

**MAINSTREAMING CLIMATE RESILIENCE IN  
LOCAL LAND USE PLANNING: CASE STUDY IN  
PENANG MALAYSIA**

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**UNIVERSITI SAINS MALAYSIA**

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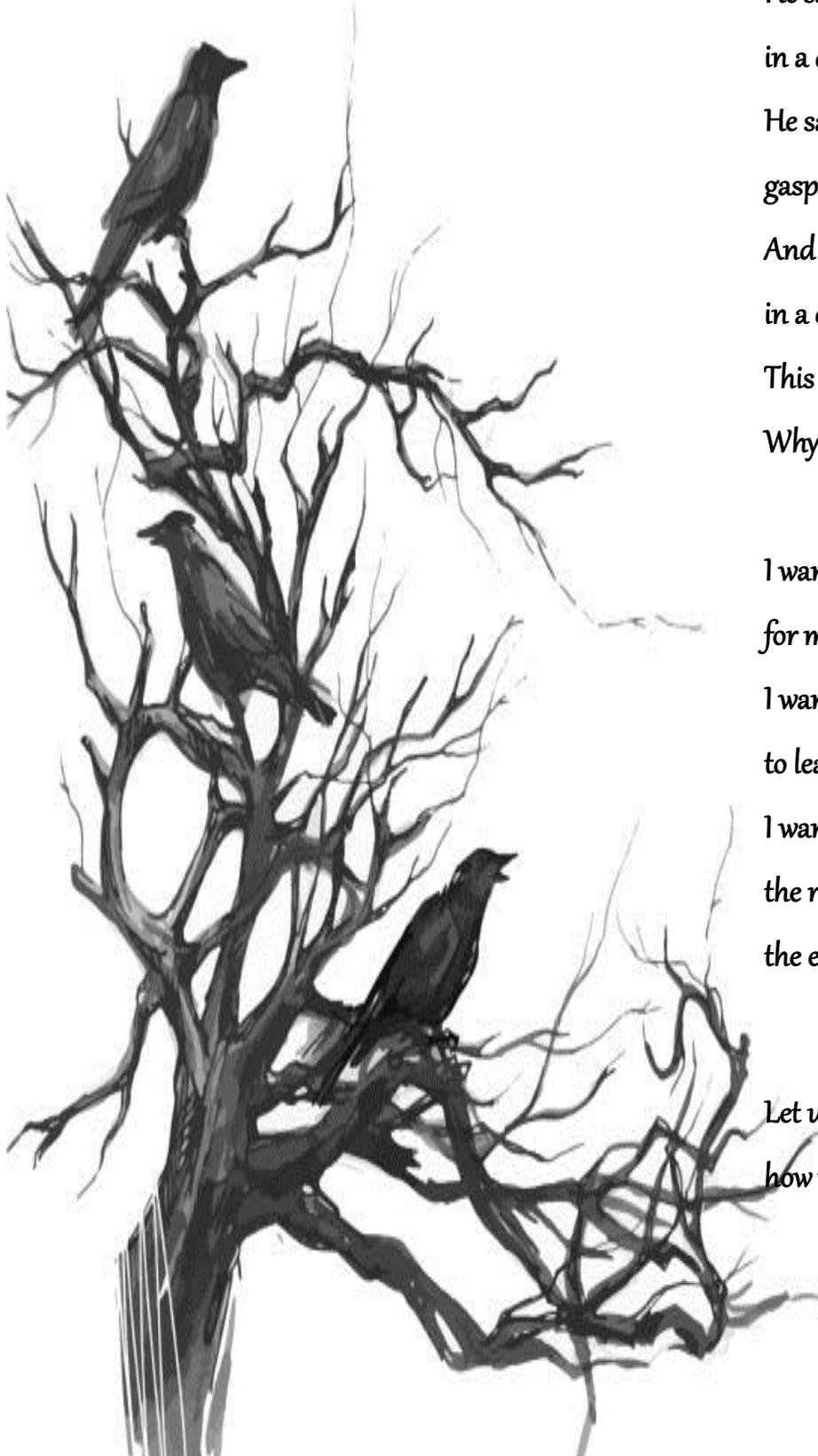
**MAINSTREAMING CLIMATE RESILIENCE IN  
LOCAL LAND USE PLANNING: CASE STUDY IN  
PENANG MALAYSIA**

by

**VISHANTHINI A/P KANASAN**

**Thesis submitted in fulfilment of the requirements  
for the degree of  
Doctor of Philosophy**

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## The Dead Crow

He saw a dead crow  
in a drain near the Post Office,  
He saw an old man  
gasping for air,  
And a baby barely able to breathe  
in a crowded morning clinic,  
This land is so rich  
Why should we suffer like this?

I want clean air  
for my grandchildren,  
I want the damned fools  
to leave the forest alone,  
I want the trees to grow,  
the rivers run free, and  
the earth covered with grass.

Let us plan,  
how we may live with dignity,  
Now and always.

Dato' A.Samad Said

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## LIST OF ABBREVIATIONS

ACCCRN	Asian Cities Climate Change Resilience Network
ADB	Asian Development Bank
AR	Assessment Report
CRED	Centre for Research on the Epidemiology of Disasters
COP21	United Nations Climate Change Conference
C2ES	Centre for Climate and Energy Solutions
DOSM	Department of Statistics Malaysia
DID	Department of Irrigation and Drainage
EPU	Economic Planning Unit
EXCO	Executive Councillors of the State
FMM	Federations of Malaysian Manufacturers
GCA	Global Centre on Adaptation
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
LCCF	Low Carbon Cities Framework
LUP	Land Use Planning
MBPP	Majlis Bandaraya Pulau Pinang (Penang City Council)
MBSP	Majlis Bandaraya Seberang Jaya (Seberang Jaya City Council)
MHLG	Ministry of Housing and Local Government Malaysia
NAHRIM	National Hydraulic Research Institute of Malaysia
NAPA	National Adaptation Programme of Action
NCLG	National Council for Local Government Malaysia
NDP	National Development Planning Malaysia
NEP	National Economic Planning Malaysia
NFC	National Finance Council Malaysia
NGO	Non-Governmental Organisation
NLC	National Land Council Malaysia
NPP	National Physical Plan Malaysia
NUP	National Urbanisation Plan Malaysia
NVP	National Vision Plan Malaysia

