PUBLIC OPINION TOWARD GREEN INFRASTRUCTURE ON BUILDINGS FOR SUSTAINABLE IN PARIT BUNTAR AND SUNGAI JAWI

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SCHOOL OF CIVIL ENGINEERING
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PUBLIC OPINION TOWARD GREEN INFRASTRUCTURE ON BUILDINGS FOR SUSTAINABLE IN PARIT BUNTAR AND SUNGAI JAWI

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ABSTRAK

Semasa tiba musim tengkujuh, beberapa kawasan di sekitar Parit Buntar dan Sungai Jawi akan mengalami banjir. Pihak berkuasa tempatan mesti menggunakan dasar perencanaan alam sekitar yang dapat membantu mewujudkan kawasan hijau baru untuk mencapai tujuan pembangunan yang lestari dan memastikan kualiti hidup yang baik untuk orang ramai, bersama dengan pemulihan persekitaran semula jadi. Salah satu cara untuk menghidupkan kawasan hijau adalah dengan meningkatkan kesedaran masyarakat akan pentingnya infrastruktur hijau. Untuk mempromosikan infrastruktur hijau secara efektif di Parit Buntar dan Jawi, penting untuk memahami sikap masyarakat terhadap infrastruktur hijau, sehingga strategi yang sesuai dan efektif dapat dilaksanakan oleh pihak berkuasa. Dalam kajian ini, seratus tiga puluh tiga responden diminta untuk memberikan persepsi dan kesedaran mereka terhadap infrastruktur hijau. Soal selidik berstruktur digunakan untuk tinjauan ini, yang dilakukan melalui media sosial seperti Facebook, WhatsApp dan Telegram bagi memudahkan responden menjawab soalan pada masa lapang dan mencegah penularan Covid-19 pada masa kini. Data dianalisis menggunakan SPSS bagi mendapatkan indeks min, kadar kebolehpercayaan dan perbandingan antara faktor demografi dan tindak balas responden terhadap persepsi dan kesedaran mengenai infrastruktur hijau. Hasil kajian menunjukkan bahawa persepsi dan kesedaran terhadap infrastruktur hijau memuaskan. Aspek ini akan membantu pihak berkuasa tempatan untuk meningkatkan kesedaran masyarakat mengenai infrastruktur hijau. Di samping itu, hasilnya menunjukkan bahawa tidak ada perbezaan yang signifikan dalam perbandingan faktor demografi terhadap respons masyarakat mengenai persepsi dan kesedaran terhadap aspek infrastruktur hijau. Oleh itu, faktor demografi tidak mempengaruhi maklum balas yang diberikan dalam kajian ini.

ABSTRACT

During rainy seasons, a few places in Parit Buntar and Sungai Jawi are prone to flash floods. Local authorities must adopt environmental planning policies that can help create new green areas to achieve sustainable development goals and ensure a good quality of life for public, along with the rehabilitation of the natural environment. One of the ways to liven up green areas is by raising public awareness of the importance of green infrastructure. In order to effectively promote green infrastructure in Parit Buntar and Sungai Jawi, it is essential to comprehend public attitudes toward green infrastructure, so that suitable and effective strategies can be implemented by policy makers. In this study, one hundred thirty-three respondents were asked to provide their perception and awareness on green infrastructures. Questionnaire's method was used for this survey, which was conducted through social media such as Facebook, WhatsApp and Telegram to facilitate respondents to answer the questions in their spare time and to prevent the transmission of covid 19. Data were analysed using SPSS for index mean, percentages and comparison between demographic factors and response of respondent on perception and awareness of green infrastructure. The results showed that the perception and awareness on green infrastructure are satisfactory. This aspect will help the local authority to increase the public awareness on green infrastructure. In addition, the results showed that no significant difference in the comparison of demographic factors on the questionnaire responses of the perception and awareness on green infrastructure aspect. This means that demographic factors do not affect any feedback given in this study.

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CHAPTER 1

INTRODUCTION

1.1 Background

Green infrastructure is a method of dealing with the effects of rain in cities that restores or preserves natural hydrology. Infiltrating, or collecting and utilising stormwater are all examples of green infrastructure methods. Green infrastructure refers to the preservation or restoration of natural landscape elements such as forests, floodplains, and wetlands on a regional scale. On a local scale, green infrastructure includes techniques such as bioretention, trees, green roofs, permeable pavements, and cisterns that are site and neighbourhood specific. Regional and local practises are combined with policies like infill and redevelopment to lower a watershed's total imperviousness (Hansen & Pauleit, 2015).

