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Ngai Weng Chan (Editor)

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NGAI WENG CHAN

School of Humanities
Universiti Sains Malaysia
Penang

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Ngai Weng Chan (Symposium Chairperson & Editor of Proceedings)

Introduction

This book of proceedings is an outcome of the 13th International Academic Consortium for Sustainable Cities (IACSC) 2022 Symposium, held on 12th - 13th September 200 in Universiti Sains Malaysia, Penang. It is part of the activities of the International Academic Consortium for Sustainable Cities (IACSC), an international group/association, established in 2009 by Yokohama City University (YCU). The IACSC theme of "Cities and Universities – Towards Collaboration for Sustainable Cities" is very relevant in today's urban-centred societies. It is one of few collaborative linkages not only between universities in the international arena, but also between universities and municipalities/city councils. This international consortium network is centred in Asia and has been growing steadily in the early years, but the Covid pandemic and other reasons have severely curtailed its activities and expansion in the last few years. The IACSC's main focus is on sustainable cities, mainly addressing SDG 11. Therefore, this book of proceedings is largely based on papers under the IACSC's main focal themes on Health, Environment and Urban Planning, with some related themes such as Disaster Management, Safety Management, Remote Sensing and Techniques in City Management, Economics, Tourism Management, Social Studies, Education and others. In the years ahead, however, in order to make future proceedings more inclusive and comprehensive, it is expected that more themes related to sustainable cities will be included. These include Climate Change, Covid-19 and Pandemic Management, Urban Agriculture, Green Design, Renewable Energy, Aging Cities, Smart Neighbourhood, Urban Sprawl, Congestion and Urban Poverty, etc.

Ngai Weng Chan (Symposium Chairperson & Editor of Proceedings)

ENVIRONMENTAL CHALLENGES IN ECOTOURISM DEVELOPMENT IN JAFFNA DISTRICT, SRI LANKA

Vipulan, P.[1]*, Ghazali, S.[1], Chan, N.W.[2], and Rahim, A.A.[2]
[1]Geography Section, School of Humanities, Universiti Sains Malaysia,
11800 USM, Penang, Malaysia.

[2]Geoinformatic Unit, Geography Section, School of Humanities, Universiti Sains Malaysia,
11800 USM, Penang
*Correspondence: vtheepa@gmail.com

Abstract

Sri Lanka is one of the fastest growing nations in tourism sector and ranked within the top ten countries. Government of Sri Lanka has taken initiatives to promote the tourism sector from time to time. As a result, tourism related facilities are well established in southern and central part of the country and tourism plays a vital role in the economy. As far as Jaffna District is concerned, development of tourism sector gained more attention from 2009 after the end of 30years of ethnic unrest. Many development activities are accelerated and more priority is given to tourism sector. It has untapped potential for ecotourism development. However, there are many challenges hindering proper utilization of these resources for ecotourism development. At this juncture, this study has been carried out to study the environmental challenges associated with ecotourism development. Thematic analysis method have been used to analyze the data obtained from focus group discussion, in-depth semi structured interview, field visit, and secondary sources. The ecotourism principles, stake holder theory have been used as the basis to conduct this study. Challenges could be identified on biodiversity conservation and protected area management, utilization of resources, environmental friendly practices, lack of environmental concern and interdepartmental Coordination among the tourism stakeholders. Challenges resulting from the perusing scenario have been taken in to consideration in formulating the strategies for enhancing environmental conservation and strengthening institutional capacity to coordinate the ecotourism related activities. Ecotourism development is new and novel to all stakeholders in the study area. Properly implementing the strategies for ecotourism development in the initial phase of tourism development will enhance the socio-economic and welfare of local people, environmental conservation and regional development.

Keywords: Ecotourism, Challenges, Environment, Conservation, Stakeholders

Introduction

Tourism is one of the rapidly growing economic sectors in the World. According to the World Travel and Tourism Council (WTTC), it generates 10.4 % of the World's Gross Domestic Product (GDP) (WTTC, 2019).The new decade's global tourism numbers and trends are growing the tenth consecutive year. Growth of all regions show a rise in international arrivals in 2019 (UNWTO, 2020). The rapidly growing tourism sector in Asia and the Pacific recorded the highest growth in arrivals and receipts. (UNWTO,

2019).Tourism sector rose out of the economic boom in the aftermath of the world wars. While boosterish prevailed in the tourism arena, limitation and damages became apparent as early as the 1970s with the degradation and the over development of paces. Thus, mass tourism was called in to question (Desbiolles & Whyte, 2014).

The global spread and diversification of tourism have produced economic and employment opportunities in many related sectors. At the same time, tourism development has put tremendous pressure and a negative impact on the natural environment. In the early part of the 1990s, the "Sustainability Concept" had been pushed forward by the United Nations Development Programme (UNDP) since the introduction of "Eco development" by World conservation strategy, and this was a strong effort to consider environmental and economic issues." (Orams, 2001). Subsequently, UNWTO had come out with guidelines and management practices for sustainable tourism to maintain a balance between socio-economic and environmental aspects (UNWTO, 2015).

Sustainable tourism practices has been promoted and more priority was given to conserving environmental resources. The environment – tourism relationship is grounded in the idea of the sustainable use of natural resources. Subsequently, Tourism is fully integrated with environmental conservation and resource sustainability (Page& Dowling, 2002). Most of the international organizations involved in environmental conservation have created guidelines and management practices for sustainable tourism. As a result, there are many types of tourism included within the sustainable tourism categories. Accordingly, ecotourism is understood as a sub-category of sustainable tourism (Weaver, 2001).

Ecotourism is one of the fastest-growing segments of the tourism industry and rising concern as one of sustainable tourism. It constitutes a niche market for environmentally aware tourist who is interested in observing nature (Page& Dowling, 2002). Ecotourism is defined as well by its benefits to both conservation and people in the host country. According to Honey (1999), "Real Ecotourism" emphasizes minimization of environmental and cultural consequences, contributions to conservation and community projects in developing countries. The emergence of ecotourism facilitates in minimizing the environmental damage associated with mass tourism. Most of the researchers and tourism-related organizations suggested adapting ecotourism to strengthen the link between conservation and sustainable development. The International Ecotourism Society (TIES) sets guidelines, standards, and technical assistance to promote the ecotourism (TIES, 2020). It is becoming increasingly popular as an alternative to mass tourism (Mondino & Beery, 2019), Most countries depending on the tourism industry move to ecotourism because of the negative impact of mass tourism. Therefore, they formulate the tourism policy to promote ecotourism. Australia is the first "region" to be presented, given its status as a world leader in ecotourism policy and planning (Fennell, 2001). Presently most of the nation adapts ecotourism as a model for future development. Such as Costa Rica, Mexico, Trinidad, Galapagos-Ecuador, Indonesia, Colombia, South Africa, and Kenya(Garcia, Orellana, &Araujo,2013), (Adeleke, 2015),(Dhar,2010).

In sustainable tourism development process, involvement of all the stakeholders have a vast potential to positively or negatively influence what is planned or being undertaken (Nicolaides, 2015, (Byrd, 2007). Therefore, "Stakeholder Theory" is being applied in ecotourism projects. The Stakeholder Participation is a way to minimize challenges or negative impacts (UNWTO, 2013). In many countries' experience, ecotourism projects have achieved a successful outcome as the result of stakeholder participation. For example, Costarica, Peru (Boronyak et al. 2010), Trinidad (Waylen, 2009), Laos

(Roche, 2009). Meanwhile, ecotourism suffered setbacks because of a lack of stakeholder participation in Maya Biosphere Reserve (Devine, 2014), Ria biosphere reserve in Mexico (Acarate, 2010) and Tanoboase Sacred natural sites in Ghana (Adom, 2019).

Sri Lanka has tremendous potential as an ecotourism destination. Tourism is one of the fastest-growing sectors and has been listed by the WTTO as one of the top 20 fastest-growing travel and tourism economic countries. Sri Lanka is a well-known Island among international tourists. It encompasses a wide variety of physical and ecologically important natural habitats (SLTDA, 2019). However, Sri Lanka's ecotourism is still not developed up to the satisfactory standards in comparison to our neighboring countries. Sri Lanka faces enormous challenges in managing ecotourism due to the lack of understanding and poor awareness of specific procedures about authentic ecotourism (Gurusinghe, 2019),(Fernando & Shariff, 2013). Sustainable tourism development is crucial to preserve the outstanding Island's natural and cultural heritage and to stabilize the economy.

Jaffna District is the study area located in the Northern part of Sri Lanka. It is reawakening from the last thirty years of protracted internal war (Balasuntharampillai, 2018). After the end of the war in 2009, priority was given to the tourism sector in the National and Provincial development plans. Development initiatives are being accelerated to provide infrastructure and service facilities to promote tourism (Northern Provincial Council, 2018). The study area has huge untapped potential for tourism. It is endowed with natural beauty such as beautiful tropical islands, lagoons with mangrove vegetation, migratory birds, wild horses, fishing sites, coral reefs, sandy coasts and pristine dune beaches, as well as historical and archeological sites, religious and cultural attractions as a tourist destination. However, it is necessary to carry out sustainable tourism practices in the initial phase of tourism development for income generation as well as to enhance and protect the environment. However, there is a lack of initiatives and academic studies regarding ecotourism development. At this juncture, this study fills the research gaps as it aims to provide new insights in the development of ecotourism. This study is focused on ecotourism development and is expected to contribute to ecotourism development and implementation of sustainable ecotourism projects in the study area.

Study Area

Sri Lanka is located in the Indian Ocean near the southern part of India. It is connected with the Indian mainland by Adam Bridge. The Jaffna district is situated in the Northern part of   Sri Lanka, and it is one of the five districts of the Northern Province. It covers an area including inland water 1012 square meter. It consists of the Peninsula and seven inhabited Islands. Jaffna district is divided into four major geographical regions. Which are Valigamam, Thenmaradchi, Vadamaradchi, and Jaffna islands. Jaffna district's land could be characterized as flat, and elevation is less than 12 meters above mean sea level (Statistical Handbook- Jaffna District, 2019). The following Figure 1 showing the location of the Jaffna District.
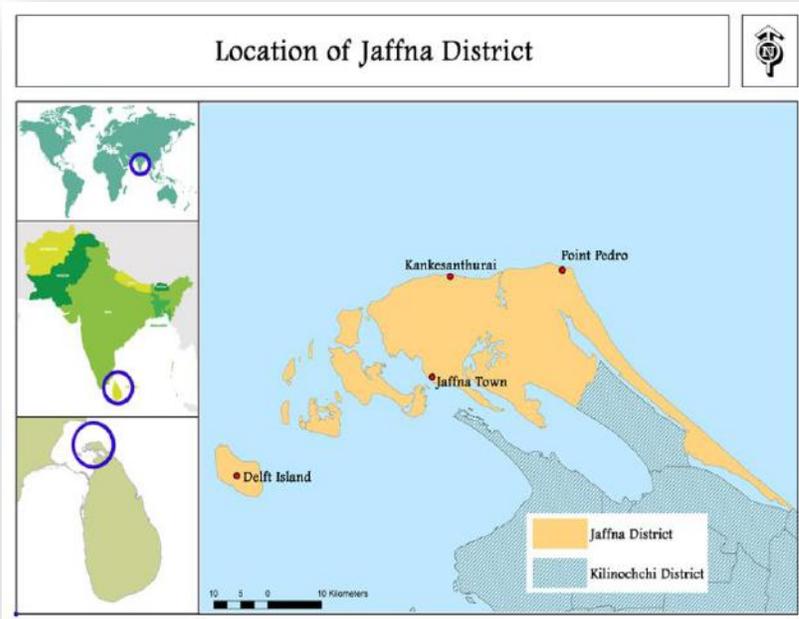
Figure. 1 : Study Area

Materials and Methods

Materials

Primary and secondary data have been used for this study. Primary data have been collected through in-depth semi structured interview, focus group discussion and field observation methods. Documents from District Secretariat and Divisional Secretariats in Jaffna, Northern Province Tourism Bureau, Sri Lanka Tourism Development Authority, and literature have been used as secondary sources of information.

In-Depth Semi-Structured Interview has been conducted to gather information from different stakeholders. The following three different types of stakeholders have been approached for this study.

➢ Officers from Government Departments (10)

➢ Non-governmental Environmental Related Organizations (10)

➢ Tourism service Providers (10)

A total of 30 officers have been interviewed. While choosing the interviewers, officer level grade staff has been selected to collect data related with challenges in ecotourism development. The selection of participants from each group was based on the Judgment Sampling method. It is an appropriate at

the initial stage. Subsequently, the snowball sampling method has been used to identify the appropriate respondent who have experience in ecotourism related administrative work. The length of the interview was 30-45 minutes.

Focus group discussions were set up where the people are living near the potential sites for ecotourism. Members of Community Based organizations (CBOs) that are functioning effectively have been selected as focus group during the first phase of field visit. Additionally, the assistance has been received from Grama Niladari in a respective area to identify the CBOs. The necessary introductory information was provided by the researcher who participated in the discussion. Field visit have been conducted to the potential ecotourism sites such as national parks, Nature reserves and coastal beaches to observe the environmental conditions.

