DEVELOPING A SUBURBAN PROTOTYPE AREA TO SUPPORT ECONOMIC, SOCIAL, AND ENVIRONMENTAL DEVELOPMENT IN BANGKOK: A CASE STUDY OF TALING CHAN DISTRICT

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Abstract

This study seeks to establish a suburban prototype area to facilitate economic, social, and environmental development in Bangkok, utilizing Taling Chan District as a case study. A mixed-methods approach was utilized, incorporating stakeholder consultations, GIS-based land use and land cover (LULC) analysis, and SWOT–TOWS strategic evaluation. We looked at multi-temporal LULC data from 2016 to 2023 to find spatial dynamics and development pressures. The findings indicate that, notwithstanding continuous urban growth, substantial agricultural land, green areas, and canal systems persist, establishing a robust basis for sustainable suburban development. The research suggests a sustainable, canal-focused suburban model that harmonizes development, environmental preservation, and community-driven economic initiatives.

Keywords: Suburban development, Bangkok, LU/LC

Introduction

Bangkok is a major city in Thailand. As the capital, economic center, and hub of national administration, Bangkok is characterized by a mixed and diverse land use, which has led to rapid expansion, particularly due to migration for employment opportunities. This makes up the high-income population. There is a need for a large residential area with comprehensive facilities, which is why it has expanded to the suburbs. There has been a rapid increase in the process of urbanization, resulting in a significant decrease in the number of suburban areas. The issues arising from urbanization lead to urban sprawl, making it essential to develop a management plan and implement measures to identify and control these issues, thereby significantly reducing the associated problems. Taling Chan District is an administrative district of Bangkok located on the west side, connecting Bangkok, Nonthaburi, and Nakhon Pathom provinces (Worachairungreung, Thanakunwutthirot, & Ninsawat, 2021). In the past, agriculture employed the majority of the Taling Chan district's population. The geographical name, such as Suan Phuk Road, indicates this area's agricultural significance. Most of the transportation is mainly by water. Later, the Kanchanapisek Ring Road network system was developed. Therefore, agricultural land continues to decrease. At present, the Taling Chan district is a critical area. In particular, this area is included in the plan to construct the Bang Sue-Taling Chan Light Red Line, which makes it highly likely that housing and suburban development will occur again, expanding Bangkok to the Phutthamonthon district of Nakhon Pathom province.

Despite growing scholarly attention to urban sustainability in Bangkok, existing studies have largely focused on inner-city redevelopment or large-scale metropolitan planning, with limited emphasis on suburban prototype development grounded in detailed spatial analysis. In particular, there remains a lack of empirical studies that systematically evaluate suburban

potential and constraints in conjunction with land use and land cover (LULC) structures to inform spatially responsive planning models.

Accordingly, this study aims to develop a suburban prototype area to support economic, social, and environmental development in Bangkok, using Taling Chan District as a case study. By integrating these analyses, the study seeks to provide spatial insights and planning implications that can inform sustainable suburban development strategies for Bangkok and other rapidly urbanizing metropolitan regions.

Research Objectives

1. To analyze the potential and limitations of suburban development.
2. To evaluate the structure of land use and land cover patterns of the suburban area.

Scope of Research

1. Population Scope

The population scope of this study focuses on the suburban spatial units within Taling Chan District, Bangkok, which represent transitional urban–suburban environments influenced by metropolitan expansion. The study population consists of all spatial features and LU/LC within the administrative boundary of Taling Chan District, including agricultural land, waterbodies, urban and built-up areas, miscellaneous, and forest areas. At the analytical level, the population includes:

Spatial units such as land use and land cover (LULC) categories, including agricultural land, water bodies, urban and built-up areas, miscellaneous, and forest areas, are used for GIS analysis.

Built and natural environments, including residential settlements, commercial and service areas, agricultural plots, green spaces, and canal networks.

Associated socio-spatial contexts, reflecting the interaction between physical space and suburban development dynamics.

This population scope enables a comprehensive assessment of suburban development potential and limitations by capturing both the physical structure and functional characteristics of the suburban area within the selected case study district.

2. Variable Scope

The variable scope of this study is structured around the two research objectives and is classified into spatial, environmental, and development-related variables, derived primarily from GIS-based land use and land cover data.