Essentially, green infrastructure is built to cover landscaping, parks and gardens, open fields, man-made permeable pavements and surfaces, harvesting, discharge or evaporative rainwater in order to resolve environmental disasters such as flooding, destruction of habitat, urban heat stress, impaired air quality and the effects of climate change (Tasiu Yusuf Idi., 2020). The following are the primary roles of green infrastructure:

- Create, recreate, or propagate an eco-system to improve air, soil, and water quality.
- Divert rainwater to avoid flooding homes and other grey infrastructure.
- Convert rainwater to resource for vegetation.
- Store rainwater through harvesting for re-use

A pleasant and healthful atmosphere contributes significantly to mental and physical well-being. This study offers public opinion of green infrastructure and looks at changes in the sustainability environment that may be predicted, based on the most recent materials, including

academic books, journal, and article. A green infrastructure must have a real (and measurable) structural efficiency in the use of resources such as energy and water, protect the health and well -being of residents and increase employee productivity (if a building is commercial). (Tokazhanov et al., 2020)

In short, green infrastructure is more focused on the aspect of efficient functional application using all natural and man -made resources. There are two types of green infrastructure which since the beginning of construction, it is indeed equipped with green features and old building renovated to include new green elements. This green infrastructure is known as an 'environmentally friendly' building. (Signorelli et al., 2020)

1.2 Problem Statement

During rainy seasons, a few places in Parit Buntar and Sungai Jawi are prone to flash floods. There are a lot of rain (rainy season) falls at Parit Buntar and Sungai Jawi in the month of April, May, June, July, August, September, October, and November (Zalilah, 2017). For decades, stormwater, also known as runoff, was thought to be primarily an issue caused by excessive rains into towns. Prior engineering methods aimed to transport rainwater away from this area as quickly as feasible to minimise potential flooding damage (MDKerian and MPSP, 2020). More recently, these approaches have evolved to consider stormwater as a resource with numerous advantages when appropriately managed inside communities. (Pinheiro & Luís, 2020)

Rainwater that used to seep into the earth now flows off hard surfaces like rooftops, parking lots, and roadways in large volumes, causing stormwater concerns. It runs into storm drains and then into lakes and streams, bringing contaminants that are detrimental to aquatic life and public health with it. Traditional stormwater management methods have relied on so-called "grey infrastructure," such as pipes, gutters, ditches, and storm sewers. In recent years,

there has been a surge in interest in “green infrastructure” technology and practises, which may be used instead of or in addition to grey infrastructure (Baptiste et al., 2015). Green infrastructure solutions absorb, evapotranspiration, or utilise stormwater runoff on the site where it is created by using or mimicking natural processes. These measures keep rainfall out of the sewage system, lowering the amount of untreated runoff released to surface waterways and preventing sewer overflows.(Olsen, 2015)

1.3 Objective

1) To identify the public perception (without green infrastructure knowledge) whether agree or not toward green infrastructure in Parit Buntar and Sungai Jawi.
2) To identify the public awareness (with green infrastructure knowledge) whether agree or not toward green infrastructure in Parit Buntar and Sungai Jawi.
3) To compare differences between respondent demographic factors with perception and awareness toward green infrastructure.

1.4 Scope Study

The public opinion toward green infrastructure on building for sustainable in Parit Buntar and Sungai Jawi. were investigated in this report. The public perception on green infrastructure were then evaluated in terms of sustainable communities and environment, the operating and maintaining cost and the role of civil engineering. This study also compared the social background of respondent with perception and awareness on green infrastructure to identify whether age, occupation and education background will affect the responses of survey or not. This study was conducted using a questionnaire survey to gather information about the public perception and awareness on green infrastructure. The data was then interpreted by using

Statistical Package for the Social Sciences (SPSS) Software to provide useful results and conclusion.

The research field is based on two towns in Malaysia known as Parit Buntar and Sungai Jawi. Parit Buntar is a town in Malaysia's Kerian District. It shares a border with Penang's Nibong Tebal and Kedah's Bandar Baharu. Because of its huge expanses of paddy fields, this district is known as Perak's Rice Bowl. To reclaim the land and manage the flow of water into and out of the paddy fields, an irrigation system was created. During certain seasons, a few places are prone to floods. The climate in this city is tropical. Even in the driest month, there is a lot of rain at Parit Buntar. The average temperature is 27.3 °C (81.1 °F). The yearly rainfall average is 2,304 mm (90.7 in). (MdKerian Portal, 2021)

Figure 1.1: Parit Buntar Area

Sungai Jawi, often known as Jawi, is the district capital of Penang's South Seberang Perai District. It's in the middle of the area, right next to the North-South Expressway. Several areas are vulnerable to flooding during the rainy season. (Official page of Seberang Perai Selatan District and Land Office Penang, 2021)