OECD	Organisation of Economic Co-operation and Development
PBT	<i>Pihak Berkuasa Tempatan</i> (Local Government)
PGC	Penang Green Council
RKK	<i>Rancangan Kawasan Khas</i> (Special Area Plan)
RT	<i>Rancangan Tempatan</i> (Local Plan)
RSN	<i>Rancangan Struktur Negeri</i> (State Structure Plan)
SPC	State Planning Committee
TCPA	Town and Country Planning Act
UN DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
USAID	United States Agency for International Development
WMO	World Meteorological Department

**MENGARUSUTAMAKAN KETAHANAN IKLIM DALAM RANCANGAN  
TEMPATAN: KAJIAN KES DI PULAU PINANG MALAYSIA**

**ABSTRAK**

Bandar berkembang melalui mengarusutamakan ketahanan iklim, di mana ia merupakan satu pendekatan yang menghubungkan perancangan penggunaan tanah dan pembangunan lestari dengan mengintegrasikan maklumat perubahan iklim. Kepentingannya berkaitan dengan rancangan pembangunan, dasar dan proses membuat keputusan yang sedia ada. Namun demikian, wujud jurang dalam proses mengarusutamakan disebabkan oleh pengabaian dalam reformasi institusi yang diperlukan dalam pendekatan ini. Oleh itu, dua kesukaran utama yang diberi penekanan untuk mengarusutamakan ketahanan iklim dalam kajian ini adalah: kekurangan koordinasi sektoral dan pembinaan kapasiti di antara kerajaan persekutuan, negeri, dan tempatan. Memandangkan perubahan iklim menjadi tumpuan terutamanya diperingkat kerajaan persekutuan, pengetahuan adalah terhad di peringkat kerajaan tempatan memandangkan kapasiti kerajaan tempatan sebagai pihak berkuasa rancangan tempatan, terutamanya di bandar-bandar Malaysia. Pendekatan kualitatif pelbagai kaedah dipilih oleh penyelidik yang bertujuan untuk mengumpulkan pelbagai bentuk data melalui perbincangan kumpulan berfokus, temuduga secara separa-berstruktur, dan semakan dokumen secara mendalam bagi proses dan amalan perancangan guna tanah tempatan di Pulau Pinang, Malaysia. Perancangan guna tanah tempatan di Pulau Pinang merupakan "kes kritikal" kerana ia membuktikan kapasiti institusi untuk daya tahan terhadap perubahan iklim jangka masa panjang dan menyediakan peluang transformasi untuk arus perdana. Kajian ini mencadangkan satu kerangka untuk menawarkan pandangan mengenai pertimbangan yang lebih praktikal

di sebalik pengarusutamaan ketahanan iklim sebagai sebahagian daripada perancangan penggunaan tanah tempatan, yang melibatkan interaksi dari konteks tempatan sesuatu bandar dan persekitaran institusi yang melangkaui skala tadbir urus. Adalah diharapkan agar, hasil kajian ini dapat membantu kerajaan tempatan Malaysia dalam menambahbaik operasi perancangan bandar dari perspektif lensa iklim.

**MAINSTREAMING CLIMATE RESILIENCE IN LOCAL LAND USE  
PLANNING: CASE STUDY IN PENANG MALAYSIA**

**ABSTRACT**

Cities grow through the mainstreaming of climate resilience, which is an approach linking land use planning and sustainable development goals by integrating climate change information. It also concerns the existing development planning, policies, and decision-making processes. However, a gap exists in the operationalisation of mainstreaming mainly due to the neglect in the institutional reforms required in the approach. Therefore, two key difficulties for mainstreaming climate resilience were emphasised in this research: the lack of sectoral coordination and capacity building between federal, state, and local government. Given the focus by much of the literature on climate change specifically on national-level actions, there is limited knowledge about how the actions should be performed at the local level within the capacity of the local governments as land use planning authority, particularly in Malaysian cities. A multi-method qualitative approach was selected as the researcher aimed to gather multiple forms of data through focus group discussion, semi-structured interview, and in-depth document review into local land-use planning processes and practices in Penang, Malaysia. Local land-use planning in Penang is a “critical case” because it proves the institutional capacity for resilience to climate change for the long term, with the transformational chances for mainstreaming being indicated. The research proposed the framework to offer insights into more practical considerations behind the mainstreaming of climate resilience as an integral part of local land use planning, which involves an interaction between the local context of a city and institutional environment transcending across governance scales. The research

result was expected to assist the Malaysian local government in improving the planned cities from a climate lens perspective.

# CHAPTER 1

## INTRODUCTION

### 1.1 Background



Source of the picture: The Star (Sunday, 5 May 2019)

*On 4<sup>th</sup> November 2017, Penang was inundated by the heaviest rainfall ever recorded on the island with water flooded streets up to 3.6 meters (12 feet) deep and seven people died. The long-running civic discussion that weighed new construction against the risks of increasingly fierce ecological impediments grew even more urgent. “When places get urbanized, the sponge gets smaller. So, when there is development, the excess rainwater gets less absorbed into the ground and comes off as flash floods. And, the flood situation is bound to worsen if climate change brings more rain and more intense rainfall” said Kam Suan Pheng, an island resident and one of Malaysia’s most prominent soil scientists.*

The consumption and destruction made by humans on the living and non-living natural foundation, which lives depend on, is feared by many. Despite the inappropriateness of the predictions, any rational individual would be aware of the

high risks in what has been done to the planet. The impacts of these actions on the future of the Earth environment, including climate change and global warming are known by many. However, many parties do not realise that the rise in oceans will flood certain cities instead of the “globe”.

In 2010, 70% of the world urban population resided in developing countries, while 80% of the world’s wealth was developed in cities. It was predicted that 60% of the world population would be located in urban areas in 2030 (UNFCC, 2015). Therefore, sustainable development is a social goal in a world that is accompanied with challenges, where planetary boundaries are crossed, while the thresholds and tipping points put the balance of the important Earth system at risk (Lenton et al., 2008). A new language of the Anthropocene<sup>1</sup> is created to represent an era in which human development pathways would continuously impact the states, which humanity might aim for or vice versa (Steffen et al., 2011).

