that protected land remains productive.

Comparative models from Japan, North Sumatera, Ontario, Maryland, and Shanghai should therefore be treated as sources of individual policy instruments rather than templates for direct transplantation. Japan demonstrates the importance of institutional support and farmland consolidation, North Sumatera combines land protection with zoning and farmer empowerment, Ontario applies Greenbelt planning to manage urban expansion, Maryland uses structured farmland-preservation mechanisms, and Shanghai demonstrates the influence of strong land policy and spatial governance (OECD, 2023; Wulan et al., 2022; Caldwell et al., 2022; Chen, 2010; Zhou et al., 2022).

The application of these instruments must nevertheless be conditioned by Sabah's state authority over land, Native and customary tenure, institutional capacity, concentration of paddy production, and continuing development pressures (Ismail, 2011; Nuar & Lunkapis, 2019; Salleh, 2021). The proposed framework therefore combines adaptable international lessons with Sabah-specific legal, institutional, socioeconomic, and land-tenure conditions.

Limitations

This paper has four principal limitations. First, it is a targeted content analysis-based overview rather than a prospectively registered systematic review. Because the original number of records before duplicate removal was not retained, the reported flow begins from an auditable set of 92 unique post-duplicate records. Three official sources added after finalisation of the thematic corpus are reported separately and excluded from the n = 76 thematic frequency calculations. Second, the full 76-source corpus was coded by one researcher. A codebook, second-pass recoding, and co-author review of ambiguous cases improved consistency, but no independent full-corpus intercoder coefficient was available. Third, the corpus combines heterogeneous academic, legal, policy, and grey-literature sources. Source-specific appraisal was used to control evidential weight, but the thematic frequencies should not be interpreted as equal-quality evidence or as effect sizes. Fourth, the paper relies on available documents and selected administrative statistics rather than a complete spatial inventory of agricultural land loss, implementation outcomes, or stakeholder testimony. Future research should combine cadastral and remote-sensing analysis, longitudinal conversion data, legal implementation assessment, and interviews with farmers, Native landholders, planners, and policymakers to test and operationalise the proposed framework.

CONCLUSION

This overview consolidates 76 analytical sources into four themes: land conversion pressure and governance vulnerability, food security implication, policy and institutional gap, and preservation strategy. The study documents how the sources were identified, screened, appraised, and coded, and distinguishes primary-theme percentages from secondary interpretive coding. The evidence indicates that Sabah's challenge is not simply a shortage of land classified as agricultural. The more important issue is whether strategically located paddy and food-crop landscapes remain legally protected, institutionally supported, and economically viable. Administrative records show continuing conversion pressure, while official paddy-area and rice self-sufficiency statistics confirm that the food-producing land base operates within a vulnerable supply context. At the same time, existing land and planning laws provide important powers but do not automatically translate food-security objectives into permanent parcel-level protection. The paper therefore proposes three integrated policy pillars: spatial and legal protection of strategic food-producing land; coordinated governance, transparent decisions, and digital monitoring; and farmer-centred economic and infrastructure support for productive land retention. These pillars are more suitable than direct transplantation of any single international model because they respond to Sabah's state land authority, Native Title and customary tenure, institutional fragmentation, paddy concentration, and development pressures. A credible preservation framework must protect land, coordinate decisions, support

landholders and farmers, and measure outcomes together. This integrated approach can strengthen Sabah's capacity to balance development with long-term agricultural resilience and food security.

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SUPPLEMENTARY MATERIAL A

Full Source-Level Content Analysis Matrix of the 76 Retained Sources

This supplementary material presents the complete source-level coding matrix used in the overview paper. Each source was classified by source type and geographical context, main issue addressed, primary and secondary thematic assignments, and relevance to Sabah. The first thematic code represents the primary theme used in the frequency and percentage calculations reported in the main manuscript. Secondary themes were retained for qualitative interpretation and were excluded from the percentage calculation to prevent double counting.

Theme codes: T1 = Land conversion pressure and governance vulnerability; T2 = Food security implication; T3 = Policy and institutional gap; T4 = Preservation strategy.

Table S1. Full Content Analysis Matrix of the 76 Retained Sources

Source: Authors' content analysis of 76 retained sources.

Note: A dash indicates that no secondary theme was assigned. Full bibliographic details are provided in the main manuscript.