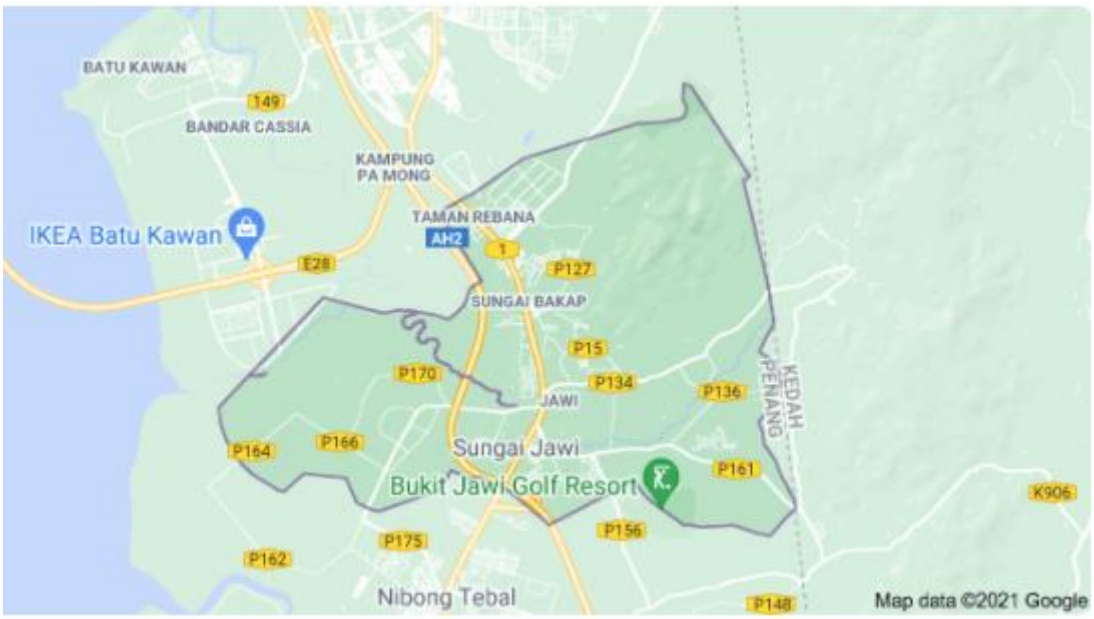


Figure 1.2: Map of Sungai Jawi

1.5 Significance of Study

Green infrastructures might play a significant role in the overall area of infrastructures, directly influencing progress toward several of the United Nations' Sustainable Development Goals outlined in the 2030 Agenda. Green infrastructures can help to improve building energy use and stormwater management, attract investment, revitalise distressed neighbourhoods and encourage redevelopment, provide recreational and social opportunities, and help to achieve a variety of other social, economic, public health, and environmental goals, such as lowering air pollution in district areas and increasing economic growth. It is essential to comprehend public attitudes toward green infrastructure, so that suitable and effective strategies can be implemented by policy makers.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses the concept of green infrastructures, the benefits of green infrastructures to solve urban issues, green infrastructure in the United States, Europe, Korea, and Malaysia, the need to incorporate green technology into civil engineering infrastructure projects, and the necessity to incorporate green technology into civil engineering infrastructure projects, as well as the substantial problems that come with doing so.

2.2 Green infrastructure

Green infrastructure is a type of infrastructure or land use strategy that promotes long-term social and economic sustainability by using a range of natural functions. Green infrastructure, or landscape projects that offer a long-term return on investment, is essentially creating healthier environments one property at a time. Green infrastructure is a natural alternative to our commercial properties' drainage, heat, air, and water quality issues. Methods and perspectives, on the other hand, are determined by nations and organisations. For example, the European Union describes green infrastructure as “a strategically organized network of natural and semi-natural areas” that implements habitat protection and regeneration, ecosystem network generation, urban construction using ecosystem services, disaster mitigation, and so on. (Green infrastructure association, 2017)

Green infrastructure, on the other hand, is described in the United States as “a simultaneous approach to accomplish rainwater control, stormwater countermeasures, and environmental conservation,” and focuses on man-made buildings (rainwater management facilities) strengthened with ecosystem functions. Both solutions seek to address urban problems using natural (green) potentials, and they are applied as a new concept that can

promote the integration of different components such as environmental conservation, urban and regional growth, and disaster prevention and mitigation. (Takaaki Nishida, 2017)

2.3 Green Infrastructure as a Solution to Urban Issues

The increase in density in many metropolitan areas has resulted in less green spaces, which has influenced not just the architectural character of cities, but also the physical and emotional health of citizens. This problem is projected to worsen in the future as the world's urban population develops in both size and number; urban areas are predicted to absorb the majority of the predicted worldwide population rise over the next 30 years. (Pinheiro & Luís, 2020). The benefit of green infrastructure as shown in Table 2.1 is described as "Benefits of Green Infrastructure" by the United States Environmental Protection Agency (USEPA, 2017).

Table 2.1: Benefits of green infrastructures (USEPA,2017)

Category	Merit	Function
Water Quality & Quantity	Water quality improvement	Reduce pollutant loads; Reduce stormwater discharge into combine sewers and rivers
	Surface runoff mitigation	Delay and reduce stormwater discharge
	Water supply	Facilitate rainwater harvesting and infiltration; Increase groundwater recharge; Improve water cycle
Air Quality	Particle pollution reduction	Absorb and filter particulate matters
	Health effects	Reduce respiratory ailments
	Grand-level ozone improvement	Reduce air temperatures; Reduce nitrogen oxides; Reduce smog
Climate Resiliency	Water disaster reduction	Infiltrate rainwater; Reduce flood risk by open space preservation
	Drought mitigation	Replenish groundwater reserve; Relieve stress on water supplies
	Heat island mitigation	Reduce temperature by evapotranspiration; Reduce temperature with green roofs
	Lower building energy demands	Reduce indoor temperature by shading building surfaces
	Lower energy usage for water management	Reduce rainwater flows into sewer systems; Reduce pumping and treatment demands for municipalities
Habitat & Wildlife	Habitat improvement	Reduce erosion and sedimentation; Provide water and food; Provide places for hiding, relaxing and mating
	Habitat connectivity	Facilitate wildlife movement; Connect wildlife populations between habitats
Communities	Green jobs	Create construction and maintenance jobs
	Health benefits	Encourage outdoor physical activity; Reduce chronic diseases
	Recreation space	Facilitate recreational activity for urban residents
	Property values	Increase property values with more vegetation and tree cover; Benefit both developers and homeowners