It has been increasingly proven in science that the climate would be dependent on the categories of pathways being achieved in the future (Masson-Delmotte et al., 2018). In this context, climate-resilient pathways are described as sustainable development trajectories consisting of the combination between adjustment and risk management to decrease climate change and its effects (Eriksen et al., 2015.). Overall, these situations are perceived as the iterative and slowly developing processes for the mainstream flexibility to change in complex local government systems, primarily due to the city planners or urban managers’ focus on the importance of transformative

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<sup>1</sup> Anthropocene defines Earth's most recent geologic time period (Anthropocene) as being human-influenced, or anthropogenic, based on overwhelming global evidence that atmospheric, geologic, hydrologic, bio spheric and other earth system processes are now altered by humans. The word combines the root "anthropo", meaning "human" with the root "-cene", the standard suffix for "epoch" in geologic time. (Chua & Fair, 2019).

responses instead of the resumption of ‘business as usual’ in cities. In this case, climate-resilient planning is known as mutually dependent approaches to address mainstream climate change issues in the emerging local planning processes (Robinson et al., 2015).

The local city government plays an imperative role in maintaining city resilience. For a city to aim for the short-term weather-related shock to long-term stress created by climate change, social change or economic shift, resilience should be mainstreamed by cities, where the critical resilience characteristics include *adaptation* (the ability to successfully adjust to new norms), *mitigation* (the ability to “return to normal” through efficacious coping with adverse effects or rapid-onset accidents), and *transformation* (the capability to move to lodge radical shifts beyond the tipping point in economic or environmental states) (Ramos, 2019; Salvador & Salvador, 2011). Mainstreaming climate resilience is a dynamic and predictive long-term local planning, which solves the issues of susceptibility and focuses on the adaptive, mitigative, and transformative capacities of the local government in cities (Agrawal & Perrin, 2009). Despite the momentum gained by the attention to ‘mainstreaming climate resilience’ in developing nations, especially Asia (Ayers et al., 2014; Pachauri & Meyer, 2014) at the national level, minimum literature was made on the operationalisation of ‘mainstreaming’, especially on the local scale: cities (Robinson et al., 2015; UN Habitat, 2020).

Two key difficulties emphasised in this research included the lack of sectoral coordination and capacity building at different government levels, namely federal, state, local government. Therefore, the local government of cities resilience to climate change in power-sharing and coordination with the federal, state, and local government is an important area to address. This area is seen as regenerating or strengthening

public participation at the intersection of ongoing land use planning and environmental protection. Linking climate change resilience to land use planning is one of the prerequisite requirements of many international agencies (*Special Report on Climate Change and Land — IPCC, 2019*) to address sustainable development. For the sustainability of the cities, strong engagement at the national and local levels is required, as highlighted by the UNDP, which also emphasises that effective government action can be achieved with having stronger coordination between different sectoral departments (UNDP 2007: 18).

The interest in climate change since the previous decade may have been noticed by the Malaysian government. This attention is gained due to irregular weather conditions, such as the increased mean surface temperature from 0.6 °C to 1.2 °C in 1969 to 2009, increase in rainfall severity with an hour rainfall severity by 17% in 2000 to 2007 compared to the values in the 1970s, and increase in sea level from 4.6 cm to 11.9 cm according to the observation of satellite altimetry data from 1993 to 2010 (NAHRIM, 2019). It could be seen in Malaysia that natural disasters have impacted lives and destructed urban communities and areas (Munn-Venn & Archibald, 2007). To illustrate, the floods in Malaysia are serious issues, while the floods in the monsoon season commonly cause landslides and lead to damaged infrastructures, including buildings and roads, and severe effect on economic progress.

While the average global flood losses in 2005 amounted to approximately RM21 billion annually, a loss of RM182 billion has been predicted by 2050 (Hallegatte et al., 2013). During the floods in Penang (a coastal city-state) on 4 November 2017, the Federation of Malaysian Manufacturers (FMM) Penang branch chairman Datuk Dr Ooi Eng Hock stated that 10,000 SMEs were present in Penang, where approximately 1,000 of the SMEs were impacted by flooding, while the companies basing in

Seberang Perai were faced with damages of approximately RM200 million (Wong Ee Lin, 2017). Following the local impacts of climate change, monetary decisions and planning commonly take place at the local level, with climate change impacting the services offered by the local government. To give an effective response to the increased pressure and stress, the local government in Malaysia, as the city local land and urban managers, should apply efficient use of planners to mainstream climate resilience into land use planning by the local government.

This chapter explores the aforementioned concerns and establishes the foundation of this research. It will introduce the concept of mainstreaming climate resilience due to its relevance with the plan in cities (local land-use planning). It will briefly explore the existing works of literature to address the knowledge gap and the relationship between mainstreaming climate resilience into local land use planning and the identified gaps. This chapter will then discuss the research problem, questions, aims, and objectives, followed by a conclusion, which presents the contribution of this research and its general structure.

## **1.2 The Problem and Aim of the Research**

The concept of ‘mainstreaming’ is common within the context of gender and poverty studies (Mukhopadhyay, 2016; Pervin et al., 2013). However, the ‘mainstreaming’ concept is gaining momentum within the disaster risk reduction, including the environmental and climate change disciplinary (Trenberth, 2015; Williams et al., 2020) with the recent focus on addressing COVID-19 pandemic from an urban perspective (UN Habitat, 2020). In general, ‘mainstreaming’ as a concept is defined as integrating issues into existing institutions and decision making (Ayers et al., 2014), mainly about the development of a system or process. This concept also

exists in various scales of government, namely international organisations, the federal government, state government, and local governments (Dovers & Hezri, 2010), which transcends different sectors (e.g., gender, poverty, environment, land use planning etc). Therefore, as a multidisciplinary approach, mainstreaming climate resilience into the planning of land use is paramount in achieving successful sustainable development (Revi et al., 2014), especially in urban settings, such as cities.

Notably, local land use planning is crucial in the adaptability of cities to climate change impacts, the mitigation of GHG emissions, the transformation of initiatives, and the measures to address severe problems enabling climate-resilient cities. To illustrate, local land use planning under the sole responsibility of local government is often referred to as the constitution of future development (KV Padmanabha Rau, 1986; Lee, 2002). Moreover, local land use planning encompasses locality physical planning within the city parameters, which is significant in reflecting the local community's needs. Hence, mainstreaming climate resilience into local land use planning addresses 'the demand and supply of space' issue as it is a key strategy to efficiently use the limited resources amid climate changes (Cuevas et al., 2014).