These variables collectively support a systematic evaluation of the suburban spatial structure and provide an empirical basis for identifying development opportunities and constraints, thereby informing the formulation of a suburban prototype model for sustainable development.

3. Time Scope: Between 2016 to 2023.

Literature Review

Suburban and peri-urban areas have increasingly become focal points in urban planning research due to their critical role in accommodating metropolitan expansion and mediating interactions between urban and rural systems. Previous studies have highlighted that suburban development is often characterized by fragmented land use, low-density expansion, and automobile dependency, which collectively contribute to inefficient land consumption and environmental degradation (Aliabad , Malamiri , Sarsangi, Sekertekin, & Ghaderpour, 2023).

In response, contemporary planning literature has emphasized the need for compact, mixed-use, and transit-oriented suburban models to enhance sustainability and spatial efficiency (Ayambire, Amponsah, Peprah, & Takyi, 2019).

Land use and land cover (LULC) analysis has been widely applied to assess suburban spatial structures and urban growth dynamics (Kulpanich, Worachairungreung, & Chaysmithikul, 2020). GIS-based studies demonstrate that changes in LULC patterns strongly influence ecosystem services, flood vulnerability, and urban heat island effects, particularly in rapidly urbanizing Asian cities (Kamarulzaman, Mohd Jaafar, Said, Saad, & Mohan, 2023). Such analyses provide critical empirical evidence for identifying development pressures and environmental constraints in suburban contexts (Liu, Zhao, Liu, & Shen, 2025).

In Bangkok, existing research has primarily focused on inner-city redevelopment, transportation infrastructure, and large-scale metropolitan planning, with relatively limited attention given to suburban districts as integrated planning units (Anantsuksomsri & Tontisirin, 2015). Studies addressing suburban areas often emphasize isolated issues, such as flood risk or land conversion, without systematically linking spatial structure to socio-economic and environmental development potential (Limthongsakul, Nitivattananon, & Arifwidodo, 2017). Moreover, few studies have proposed prototype-based planning frameworks that translate spatial analysis into practical suburban development models (Manna , et al., 2025).

This study addresses these gaps by integrating suburban potential and constraint analysis with detailed LULC evaluation in a representative suburban district. By doing so, it contributes to suburban planning literature through a spatially grounded approach that supports balanced economic, social, and environmental development in metropolitan regions (Nishiura & Leeruttanawisut, 2022).

Research Methodology

1. Research Methodology

This study adopted a mixed-methods research approach, integrating qualitative stakeholder consultation with quantitative spatial analysis to examine suburban development potential and land use structure in Taling Chan District, Bangkok. Qualitative methods were employed to capture planning perspectives, local knowledge, and contextual insights from key stakeholders, including district officials, urban planners, and community representatives. These inputs supported the identification of development opportunities and constraints relevant to suburban planning. Quantitative analysis was conducted using Geographic Information Systems (GIS) and multi-temporal land use and land cover (LULC) datasets obtained from the Land Development Department of Thailand (LDD). Spatial analysis focused on evaluating land use structure, spatial distribution, and land conversion patterns across selected time periods. The integration of SWOT–TOWS analysis with GIS-based overlay analysis enabled a comprehensive assessment that links spatial evidence with strategic planning considerations. This methodological framework supports the formulation of a suburban prototype model that balances economic, social, and environmental development objectives.

2. Research Steps

The research was conducted through the following five main steps:

2.1 Literature Review Relevant documents and previous studies on suburban development and urban planning were reviewed to establish the conceptual framework and define analytical criteria.

2.2 Stakeholder Consultation Stakeholder consultations were conducted to collect qualitative data on local development conditions, planning challenges, and future development aspirations in Taling Chan District.

2.3 Data Collection and Pre-processing Multi-temporal land use and land cover datasets for the years 2016, 2019, and 2023 were collected and pre-processed to ensure spatial consistency and comparability across time periods.

2.4 Spatial and Strategic Analysis GIS-based spatial analysis, including overlay analysis, was performed to examine land use structure and identify spatial patterns of land conversion and environmental constraints. In parallel, SWOT analysis was applied to identify internal and external factors influencing suburban development, followed by TOWS matrix synthesis to derive strategic planning directions.