No.	Author Document	Year	Source type / context	Main issue addressed	Primary theme	Secondary theme	Relevance to Sabah
1	Ahemad et al.	2026	Empirical / Sabah	Land conversion, tenure vulnerability and weak zoning threaten food security.	T1	T3	Core Sabah evidence on land conversion and governance gaps.
2	Baharuddin et a	2025	Journal / Sabah	Shift from food crops to industrial crops reduces food crop production.	T2	—	Supports food-crop land preservation in Sabah.
3	Abdul Sani et al	2022	Policy review / Sabah	Food security policy needs stronger alignment with agricultural policy.	T3	—	Supports policy coordination for Sabah food security.
4	Tahir & Al Talip	2020	Case study / Kota Belud	Government paddy policy improved rice production.	T2	—	Government paddy policies have supported rice-production development in Kota Belud.
5	Godfray et al.	2010	Journal / Global	Rising food demand increases pressure on land and food systems.	T2	—	Provides global food security context.
6	Candel	2014	Systematic literature review / International	Food security requires governance coordination and institutional capacity.	T3	—	Supports governance-based analysis for Sabah.
7	Anggono et al.	2023	Journal article / Indonesia	Spatial planning is needed to control agricultural land conversion.	T4	—	Offers regional lesson for land-use control.
8	Harini et al.	2025	Empirical / Indonesia	Land-use change affects agricultural carrying capacity and food security.	T1	T2	Supports land-use change and food security linkage.
9	King et al.	2023	Report / Global	Global land competition threatens food security and sustainability.	T1	T2	Provides global land-pressure context.
10	Viana et al.	2022	Systematic review / Global	Agricultural land systems support SDG 2 and food security.	T2	—	Provides conceptual support for land preservation.
11	Zhou et al.	2022	Case study / China	Land policy affects land-use change and spatial governance.	T4	—	Provides Asian comparison for spatial governance.

12	Wulan et al.	2022	Case study / Indonesia	Farmland protection can be supported through zoning and SWOT strategy.	T4	—	Provides regional strategy for agricultural land protection.
13	Sahari et al.	2020	Taxation study / Malaysia	Land taxation may influence land-use and retention decisions.	T4	—	Supports fiscal tools for land preservation.
14	Mahfud et al.	2023	Legal analysis / Indonesia	Agricultural land conversion should be selective due to farmer welfare impacts.	T3	—	Agricultural land conversion should be tightly controlled because of its effects on farmer welfare.
15	Ismail	2011	Land-policy review / Malaysia	Land administration is mainly under state authority.	T3	—	Explains need for Sabah-specific framework.
16	Abdulraheem al.	2021	Journal / Nigeria	Transport affects agricultural production and rural food security.	T4	—	Supports infrastructure and market-access strategy.
17	Jilcott Pitts et al	2022	Journal / USA	CSA cost-offset models improve food access for low-income groups.	T4	—	Provides a comparison for food access strategies.
18	Jilcott Pitts et al	2014	Journal / USA	Farmers' market use is linked to fruit and vegetable consumption.	T4	—	Provides support for local market access.
19	Franck et al.	2023	Case study / USA	EBT expansion improves access to farmers' markets.	T4	—	Provides comparison for rural market support.
20	Mohidem et al.	2024	Review / Malaysia	UAV and multispectral tools support paddy crop monitoring.	T4	—	Supports digital monitoring of Sabah paddy areas.
21	Mohamed Rus et al.	2024	Empirical / Malaysia	Rice production has environmental impacts linked to farming inputs.	T4	—	Supports sustainable paddy management.
22	Mohamed et al.	2016	Journal / Malaysia	Paddy farmers show weak sustainability practices.	T2	T4	Supports farmer assistance and sustainable farming strategies.
23	Daud et al.	2023	Empirical regional-sector study / Indonesia	Integrated agriculture depends on regional commodity potential.	T4	—	Provides optional regional agricultural planning comparison.
24	Pradhan et al.	2017	Systematic SDG-interaction study / Global	SDGs interact and influence each other.	T2	—	Supports SDG framing for food security.
25	Seto et al.	2011	Meta-analysis / Global	Urban land expansion is increasing rapidly worldwide.	T1	—	Supports urban expansion as land conversion pressure.
26	Tran & Van Vu	2021	Empirical / Vietnam	Land fragmentation increases food insecurity among rural households.	T1	T2	Supports tenure and land-structure concerns.
27	Jamru et al.	2023	GIS study / Kota Belud	Paddy cultivation change can be monitored using GIS and remote sensing.	T4	—	Supports spatial monitoring in Sabah.
28	Madjid et al.	2025	Scientometric / Indonesia	Social forestry research highlights conservation and land-use themes.	T4	—	Provides a comparison for integrated land conservation.
29	Sahide & Giesse	2015	Policy study / Indonesia	Fragmented land administration affects land-use transformation.	T3	—	Supports institutional fragmentation argument.
30	Marzuki & Jais	2020	Empirical / Malaysia	Urbanisation affects food security and agricultural self-sufficiency.	T1	T2	Provides Malaysian evidence of urban land pressure.
31	OECD	2023	Policy report / International	Agricultural policy must adapt to climate and food-system challenges.	T3	—	Provides policy context for agricultural resilience.