Whilst most of the discourses in this disciplinary either focused on how humans have caused or influenced the destructions on the global climate, extremely few studies recognised the role of an institution in addressing climate impact. Institutions in various levels of governments are important due to the challenges in acknowledging the ineffectiveness of planning process or practices, which often involve a minimal participatory approach to mitigate, adapt, and transform climate change impacts on cities. Likewise, several studies were performed to investigate mainstreaming process in specific cases, such as municipal planning in South Africa (Gibberd, 2017), land use policies in Indonesia (Yoseph-Paulus & Hindmarsh, 2016), and risk-sensitive

planning in Vietnam (Sudmeier-Rieux et al., 2015). However, these studies neither enriched the literature in mainstreaming climate resilience from a land use planning nor did so from the institution (local government in cities) perspective, leading to a significant knowledge gap. Therefore, the following improvements could be made on the overview idea of mainstreaming climate resilience into an institutional land use planning process in cities:

- i. Identifying the challenges faced by local governments especially in cities, and
- ii. Bridging mainstreaming gap from planning to implementation, especially at local land use setting

Challenges in mainstreaming have been identified differently in works of literature, such as barriers, constraints, concerns, issues, and obstacles that disrupt the advancement of climate-resilient measures and initiatives (Lehmann et al., 2015; Pieterse et al., 2018; Yoseph-Paulus & Hindmarsh, 2016). According to Waters et al. (2014), approximately 50 identified challenges could be categorised into five groups, namely governance, policy, psychosocial, resources, and information. This finding was further examined by Moser & Boykoff, (2017) who suggested that the most common barriers and most commonly applied strategies to overcome were institutional, followed by attitudinal and values-based impediments, lack of resources, and politics. The institution in this research, which referred to the different levels of government, specifically local government, were self-imposed constraints (formal or informal) that shaped human interactions in societies. These institutions showed the opportunity to frame how the challenges in climate change could be addressed in cities by enabling collaborative solutions to bridge the gap between formal organisations,

such as local governments and informal organisations (e.g., local community or NGOs).

The mainstreaming initiatives on the ground go beyond identifying the challenges of mainstreaming. Various research works demonstrated the lack of coordination and capacity built inside and outside of governmental agencies in terms of the significant impact of climate change and the importance of planning local land use as a platform for predictive instrument and effective mainstreaming of climate resilience (Djalante, 2014; Lehmann et al., 2015). Given that mainstreaming involves interdependencies among challenges, interactions among various sectors and stakeholders through sectoral coordination and capacity building are crucial for strengthening social linkages among various actors. This action is a start across the sectors of climate change and land use planning to ensure climate-resilient cities. In this case, the limitation of institutional preparedness could be addressed by emphasising the increase in the ability of planners (land use) and policymakers to operationalise mainstreaming at different levels, which goes beyond the legal requirement of land use planning and converging with climate change pathway. Therefore, mainstreaming climate resilience requires the application of ‘climate lens’ within the institutional transformation, which the current process is lacking.

Climate resilience is still seen as a ‘vague concept’ (Schaefer et al., 2020), which should be translated and interpreted into a language that planners (land use) could understand. To illustrate, even though planners are aware of the impacts of climate change, they are unaware of how they could leverage to operationalise ‘land use planning’ in resolving issues regarding climate change (IPCC, 2015). The cities in developing nations, particularly coastal cities, which are more vulnerable to climate change, such as Penang City Council (MBPP) and Seberang Perai City Council

(MBSP) in Malaysia are encouraged to mainstream climate resilience into their respective local land use planning procedures to manage the effects of climate change.

Despite the growing interest and knowledge in climate change issues, planners (local land use) and policymakers still lack the understanding of the practical aspect of mainstreaming climate resilience. Therefore, it is evident that a knowledge gap is present regarding the challenges encountered in mainstreaming and the ways to address these challenges, especially in terms of the operationalisation or implementation of ‘on the ground’ efforts of mainstreaming climate resilience. Hence, the aim of this research is two-fold, where the primary goal is the development of a framework to empower Malaysian Local Government to mainstream climate resilience initiatives in the planning context – Local Plan. The second aim is the understanding of the obstacles and issues experienced by the Malaysian Local Governments to mainstream climate resilience in the processes of local land use planning.

### **1.3 Research Questions and Research Objectives**

This research examines the interdisciplinary relationship linking the mainstreaming between the local government of cities, climate resilience, and local land use planning from a coastal city in a developing country context, with a focus on the city-state of Penang Malaysia: Penang City Council (MBPP) and Seberang Perai City Council (MBSP) as the case study. The research aims to raise local land use planning from a ‘climate lens’, which ensures the mainstreaming of climate resilience for a more sustainable city. This research also attempts to bring light to two interdependent perspectives, which are often overlooked in the literature works about climate-resilient cities, namely the importance of the local context of a city (the city character) and institutional environment that is important for integrating climate-

resilient considerations in local land use planning process. Therefore, several related themes focusing on the challenges in mainstreaming and institutional constraints, which shape the local land use planning from a climate lens, were addressed. The objectives of this research were explored by seeking answers to the following research questions:

- i. What are the challenges of the existing Local Plan process/governance structure in mainstreaming climate resilience?
- ii. Why it is important and crucial for the local government to mainstream resilience within the context of local land use planning?
- iii. How the local government could effectively mainstream climate-resilient initiatives in the local land use planning processes?

The key purposes that the study attempted to approach are as follows:

- i. To determine the obstacles/disadvantages of the present Local Plan procedure/governance structure in mainstreaming climate resilience,
- ii. To examine the climate-resilient management procedure from the government and institutional points of view,
- iii. To study the current condition of land use planning and the institutional status that determine the planning decisions associated with climate resilience in Penang Malaysia and
- iv. To develop a framework that identifies the key impediments to a mainstreamed approach to the climate-resilient response land use planning, which offers an organised approach to making climate-resilient an imperative part of the land use planning process.

#### **1.4 Research Approach**

A study is a methodical and systematic procedure of examination and enquiry. It involves an increase in the knowledge domain (Collis & Hussey, 2009), which is crucial in finding an appropriate focus for the research and needs to be continuously focused and re-focused (Easterby-Smith et al., 2008). In this case, the selection of an area of research that is compatible with the researchers' interest and strength is important (M. N. K. Saunders et al., 2009) to focus and re-focus to enhance the knowledge domain. Therefore, the subject area of interest for this study originated from the researcher's work experience in the Malaysian local government and strong interest to "make cities adapt to climate change resilience".