2.5 Integration and Framework Development The results from qualitative stakeholder inputs and quantitative spatial analyses were integrated to propose a suburban prototype development framework and formulate planning implications for sustainable suburban development in Bangkok.

3. Data Collection

Firstly, this study incorporated a stakeholder consultation process to ensure that the spatial analysis and development framework reflected local planning priorities and contextual realities. Opinions and insights were collected from key stakeholders, including officials from the Taling Chan District Office, urban planners from the Department of Public Works and Town & Country Planning, planners from the Bangkok Metropolitan Administration's Department of City Planning and Urban Development, as well as representatives of local residents and interested community members in Taling Chan District. These consultations provided qualitative inputs regarding development pressures, planning constraints, and local aspirations, which informed the interpretation of spatial analysis results.

In parallel, this research utilized multi-temporal land-use datasets sourced from the Land Development Department of Thailand (LDD), which provides nationally standardized and regularly updated land-use mapping products. Land-use statistics from 2016, 2019, and 2023 were selected to represent key phases of recent urban development in Bangkok. The datasets were derived from satellite image analysis combined with official land-use surveys conducted by the LDD, ensuring spatial consistency and comparability across different time periods. The integration of stakeholder perspectives with longitudinal land-use data enabled a comprehensive assessment of suburban development dynamics in Taling Chan District, supporting both empirical analysis and practical planning implications.

4. Data Analysis

4.1 The analysis of suburban development potential and limitations was conducted using a SWOT–TOWS framework. Qualitative information obtained from stakeholder consultations was systematically reviewed and classified into internal and external factors influencing suburban development in Taling Chan District. Internal factors were categorized as strengths and weaknesses, reflecting spatial characteristics, land-use structure, infrastructure conditions, and community attributes. External factors were identified as opportunities and threats, representing policy directions, development pressures, environmental risks, and regulatory constraints. The identified SWOT factors were subsequently synthesized into a TOWS matrix to derive strategic planning directions. This process involved cross-analyzing internal and external factors to formulate four strategic dimensions: proactive (SO), corrective (WO), preventive (ST), and defensive (WT) strategies. The TOWS analysis facilitated the translation of qualitative assessments into strategic planning implications, supporting the

development of a suburban prototype that integrates economic, social, and environmental considerations.

4.2 A GIS-based overlay analysis was employed to evaluate the structure of land use and land cover in Taling Chan District using multi-temporal datasets obtained from the Land Development Department of Thailand (LDD). Land use and land cover maps for 2016, 2019, and 2023 were pre-processed by harmonizing classification schemes and standardizing coordinate systems to ensure spatial consistency.

Overlay analysis was then conducted by superimposing land use layers across different time periods to identify spatial patterns of land conversion and transitional zones. Changes in built-up areas, agricultural land, green spaces, and water bodies were quantified to assess development intensity and environmental constraints. The spatial outputs from the overlay analysis provided empirical evidence of suburban land use dynamics, supporting the identification of areas with development potential and areas requiring environmental protection for sustainable suburban planning.

Research Results

This study examines the possibilities and constraints of suburban development in the Taling Chan District of Bangkok. The results show that Taling Chan has strong intrinsic spatial and socio-environmental assets that make it a good place for sustainable suburban development. The large network of traditional canals, along with the large amounts of agricultural land and green space that are still there, makes a strong blue-green infrastructure that helps with hydrological regulation, ecological balance, and climate resilience. The district's strong canal-based community identity and social capital add to these environmental strengths. The district's closeness to Bangkok's inner city also makes it easier to connect and more appealing for development. But these benefits are limited by a number of structural problems, such as road networks that are not very connected, land-use patterns that are not very clear, and urban infrastructure and public services that are not very good. These kinds of restrictions make the area less efficient and more likely to flood because it is so low. At the same time, there are big opportunities because of supportive policy frameworks that encourage sustainable and compact urban growth, improvements in GIS-based planning technologies, and a growing interest in cultural and economic tourism in communities. On the other hand, rapid urban growth, the effects of climate change, land-use conflicts, and problems with enforcing regulations are all major threats. The results show that we need a suburban development strategy that takes into account both the environment and the people who live there, as shown in Table 1. This strategy should use the strengths of the area while also dealing with structural problems and outside pressures.