The use of vegetation in architecture is a suitable design technique that attempts to improve not only building efficiency but also the outdoor environment. Various technological options for covering buildings with plants, such as green roofs, green walls, and green balconies, have been proposed through the years. Green infrastructure, as opposed to single-purpose grey infrastructure that can only work during rain events, such as traditional civil engineering approaches, can bring various benefits, which is its most important point. Green infrastructure can have a positive impact on various aspects, including (Serra et al, 2017):

1) Save cost in maintaining the building.

This is probably the most attractive factor for residents and developers, even for those who do not have a deep awareness of environmental care. The cost of erecting a green infrastructure may be more expensive than usual because it uses different materials, equipment, and designs. Not forgetting the various rules that need to be followed. Yet this investment is worthwhile in the long run due to the savings gained from the use of water, electricity, heat care, and so on.

2) Maintain health and increase productivity

Human and nature should not be separated. So, architects, engineers, and developers try to re-apply the features of nature in the projects they build. Among the things that are always implemented is to plant more trees in the building, or their municipal area. In office buildings that have areas like this, they find more employees go downstairs, and sit on benches provided to rest their eyes. Developers and engineers are also beginning to replace toxic materials as well as upgrade ventilation systems to reduce the risk of asthma and lung cancer.

3) Reduce waste and pollution in the environment.

The most essential goal of green infrastructure is to lessen the environmental effect. As a result, the construction of a green building necessitates careful consideration of the materials to be used, the amenities to be supplied, and so on.

2.4 Green infrastructure in the United States

2.4.1 Development of green infrastructure in U.S

Green infrastructures are gaining popularity U.S country. They have become common practice for introducing plants into heavily populated urban areas, including ecosystem services such as biodiversity support, emissions management, increased air quality, noise reduction, and urban heat island mitigation. Green roofs will also collect rainwater, minimize pollution, and provide energy benefits to building owners while also improving their aesthetic profile. (Kapecki, 2020)

Green walls have many advantages to urban areas, but they use a lot of water and are not suitable for use in dry climates. Green walls, on the other hand, could become more cost-effective and popular if they were designed to handle greywater. Furthermore, balconies are an underutilized possible greening space. When evaluating the possibility of installing green infrastructure on houses, it is important to understand public opinions and beliefs to make planning initiatives more successful. Several research on citizen behaviours and desires in landscape architecture have been published. (Prodanovic et al., 2017)

In the American southwest, for example, homeowners tend to favour desert-adapted environments, arguing that high desert plants have an appropriate green palette for urban

landscapes. The urban areas of the continental United States (US) are used to about 80% of the nation's population and 25% of its tree canopy. This green infrastructure has immediate environmental benefits through absorbing and slowing storm water runoff, sequestering carbon, mitigating urban heat island effects, reducing metropolitan air pollutants, and enhancing capital accumulation. (Rupani et al., 2020)

2.4.2 Potential cost saving

As a result of green infrastructure efforts like New York City and Chicago, increasing numbers of US communities are making savings. The first $2.4 trillion in projected public and private funds in the next 18 years to implement green infrastructure techniques was in 2012 New York City, which signed an amended consent agreement with state and local officials to invest $187 million in the next three years in green infrastructure for control of combined sewer overflow. (Claudia Copeland 2016)

The agreement permits the city to set green investment priorities in regions which would most benefit from the resultant overflow reductions. The state decided to postpone judgments on the need for major grey infrastructure projects until the green infrastructure projects are completed, saving the state almost $2 billion in capital expenses. The strategy might save $1.5 billion over 20 years by combining grey and green initiatives. (Wang et al., 2019)

Chicago has been a pioneer in the promotion of urban green roofs. By lowering the urban heat island effect around City Hall, the 20,000 square foot green roof atop the building has helped to reduce stormwater runoff and enhance air quality. Since its installation in 2001, the green roof has saved $3,600 in yearly energy costs at the building level. Similarly, the green

roof atop Minneapolis' Target Center Arena catches over 1 million gallons of rainwater per year and saves $300,000 in yearly energy expenditures. (Barau, 2015)

2.5 Green infrastructure in Korea and Indonesia

2.5.1 Development of green infrastructure in Korea

Global warming has a direct impact on Korea. The rate of growth in average temperature well exceeds the global average, and average temperature has risen by 1.7°C in the last 100 years (1912 - 2008) (Figure 2.2). Global warming has intensified the impact on the Korean Peninsula. (KNEMA, 2018)