Based on the first literature review, the research aim, objectives, and problem could be established and improved according to the expert's view. Meanwhile, unstructured interviews were performed with two experts, where one took part in city planning (local land use planning), while the other was involved in resilient cities initiatives. These interviews were made to improve and create relevance in the study. An interpretation was implemented as the philosophy and theoretical underpinning in the study that primarily aimed to create a framework in allowing the adaptability of the local government to climate change resilience in the context of local planning, which had complexity and could not be theorised by definite laws, such as physical sciences (M. Saunders et al., 2012). Two crucial study principles were also referred, where the theoretical stage of the study procedure was explanatory science, which led to relevant knowledge about the social world or the explanation and prediction about the status of the social world (Aken, 2005).

The recommendation stage of the study was design science, which mainly aimed to create a framework that could be employed by the local government to solve issues related to the adaptation of climate change resilience. The funnel method was also employed (Berthon et al., 2003) in the exploration stage due to its similarity to bird's eye scanning – the process before identifying the particular information about the research. Therefore, a qualitative method was selected to conduct this research, as shown in the funnel schematic overview in Figure 1.1.

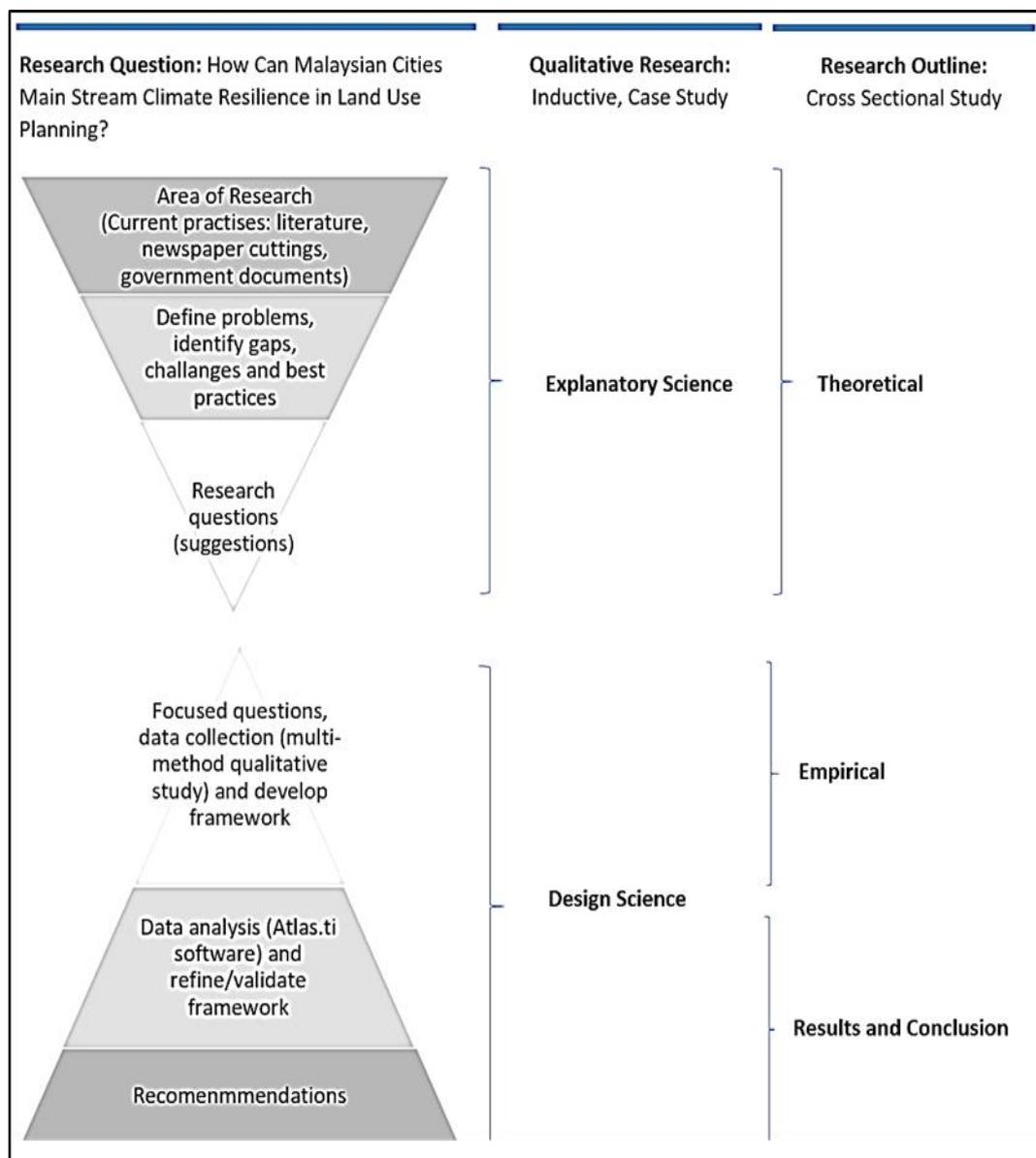


Figure 1.1 Schematic overview of this research

### **1.4.1 Case Study as the Research Strategy**

According to John W. Creswell (2014), research questions of ‘how’ and ‘what’ could be classified as qualitative study and case study approach, where the subject investigated through one or more cases in a bounded system was indicated in the qualitative inquiry. This research was suitable with the case study approach as it aimed to answer a ‘how’ question about ‘how the local government can adapt to climate change resilience’. Furthermore, this research aimed to gain a thorough comprehension of the study context and the procedures involved (M. N. K. Saunders et al., 2009), while the case study possibly provided insights that could not be acquired using other methods (Rowley, 2002).

A case study was selected in this study as a suitable research strategy. Given the vulnerability of the single case designs as all eggs were stored in one basket (Robert K. Yin, 2014), this study employed multiple case design to ensure a substantial analytical benefit. Two coastal local governments classified as cities under the Malaysian Local Government Act 1976, namely Penang City Council (MBPP) and Seberang Perai City Council (MBSP), were potentially vulnerable to climate change and selected for this study. A multi-method qualitative approach was employed as the researcher aimed to collect multiple forms of data through focus group discussion, semi-structured interview, and in-depth document review that allowed triangulation to construct research validity.