Methods

Thematic analysis method has been employed to analyze data collected via In-Depth semi-structured interviews and focus group discussions. The following steps have been included in this analysis. Typically, interview has been recorded, and the data were transcribed in English. Then coding method has been done. Accordingly, sub-themes have been categorized.

Result and Discussion

Environmental Challenges

Biodiversity Conservation and Protected Area Management

Presently, various efforts are being taken to promote tourism sector in the study area. At this juncture, there are many environmental issues identified which will affect the ecotourism initiatives. Study area has different protected areas which have the potential to develop ecotourism. After the end of war, Chundikulam National Park, Nakar kovil Nature Reserve and Delft National Park have been declared. All these boundary demarcation was done by the Wild life Conservation department without proper consultation of stakeholders. It has created an adverse situation among the government officers as well as the public. This led to a negative impact and hindered in gaining the local people participation in environmental conservation efforts. The public made their complaint to the concerned authority to re-demark the boundary. Because of local people fear that the land utilized for their lively hood activities will be further encroached within the protected area. In this circumstance, there are barriers to carry out the ecotourism development activities. The following Figure 2 shows the boundary of protected area in the Jaffna District.
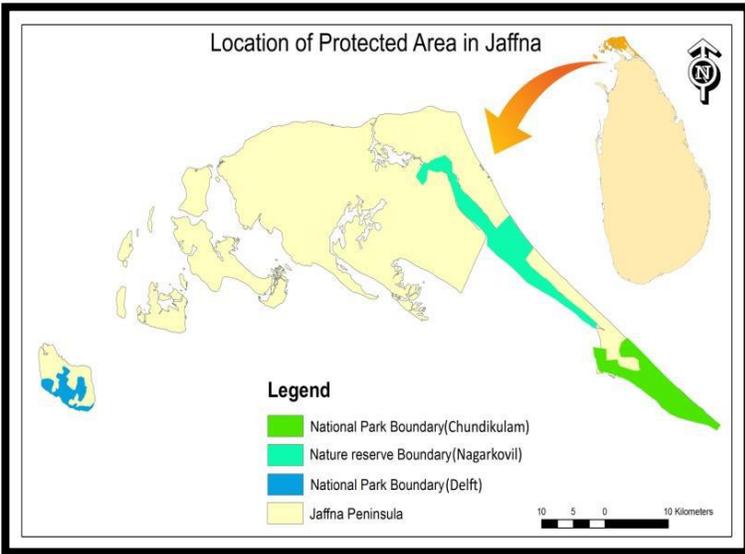
Figure 2: Protected area boundary in Jaffna Peninsula.

Further, strict restrictions have been enforced to control the public activities within the park by the wild life conservation department. But proper environmental conservation initiatives have not been taken until now. For instance, the area of wild horses is considered as an important ecotourism site in Delft Island. Here, food and water are scarce for horses, and it seems to be the major problem in drought seasons. Therefore, the death of horses 'has been reported during acute drought seasons. At this juncture, there are no active plans to sustain this habitat and supply enough food and water during the adverse drought seasons. This impact will threat this biological diversity in future by the Climate change and no measures have been taken by the respective authorities to protect the physical and biological resources within the protected areas.

Further, Chundikulam National park (Figure.3.a), Nagar Kovil Nature Reserve (Figure.3.b) and Mandaithevu Island (Figure.3.c) have the opportunities for bird watching. But there are no proper arrangement for bird watching and habitat preservation. Tourism authority face challenges to get approval from the park authority to establish basic amenities for ecotourism development. It cause for barrier to promote ecotourism along the protected area.

Figure 3: (a)

Figure 3: (b)

Figure 3: (c)

Lack of Environmental Concern among the Stakeholders

There are lacks of environmental concern among the stakeholders. Particularly, private investors are interested to invest in tourism sector in the study area. Even though the concerned authorities did not find the mechanism to guide the investors to find out the possible investment. Presently, private investors actively involved in purchasing land along the coastal site, constructing restaurant and other facilities. The private has lack of concern regarding the environmental sensitive area. As per the local people, they give priority for their economic survival than the protection of the environment. Therefore, their activities caused to damage the environmental resources. For instance: fishing people damage this coral reef while constructing the channel for fishing activities along the North coastal region (Figure 4.a). In addition, Casuarina forest in the eastern coast burn for firewood collection (Figure 4.b) and beautiful sand dunes are over mining without considering the environmental impact (Figure 4.c).The following figures clearly show the impact created by the manmade activities.

| Figure 4: (a) | Figure 4: (b) | Figure 4: (c) |

Utilization of Natural Resources

Despite the variety of resources are available for ecotourism development in the study area, tourism related stakeholders have failed to use it properly. Jaffna is a unique region for ecotourism development such as 27 Small Island including 7 inhabited Island, limestone uniqueness with geological features, climatic uniqueness, and different coastal features with traditional fishing activities, seafood attraction, various agricultural pattern and biodiversity. Here important to notice that there are lack of awareness and training among tourism stakeholders by utilizing the available resources as properly to attract the tourist. This is one of the major challenges in developing ecotourism in the study area.

Tourism plans give priority to use the Islands unique resources. For instance, the main target of ecotourism development in Delft Island is to utilize local resources by involving the local community. Especially, half of the population on this Island involve in fishing activities. But, the fishing community is not interested in reaping the potentiality. They do not realize how to use these resources to promote the ecotourism.

Further, the Palmyra trees spread abundantly throughout the entire area of the Island and there has been increasing demand for Palmyra products among the tourists in the Jaffna District. Still, the Palmyra resources have not been utilized optimally so far. If these resources use properly, it would attract the tourist with different experience to this Island.

In addition, hotels are consuming huge amount of water. The monitoring mechanism of water serving method, efficient usage of water and water treatment process, are not strictly implemented. CEA issue the Environmental protection License to the hotels. But, contribution of Environmental related government institutions are not effective. However, majority of hoteliers have effective mechanism for water usage for their own benefits.

Environmental Friendly Practices.

There are lack of initiatives among the government departments to implement the eco-friendly practices in tourism sector in the study area. But, majority of the hoteliers are interested to implement this method to full fill the international tourist expectations and face the competitive market. More than half of the hoteliers already have started to provide ecofriendly products and services. Following are some of the ecofriendly practices- reusable glass water bottle, paper straw, paper box for packing food, wooden furniture, reuse waste water for organic farming and food waste for pig farm. Most of the local people are also attracted this kind of services. But there is lack of concern to promote this kind of services among the respective government departments especially to the local authority.

Even though, private sector and non-governmental organizations are keen to promote eco-friendly practices, proper work plan has not been prepared to promote this kind of activities by the tourism related institutions. As for the local communities who are participated in focus group discussion have lack of awareness in this regard.

Further, challenges could be observed in environmental sensitive area during the hotel construction. Proper guidance has not been given by the concern authorities to adapt eco- friendly practices (eco lodges) in hotel construction. Due to this reason, construction of tourism related infrastructure cause to environmental damage. In addition, usage of eco-friendly energy sources have been insisted to minimize the impact in tourism sector. The Islands of Jaffna have great potential to utilize these resources. But the efforts to use these green energy sources go at snail's speed. Here, importance to notice that the Delft Island has been targeted to promote as an eco-friendly tourist Island. Hence, the thermal power is used to produce electricity to meet out the electricity demand of the entire Island.

Lack of Interdepartmental Coordination among Government Institutions

There are short of coordination between Geological survey and Sand Mine Bureau (GSMB), Central Environmental Authority(CEA) and Coastal Conservation Department (CCD),Wild Life Conservation Department, Forest department, Divisional Secretaries and Local authorities to carry out the environmental conservation initiative such as monitoring and protecting the sand dunes along the coast, managing the environmental sensitive area / protected area, implementing the coastal regulation and waste management activities. It can be observed that there are no concerted efforts between the environmental related government departments. This created negative consequences on environmental conservation and promote the ecotourism initiatives

Lack of Support to the Tourism Stakeholders

There are lack of support and encouragement of the local authority in environmental conservation activities carried out by the non-governmental or volunteer organizations. Some of the organization, working the activities of tree planting, coastal cleaning and solid waste management activities. Even they are interested to expand their programme, they are unable to work effectively. Because of they face difficulties by getting support from government institutions.

Hoteliers are keen to adapt proper environmental management practices such as waste water treatment and reuse the water, compost the organic waste and use for organic farming, provides gift voucher for using less amount of air-conditioning, efforts to reduce laundry water. One of the hotels in the study area implement "I like Green" programme and have idea in their 5 year plan to promote ecotourism in this region. But, tourism related institutions do not conduct regular monitoring activities and don't have programme to promote their initiatives. Due to this reason, hoteliers face difficulties to carry out this kind of practices.

Discussion

Importance is being given for the development of tourism in Jaffna District after the end of war in 2009. This thrust has actually been a milestone as far as ecotourism is concerned. This study revealed the environmental challenges in developing the ecotourism in the Jaffna District. Environmental conservation plans are being implemented in order to initiate the tourism development .However implementation of those plans seems to be going at very slow pace. Jaffna district is specific and unique in many aspects. It has various physical and biological resources. However these resources have not been tapped effectively so far. There are lack of proper training and awareness among the stakeholders. As a result, the local community has not shown any interest in ecotourism related activities. Here, it is important to notice that the people of this region trapped within the protracted war. Therefore, ecotourism initiatives are new one phenomenon. Proper guidance should be given not only to local community but also to other stakeholders in relation with ecotourism and environmental conservation practices. In addition, the role of environmental related organizations have been listed in national ecotourism policy, but their activities are limited. Further they also failed to motivate the NGOs and private sector which have interest to implement the programme to enhance the environmental condition. As a result, most of the projects in relation with environmental conservation and ecotourism development have so far failed to achieve the expected outcome. There could be observed that the "Protected Area Management" effort has not been effective without participation of local community in the study area. Thus resulting in many difficulties and hurdles to promote the ecotourism and gain the people participation. At this juncture, there are essential to formulate strategies to strengthen the institutional capacity and improve the environmental conservation measures. Accordingly, ensuring the inter-departmental coordination among environmental related institutions and tourism authorities to promote the ecotourism initiatives, preparing ecotourism zoning plan and implementing co-management activities to undertake the environmental management practices as successfully.

Conclusion

This study concludes that Jaffna District has huge ecotourism potentials. However, these potentials are currently not developed or adequately protected. Results show that there are huge challenges facing the authorities due to the emphasis given to mass tourism. The authorities should take into consideration formulating appropriate strategies for enhancing environmental conservation and strengthening institutional capacity in coordinating ecotourism related activities. Ecotourism development is new and novel to all stakeholders in the study area, and properly implementing the strategies for ecotourism development in this initial phase of tourism development will help to enhance the socio-economic and welfare of the local people, protect the environment and ecosystems, leading to sustainable tourism development, environmental conservation and overall sustainable regional development. Currently, tourism is still in its initial stage. As such, ecotourism development and environmental conservation activities should be carried out with the participation of all stakeholders in order to raise awareness levels and to avoid destroying the rich ecotourism heritage of the area. Ecotourism initiatives will not be the successful without benefits to the local communities. Ecotourism development is new and novel to all stakeholders in the study area, and should be marketed appropriately. Implementing the strategies for ecotourism development will help to enhance the socio-economic welfare of the local people, environmental conservation, and regional development and also promote the sustainable tourism practices in the study area.

Conflicts of Interest

There are no conflicts of interest in this study.

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APPLICATION OF SMART CITY CONCEPT IN PENANG: A PRELIMINARY OVERVIEW OF URBAN SAFETY ASPECTS

Ibrahim, N.[1,*], Dawood, S.R.S [2]
[1] Geography Section, School of Humanities, Universiti Sains Malaysia, 11800 USM, Penang.
[2] Geoinformatic Unit, Geography Section, School of Humanities, Universiti Sains Malaysia, 11800 USM, Penang
*Correspondence: norshabihaibrahim@gmail.com

Abstract:

The Smart City is a concept of solving urban issues intelligently. This concept is used today to improve the quality of life of urban communities so that they can live in urban areas safely through the assistance of smart applications and technology. The application of the smart city concept is very important in urban security issues because the incidence of crime in Malaysian cities is still considerably high compared to smart cities in most developed countries. Therefore, it is important to study the components found in Penang Smart city, and to analyze the real needs of Penang smart city development in terms of security, as well as the changes taking place in George Town towards making Penang an International Smart State. A mixed method approach was applied in this study: questionnaire involving 400 respondents consisting of traders, urban residents, and employees working in the Smart city of George Town; and in-depth interview involving ten key informants using purposive sampling method. These informants involved traders, authorities such as the Penang Municipal Council and the Police Department. The study found that Smart City in Penang has undergone drastic changes in terms of achievements towards making Penang a smart state by 2030. The study also found that there are five main components that are the main domains in realizing Penang as an international Smart City.

Keywords: Smart City, Urban Safety, Crime, Application, Technology.