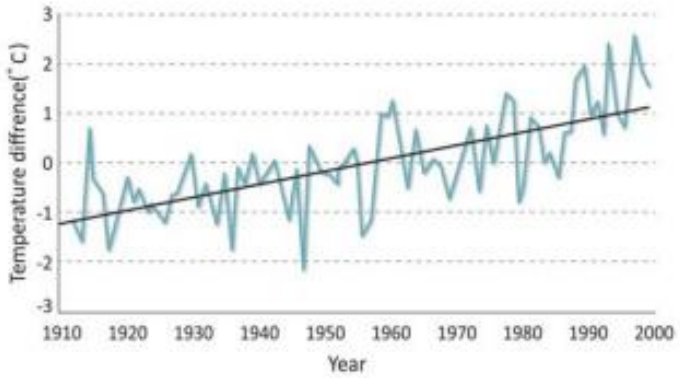


Figure 2.2: Temperature change in Korea

In response to global warming, the Korean government has promoted a green growth agenda that seeks to use green growth as a driving force for national development through green conversion (Figure 2.2). Green growth policy is a national growth plan that promotes sustainable growth while also protecting the environment, achieving a competitive advantage by converting each business value chain into low-carbon and eco-friendly and thereby generating a new market. The following are the key components of Korea's leading green development policy. (Park et al., 2020)

- Increased use of renewable energy
- The advancement of green technologies and its use as a growth engine; the creation of resource recovery structures in the environment and industry.
- The establishment of a foundation for a green economy; reviving carbon markets and developing green finance infrastructure.
- Enhancing climate change response capability.
- Creating green national land by resource use -regional recycling growth.

2.5.2 Korean Green New Deal

Unlike the European Green Deal and the United States' Green New Deal, South Korea's Green New Deal originated as a direct response to the COVID-19 pandemic. The Green New Deal differs from previous policy proposals in that it not only addresses the climate crisis, but also attempts to eliminate social inequality and poverty. This is usually in line with the methods of the EU and the US. (Wang et al., 2019)

The Green New Deal was tacked on at the last minute to the Korean New Deal, indicating a desire to follow global trends in new green deal policy (UNDP Seoul, 2021). Three key areas and eight unique implementation goals are defined in the Korean Green New Deal. The government projects that a total investment of 73.4 trillion KRW (42.7 trillion KRW from the Treasury) and the creation of 659,000 employment. Funding for Green New Deal projects is expected to come from both public and private sources.

The first is infrastructure transformation to a greener state. By 2025, a total of 30.1 trillion KRW would have been invested (including 12.1 trillion KRW from the Treasury), resulting in the creation of 387,000 employment. One of the biggest projects that will generate the most jobs is the installation of renewable energy equipment and high-performance

insulation to turn public buildings green and energy efficient. The government intends to preserve the terrestrial, coastal, and urban habitats by undertaking a systematic diagnosis on a city's climate and environmental challenges. (Mattarocci & Roberti, 2020)

2.5.3 Green City Development in Indonesia (P2KH)

The Green City Development Program (P2KH) of the Ministry of Public Works and Public Housing in Indonesia is an initiative by the Indonesian government to implement GI standards in urban areas in a systematic and widespread manner. P2KH is a method of implementing City/Regency Spatial Planning (RTRW) that involves the active involvement of residents to increase the quality of urban space. P2KH is held to address climate change and minimize carbon emissions on a national scale, as well as to fulfil the directive of UUPR (Spatial Planning Law) Number 26 of 2007 concerning Spatial Planning, which includes the aim of achieving 30% of Green Open Space (RTH) in urban areas. (PUPR, 2017).

P2KH is an initiative to create an inclusive and comprehensive green city that achieves 8 (eight) green city attributes, including: (1) green planning and design; (2) increasing the role of the community as a green community; (3) availability of green open space; (4) efficient energy consumption; (5) effective water use; (6) waste management based on the principle of green waste; and (7) energy-efficient transportation (green transportation). P2KH is focusing on the realization of three (three) qualities currently, namely, environmentally sustainable urban planning and architecture, embodiment of 30% green open space, and increasing the involvement of the city through the green community. The following stage is supposed to be much bigger. (Awadh, 2017)

2.6 Green infrastructures in Malaysia

2.6.1 Green infrastructure is being promoted by the government.

The recovery from the COVID crisis must prioritise green infrastructure and foster a regulatory framework that encourages green and creative investment. (World Bank, 2020) Malaysia has already seen major negative effects from climate change, such as higher annual surface temperatures and rainfall, sea level rise, and other extreme weather occurrences. Due to its fast expansion, the country is also confronted with diminishing natural resources and rising greenhouse gas (GHG) emissions. (Abullah et al, 2017)

Currently, public finance and Public Private Partnerships (PPP) projects account for most of the infrastructure investment in Malaysia. However, public finance will not be enough to fulfil the rising demand for green infrastructure; new pathways for private capital mobilisation will be required. Existing government financing pledges may be jeopardised by the current COVID epidemic and resulting economic crisis, therefore access to financing markets will be critical to expanding green pipelines. The Malaysian government's commitment to greening the economy will determine how much sustainable investment can be scaled up. (Zarghami et al., 2018)