## 1.4.2 Research Setting: Penang, Malaysia

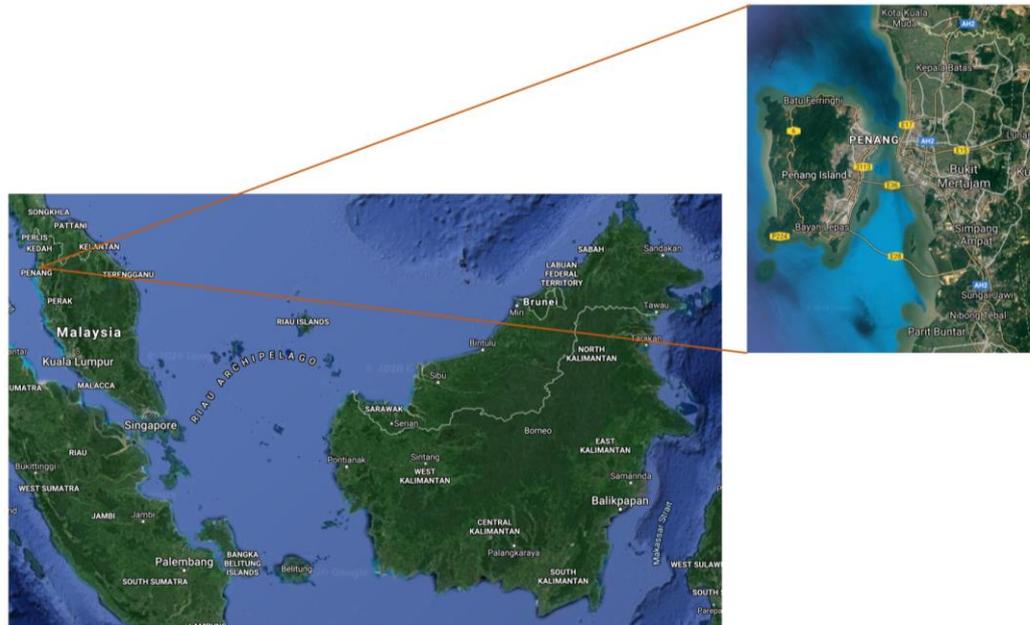


Figure 1.2 The map location of Penang, Malaysia

(Source: *Google Maps: Malaysia*, 2020)

Malaysia is situated in Southeast Asia (Figure 2) with an area of nearly 330000 km<sup>2</sup>, average precipitation from 2000 mm to 4000 mm, and temperatures ranging from 26 °C to 32 °C (Shah et al., 2017). Throughout the year, Malaysia consists of three climate attributes, namely uniform temperature, high humidity, and copious rainfall (Zulhaidi et al., 2010). The country is blessed as it is not affected by natural disasters such as hurricanes, tornados, typhoon, volcanic eruptions, and tsunamis (Chan, 2015). However, the climate in Peninsula Malaysia receives an impact from the wind from the mainland, while East Malaysia experiences more maritime weather with climate change, which possibly has strong impacts on Malaysia including the increase in sea level and rainfall, including flooding risks that cause heavy droughts. Floods are among the most known natural disasters in Malaysia in the aspect of frequency, area,

time, impacted population, and damage towards the socio-economic condition of the country (Shafiai & Khalid, 2016).

Approximately 29,800 sq. kilometres were faced with a flood, which affected 4.82 million people and led to physical damages of up to RM915 million. Therefore, floods are the most notable natural hazard in Malaysia. Fast development, urbanisation without planning, changing climate, and environmental deterioration have increased the high frequencies of flash floods, particularly in urban areas. As a fast-developing country that is highly prone to natural disasters, such as floods, landslides, droughts, and tsunamis (UNISDR, n.d.), Malaysia is susceptible to climate change and strongly needs to create climate change resilient cities. The city state of Penang is among the coastal state that is highly affected by climate change due to heavy downpour and increasing sea level, which leads to massive flooding (JPS, 2019) and poses an indirect impact on economic loss. As a result, the local government is faced with more financial burdens.

It was projected that by 2030, approximately 77.6 per cent of Malaysia's total population would continue residing in urban areas, while the population distribution as and growth rates by states represented the rise in the urbanisation trend in all the provinces, with the Federal Territories (Labuan and Kuala Lumpur) as an exception. To illustrate, in 2000, the Federal Territories experience the highest urbanisation level of over 80 per cent, while Selangor, Penang, Malacca, and Johor experience an urbanisation rate above the national average of 62 per cent. The provinces with high urbanisation experience the highest gross domestic product per capita (Sukuran bin Taib & Chin Siong, 2008). These economic indicators show that most economic activities are performed in urban areas, making urban areas more vulnerable to climate change impacts.

The choice of MBPP and MBSP for this research was strategic based on the current vulnerability of cities. Over recent years, both cities experienced rapid urbanisation and adverse climatic events due to the coastal locations and hilly terrain on the island of Penang. Therefore, most of the population and economic activities were concentrated along with the unprotected coastal areas, while the sea-level rise could be severe as a result of devastating effects and unprepared planning system to manage climate change effects (Ghazali et al., 2018). Therefore, fast urban development and vulnerability to climate change (disasters such as flood and drought) are the strong basis for the scope of the research focusing in Malaysia, particularly Penang cities.

### **1.5 Significance of the Research**

The cities attempting to mainstream climate resilience for local land use planning would normally face various challenges (Kanasan & Hassan, 2019). Many of the currently present works of literature on climate change highlight the obstacles and problems in mitigating and adapting to the impacts instead of using resilience, which is a holistic approach of mitigation, adaptation, and transformation approach tackling climate change. However, few works of literature were identified to incorporate mainstream climate resilience within the capacity of the local governments for planning authority over local land use. It was found that a knowledge gap was present in the knowledge about the mainstreaming of climate resilience initiatives for land use planning from the city context, particularly local government capacity in Malaysia. This finding was important as the local governments are responsible solely for local land use planning. Accordingly, the finding of this study was expected to help improve cities in Malaysia in the planning from the climate lens perspective.

### **1.5.1 Uniqueness and Novelty**

The proposed conceptual framework of climate resilience in Malaysian local government in the context of land use planning in cities could be benchmarked by the city and policy makers from different levels of governments. Following that, the improvement in land use planning processes is undertaken to address climate change impacts. The framework that incorporates both characters of the city and institutional environment enables a bottom-up approach by ensuring participative planning and availability of reliable data for climate-proof land use planning. Besides, the focus on capacity building and sectoral coordination within the framework could lead to the relevance of various government and non-government institutions to climate change for the management of knowledge from various sources within the organisations. Subsequently, the planning of climate-resilient cities could be ensured.