Introduction

The smart city concept is a smart solution concept developed by the Malaysian Government in recent years. This concept is not only introduced in Malaysia, but has long been introduced in developed countries such as Korea, Dubai, Canada, Singapore, United Kingdom and others to improve the functional efficiency in a city by using smart applications and technologies (Plan Malaysia, 2019). The concept of smart city is a concept developed with the use of technology, Information and Communication Technology (ICT) infrastructure that enables the implementation of more efficient and comprehensive urban systems aimed at improving the efficiency and productivity of management in a city (Town and Country Planning, 2018). According to Zurinah Tahir and Jalaluddin Abdul Malek (2016), a smart city is a city that is highly developed, innovative, environmentally friendly and combines aspects related to the economy, technology, mobility, quality of life and other aspects that contribute to the well-being of its residents.

This implementation aims to provide smart solutions to city services in addressing issues in the city including urban security issues. A study by Cummins (1999) also emphasizes that safety becomes the measures to achieve a quality life. The concept of smart cities introduced is in line with the Sustainable Development Agenda especially the 11th agenda which is Sustainable Cities and Communities which aims to make cities and human settlements more inclusive, safe, resilient and sustainable (United Nation, 2019).

By introducing this concept can indirectly improve the lives of urban communities, especially in this era of globalization (Jamaluddin, 2005). The smart city concept implemented in Malaysia is to have 16 Policies, 36 Strategies, 112 Initiatives and 94 Indicators to make cities more competitive and on par at the international level apart from providing cooperation between stakeholders and strategic planners and enabling urban issues to be addressed (Plan Malaysia, 2019). In Malaysia, seven main domains are outlined as priority areas in the development of Smart Cities in Malaysia, namely:

1. Smart Economy
2. Smart Living
3. Smart Environment
4. Smart Communities
5. Smart Government
6. Smart Mobility
7. Smart Digital Infrastructure

However, this study only focuses on the security component in the George Town smart city area. This is because one of the issues that is a priority in the smart city of Penang is on the issue of urban security to improve the quality of life of the people such as reducing the problem of crime that is still prevalent today (Penang City Council, Engineering Department, 2020). This is due to the fact that crime in George Town is still showing high numbers compared to smart cities in other developed countries. The evidence can be seen from the statistics of criminal cases that took place over the years. The number of crimes occurring in Penang showed a decreasing trend from year to year from 5541 cases in 2017, to 5008 in 2018 and further to 4692 cases in 2019 (Royal Malaysian Police, Penang, 2020). However, this figure is still high as compared to the number of crimes in smart cities in developed countries. Things are more serious because they can cause serious injuries that can take the life of the victims (Berita Harian, 2019).

A crime is an act committed by two or more people and consenting to an unlawful act or a non-unlawful act (Legal Research Board, 2002). According to Larry (2004), a crime is a violation of social rules as interpreted in a code of law made and enacted by those with social and political power. This means that an act is considered a crime if an act violates any provision of the law or even omits an act that is required by law to do so.

There are evidence of many cases of criminal incidents such as kidnapping, murder, attempted murder, robbery of groups with firearms, robbery of groups without firearms, theft of property, rape and violent activities that caused injuries on victims (PDRM, 2019). Among the criminal activities that are threatening the quality of life of city inhabitants are murder, robbery, rape and theft (Saravanan, 2010). A study by Wan Rozali Wan Hussin (2002) proves that the occurrence of criminal cases can cause a variety of emotional trauma, loss of property, injuries, feelings of insecurity, isolation among neighbors and these degrade the meaning and expectation of a proper quality of life living in a city.

Prior to the concept of smart city, various efforts were made by the Government and non-government in helping to combat crime such as Rakan Muda Program (6MP), Caring Society Program (7MP), Social Services Program (8MP), Lifelong Learning Program, Center for Unity Activities (9MP) and Crime Prevention Through Environmental Design, Rakan Cop, Safe City Program, Crime-Free Slogan and others (Rasidah Sakip, 2011). In fact, crime is still at a high level. Overall, crime is rampant in large cities such as Kuala Lumpur, Selangor, Johor Bharu, Penang, and other major cities (Faizah, 2008). Therefore, to address this problem, the smart city concept application approach has been used to solve the problem of crime in the smart city of George Town. Careful and balanced planning needs

to be done to ensure that the quality of life in the city will always be good and in turn can increase the productivity of its citizens (Nor A'aini, 2009).

Apart from that, the real needs that need to be in the smart city of George Town in terms of security is very important for the authorities to know what are the real needs that need to be improved in smart city planning. In making a city the ideal smart, the needs of the urban population must be taken into account (Hollands, 2008). Therefore, this study is important in understanding the effectiveness of projects implemented in the development of the smart city of George Town.

Study Area

The study focuses on the George Town area of Penang (Figure 1) only because the George Town area is highest crime rate area in Penang. George Town is an area that has been improved and redeveloped by applying the concept of smart city to solve urban issues. George Town Smart City is located in the Northeast district of Penang which is a residential area, administrative center, business center, tourist center, education center and others. The North East District is a densely populated area with the smallest population with the smallest area (119 km2) compared to other districts (Penang Department of Statistics, 2020). George Town Smart City is located at coordinates 5°24′52.2″N 100°19′45.12″E / 5.414500°N 100.3292000°E. The map below shows the study area of the smart city of George Town.

In terms of ethnicity, the Chinese represented 57.9% (340.3 thousand people) followed by Bumiputera representing 22.5% (132.6 thousand people), Indians 10.1% (59.7 thousand people), and non-citizens represented 0.4% (53.3 thousand people).
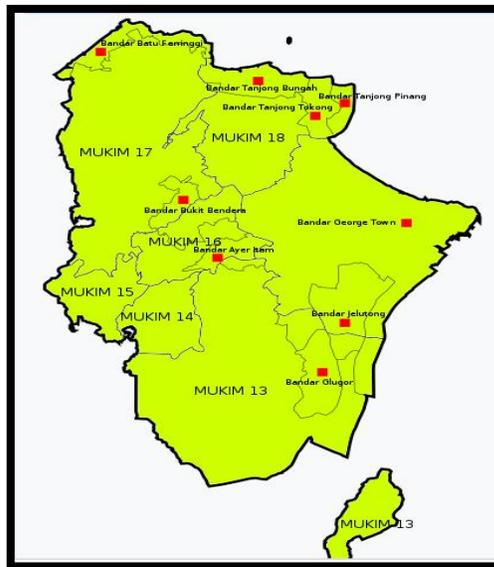
Figure 1: George Town City

Materials and Methodology

A mixed method approach was applied in this study: questionnaire involving 400 respondents consisting of urban traders, urban residents, and employees working in the Smart city of George

Town; and in- depth interviews involving ten informants using purposive sampling method. These informants involved traders, authorities such as the Penang Municipal Council and the Police Department.

Materials

To obtain information in this study, several data collection techniques were used such as preliminary surveys/pilot studies, interviews, and questionnaires (Blaike, 2000). A preliminary survey was conducted in the study area to look at security issues in the city. In addition, a preliminary survey was also conducted to look at the smart initiatives and smart technologies that have been made for the development of the smart city of George Town. Through this survey, it can provide insights and ideas to study in more in-depth. The instrument in this study including questionnaires and was followed with in-depth interviews. Before the questionnaire was constructed and distributed in the final stage, the researcher conducted a pilot study with 30 respondents first to see the value of Cronbach Alpha. The Cronbach Alpha value obtained was 0.90.

Following that, questionnaires were distributed by using purposive sampling method so that the data can be collected accurately and correctly. In the questionnaire there are closed and open questions to be marked by all respondents. To analyze the questionnaire, SPSS version 24 was used to analyze the quantitative data involving the profiles of 400 respondents. The selection of respondents are residents living in the Smart City of George Town, traders who do business in George Town such as in markets, public and private employees working in the George Town area of Penang. This is because they are more knowledgeable about the area and researchers get more accurate information. The study also interviewed residents, traders, authorities such as the Penang Municipal Council and Police Officers in the North East IPD. Data triangulation was used to increase the reliability of the study. The determination and calculation of sample size proposed by Krejcie & Morgan (1970) were used to determine the sample size of this study. According to Krejcie & Morgan (1970) the procedure for determining sample size is based on the following formula:

$$S = \frac{X2\ NP(1-P)}{d2\ (N-P)} + X2\ P(1-P)$$

S = Sample size

X2 = Chi-square Value Table for 1 degree freedom with confidence level of 3.841

N = Population size

P = Population Ratio

d = Degree of Accuracy

Methodology / framework / theory

Figure 2 below shows the conceptual framework in this study. Starting with a dense urbanization process will cause various problems including crime. With the increase in crime rates in the city, the concept of smart city was introduced to solve the problem of crime by using technology and smart applications. In this study, the community in the George Town area and the authorities such as the

Local Government, and the Police are the respondents for this study. There are three objectives in this study which is to analyze the components of George Town smart city in terms of security, second to study the real needs of George Town smart city development in terms of security and third is to look at the changes happening in George Town Smart City. The results obtained can see the effectiveness of George Town Smart City development in terms of urban security.

Figure 2: Conceptual Framework
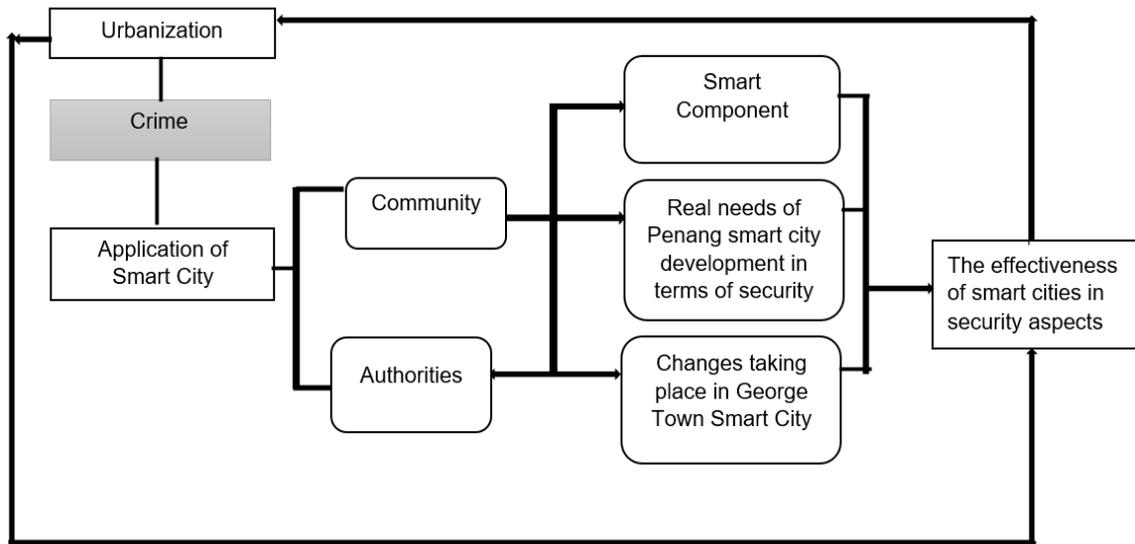
In this study, the smart city model used is the model developed by Rudolf GIffinger (2007) & Cohen (2013). This model was chosen in this study because it is very similar to the domain developed by the Smart city of Penang which is the study area. The thing that differentiates this model from the smart city of Penang is the number of domains where Penang does not have a domain of smart living as a stand-alone domain. According to interviews conducted with the Penang Local Authority, this smart living has been included in the domain of smart community, smart mobility, and smart environment.

As for crime, the Theory of Crime Prevention through Environmental Design (CPTED) is widely used to manage the administration of a city to plan the environment that is in preventing crime through urban design. According to Donoldson (2002), this CPTED is a multi-disciplinary approach to preventing criminal behaviour through environmental planning. Strategy of CPTED is to assure that by implementing an environmental design strategy will influence a person's decision to commit a crime. This is due to the accurate and effective design that can reduce the occurrence of crime and concern about crime and can improve the quality of life of the community in the city. Here it can be concluded that the selected models and theories are very much in line with the conceptual framework of this study.

Results

Result 1

The study found that the main components found in George Town smart city have five main domains namely Smart Community, Smart Environment, Smart Mobility, Smart Economy and Smart Government. This component is a smart domain that is the direction that the Government of Penang wants to achieve towards making Penang a Smart State 2030. The difference in the number of

domains between cities differs due to the condition of the city, the status of the city and the more important things to be achieved in the development of the city. Studies show that George Town is a city that is categorized as Brownfield city and does not require many other domains stand alone to be achieved in the development of Penang Smart city because it is different from the city with Greenfield city status. However, only 4 domains involve security issues namely Smart Community, Smart Environment, Smart Mobility, and Smart Governance.