Table 1: Spatial SWOT Analysis of Taling Chan District

Dimension	***Analytical Items***
Strengths (S)	S1 A traditional canal and water network functioning as blue–green infrastructure that supports drainage, ecological balance, and environmental resilience. S2 Agricultural land and green spaces that help mitigate urban heat island effects and enhance water retention capacity. S3 Strong canal-based community identity and social capital rooted in traditional livelihoods and local cultural practices.

Dimension	*Analytical Items*
	S4 Strategic location in close proximity to Bangkok's inner city, enabling convenient spatial and functional connectivity with central urban areas.
Weaknesses (W)	W1 Limited road network characterized by narrow streets and discontinuous accessibility within the district. W2 Fragmented land-use patterns and a lack of integrated land-use planning control. W3 Insufficient urban infrastructure and public services, particularly in wastewater management, solid waste disposal, and public open spaces. W4 High vulnerability to flooding and tidal influence due to low-lying terrain and hydrological conditions.
Opportunities (O)	O1 Policy support for sustainable urban development, green city initiatives, and alignment with the Sustainable Development Goals (SDGs). O2 Growth potential of community-based economic activities and cultural and lifestyle-oriented tourism. O3 Promotion of compact city concepts and moderate-density development in suburban areas. O4 Increasing application of GIS and spatial data technologies to support evidence-based urban and spatial planning.
Threats (T)	T1 Development pressure from urban expansion and real estate development, potentially leading to land-use conversion and loss of green areas. T2 Impacts of climate change, including increased flood frequency and intensity as well as rising urban heat stress. T3 Conflicts between conservation objectives and commercial development interests. T4 Limitations related to urban planning regulations and challenges in effective enforcement.

Furthermore, the TOWS matrix analysis provides a structured framework for guiding suburban development strategies in Taling Chan District. Proactive strategies (SO) emphasize leveraging the district's canal system and remaining agricultural land to develop a green, canal-oriented suburban prototype, while simultaneously promoting community-based economic activities and eco-tourism to position the area as a Green Suburban Prototype for Bangkok. Corrective strategies (WO) focus on using opportunities from green city policies and spatial technologies to address fragmented land-use patterns, improve accessibility through integrated transit and water-based mobility, and enhance the allocation of urban infrastructure and public services. Preventive strategies (ST) prioritize the use of green spaces and canal networks as ecological buffers to mitigate the impacts of urban expansion and climate change, alongside strengthening community participation in protecting the area from excessive commercial development. Defensive strategies (WT) aim to reduce spatial vulnerability through the implementation of specific area plans, reinforced urban planning regulations and enforcement, and the development of localized water management and disaster risk reduction systems. Overall, the SWOT–TOWS analysis indicates that Taling Chan District has strong potential to serve as a sustainable suburban development prototype, with success largely dependent on the

integrated application of urban planning, spatial technologies, and active community engagement. As shown in Table 2.

Table 2: TOWS Matrix for Suburban Development Strategies in Taling Chan District

	OPPORTUNITIES (O)	THREATS (T)
STRENGTHS (S)	SO Strategies (Proactive) • Utilize the canal system and green spaces (S1, S2) to support green city policies (O1). • Promote community-based economies and canal-oriented tourism (S3 + O2) • Upgrade Taling Chan District as a green suburban prototype of Bangkok (S4 + O3).	ST Strategies (Preventive) • Use green spaces and canal networks as ecological buffers (S1, S2) to mitigate climate change impacts (T2). • Strengthen the role of local communities in protecting the area from excessive development pressure (S3 + T1). • Preserve local identity to reduce land-use conflicts (S3 + T3).
WEAKNESSES (W)	WO Strategies (Corrective) • Apply sustainable urban development policies (O1) to address fragmented land-use patterns (W2). • Develop transportation networks to improve accessibility (W1 + O3). • Apply GIS-based tools to enhance urban infrastructure and public services (W3 + O4).	WT Strategies (Defensive) • Control land use through specific area plans (W2 + T4) • Strengthen water management and flood protection systems in vulnerable areas (W4 + T2) • Improve urban planning enforcement mechanisms to reduce development pressure (W2 + T1).