32	Ationg et al.	2020	Review / Sabah	Agriculture is linked to poverty reduction and rural livelihoods.	T2	—	Connects agricultural land preservation with rural welfare.
33	Caldwell et al.	2022	Case study / Canada	Farmland preservation can be supported through urban growth control.	T4	—	Provides model for permanent agricultural zones.
34	Ranathilaka Arachchi	2019	Empirical / Sri Lanka	Fertilizer subsidy affects small-scale paddy production.	T4	—	Supports subsidy and farmer-support strategy.
35	Priyanto et al.	2023	Empirical / Indonesia	Fertilizer and machinery subsidies affect paddy productivity.	T4	—	Supports productivity-enhancing assistance for paddy farmers.
36	Waage et al.	2015	Conceptual commentary / Global	SDG governance depends on institutions and interactions.	T3	—	Supports institutional coordination for SDG-linked policy.
37	Alam et al.	2011	Empirical / Malaysia	Farmers' socio-economic profile affects paddy productivity.	T2	T4	Supports farmer-level factors in paddy productivity.
38	Alam et al.	2013	Empirical / Malaysia	Climate and socio-economic factors affect agricultural productivity.	T2	T4	Supports wider productivity and resilience concerns.
39	Olaniyi et al.	2013	Historical review / Malaysia	Agricultural land-use change in Malaysia has implications for food security.	T1	T2	Provides Malaysian background on how land-use change affects food production.
40	Waage et al.	2018	Interdisciplinary programme paper / Global	Agriculture and health research need integration for food system development.	T2	T3	Supports the need to connect agriculture, food security, and governance in Sabah.
41	Azizan & Hussi	2015	Journal / Malaysia	Pressure on agricultural land threatens food security in Malaysia.	T1	T2	Supports the argument that agricultural land must be safeguarded for food security.
42	Azizan et al.	2016	Overview / Malaysia	Urbanisation creates pressure on food-producing land.	T1	T2	Provides Malaysian evidence linking urbanisation with food security concerns.
43	Barrett	2010	Methodological paper / Global	Food security must be measured through availability, access, utilisation, and stability.	T2	—	Provides conceptual support for defining food security in the overview paper.
44	Rondhi et al.	2019	Book chapter / Indonesia	Agricultural land conversion is linked to food policy and rural transformation.	T1	T3	Offers regional comparison on how conversion affects food policy.
45	Suardi et al.	2022	Policy study / Indonesia	Sustainable control strategies are needed to manage agricultural land conversion.	T1	T4	Provides regional lessons for conversion control strategies relevant to Sabah.
46	Arimoto et al.	2010	Historical study / Japan	Land tenancy affects agricultural productivity and land management.	T3	T4	Supports comparison with Japan's land governance and productivity experience.
47	Hashimoto Nishi	2016	Policy study / Japan	Land consolidation and rural development policies support agricultural restructuring.	T4	—	Provides lesson for farmland consolidation and rural agricultural planning.
48	Epp et al.	2018	Book chapter / Canada	Farmland preservation supports rural development and land-use planning.	T4	—	Provides comparative lesson on farmland protection and rural policy.
49	Pearce	2022	Policy paper / Canada	Agrivoltaics can combine renewable energy with agricultural land use.	T4	—	Provides an example of multifunctional agricultural land use through the integration of farming and renewable energy.