Result 2

The study found that the real need for George Town smart city development in terms of security is that the majority of the community agrees with the development of technologies and applications developed by the Government and those responsible in terms of security. The study also found that the community needs free internet connection in every residential area, Smart technology awareness campaign, adding more CCTV in small alleys, reviving dead areas, crime awareness campaign, creating an IT literate community, creating technology centers in every residential area, increase the number of parking spaces in safe areas, simple and easy-to-use applications, authority monitoring in quiet and dark areas, increase lighting in small lane lanes, add Patrols, community police activities, *Rukun Tetangga* (Neighborhood Association) and add more security alarms in the city.

Result 3

The study found that the development of George Town's smart city is changing drastically and rapidly compared to other smart cities. This can be evidenced by the information on the implementation of smart initiatives that have been ready to be developed.

Discussion

Based on the objectives of the first study found that the smart city of George Town has five main domains namely Smart Community, Smart Environment, Smart Mobility, Smart Economy and Smart Government. These domains are known as smart domains which is the direction of Penang to achieve the status of International Smart State. These domains have their own objectives, themes, and aspects (MPPP, 2022). Based on the analysis of the study, there are 4 main domains identified in the aspect of urban security namely smart community domain, smart environment, smart mobility, and smart government very clearly have indicators to improve security in the smart city of George Town. Table 1 below shows the key components or domains in the security aspects of George Town's smart city.

Table 1: Smart Components

Domain (Component)	Objectives	Themes	Aspects/characteristic
Smart Community	To improve lifestyles by creating a sustainable, vibrant and superior place for the community	Quality and Productivity of life	High human development Index Racial Harmony Community Safety
Smart Environment	To create a safe, resilient and sustainable smart environment, reduce risk, improve the quality of the environment through the use of technology	Safe Resilient Sustainable	Warning System Reporting System Environmental Quality
Smart Mobility	To increase the city's effectiveness in mobilizing people and accessing data smoothly To make all components in intelligent mobility more intelligent, flexible, and compatible with the use of ICT	Flexibility Efficiency Reliability Integration Safety	CCTV Management Traffic Management Infrastructure Education & Awareness Open data, application and ICT based infrastructure
Smart Governance	To provide international standard Government services to the people	Smart Efficient Transparent Inclusive	Public participation Public services Transparent governance Strategic eGovernance Driven by data & paperless technology

Source: Field work (2022)

Table 1 above summarizes the key domains or components of George Town's smart city that cover aspects of urban security. The study found that there are 4 main domains that relate to urban security issues in solving the problem of crime that occurs in the smart city of George Town. Table 1 above has been modified according to the needs of this study by prioritizing domains related to aspects of urban security. The results of the study found that the components or domains used are different from other smart city development domains. For example, Selangor, Kuala Lumpur, Iskandar where their smart cities have their own domains from the aspect of security which is "smart living" or known as smart living. In contrast to Penang where aspects of urban security are included in smart communities, smart environments, smart mobility and smart government.

The study also found that each smart domain for a city is different. For example, Selangor has 12 main domains, Kuala Lumpur has 6 main domains. A study by Frost & Sullivan (2014) defines there are 8 main components in a Smart City namely Smart Government, Smart Energy, Smart Buildings, Smart Infrastructure, Smart Healthcare and Smart Citizens.

However, according to an interview conducted with the Town and Country Planning Officer (2021), he said this difference was due to the needs of the city. For example, George Town is a high crime area, so more sophisticated CCTV cameras have been paired in urban areas by connecting directly with the Penang Municipal Council control center and the Police (Department of Engineering, 2021). This can provide early action to the police to help combat crime by using advanced technology. In contrast to the safe city study emphasized more on aspects of the urban environment, this study focuses more on the application and use of smart technology in combating crime.

Based on the study, it is very important to observe and examine what the real needs of the community are to succeed in the mission and vision of the Government to achieve an international standard George Town smart city. This is because the local community knows more about what is really needed to further improve their quality of life and improve safety in their lives over time. Therefore, the views or urban communities are very important in achieving the government's aspiration to create safer, resilient and sustainable areas. The results of the study can be seen based on Table 2 below.

Table 2: The real needs for George Town for increasing the sense of security in the city

The real needs for George Town for increasing the sense of security in the city	Frequency	Percent
Agree with what the government has done	105	26.25
Free WIfi in all residential areas	73	18.25
Smart technology usage campaign and smart applications	48	12.00
Add CCTV in small, secluded areas	39	9.75
Revive dead areas	23	5.75
Crime Awareness campaign	21	5.25
Create an ICT literate society	21	5.25
Establish technology centers in each residential area	13	3.25
Add parking in a safe area	12	3.00
Applications created must be easy to use, and up-to-date	9	2.25
Authority monitoring in frequently visited places, and quiet and dark area	8	2.00
Add lighting in small streets/areas	8	2.00
Increase patrolling	8	2.00
Police activities with the communities	7	1.75
Neighborhood Association (RT)	4	1.00
Add more Security Alarms	1	0.25
Total	400	100.00

Source: Field work (2022)

Based on results, it is clear that the respondents strongly agree with what is done by the Government and the responsible parties which is 105 respondents (26.25 %), and followed by 73 respondents (18.25%) who suggested that the responsible party provide free internet connection in each residential area. Next is to increase the campaign on the use of technology and smart applications by 48 respondents (12%). The rest can be referred in the table above.

According to an interview conducted with MPPP 2021, Penang Free WIFi has been installed in public places such as libraries, houses of worship, supermarkets, food courts, colleges, and George Town urban areas, but its service has been terminated since February 2019 until now. However, the State Government is planning to include a free WiFi element in projects that come along with other technologies such as Smart Street Pole and others. According to the results of an interview with respondent 1, free WiFi is very important for those who live and work in George Town. This is because many things require an internet connection for survival. For example, for vehicle parking, making payments, use of smartphones, learning etc. requires a high-speed internet connection. Therefore, this need is very key to realize George Town as an international smart city by 2030.

Based on the study conducted, it was found that the development of George Town smart city has changed drastically and quickly compared to other smart cities. This can be evidenced by information on the implementation of smart initiatives that have been prepared by the Government and the authorities. For example, the addition of high powered CCTV in the city of George Town. The results of the study found that the installed CCTV has more advanced technology than before. Through this cutting-edge technology, crime in the smart city of George Town is showing a reduction. However, this study differs from the study by Berry (2018) who found that smart technology has weaknesses that can be manipulated by criminals.

The second is the Intelligent Operation Center (IOC) in KOMTAR. The IOC is a Smart operations center that acts as a command center, integrating and linking all information and subsequently processing that information such as speeding up emergency response, monitoring all activities in the city in real time through surveillance cameras and IoT tracking network. For example the monitoring of emergency calls, crime, public safety, disaster prevention, facial recognition systems, illegal parking and others.

The third is the Smart Bus Stop. This Smart Bus stop was built to reduce the risk of crime, vandalism, and snatch theft in the area around the bus waiting area. This smart bus stop has WiFi connection facility, CCTV monitoring, emergency button facility, charging service and digital advertisement display as well as bus movement schedule and route. This has been implemented since 2019 and is increasing nowadays.

The fourth is the construction of the Smart Pole. This construction has been implemented since 2018 where it can create an environmentally friendly environment and can improve public safety through CCTV monitoring in real time. The technology is also capable of lighting, with WiFi and has video analytics and LED lighting.

The fifth can be seen with the No Cash initiative. This initiative is made to provide a simple, fast and secure payment platform to the public. This is because the city of George Town is among the cities where many crimes occur such as snatch theft, violent beggars, street thugs and others (Shabiha, 2022). Therefore, with the availability of cashless payments it benefits traders and buyers to make transactions quickly and securely without having to go to the bank. The study found that almost all merchants use the initiatives and applications such as Touch n Go e-wallet, payWave, Favepay and others. This initiative is also made in Government Departments or Agencies for easy, fast and secure payment for the public with online payment methods and payment at the payment counter via e-payment.

The sixth is smart parking. This project was implemented in 2019 to encourage the use of smart applications for parking payments and be able to connect directly with local authorities. The results of the study found that the vehicle parking project can save time to find parking and can pay charges

online safely without having to queue long. The study also found that there are 12 000 parking sensors in the Penang Municipal Council.

The seventh can be seen through Fiber Forward Penang. The study found that Fiber Forward Penang is a fiber optic network installation project on the streets throughout George Town to improve the quality of internet services since 2015. This can increase high speed internet access to the people.

Based on these initiatives, it can be concluded that the development of the smart city of George Town has undergone drastic changes in terms of security. This can also be evidenced by the decrease in criminal cases in the Smart City of George Town from year to year as a result of the assistance of the use of smart technology and the cooperation of the public and the authorities. According to Pellicer (2013), a city needs to grow towards a smart dynamic infrastructure that serves the people by meeting the criteria of energy efficiency and sustainability from all aspects.

Conclusion

Based on the above analysis, it can be concluded that the development of George Town smart city is important in solving security issues in the city today. The components found in the George Town smart city and the initiatives that have been implemented by the authorities coincide with the need to make George Town an international-class smart city by 2030. George Town Smart City changes are drastic based on the results of initiatives and projects that have been implemented. Therefore, the cooperation of all parties whether the community in the area as well as the authorities is very important in realizing the vision and mission of Penang as a smart state of international standard by 2030. This is because urban security is very important for city inhabitants to live and work in an environment that possesses a high quality of life that is safe and smart in all aspects.

Acknowledgement

Conflicts of Interest

There are no conflicts of interest in this study.

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STUDY ON THE INFLUENCE OF ENGO ON THE SITE SELECTION OF POLLUTING ENTERPRISES BASED ON "PX EVENT IN KUNMING" AND "PX EVENT IN XIAMEN"

Jiao, Y.J.[1,*], Shen,J.[2], Tan,M.L.[1] and Nooriah, Y.[1]

[1] Geoinformatic Unit, Geography Section, School of Humanities, Universiti Sains Malaysia, 11800 USM, Penang.
[2] School of Geography and Planning, Sun Yat-Sen University, Guang Zhou, China,510260,SYSU,Guangzhou.
*Correspondence: jiaoyijuan@student.usm.my

Abstract

Disputes caused by environmental problems have increasingly become a new factor easily leading to Group Events after land acquisition and demolition that is contradictory in the accelerating background of China's industrialization and urbanization. As a third-party, environmental non-government protection organizations (ENGOs) that influence government and corporate environmental behavior through organizing environmental activities to affect environmental governance has become increasingly important. However, the research on how ENGO impacts the industrial development is still relatively scarce in the literature of current economic geography. From the perspective of economic geography, this paper comprehensively analyzes the domestic and international ENGO impact on industrial development on the basis of literature review, particularly in analyzing the impact of environmental non-government organization on polluting enterprises location by adopting the environmental agreement and shareholders theory. This paper takes "Xiamen PX Incident" and "Kunminganning PX Incident" as the study cases, adopts the semi-structured interview research methodology, and explores how ENGOs intervene the location of polluting enterprises and the relationship between rights and interests behind through analyzing the ins and outs of the matter comprehensively. The methodology also includes comparison and analysis of similarities and differences of ENGO environmental agreements between these two events, analysis on ENGOs' influencing factors on the location of polluting enterprises, and finally putting forward the ENGO strategy on the location of polluting enterprises based on the case comparison and influencing factors analysis, and combined with China's specific national conditions. Results show that the issues of polluting enterprises location is not only the problem the government and enterprises concerns, but also the government, enterprises, experts and scholars, ENGO, the public and other parties involved in environmental and social issues of common concern. The power and interests behind the location decisions are very complex. Whether ENGO takes oppositional or cooperative environment cooperation agreements, it can bring some influence on the location of polluting enterprises, however, the fundamental rights, including the right to participate in and the influence on decision-making, is the key to resolve the conflict. This paper also proposes that only ENGO put the negotiation process into proper area, it can effectively undertake the environmental agreement. Generally speaking, although the participation of ENGO in environmental decision-making and the impact on government and corporate environmental behavior is still limited, it still has some impact on the government and corporate environmental behavior and also plays a certain part in the location of polluting enterprises.

Keywords: Environment non-government organization, Environment agreement, PX Incident, Polluting enterprises

Introduction

Since the middle of 20 century, ENGOs have increased quickly and promoted the global environment movements with public environmental awareness's enhancement. The first ENGO was found in 1994 and then ENGOs have developed. Environmental pollution and ecosystem damage have become serious problems in China with the development of industrialization and urbanization since the reform policies and opening of the Chinese economy (Wang et al., 2020; Yu et al., 2021).

ENGO can incorporated into localized bargaining process as voices that claim resources from an environmental perspective environmental bargaining is interpreted distinguishing between bargaining parties and their power forms of bargaining and spatial dimensions of environmental strategies (Cao et al., 2019). Environmental bargaining (EB) is the agreement process used by environmental activists. Environmental bargaining processes and their outcomes can be evaluated by measuring the distribution of power between actors and the potential for conflict that is reflected in the strategies that are used.

P-Xylene (PX) is a dangerous chemical in the production plastics. PX is very harmful to the environment and human health. China is the largest manufacturer of P-Xylene, or PX projects. Recently there have been public boycotts and protests for the establishment of PX projects (Sun & Huang, 2020). From 2007 to 2015, environmental group events against the building of PX production plants have occurred frequently in seven cities: Xiamen, Chengdu, Dalian, Ningbo, Kunming, Maoming & Shenyang (Sun & Huang, 2020; Yu et al., 2021).