Policies that encourage public investment in green infrastructure have the potential to put Malaysia on a long-term sustainable path, sending a powerful signal to the market and allowing the country to access fresh funding. Green investments are in high demand across the world. A substantial and visible Malaysian green infrastructure pipeline might also assist investors recognise that there is a significant enough pool of financially appealing green initiatives. (Andris, 2016)

This implies that there are viable alternatives to non-green assets and initiatives, and that investors may voice their green preferences, resulting in the formation of a bigger pool of green investments. There has been a lack of understanding and appreciation of "what are green investments." Because of this problem, governments are finding it difficult to build pipelines of economically viable green infrastructure investment possibilities that would help the country transition to a low-carbon economy.(Al Amri, 2021)

Improving the overall investment climate and fostering more green financing will aid in funding the infrastructure required to fulfil climate commitments. This involves keeping the doors open to green investors and guaranteeing a pipeline of bankable, investment-ready projects. These steps will help Malaysia transition to a low-carbon economy while also making it more robust to the effects of climate change and other global shocks. Green infrastructure is beneficial to both the environment and the economy. (Hok and Tang, 2019)

2.6.2 Malaysia's climate policy

Malaysia's environmental policies Malaysia has already seen major negative effects from climate change, such as higher temperatures and rainfall, sea level rise, and other extreme weather occurrences. Malaysia's main approach for reducing greenhouse gas emissions is to focus on energy, waste, and forests. Other sectors, such as industrial processes and products utilised (IPPU) and agriculture, have yet to be quantified in terms of mitigation.(Mohammadian et al., 2020)

Starting with the Eighth Malaysia Plan (2001–2005), which established the Five Fuel Diversification Policy, renewable energy was pushed as a source of energy for the first time, despite the fact that hydropower was already in use. Energy efficiency was also addressed in the Ninth Malaysia Plan (2006–2010). The Tenth Malaysia Plan (2011-2015) established new

goals for Malaysia's renewable energy development, introducing the New Energy Policy, which addressed energy pricing, strategic supply developments, end-use energy efficiency, energy governance and regulation, and change management and affordability. (Mohammadian et al., 2020)

Green growth was also identified as one of the key thrusts in the eleventh Malaysia Plan 2016-2020, allowing Malaysia to remain ahead of environmental issues and establish a sustainable economy. While the release of the twelfth Malaysia Plan has been delayed, Environmental Sustainability will be a fundamental pillar, with an emphasis on climate mitigation and adaptation, as well as green technologies, sustainable production and consumption. (Ataei et al., 2021)

In 2009, the National Green Technology Policy was enacted in order to boost the country's economy and promote long-term growth. The strategy includes five key strategic thrusts to support green technology application and growth in most industries, with renewable energy, environment, economics, and social viewpoint serving as four primary pillars. Green Investment Tax Allowances (GITA) and Green Income Tax Exemption (GITE) are two incentive programmes that were implemented in 2014 to promote green technology development. (Zarghami et al., 2018)

Companies who acquire green technology assets, build green technology projects, or provide green technology services are all eligible to qualify for the incentives. Several GHG mitigation projects and services, the majority of which are renewable energy and energy efficiency initiatives, have been approved under both GITA and GITE. The government's commitment to a successful transition to a more sustainable and low-carbon economy may be seen in the progress of these national initiatives. (Ferwati et al., 2019)

2.7 Green infrastructure is highly important in civil engineering projects.

When we face significant planetary challenges such as global warming, the engineering profession will have a huge impact on our planet's future. Environmental sustainability would be driven by demand for energy, drinking water, clean air, safe waste disposal, and transportation, as well as infrastructure growth. Engineers play a crucial role in achieving long-term development. It is clear that becoming a successful engineer means ignoring the difficulties and opportunities that come with achieving sustainable growth (Akhanova et al., 2019)

The engineering group also has a significant role to play in the planning of infrastructure projects. Due to a lack of sustainability programmes or tools, poor design solutions have resulted, and the environment became worse. Engineers will have to be on the cutting edge of innovations, whether it is maximising water capture or ensuring resource conservation from supply to delivery, issues like innovation, technology, design, and management will be crucial for engineer in meeting future challenges. (Illankoon et al., 2017)

If not properly planned, constructed, and implemented, civil engineering projects can have significant site specific and cumulative impacts on our ecological and social systems. Engineers are at the forefront of civil engineering and play an important role in avoiding or mitigating environmental impacts. As a result, it is important for them to comprehend the context of the environment in which they work. There is an urgent need to implement innovations and methods that provide better and more sustainable results in a cost-effective manner in the field of sustainability. (Olawumi et al., 2020)

As a result, in the design of infrastructure, sustainable, adaptive, and mitigation approaches to climate change are important steering components. Few designers have yet to investigate the transformative potential of ecological design, preferring to remain apolitical and

unconcerned about the distributional effects of design on human and ecosystem health. (Nguyen & Altan, 2011)