50	Han & Go	2019	Comparative policy study / International	Greenbelt policies vary across countries and influence land-use control.	T4	—	Provides comparison for possible permanent agricultural protection zones.
51	Mackenzie	2008	Master's thesis / Canada	Ontario's Greenbelt supports environmental stewardship and livelihood benefits.	T4	—	Provides a preservation model that can inform Sabah's land protection framework.
52	Hasan et al.	2020	Review / International	Land-use change affects ecosystem services and human well-being.	T1	T2	Supports the wider impact of land conversion beyond agricultural production.
53	Naim et al.	2024	Case study / Malaysia	Smart paddy-field initiatives can improve productivity and farmer outcomes.	T4	—	Supports smart farming as a strategy for Sabah's paddy areas.
54	Amiri-Zarandi al.	2022	Smart farming study / Global	Smart farm information systems support data-driven agricultural decisions.	T4	—	Supports digital agriculture and land-use monitoring strategies.
55	Bujang & Ab Bakar	2019	Policy-platform article / Malaysia	Agriculture 4.0 can strengthen Malaysia's agro-food sector.	T4	—	Supports modernisation of Sabah's agricultural sector through data-driven approaches.
56	Abd Hamid et a	2023	Taxation study / Malaysia	Taxation can encourage development of idle agricultural land.	T4	—	Supports fiscal intervention as part of Sabah's preservation strategy.
57	Mohd Shafiai Moi	2015	Finance study / Malaysia	Farmers face financial constraints that affect agricultural productivity.	T2	T4	Supports the need for farmer financing and support mechanisms in Sabah.
58	Wang & Shen	2014	Empirical economic study / China	Agricultural tax abolition affects rural income and production.	T4	—	Provides comparison on how fiscal policy can influence agricultural production.
59	Ng et al.	2022	Policy review / Sabah	Forest and land-use policy changes affect land governance in Sabah.	T3	T4	Supports Sabah-specific discussion on land-use policy and governance change.
60	ECD-CAB Project, Sabah	2001	Background paper / Sabah	Land alienation and development procedures shape planning decisions.	T3	—	Explains Sabah's administrative process for land development applications.
61	Rabe et al.	2011	Conference paper / Sabah	Development control operates within Sabah's planning system.	T3	—	Supports discussion on planning control, enforcement, and institutional gaps.
62	Handayani et al	2018	Conference paper / Indonesia	Agricultural land conversion policy requires stronger implementation.	T3	T4	Provides regional comparison for agricultural land conversion control.
63	Kamil	2020	Conference paper / Indonesia	Agricultural land protection supports sustainable food sovereignty.	T3	T4	Supports the link between land protection policy and food sovereignty.
64	Salleh	2021	Legal / Sabah	Native law is an important source of Sabah's legal system.	T3	—	Supports analysis of Native law, land rights, and Sabah-specific land governance.
65	Caldwell et al.	2021	Case study / Canada	Municipal capacity affects Greenbelt response to agri-food priorities.	T4	—	Provides lesson on institutional capacity for agricultural land preservation.
66	Chen	2010	Master's thesis / USA	Maryland farmland preservation requires systematic selection and best practices.	T4	—	Provides model for structured agricultural land preservation programmes.
67	Nuar & Lunkap	2019	Case study / Sabah	Customary land is important for indigenous livelihood and land-use practices.	T3	—	Supports the need to consider Native Customary Rights in Sabah's framework.
68	Sabah Forest Department	2013	Policy report / Sabah	Land-use planning must balance development, conservation, and resource management.	T3	T4	Provides Sabah policy context for integrated land-use governance.

69	Sabah Lan Ordinance (Ca 68)	1930, revised 2021	Legal document / Sabah	Main legal basis for land administration, title, use, and conversion in Sabah.	T3	—	Core legal source for analysing agricultural land governance in Sabah.
70	Third Saba Agricultural Policy (SAP3)	2015	Policy document / Sabah	Sabah agricultural policy recognises food security, land constraints, and productivity needs.	T2	T3	Provides state policy basis for agricultural land preservation and food security.
71	National Agrofood Polic 2021–2030 (NA 2.0)	2021	Policy document / Malaysia	National agrofood policy promotes modernisation and national food security.	T3	T4	Supports alignment between Sabah land-use planning and national food security policy.
72	Wong et al.	2017	Econometric study / Sabah	Paddy self-sufficiency depends on land demand and production capacity.	T2	—	Provides direct Sabah evidence linking paddy land availability with rice SSL.
73	Saadi et al.	2020	Conservation model / Iran	Agricultural land conservation requires social, economic, policy, and spatial strategies.	T4	—	Provides model-building support for Sabah's land preservation framework.
74	Walter et al.	2017	Journal / Global	Smart farming supports sustainable agriculture and resource efficiency.	T4	—	Supports smart farming as a technical strategy for sustainable land use.
75	Achury et al.	2026	Journal perspective / Global	Smart farming should integrate biodiversity targets.	T4	—	Supports sustainable and biodiversity-sensitive agricultural land management.
76	Daud et al.	2018	Empirical / Nigeria	Rural infrastructure improves profitability of food crop production.	T4	—	Supports rural infrastructure and market-access strategy for Sabah farmers.