The research question is as following: 1) How do ENGOs of environmental bargaining (EB) of the locations decision-making of pollution-intensive enterprises (PIEs) take place? Specifically does environmental bargaining theory partially explain some choices of PIEs?

Study Area

This research chooses the two cases which are from Xiamen and Kunming (Figure 1) to analyze the Environmental bargaining process of the location decision-making of PIEs. Why choose the two cities?

1) Different location conditions;

2) Coastal area and inland area;

3) Different economic development level.

4) Different enterprise characteristic: new and old;

5) Outcomes of environmental events: relocation and maintaining the site.

The two cases are located in different area, Xiamen is in coastal area and Kunming is inland area. There are two reasons for choosing these two cities, the different location conditions, the different enterprise characteristic and the different outcomes created by the environmental events.
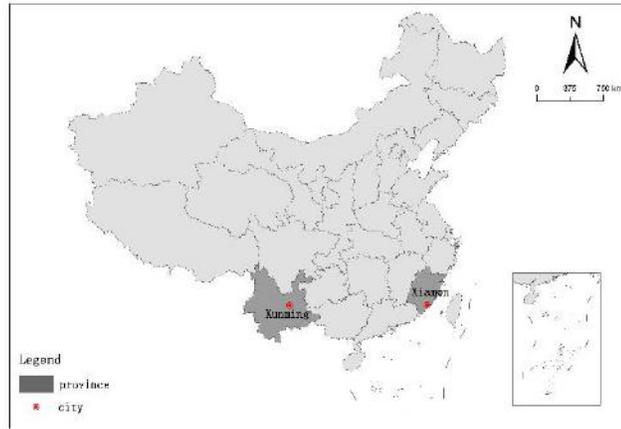
Figure 1: Study area

Methodology and Theory

Materials and Methodology

The research method of this paper mainly adopts the research method of semi-structured interview. The interview is divided into the following two stages. Specifically, the initial stage is ranging from January 2016. We were stepping to Kunming's government environmental protection department, local ENGOs Association, Kunming Daily and Sinopec Yunnan Branch. In the second stage, from February 2016, researchers went to Xiamen for investigation through investigating the successful case of the event. The interviewees included government departments, enterprises, ENGOs, citizens, journalists and other stakeholders etc. The specific interview contents and sample numbers are as follows, in which the interview samples basically cover all stakeholders in the two cities. Nevertheless, there are two issues in the research and interview of the paper as follows: the initial is that there is a certain time interval before the event happens, and researchers have learned about the event by recalling the interviewees; the other is that this kind of mass event itself is quite special. Meanwhile, the information was confusing, and rumors and truth were mixed with each other. After the event, their perspectives and attitudes towards other people were also different because of their different positions, perspectives of different stakeholders. Owing to their personal tastes and aversions, the authenticity and objectivity of the interview content would also be significantly affected. Therefore, this paper also collects a large number of relevant news reports, online forums, Weibo, WeChat and other related reports in the era of online media, as well as the work reports and documents of government departments and enterprises collected in the investigation, so as to truly understand the event context and the roles and functions of ENGO, government and enterprises in the process of environmental agreement, focusing on analyzing how ENGO changed the location of polluting enterprises through environmental agreement, and conducting a comparative analysis of two cases, aiming at discovering the geographical factors that affect the location of polluting enterprises by ENGO in various regions. The design of the interviews is shown in Table 1 as follows.

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Table 1: Research design of half-structured interview

Interview Object	Interview Content	Sample Size
Government Departments	Overview of local environmental protections Reasons for PX project participation Measure effectiveness of solutions managing environmental conflict	10
Enterprises	Measure effectiveness of solutions that deal with environmental conflict	6
ENGOs The Public organization	Overview of local ENGO Measure effectiveness of solutions that deal with environmental conflict	52
Other Participants	How to view the PX project and environmental conflict? How to review measurements of solutions proposed by government, enterprises, and ENGOs	10

Theory

Environmental bargaining (EB) is the agreement process used by environmental activists (Table 2). Environmental bargaining is a special way of current environmental governance. Its definition varies from country to country or region. The German environmental protection agency defines the environmental protection bargaining as "a binding bargaining or a non-binding bargaining in the economic field designed to protect the environment, in order to achieve environmental goals, to reduce environmental burden activities or to terminate environmental burden activities". Environmental bargaining as defined by researchers refers to polluting companies making promises to the government and society, via agreeing to carry out environmental governance by the company. The conceptual interpretation of the environmental sector of the European Union points out that organizations, including enterprises and groups, make environmental commitments to public rights agencies (including governments) through negotiation and negotiation (Julia Affolderbach,2012).

Table 2: Corresponding relationships among the elements of EB

Bargaining Stage	Bargaining Power	Bargaining Strategies	Bargaining outcomes
High-conflict	Dominating party leads	Informal / violence, boycott	Weak party compromises
Transition	Dominating party＞weak party	Informal, formal / market, negotiations	Respect the weak party's opinions, but the decision-making right is controlled by the dominating party
Low-conflict	Balance of power	Formal / cooperative negotiations	Two parties reach an agreement

Results

Different parties to the agreement represent different interest demands. According to Stakeholder Theory, the key stakeholder in two cases in EB was the local government and PIEs. With respect to bargaining power, public and ENGOs, have less power, but high interest. The key EB relationship was between local government and ENGO who was the representative of the public in China. The government and the corporate headquarter would give the stress to the local government and PIEs respectively (Cao et al., 2019).

The ENGOs in Xiamen include several groups (listed on the slide, was a temporal organization) while those in Kunming included different groups.it has a temporal community organization led the event. The other important actors in Xiamen included membership of deputies of the National People's Congress (NPC) as well as experts and scholars (Deng & Yang, 2013).

In the decision-making of polluting enterprises by ENGOs using environmental agreements, the agreement parties mainly include local governments, enterprises, local residents, ENGOs and other interested parties (such as experts, journalists, etc.), and the interests and powers of each subject are different. Among them, local governments and enterprises, as key stakeholders, control resources and obtain direct economic benefits from decision-making, and have great power of agreement, which is in the dominant position of agreement. The demands of government and enterprises for economic interests make it easy for them to form a community of interests (Cao et al., 2019; Steinhardt & Wu, 2016). Local residents and ENGOs have the characteristics of high interest demands and low power, and they are also stakeholders who have no economic profits and do not control resources, hence they are in a lower position in the agreement.

In the mentioned above two cases, local governments and enterprises, as key stakeholders, have relatively large power of agreement, while the power of other subjects is weak, and the degree of acceptance is different since the rationality of expression of environmental demands is also various (Lang, 2013). In the "Xiamen Event", members of the Chinese People's Political Consultative Conference (CPPCC) and deputies to the National People's Congress (NPC) participated. They questioned and concerned the rationality of PX project site selection through official channels in the form of "CPPCC proposal". Because the CPPCC has the functions of democratic supervision over the government and participating in the administration of state affairs, it has certain power constraints on local governments, and these experts have extensive professional knowledge compared with ordinary people. For instance, they dare to doubt whether PX project site selection does not conform to the site selection specifications of polluting enterprises. The location is too close to the city center and residential areas, and the proposal of the CPPCC explicitly requires a regional environmental impact assessment of the project (Sun & Huang, 2020). These demands are based on professional knowledge and finally accepted by the local government. Comparatively speaking, ENGO lacked the participation of experts, scholars and other groups in the Kunming event, and its environmental appeal was vague to a large extent. Although it was thought that it was located in the upwind of the city for the aim of opposing PX project, and the polluted gas would affect the public health of urban residents with the atmospheric flow, the PX project was not established at that time, and the location of the enterprise was more than 40 kilometers away from the urban area, which was far greater than the requirements of relevant regulations (Wang et al., 2020). Afterwards, due to the deterioration of relations with the government, the environmental appeal evolved into opposition to Kunming oil refining project, which was eventually not accepted by the local authorities. In addition, although there were no experts, scholars and other groups involved in the Maoming event, the development of the early chemical industry led to serious air pollution and demonstration effect in the city, and the environmental appeal was widely embraced by the local citizens (Liu et al., 2014; Yu et al., 2021). Ultimately, the consequences of the environmental event prompted the local petrochemical company to take strict measures to grasp the sewage disposal project and strictly monitor various sewage discharge indicators, and made a promise that if the monitoring indicators were unqualified,

It must be acknowledged that an ENGO plays an organizational role in environmental agreements, and it is affected to different degrees by the differences of its contents in environmental agreements. "Xiamen 611 Environmental Volunteers Alliance" and "Embrace Xiamen's Clear Water and Blue Sky" are environmental protection alliances formed temporarily by Xiamen PX Event. Xiamen GreenCross Association was formally registered in August 2007 and has become an influential environmental protection organization in Xiamen. This ENGO is committed to promoting enterprises' participation

and concern for environmental protection, urging enterprises to take social responsibility, and training a large number of outstanding environmental protection talents for the country (Liu et al., 2014). In the Kunming event, the ENGO organization was mainly composed of two local organizations, namely "Green Kunming" and "Green Watershed", which were established in June 2006 and August 2002, respectively, but the public's acceptance of local ENGO was not high. However, although China's ENGO has the above characteristics, it is significantly tough to play the role of the leader of environmental agreements. According to the relevant research, it is mainly due to the limited organizational capacity and weak influence of China's ENGO. The vast majority of the citizens in the survey said that they didn't even know the existence of ENGO (Wang et al., 2020; Yu et al., 2021).

Furthermore, it must be admitted that the influence of external power subjects is also significantly important. For instance, Xiamen event has raised the attention of Fujian provincial government and the State Environmental Protection Administration, and exert considerable pressure on local governments (Figure 2, Figure 3, Figure 4 and Table 3).
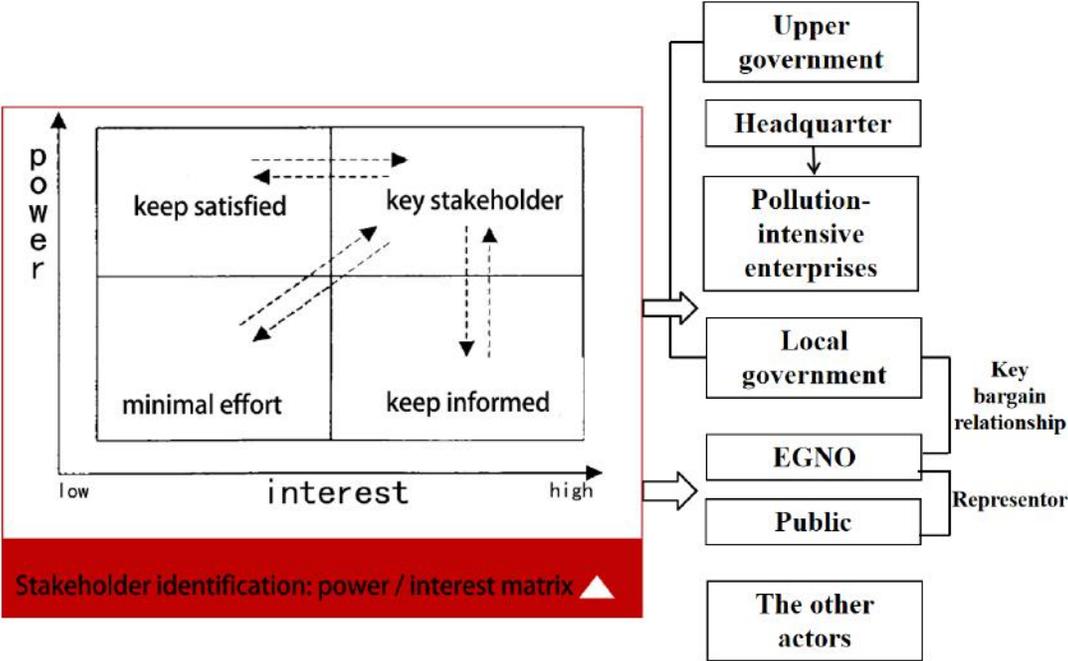
Figure 2: Bargaining power framework

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Table3: Bargaining Power comparison of two cases in EB

	Xiamen	Kunming
Enterprises	Cooperate with government; Conduct active dialogue with the public	Conceal truthful information; Pay some people to support PX project demonstration
Government	Positive response; Strive for communication;	Negative response; Severe blow (suppression) in the first stage;
ENGOs	Protest of Xiamen 611 environmental volunteer alliance; Gather the rally walk parade;Participate in the EIA Forum;	Green river, green Kunming etc.Dialogue; Participate in investigation; Attend the meetings with government and enterprises ;
The other actor	Deputy to the People's Congress; CPPCC member; specialist; the media	The media

Figure 3: Xiamen "PX event " EB outcome
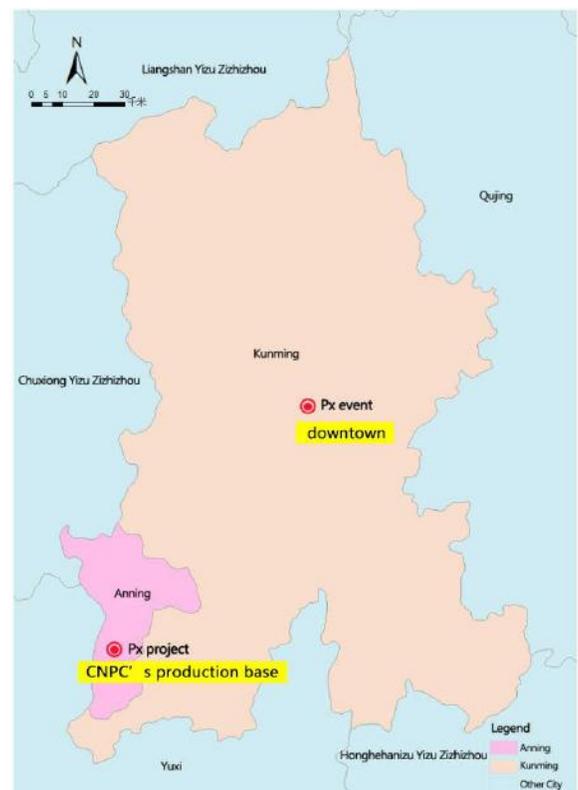
Figure 4: Kunming "PX event " EB outcome

Discussion

For two cities, the ENGO events began as informal high-conflict strategies with demonstrations and parades. Then formal low-conflict strategies work with symposium and negotiation. The process of EB is accompanied with local government's attitude changing from coercion to negotiation, enterprise attitude turning confrontation to collaboration. That is because the power of ENGOs in EB increased though the informal strategies (Deng & Yang, 2013; Yu et al., 2021).