In the region, infrastructure development has primarily concentrated on financing and engineering issues. Environmental considerations and the ecoefficiency concept have not been considered as much as they should have been at various stages of infrastructure growth. Policymakers, planners, and decision-makers all need to improve their understanding of eco-efficiency concepts. However, the requirements for creating eco-efficient and sustainable infrastructure, as well as the measures for doing so, have yet to be completely defined. (Nguyen & Altan, 2011)

2.8 The major challenges associated with implementing green infrastructures.

Despite the advantages of green infrastructure, one of the biggest barriers to adoption is the lack of clarity on how it will be maintained. Operation and maintenance have been consistently posed as a technological obstacle to green infrastructure adoption, and it continues to be a challenge for many local governments and those unfamiliar with these approaches across the world. Green infrastructure, like any other form of infrastructure, can fail if it is not properly maintained; rain gardens, like a neglected detention pond or a roadway, will lose functionality and fail. (Tleuken et al., 2021)

Finding suitable financing sources is one of the most difficult aspects of successful green infrastructure operations and maintenance. Stormwater projects are also funded by general funds, which compete with schools and other priorities in many priorities. Green infrastructure services must have a consistent and stable source of funding for maintenance, more closely linking a user fee to influence and potentially incentivizing private investment. Beneficiary opportunity funds, public-private partnerships, infrastructure development

districts, and dedicated clean water funds are examples of alternative funding strategies. (Stevens and colleagues, 2020)

Green infrastructure is a responsibility of public and local authority. Some municipalities have struggled with a negative public view of green infrastructure or a lack of knowledge about the activities, which can obstruct successful maintenance and overall performance. Residents can be engaged and educated about maintenance responsibilities through voluntary homeowner incentive programmes. Green infrastructure practises can be taught by local authority through workshops, tours, and other activities. Volunteer projects may help people take an active role in the management of green infrastructure activities by allowing them to collaborate with community groups. (Tonne, 2021)

Finally, practitioners such as landscape contractors, engineers, and landscape architects have few opportunities to become accredited or obtain training in the operation and maintenance of green infrastructure practises. Developing green infrastructure maintenance standards would serve as a foundation for developing tailored trainings and certifications based on current models, such as local government training programmes. (Mladenović, 2018)

CHAPTER 3

METHODOLOGY

3.1 Introduction

A strategy or technique for guiding the implementation and execution of research is known as research methodology. The approach is an important factor in obtaining a good and trustworthy study outcome. It is to make sure that the researchers' procedures are in line with the variables being researched and the hypotheses being tested in this study. The research approach followed by the researchers to perform this study is described in this chapter. The following are some of the methods employed to conduct this research:

(a) Initial discussion

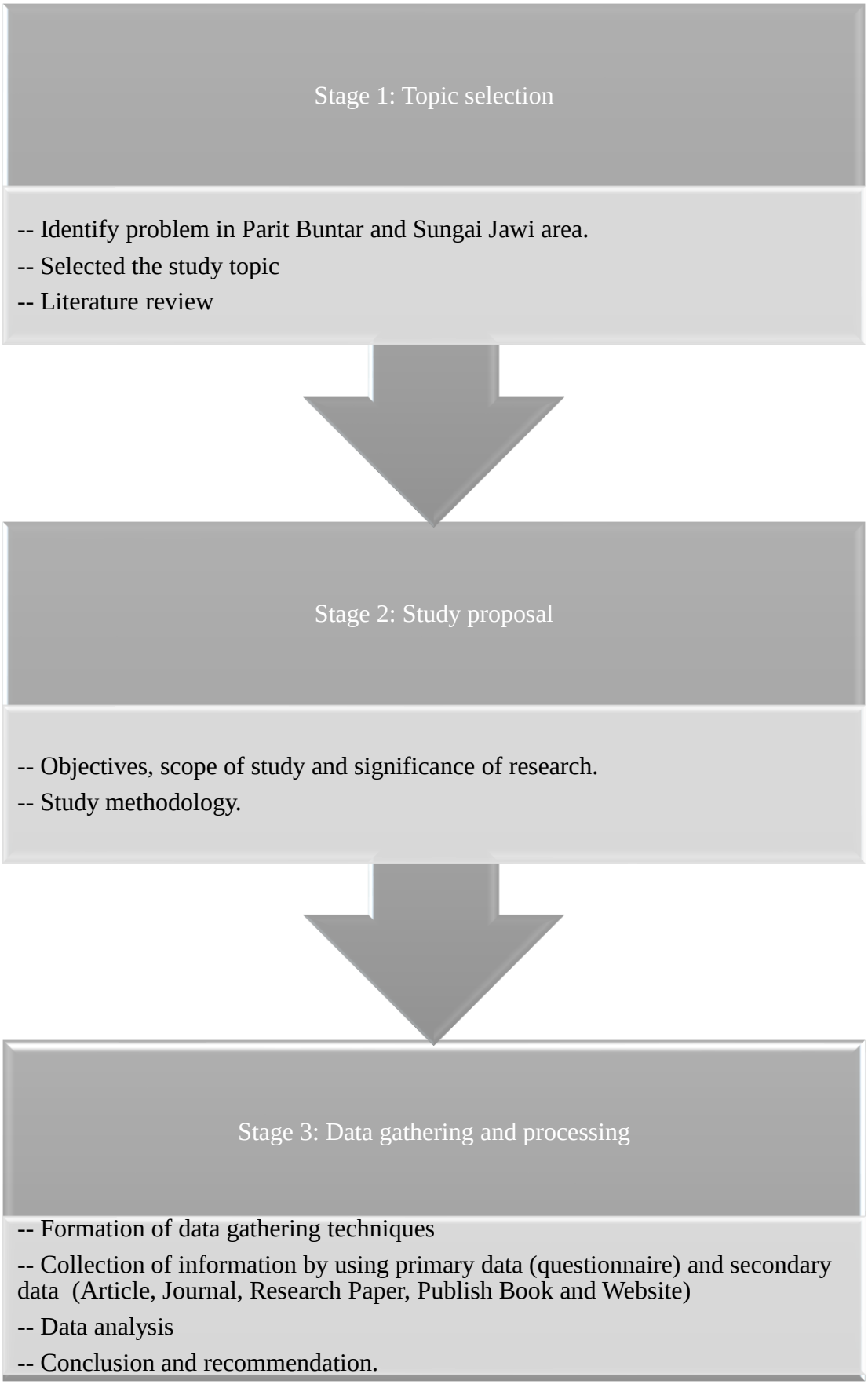
(b) Literature review

(c) Questionnaire

(d) Data analysis

(e) Conclusions and recommendations

3.2 Flow chart of methodology



3.3 Initial research

The initial research would concentrate on the analysis and comprehension of the actual problems in Parit Buntar and Sungai Jawi to be studied. Initial research was conducted with an interpretation of:

(a) The problem statement for the need to study.

(b) The purpose of the study.

(c) Objectives achieve in this study.

(d) The scope involved in a study.

(e) The significance of research.

3.4 Literature review

Before developing a questionnaire, it is important to study previous surveys on the green infrastructure topic. This aids in understanding the different components of a survey on that topic, as well as calibrating the duration and estimated time of surveys. Furthermore, it may be of interest to verify that the wording of questions exactly fits the wording of a sample used in another context, or to learn how randomizations can lead to the discovery of new information. The most recent data is needed for this study's data sources. Usually, this type of data is constantly changing according to the current public awareness and perception of green infrastructures.

The sources for references in the preparation of a literature review are classified into two categories. The source is the primary source, as well as secondary sources.

(a) Premier source – Books, journal, thesis

(b) Secondary source - Internet

3.5 Questionnaire's development

The study conducted a case study method. Therefore, a complete set of questionnaires effective and included with questions that were formulated provided to respondents at Parit Buntar and Sungai Jawi for the purpose of research information. Each question must be simply, easy to understand and organized. Designed questionnaire consisted of two main parts:

(a) Part 1: In this section, there is item that has formed the range of the demographic and background information of the respondents to achieve the objective of this study. In this section, the respondent should choose in accordance with one preferred answer statement.

(b) Part 2: In this section, there are two parts of question which is perception and awareness on green infrastructures. This part of questionnaire items is provided in the form of Likert scale. The score provided to a rating-based inquiry is shown in Table 3.1.

Table 3.1: Likert scales

Score	Classification
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

The age range, gender, occupation, and level of education included in the question were all closely related to the study's objective. The factors employed in this study have to do with sociodemographic characteristic (Questions 1 - 4 of Appendix A). The multiple item variables are (a) "public perception on green infrastructures" (Q5–Q20 of Appendix A), which determines the level of understanding of green infrastructures, and (b) "sources that raise public awareness and provide information on green infrastructure" (Q5–Q20 of Appendix A), which determines the level of awareness of green infrastructures." (Q21 – Q32), which collected

information on the media citizens use to receive information, and the action plans and programs by local authorities in green infrastructure which mainly involved the public' perspective on local authority responsibilities on green constructions were measured.

3.6 The collection of data

The data collection began in April 2021 and ended in May 2021. The research will take place through online survey provided questionnaire to the public, targeted at an estimated 133 respondents. Questions will be distributing to people aged 18 and above such as University students, working and non -working people. The survey was conducted through social media such as Facebook, WhatsApp, and Telegram. The duration for answer each question was about 5 minutes. The questions survey will attempt to obtain the degree of awareness, actual behaviour and understanding of green infrastructure and related concerns from the two study areas. This survey would also aim to identify public perception and awareness of green infrastructure, the function of green infrastructure to environment and human, and the operation and maintenance cost of adopting green infrastructure technology.

3.7 Analysis of data

After the respondents have completed the online survey, 32 questions will be analysed by using SPSS software. This is done by Reliability analysis, Descriptive analysis and Independent Sample T-test analysis from the data. The survey was designed to include question that pertained to gender, age range, occupation status and education level that were directly relevant to the objectives of this study.

The data was examined using the Statistical Package for Social Science computer (SPSS). In addition, Microsoft Excel software was employed to assist in the presentation of the study's findings in a clear and appealing manner.