### **1.5.2 Contribution to Knowledge**

This dissertation contributes to the existing body of knowledge, as summarised as follows:

- (a) The research added and filled the gap in the existing literature regarding the importance of mainstreaming climate resilience in local governments, especially cities in Malaysia by identifying the climate change concerns that have impacted the cities and the inhabitants.
- (b) The research led to the identification and understanding of institutional challenges, which were extremely pivotal for mainstreaming climate resilience in the local land use planning of cities. Subsequently, the importance of institutional environment and character of a city, which

indirectly allowed the improvement in service delivery in local government administrations, could be enhanced. These factors were not systematically presented before.

- (c) The framework presented in this research represented an integrated bottom-up approach in the context of mainstreaming climate resilience to enable holistic interaction between various stakeholders and actors for an effective local land use planning.
- (d) The framework established the significance of mainstreaming to present an integrated approach for the stakeholders and actors involved in local authorities regarding their duties, responsibilities, where such duties and responsibilities to mainstream climate resilience were successfully performed in relevance to land use planning.
- (e) Besides, this research offered awareness and understanding of the climate change impact in institutions and the ways to preserve the tacit knowledge held in the employees' minds via effective sectoral coordination and capacity building. And, overall, this thesis contributes to graphic illustration of the research road map, as shown in Figure 3.

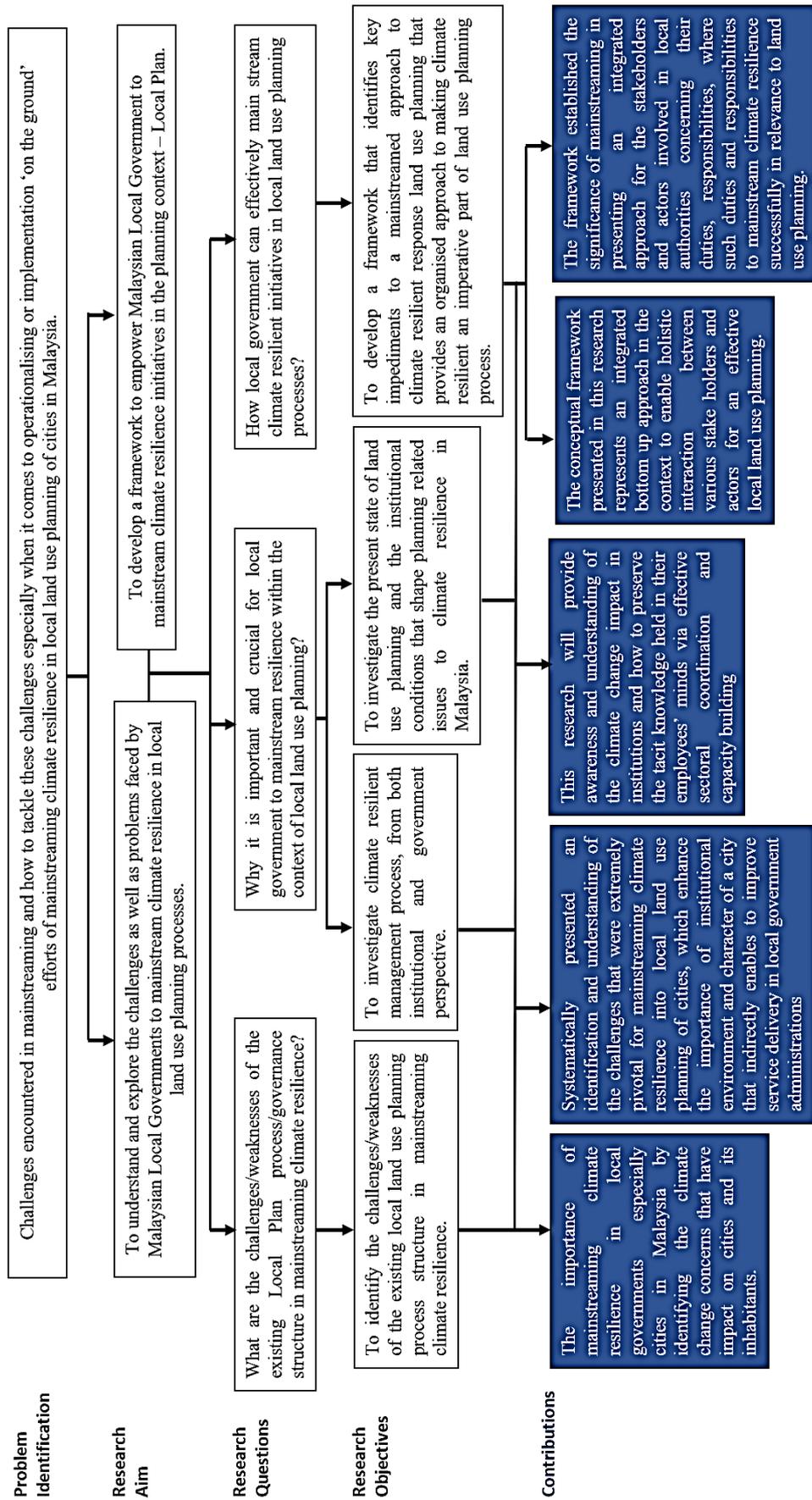


Figure 1.3 Research Road Map

Figure 1.3 Research Road Map

## 1.6 Structure of the Research

This dissertation is divided into three major parts, namely Part A with the literature review, Part B with the methodology, and Part C with the results and discussions (Figure 1.4) presented in the following six chapters:

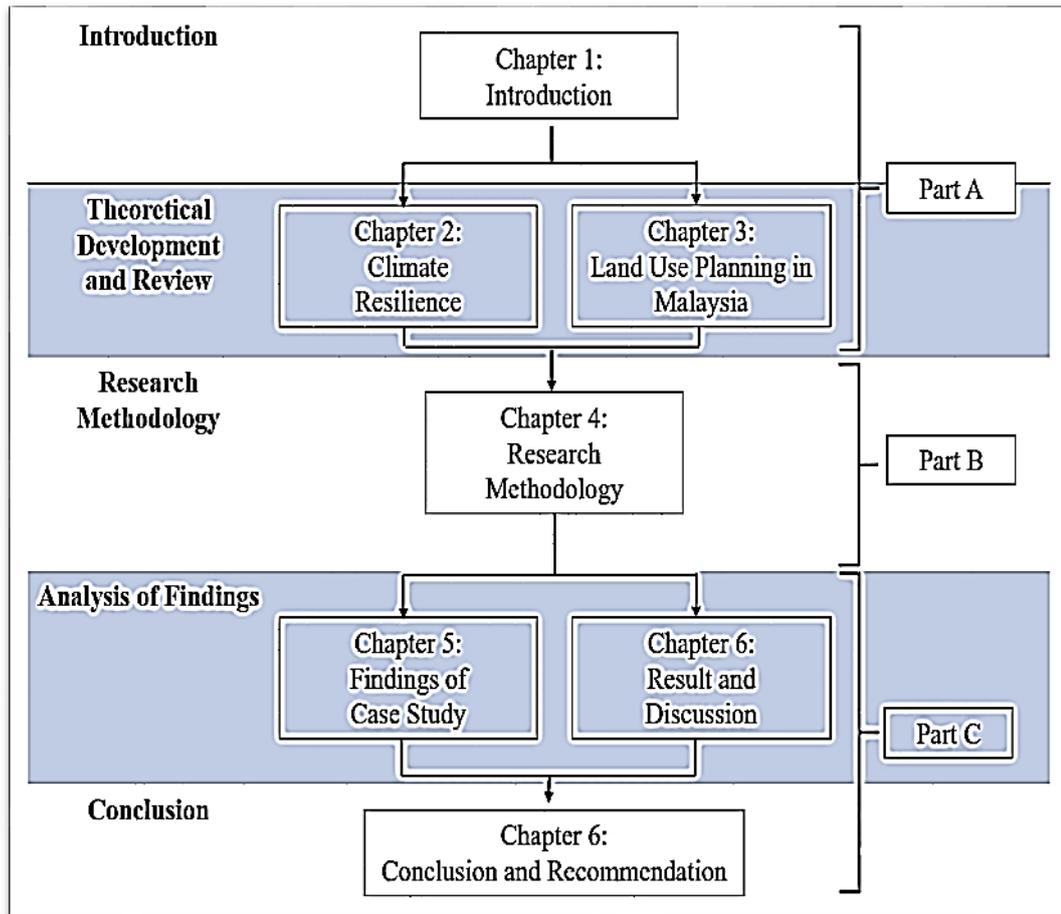


Figure 1.4 Structure of the dissertation

## **Chapter 1: Introduction**

This chapter provides the background of this research and the procedure of identifying the issue, followed by the development of the aim, objectives, and questions. This chapter also summarises in a nut-shell the methodology of the research and contribution of knowledge that the research is aimed to provide.

## **Chapter 2: Climate Resilience**

In this chapter, the comprehensive literature review is presented, followed by synthesis determining mainstreaming climate resilience within land-use planning processes is an institutional concern as it enables institutional change and indirectly entails institutional transformations although the effectiveness of mainstreaming process itself is questionable. Mainstreaming climate resilience requires the emphasis on incorporating the institutional perception in the operational analysis of land use planning. Being the research first objective, this focus is then placed on the identification, comprehension, and specification of the sources of the challenges to mainstreaming climate resilience in land use planning.

## **Chapter 3: Land Use Planning in Malaysia**

In this chapter, the research offers insights regarding the local government and land use planning in the Malaysian context. It elaborates further on local capacity building and sectoral coordination function together and are recognised as the methods to address an effective mainstreaming approach of climate resilience into local land use planning. Following these challenging areas, this research aims to address the inadequate emphasis placed on these aspects in land use planning, the rising significance of city local government in mainstreaming climate-resilient initiatives via

the establishment of the conceptual framework by determining the primary problems in literature review of Chapter 2 and 3 respectively.

#### **Chapter 4: Research Methodology**

This chapter explores the aims and objectives for this research through the outlined adopted research design and methodology. A rigorous investigation involving interpretation and preferences is a complex task, which requires systematic data collection and analysis approach of organisational processes, human behaviour, and culture to achieve meaningful research findings. This chapter is divided into two parts, which are as follows; the first part outlines the research ethics and integrity of the data, and the next part describes how the aforementioned design and methods were used for this research.

#### **Chapter 5: Findings of Case Study**

This chapter elaborates the data analysis and discussions of focus group sessions and semi-structured interviews, which involved extensive document analysis performed by the researcher that would address the three research questions accordingly. The chapter begins with analysing strategic plans, development plans, and local plans in Penang with the narratives derived from FGD sessions on environmental concerns to observe the issues in the climate change in Penang. This process includes a brief investigation of the recent and upcoming progress in development planning and climate. The elements underlying climate change impacts on local communities are focused on, including their roles in shaping mainstreaming climate resilience.

## **Chapter 6: Results and Discussion**

This chapter demonstrates the reflection of Chapter 5 that will discuss the responses and next stage analysis of FGD and semi-structured interview sessions specifically about effective sectoral coordination. Notably, strong local capacity building between various stakeholders is key to an effective response to climate-resilient local land use planning. In addition, the chapter also presents the discussion of the final stage data analysis that summarises the cross-connection between the four key themes of this research: awareness and challenges, mainstreaming, sectoral coordination, and capacity building to reflect the refined and updated framework to reflect the findings of this research findings.

## **Chapter 7: Conclusion and Recommendation**

This chapter summarises the importance of mainstreaming climate resilience into local land use planning process when climate change impacts the cities. It is concluded with a discussion on the implications of the research findings and recommendations as well as identification of suitable gaps for future research opportunities.

### **1.7 Research Limitations**

This PhD research employed the multiple case study method as the replication logic to achieve the external validity of the study results. The chosen case studies were situated in Peninsula Malaysia as the data and financial feasibility could be obtained. However, it was faced by common time and resource limitations. Despite the achievement of the external validity, the constraint of the study should be addressed using the case study method, which was mainly in the context of the study and

indicated by the study objectives and selection criteria to generalise the study results. This study was related to the evaluation of the applicability of the developed framework. The duration of the PhD research and the inadequate access and authority to put the proposed framework into practice was also identified as other constraints in this research.

## **1.8 Summary**

This chapter is introductory to this dissertation, which presents an overview of the research. This is followed by the study background and aim, which creates the basis for the study. Before the summary of the study methodology is discussed, the study objectives and questions are highlighted. Finally, the distinctiveness, novelty, anticipated contribution to knowledge is illustrated, followed by the research structure. The next chapter illustrates the literature review for this study.