Figures compared the informal and formal EB strategies of two cities. In Xiamen and Kunming, the bargaining evolved to be low-conflict (Table 4 and Table 5). They entered the transition stage to negotiate with government and enterprises, government accepted the result of public vote in symposium and the project relocation. However in Kunming, the strategies did not evolve. Government reduced public attention by stonewalling and the project was built in original place (Jian & Chan, 2016).

The strategy refers to the collection of all kinds of formal and informal activities taken by people or in the process of ENGO environmental agreement. Frankly speaking, the choice of environmental strategy is closely related to the status of people or ENGO, while the power relationship changes with time. Environmental strategies generally originate from confrontation and conflict, and then change towards negotiation and cooperation, namely the process of changing from informal game to formal game (Affolderbach, 2011). In the process of informal game, due to the large environmental conflicts among various subjects, the power status of the people and ENGO is relatively low, mainly through direct protection activities, indirect market resistance, and street protests, etc. The informal forms of activities enhance the social influence of the people and ENGOs, and then enter the formal game stage. The form of agreement changes mainly to cooperation, and the forms mainly include negotiation and consultation, joint participation in decision-making, joint decision-making, etc. The result of environmental agreement is conducive to the consensus of all parties, and ultimately achieves the expected effect (Lora-Wainwright et al., 2012). Every actor behaves differently in different strategic stages (Figure 5).

The environmental agreement strategies in the two events mentioned above all started from informal games. The two parties to the agreement mainly formed an economic interest community by the government and enterprises, and environmental interest groups dominated by the people and ENGO. Owing to the antagonistic relationship between the two, the people took informal agreements such as rallies, street parades and street walks to fight and exert pressure. In "Xiamen event", ENGO initially organized a street parade, and the government finally detained the main parade organizers (Chen et al., 2021; Wang et al., 2020). While in "Kunming event", ENGO and government and business leaders asked to publish the environmental assessment report, which was also rejected because of the confidentiality involved. Consequently, a street parade involving 3,000 people was successfully organized, during which the police clashed with the people.

In the above-mentioned two cases, as the demonstrations and organized by the people were reported by the media, the superior government focused on them and exert pressure on the local government, and the attitude of the local government changed, and it began to enter the formal game stage with cooperation and consultation as the main factor (Steinhardt & Wu, 2016). At this stage, the government took the initiative to hold a forum, inviting people, experts and ENGOs organizations to participate in the consultation and decision on the location of PX project, and enterprises also actively cooperated with the forum led by the government. In the "Xiamen event", because the environmental assessment report provided by a third-party environmental assessment agency eventually pointed out that it was not suitable for building a chemical industry here, the local government took the initiative to invite all social parties and media representatives to carry out an open and fair decision-making

process, and invited the "Embrace the Blue Sea and Blue Sky in Xiamen" organization to supervise the decision-making process. In addition, it also guaranteed the fairness and openness of government affairs through the use of open procedures and live media broadcasts (Sun & Huang, 2020). Ultimately, in accordance with the voting results of two rounds of symposiums, it is suggested to relocate PX project, and the attitude of enterprises has also changed. The slogan of "taking environmental protection as one's own responsibility" is proposed and the decision result is finally accepted. In "Kunming event", although the government publicly pronounced that it would conduct PX project on the basis of respecting the public opinions, and try to eliminate the social adverse effects brought by the event, but in the end PX project was still under way quietly (Yu et al., 2021).
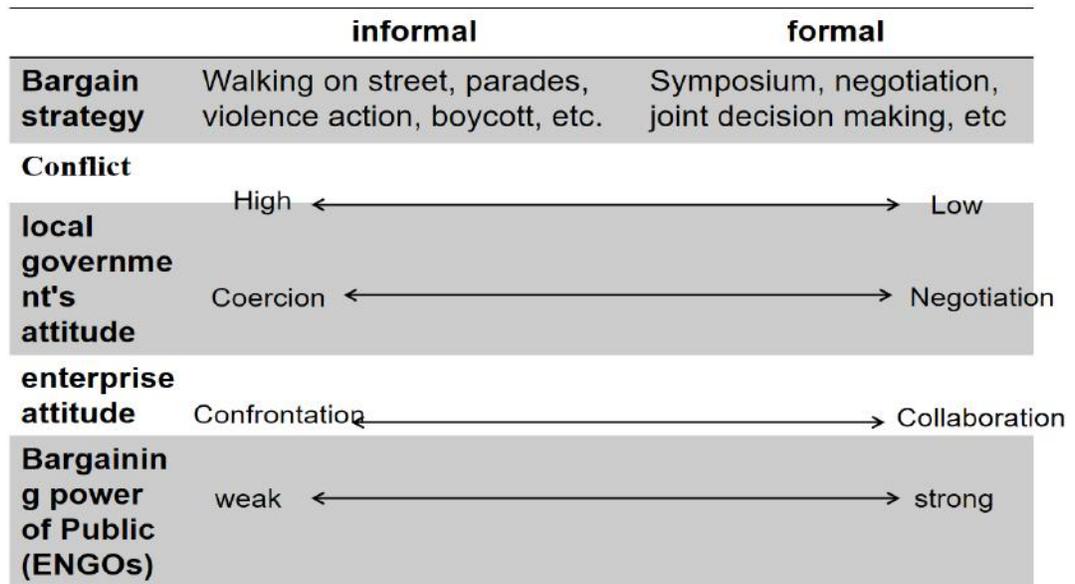
Figure 5: Environmental bargaining strategies framework

Table 4: Comparison of different bargaining strategies in two cases

		Xiamen	Kunming
Informal	ENGO Government	Gather the walk parade Threat leader of ENGO at first No violent conflict in Parade	Organize two street parades Round up the mess;Demolish the shed of resident in factory site
formal	Government	Publish information through the local newspaper Held a special symposium by inviting ENGO participate in Organizations	Held a symposium to show respect for public opinion.Reduce public attention by stonewalling
Joint Decision-making		Respect the result of public vote in symposium The project relocation	The project has been built in original place

Table 5: The comparisons of reasons for bargaining outcomes between Xiamen and Kunming

	Xiamen	Kunming
EB Power (power, interest and influence)	Multiple identities of the local ENGO participants with higher power status	Single identity of the local ENGOs with relatively weak power
EB Strategies(high-conflict to low-conflict)	High-conflict at first; Low-conflict at last	High-conflict at first; Not enter the low-conflict stage
Regional Environment (economic, institutional, culture, citizen quality and historical tradition, etc.)	Socio-economic condition well developed;Open social culture High civic consciousness	Socio-economic level developing area Conservative social culture, Weak civic consciousness

Conclusion

This study found that ENGOs can have a significant impact on the location of polluting enterprises through informal (non-cooperative) and formal (cooperative) environmental agreement countermeasures, and different environmental agreement strengths and agreement countermeasures produce different agreement outcomes. There is a correlation between the way of ENGO environmental agreement and the potential of environmental conflict. ENGO's own power advantages (the amount of key resources, the right to participate in the decision-making process, and the influence of decision-making) are the key to resolving conflicts. Furthermore, the environmental agreement itself can only be properly understood by placing the environmental agreement process in its global and regional context. Because there are differences in institutional environment, social culture, historical factors, individual roles and external influences in different regions.

Acknowledgement

Conflicts of Interest

I declare any conflicts of interest or state "there are no conflicts of interest in this study".

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EXTRACTION OF LAND SURFACE TEMPERATURE USING TIME-SERIES SATELLITE IMAGE AND ITS RELATIONSHIP TO LAND USE: HOT SPOTS AND COLD SPOTS

Onishi, A. [1,*], Ichinose, T. [2] and Tsai, P. [3]
[1] School of Data Science, Yokohama City University.
[2] National Institute for Environmental Studies.
[3] Global Cooperation Institute for Sustainable Cities, Yokohama City University.

*Correspondence: onishi@yokohama-cu.ac.jp

Abstract

The heat island phenomenon is caused by an increase in the artificialization of land use and cover inside the city. It is also known that promoting natural land use and land cover is effective in mitigating temperature increase. In this study, using summer time-series data for the Tokyo metropolitan area, chronic hot spots and cold spots of the land surface temperature (LST) were extracted using the spatial statistics method. Then, the spatial characteristics of these hot spots and cold spots were statistically analyzed in relation to land use. Upon calculating the correlation coefficient between LST and each land use area ratio in the entire metropolitan area, only forests and wasteland showed a negative correlation. The correlation coefficient between the LST and each land use area ratio in the chronic hot spots tended to be different from that in the entire Tokyo metropolitan area, and a negative correlation was shown for rice fields, other agricultural land, forests, rivers, lakes and marshes, sea areas, and golf courses during most of the period. This indicates that in chronic hot spots, the LST tends to decrease as the area ratio increases. Finally, the relationship between LST and land use was analyzed using a multiple regression analysis for chronic hot spots. This shows that paddy fields can be expected to mitigate LST, while an increase in building land and other land may contribute to an increase in LST.

Keywords: Hot spots, Cold spots, Time-series land surface temperatures, Land uses

Introduction

It is widely known that the cause of the heat island phenomenon is exacerbated by land use (LU) and artificial land cover (LC) inside cities. It is also known that promoting natural LU and LC (LULC) is effective in mitigating temperature increase.

There are many existing studies on the heat island phenomenon targeting the Kanto region or Tokyo metropolitan area, such as Kondo et al. (1993), Takayama (2001), and Harada (2003). When analyzing this phenomenon, satellite images are often used as information on land surface temperature (LST), vegetation, and LULC, among others. Hung et al. (2006), Cao et al. (2010), and Onishi et al. (2010a) are examples of the analysis. Recently, Yamamoto and Ishikawa (2018) and Uchida et al. (2017, 2018) used LST information from the geostationary meteorological satellite Himawari-8, launched on October 7, 2014. Himawari-8 has improved temporal resolution, so it is possible to observe the area of Japan every 2.5 min and analyze the state of the LST throughout the day. However, most of the existing studies deal with a certain time or diurnal variation, and not many studies have investigated the relationship between time-series LST characteristics and LULC over a specific period, such as summer. Onishi and Morisugi (2011) analyzed the mitigation effect of the urban heat environment by planting greenery in unused areas by using satellite LST data for nighttime

in summer as well as daytime in each season. However, the LST data used were certain time data for each season, not continuous time-series data.

The Moderate Resolution Imaging Spectroradiometer (MODIS) stored on Terra is a polar orbiting satellite that can only be observed once or twice a day and night (Uchida et al, 2018). Using multiple satellite images from August, it is possible to determine the characteristics of continuous LST. Using this information, hot spots with chronically high LST and cold spots with chronically low LST can be extracted, and their relationship with LU can also be determined. For example, the LU improvement method for effectively carrying out temperature mitigation in hot spots can be examined. Onishi et al. (2010b) and Onishi and Maezaki (2014) analyzed the relationship between LST and LULC or LC using the geographically weighted regression which is one of the spatial statistical methods. However, this study did not identify chronic hotspots or cold spots.

In this study, using time-series data from the summer of 2020 for the Tokyo metropolitan area, chronic hot spots and cold spots of the LST were extracted using a spatial statistics method. Then, the spatial characteristics of these hot spots and cold spots were determined from their relationship with LU.