For the next section, the results of the land use change analysis, with details as follows: Table 3 presents land use and land cover (LULC) changes between 2016 and 2023, comparing areas that remained unchanged with those converted to other land-use types, measured in square kilometers. The results indicate that urban and built-up areas exhibit the highest level of stability, with approximately 1,040.80 sq km remaining unchanged, reflecting the continued consolidation of urban development during the study period. Agricultural areas are also relatively stable, with about 360.92 sq km maintaining their original land-use function, highlighting the ongoing importance of agriculture in the suburban context. However, between 2016 and 2023, approximately 12.62 sq km of agricultural land were converted into urban and built-up areas, along with smaller transitions to other land-use categories, indicating increasing development pressure. In contrast, water bodies remained largely unchanged, covering about 46.05 sq km, suggesting relative stability of hydrological features. Overall, the results reveal a clear trend of urban expansion alongside the persistence of agricultural land and water bodies, which has important implications for sustainable suburban land-use planning, as illustrated in Figure 1.

Table 3: Land use and Land cover changes in Taling Chan between 2016 to 2023

Land use and Land cover changing	Area (Sq.km.)
Agricultural Area - Agricultural Area	360.9153
Agricultural Area - Miscellaneous	10.05963
Agricultural Area - Urban and Built-up Area	12.61983
Miscellaneous - Miscellaneous	78.59995
Miscellaneous - Urban and Built-up Area	5.841945
Urban and Built-up Area - Urban and Built-up Area	1,040.797
Water Bodies - Water Bodies	46.0492

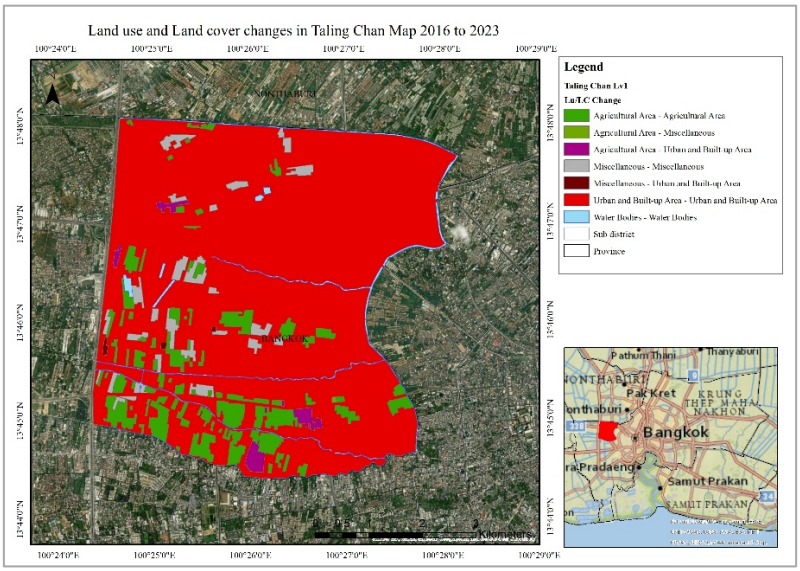

Figure 1 Land use and Land cover changes in Taling Chan between 2016 to 2023

Discussion

This study effectively investigates the establishment of a suburban prototype that facilitates economic, social, and environmental advancement in Bangkok, using Taling Chan District as a case study. The results demonstrate that the district's conventional canal system and existing agricultural and green areas establish a robust environmental basis that facilitates flood mitigation, climate resilience, and ecosystem services. Simultaneously, these spatial assets facilitate community-oriented economic endeavors, like urban agriculture and canal-focused tourism, while enhancing local identity and social cohesion. The GIS-based analysis of land use and land cover verifies that, despite ongoing urban expansion from 2016 to 2023, essential natural features remain preserved, facilitating the development of a green suburban model instead of traditional urban sprawl. Furthermore, the incorporation of SWOT–TOWS analysis illustrates that a suburban model in Taling Chan can be realized through methods that harmonize growth with conservation, integrate spatial planning with green city initiatives, and enhance community engagement. Moreover, this analysis is constrained by the reliance on aggregated land use data and the lack of comprehensive socio-economic indicators. Subsequent study ought to integrate higher-resolution geographical data and social data to enhance the

suburban prototype model and facilitate its application to additional suburban areas in Bangkok.

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