Data used and analysis methods
Data used

We used the "MODIS/Terra Land Surface Temperature/Emissivity 8-Day L3 Global 0.05Deg CMG V006" (Wan et al, 2015) dataset for four periods of August 2020. The details of the data are provided in Appendix (1). Data from July 27, 2020 to August 3, 2020, were excluded because they contained missing values. We also acquired LU data from the National Land Numerical Information (Appendix (2))". To extract the above LST and LU data for the metropolitan area, the numerical data of national land "administrative division data (2020)" were also used (Appendix (3)). The Tokyo metropolitan area covers one capital and seven prefectures (Tokyo, Kanagawa, Saitama, Chiba, Ibaraki, Tochigi, Gunma, and Yamanashi), referring to the application range of the "Capital Region Improvement Act" (Figure 1).
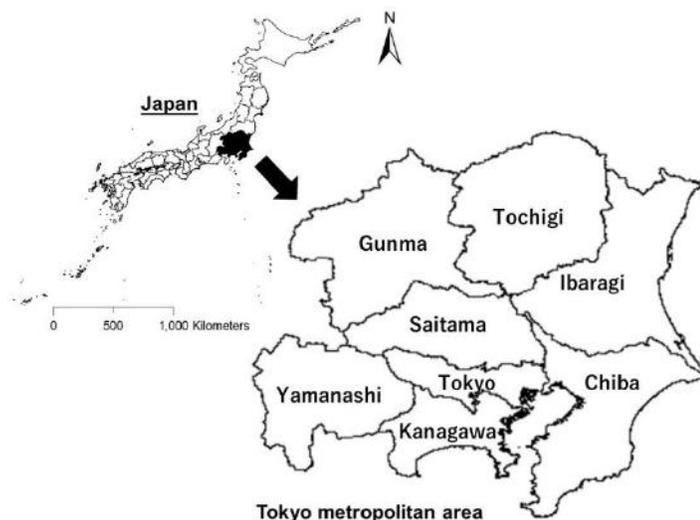
Figure 1: Tokyo metropolitan area

Analytical method

First, after obtaining the LST data, they were converted into Celsius temperature data. Second, to analyze the relationship with the LU tertiary mesh data, a unified grid was arranged, and the LST and LU data were aggregated. Here, the grid was made to be 0.05° in proportion to the LST data, and the LST and LU data were aggregated in this spatial unit. Third, hot and cold spots were extracted every four periods using spatial autocorrelation analysis. Hot and cold spots that appeared in common in all periods were labeled as chronic hot and cold spots respectively (in August 2020). This study arranged the LU characteristics of chronic hot and cold spots and compared the result of the correlation between LST and LU of the entire Tokyo metropolitan area and the result of the correlation of hot and cold spots. By this comparison, the spatial characteristics of hot spots and cold spots can be determined from the relation with LU.

In this study, two different methods of spatial autocorrelation analysis were applied to the LST data. One of the examples of using spatial autocorrelation analysis, You et al. (2021) studied the spatial pattern of urban heat island targeted in the Fuzhou central area of China by Moran's I and hotspot analysis (Getis-Ord Gi∗). This study applied local Moran's I to extract hot and cold spots instead of using the Getis-Ord Gi∗.

(Global) Moran's I is an index that includes elements of the spatial weighting matrix in the correlation analysis. (Global) Moran's I, similar to the correlation coefficient, takes a value between −1 and + 1 (Equation (1)). When it is close to + 1, positive spatial autocorrelation is strengthened by the adjoining meshes with values close to each other. In contrast, when it is close to −1, the negative spatial autocorrelation becomes strong because the values of the neighboring meshes are different, or the meshes with close values are dispersed.

$$(Global)Moran's\ I = \frac{N}{\sum_{i=1}^{N}\sum_{j=1}^{N}w_{ij}}\frac{\sum_{i=1}^{N}\sum_{j=1}^{N}w_{ij}(x_i-\bar{x})(x_j-\bar{x})}{\sum_{i=1}^{N}(x_i-\bar{x})^2}$$

(1)

Local Moran's I measures the local spatial autocorrelation within the target area. Although (Global) Moran's I shows the degree of pattern in the entire target area, it has the disadvantage that local clusters cannot be detected. Therefore, Anselin (1995) devised a local Moran's I calculated for each observation point in the target area, showing the peculiarity of comparing the values obtained at each observation point with the surrounding observation points.

In an object area consisting of *N* meshes, the mesh of area *i* is denoted as x_i. The average value of the mesh in the whole area is shown as $\bar{x}$, and the element of the spatial weighting matrix between the meshes *ij* is shown as w_{ij}. Local Moran's I means local spatial autocorrelation, and Moran's I value is calculated for each mesh (Equation (2)).

$$Local\ Moran's\ I = \frac{(x_i - \bar{x})}{\frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2}\sum_{j=1}^{N} w_{ij}(x_j - \bar{x})$$

(2)

Results
Results of spatial autocorrelation analysis

Table 1 shows the results of (Global) Moran's I values. The (Global) Moran's I value is close to +1 in any period, which indicates the clustering of meshes with high LST and meshes with low LST.

Table 1: (Global) Moran's I values

	(Global) Moran's I value	Z Score	p-value
August 4–August 11	0.85	45.39	0.00
August 12–August 19	0.87	46.57	0.00
August 20–August 27	0.85	45.33	0.00
August 28–September 4	0.83	44.32	0.00

Concept: Inverse distance,   Distance calculation method: Euclidean, Distance threshold: 7,114.7,586 m

Using Local Moran's I, hot spots and cold spots were extracted for four periods. The mesh in which these spots were extracted during the entire period was named as "chronic hot spots" or "chronic cold spots".

Figure 2 shows the results of the extracted chronic hot spots and cold spots. As a result, hot spots were identified in 23 wards of Tokyo, the eastern part of Kanagawa Prefecture, the southern part of Saitama Prefecture, and major cities in other prefectures. In contrast, the cold spots were identified in mountainous areas as well as in locations with high green cover, such as forests.
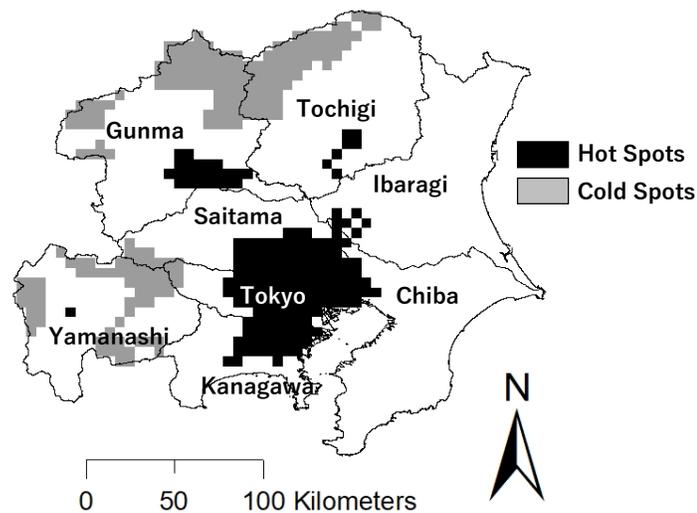
Figure 2: Identified chronic hot spots (black) and chronic cold spots (grey)

Relationship between LST and LU

Table 2 shows the results of the average LST for chronic hot spots and cold spots. The average LST of the chronic hot spots was approximately 37 °C; that of the chronic cold spots was approximately 23 °C; the difference between them was approximately 12–15 °C.

Table 2: Results of mean land surface temperatures of chronic hot spots and chronic cold spots

	August 4– August 11	August 12– August 19	August 20– August 27	August 28– September 4
Hot spots （*N*=174） Average LST	37.27 °C	37.84 °C	36.98 °C	35.98 °C
Cold spots （*N*=203） Average LST	24.22 °C	23.11 °C	24.54 °C	22.56 °C

Figure 3 shows the LU characteristics within the chronic hot spots and chronic cold spots. It was found that the ratio of artificial LU, such as building land, was high in chronic hot spots. In addition, paddy fields, other agricultural land, forests, rivers, lakes, and marshes existed in a certain proportion of the chronic hot spots. In the chronic cold spots, the proportion occupied by forests exceeded 90%, whereas that of wasteland was approximately 3%.
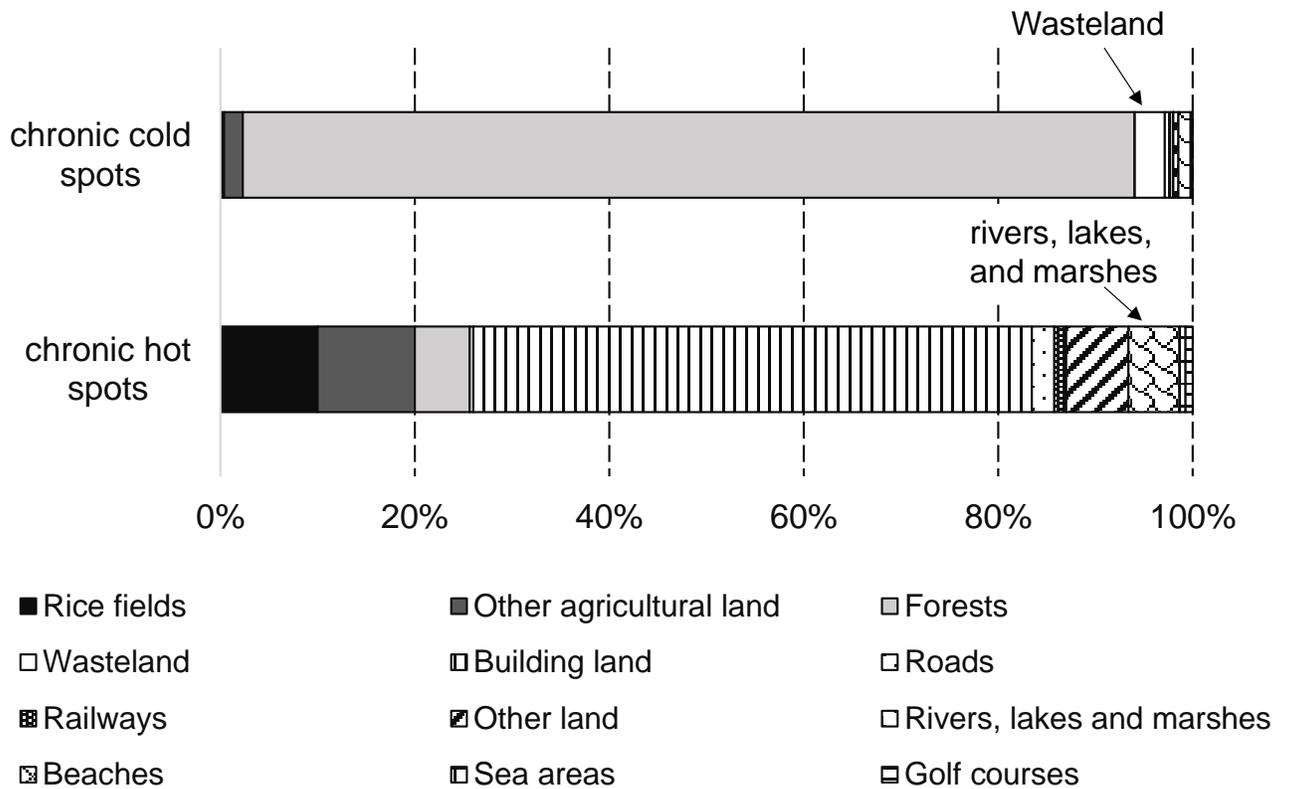
Figure 3: Characteristics of LU within chronic hot spots and chronic cold spots

Results of the correlation analysis

The correlation coefficients show the relationship between LST and the area ratio of each LU. Table 3 presents the results of the correlation analysis for the entire Tokyo metropolitan area. As a result, only forests and wasteland were negatively correlated with the LST. Except for these, the correlation coefficients were mostly positive. Interestingly, even natural LUs, such as rice fields, other agricultural land, rivers, lakes, and marshes, showed positive correlations.

Table 3: Results of correlation analysis for the entire metropolitan area

	August 4–August 11	August 12–August 19	August 20–August 27	August 28–September 4
Rice fields	0.33**	0.27**	0.32**	0.31**
Other agricultural land	0.35**	0.31**	0.35**	0.31**
Forests	−0.81**	−0.76**	−0.82**	−0.74**
Wasteland	−0.22**	−0.22**	−0.23**	−0.24**
Building land	0.80**	0.79**	0.81**	0.74**
Roads	0.54**	0.55**	0.57**	0.50**
Railways	0.52**	0.52**	0.54**	0.47**
Other land	0.54**	0.51**	0.56**	0.49**
Rivers, lakes and marshes	0.18**	0.16**	0.20**	0.20**
Beaches	0.04	0.03	0.04	0.03
Sea areas	0.05*	0.07**	0.07**	0.04
Golf courses	0.12**	0.10**	0.11**	0.12**

N=1,459, test of no correlation of population correlation coefficient * $P<0.05$, ** $P<0.01$

Table 4 shows the results of the correlation analysis for chronic hot spots. The results of the chronic hot spots tended to be different from those of the entire Tokyo metropolitan area. A significant negative correlation was observed in rice fields, other agricultural land, forests, rivers, lakes and marshes, sea areas, and golf courses in most periods. This indicates that, in chronic hot spots, LST tends to decrease as the proportions of those areas increase.

Table 4: Results of correlation analysis within chronic hot spots

	August 4–August 11	August 12–August 19	August 20–August 27	August 28–September 4
Rice fields	−0.32**	−0.47**	−0.45**	−0.30**
Other agricultural land	−0.09	−0.15*	−0.25**	−0.16*
Forests	−0.20**	0.02	−0.28**	−0.02
Wasteland	0.04	−0.11	−0.05	0.01
Building land	0.44**	0.44**	0.58**	0.37**
Roads	−0.03	0.12	0.15*	−0.02
Railways	0.02	0.08	0.20**	−0.07
Other land	0.07	0.18*	0.22**	0.19*
Rivers, lakes and marshes	−0.07	−0.08	−0.03	−0.09
Beaches	−0.13	−0.04	0.03	−0.13
Sea areas	−0.26**	−0.17*	−0.13	−0.24**
Golf courses	−0.15*	−0.06	−0.22**	−0.01

N=174, test of no correlation of population correlation coefficient * P<0.05, ** P<0.01

Table 5 shows the results of the correlation analysis for the chronic cold spots. Because the chronic cold spots did not include beaches and sea areas, they were excluded from the correlation analysis. Rice fields, other agricultural land, building land, roads, and golf courses showed almost positive correlations. In other words, the LST in chronic cold spots increased as the LU area ratio increased. However, the effect of LST mitigation was negatively correlated in the wasteland. This is characteristic of chronic cold spots. Forests were not significantly correlated because the P-value was greater than the significance level of 0.05 (5%) for the entire period.

Table 5: Results of correlation analysis within chronic cold spots

	August 4–August 11	August 12–August 19	August 20–August 27	August 28–September 4
Rice fields	0.22**	0.24**	0.26**	0.22**
Other agricultural land	0.29**	0.37**	0.31**	0.19**
Forests	−0.08	−0.12	−0.03	0.02
Wasteland	−0.24**	−0.22**	−0.30**	−0.25**
Building land	0.27**	0.33**	0.27**	0.19**
Roads	0.23**	0.28**	0.27**	0.14*
Railways	0.15*	0.11	0.17*	0.07
Other land	0.09	0.09	0.11	0.03
Rivers, lakes and marshes	0.04	−0.06	0	0.01
Beaches	—	—	—	—
Sea areas	—	—	—	—
Golf courses	0.15*	0.22**	0.15*	0.07

N=203, test of no correlation of population correlation coefficient * $P<0.05$, ** $P<0.01$

Results of multiple regression analysis of hot spots

In the previous section, we showed that the correlation analysis between LST and LU in hot and cold spots differed from that in the Tokyo metropolitan area. Here, we only focused on the regression analysis of chronic hot spots, where mitigation of LST is required.

Table 6 shows the results of the multiple regression analysis of LST and LU in the chronic hot spots. Because multicollinearity occurs when all explanatory variables are considered in the analysis, the variables are selected. Variable selection was determined by manually increasing or decreasing the variables based on the stepwise method.

Table 6: Results of multiple regression analysis of chronic hot spots

	August 4–August 11	August 12–August 19	August 20–August 27	August 28–September 4
Rice fields	−3.94**	−5.62**	−4.18**	—
	(−2.80)	(−4.16)	(−3.05)	
Other agricultural land	—	—	—	—
Forests	−5.44**	—	−6.24**	—
	(−2.83)		(−3.50)	
Wasteland	—	—	—	—
Building land	0.97	1.66	2.90**	2.92**
	(0.94)	(1.73)	(2.92)	(4.20)
Roads	—	—	—	—
Railways	—	—	—	—
Other land	—	—	—	12.21**
				(2.78)
Rivers, lakes and marshes	—	—	—	—
Beaches	—	—	—	—
Sea areas	−11.31**	−8.94**	—	−11.29**
	(−4.27)	(−2.93)		(−3.69)
Golf courses	0.02	—	—	—
	(0.00)			
Constant	37.48**	37.50**	36.08**	33.59**
	(46.98)	(55.88)	(47.73)	(76.62)
R^2	0.29	0.28	0.38	0.21
Adjusted- R^2	0.27	0.27	0.37	0.20

N=174, significance level: **: P<0.01

As a result of multiple regression analysis, few variables were selected, and the adjusted-R^2 value of approximately 0.2 to 0.4 was not high. Based on these results, rice fields, forests, and sea areas showed negative coefficients for LST, indicating that mitigation of LST might be effective. In particular, rice fields have a significantly negative coefficient at three points, indicating the effect of mitigation. However, with regard to sea areas, it is difficult to increase the area; therefore, the effects of countermeasures cannot be expected. Although significant estimates of the coefficients are limited, an increase in the area of building land and other land may exacerbate hot spots.

Conclusion

In this study, chronic hot and cold spots were extracted by the spatial statistics method using time-series LST data from August 2020 for the Tokyo metropolitan area. Then, the spatial characteristics of these hot spots and cold spots were determined from their relationship with LU. We found that the results of the correlation analysis of the entire Tokyo metropolitan area differed from the results of the correlation analysis in chronic hot spots and cold spots. Therefore, the results obtained in the current investigation could provide valuable information for considering countermeasures for LST mitigation in chronic hotspots.

However, the results of adjusted-R^2 values analyzed using multiple regression analysis were not high. Therefore, further study is required.

This paper was partially expanded based on Onishi and Ichinose (2021) (formal examination: content is not peer reviewed in principle).

Appendix

(1) The following data were used.

MODIS/Terra Land Surface Temperature/Emissivity 8-Day L3 Global 0.05Deg CMG V006
・August 4 - August 11, 2020: MOD11C2.A2020217.006.2020225085711.hdf
・August 12 - August 19, 2020: MOD11C2.A2020225.006.2020234230026.hdf
・August 20 - August 27, 2020: MOD11C2.A2020233.006.2020241190101.hdf
・August 28 - September 4, 2020: MOD11C2.A2020241.006.2020249143143.hdf

The above data were downloaded from the NASA Earthdata Search below.

Earthdata Search. 2019. Greenbelt, MD: Earth Science Data and Information System (ESDIS) Project, Earth Science Projects Division (ESPD), Flight Projects Directorate, Goddard Space Flight Center (GSFC) National Aeronautics and Space Administration (NASA). URL: https://search.earthdata.nasa.gov/

(2) Ministry of Land, Infrastructure, Transport and Tourism, Japan: National Land Numerical Information, Land Use Tertiary Mesh Data (2016), https://nlftp.mlit.go.jp/ksj/gml/datalist/KsjTmplt-L03-a.html. Accessed 2021-07- 03.

(3) Ministry of Land, Infrastructure, Transport and Tourism, Japan: National Land Numerical Information, Administrative Division Data (2020), https://nlftp.mlit.go.jp/ksj/gml/datalist/KsjTmplt-N03-v3_0.html. Accessed 2021-07-03. The (base) maps in Figures 1 and 2 were created by processing this data.

Conflicts of Interest

There are no conflicts of interest in this study.

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ENVIRONMENTAL POLICY FOR WASTE MANAGEMENT IN TAIWAN: REGULATORY MEASURES, IMPLEMENTATION STATUS, AND CHALLENGES

Tsai, P.[1*], Kuo, Y.L.[2], Onishi, A.[3]

[1] Environment Unit, Global Cooperation Institute for Sustainable Cities (GCI), Yokohama City University, 22-2 Seto, Kanazawa-ku, Yokohama, Japan.
[2] Department of Economics, National Cheng Kung University, Tainan, 701, Taiwan.
[3] School of Data Science, Yokohama City University, 22-2 Seto, Kanazawa-ku, Yokohama, Japan.
*Correspondence: tsai@yokohama-cu.ac.jp

Abstract

Increasing usage of plastic in packaging has a direct impact on the environment, particularly in the ocean. To control the environmental problems posed by plastic waste, the Taiwanese government has developed a waste management policy and promulgated several regulations since 1997 to reduce the generation of plastic waste. In addition, Taiwan was one of first countries that initiated a plastic bag charge in 2002. In this study, we reviewed the strategies and regulatory measures developed and applied in Taiwan for managing plastic waste, and discuss barriers to the elimination of single-use plastics in Taiwan. Owing to effective waste management, Taiwan's recycling rates of municipal solid waste between 2001 and 2021 increased from 12.7 to 61.1 percent. Additionally, the number of single-use plastic bags consumed was reduced by 200 million annually after banning plastic bags at retail establishments. However, the plastic composition of garbage has increased slightly in recent years, and plastic bag consumption remains high. Taiwan consumes approximately 15 billion single-use plastic bags annually, which is 3.9 times more than the number consumed by the EU. To keep pace with the global trends of reduction in plastic waste, the Taiwanese government has expanded restrictions on single-use plastic products since 2018, and Taiwan aims to reach a complete ban on all plastic bags, disposable cups, utensils, and straws by 2030. To achieve this goal, measures and support for traditional markets and food and beverage businesses are key factors.

Keywords: Waste management, Legal framework, Plastic waste, Taiwan

Introduction

As a consequence of population growth and rapid urbanization, the generation of waste is increasing drastically and multiple solid waste (MSW) management has become a challenging task in many countries (Karim et al., 2020; Chen, 2018; Hannan et al., 2015). In recent years, improving waste reduction and resource recycling programs has become a priority (Anngrete, 2001). Microplastic pollution or marine debris is one of the most pressing global environmental issues, and has attracted considerable attention and public concern worldwide (Barrettet al., 2020; Peixoto et al., 2019; Sharma and Chatterjee, 2017). Plastic waste has become one of the most prevalent ocean pollution problems, with plastic waste constituting over 60% of marine debris. Furthermore, the presence of microplastics within the food chain poses a serious threat to food safety and is a public health concern (Barboza et al., 2020).

As with many developing countries, Taiwan had one of the world's worst urban waste problems and some media reports referred to Taiwan as "Garbage Island" in the 1970s–1980s. Today, Taiwan has the second-highest effective waste recycling rate, following Germany (Eunomia, 2018). To ensure proper waste management, Taiwan has implemented a very specific waste collection system since

1998 and started to improve resource recycling, including plastic and food waste, in the 2000s. Furthermore, Taiwan is one of the first countries to initiate a plastic bag charge to restrict the use of plastic products. As a result of a series of waste measures, the recycling rate of MSW between 2001 and 2021 increased from 12.7 to 61.1 percent, and the number of single-use plastic bags consumed was reduced by 200 million annually after banning plastic bags at retail establishments (Taiwan Environmental Protection Administration (EPA), 2018). However, plastic bag consumption and the plastic composition of garbage are high. Taiwan consumes approximately 15 billion single-use plastic bags annually, which is 3.9 times higher than the number consumed by the EU. To further reduce plastic waste, the EPA has expanded restrictions on single-use plastic products since 2018, and Taiwan aims to reach a complete ban on all plastic bags, disposable cups, utensils, and straws by 2030.

In this study, we reviewed the strategies and regulatory measures for managing waste in Taiwan and discuss barriers to the elimination of single-use plastics in Taiwan. This study provides a comprehensive review of Taiwan's current MSW management situation and the future perspectives related to the application of a "zero single-use plastics" frameworks by 2030. The discussion and results of this study are divided into four sections. Section 1 provides a comprehensive overview of Taiwan's MSW management, including a comparative status of MSW generation and composition among several selected countries, particularly Asian countries. Section 2 discusses regulatory measures and policies for MSW management in Taiwan. Section 3 focuses on policies aimed at reducing the use of plastic products in Taiwan. Finally, Section 4 presents our conclusions and recommendations.

Materials and Methods

Descriptions of the Study Area

Taiwan is a small and densely populated island with a population of over 23 million and an average population density of 650.9 people/km^2 in 2020 (MOI, 2021). Taiwan has experienced rapid industrialization and high economic growth since the 1980s (Figure 1). From 1955 to 2000, Taiwan's GDP per capita growth rate was among the highest in the world, with an average growth rate of 6.82%. In contrast, the growth rates of the U.K. and U.S. were 2.49% and 2.45%, respectively (Wu, 2016). Underpinned by this rapid economic development, the quantity of MSW generated has climbed dramatically, and the average daily production of MSW per capita in Taiwan increased from 0.63 kg in 1981 to 1.14 kg in 1997. The average annual growth rate of MSW generation is over 4.78% (Lu, 2006). In the early 1970s, there was a complete lack of planning for the correct disposal of the large amounts of MSW produced by urban populations. Households disposed of their garbage through unsafe methods, such as open dumping and burning, and unsanitary landfilling. To properly manage MSW, the Taiwanese government began to improve waste management systems and enacted Taiwan's Waste Disposal Act in 1974. According to the Waste Disposal Act of Taiwan, general waste is defined as waste generated by non-industrial sectors that is collected and administered by local government agencies.
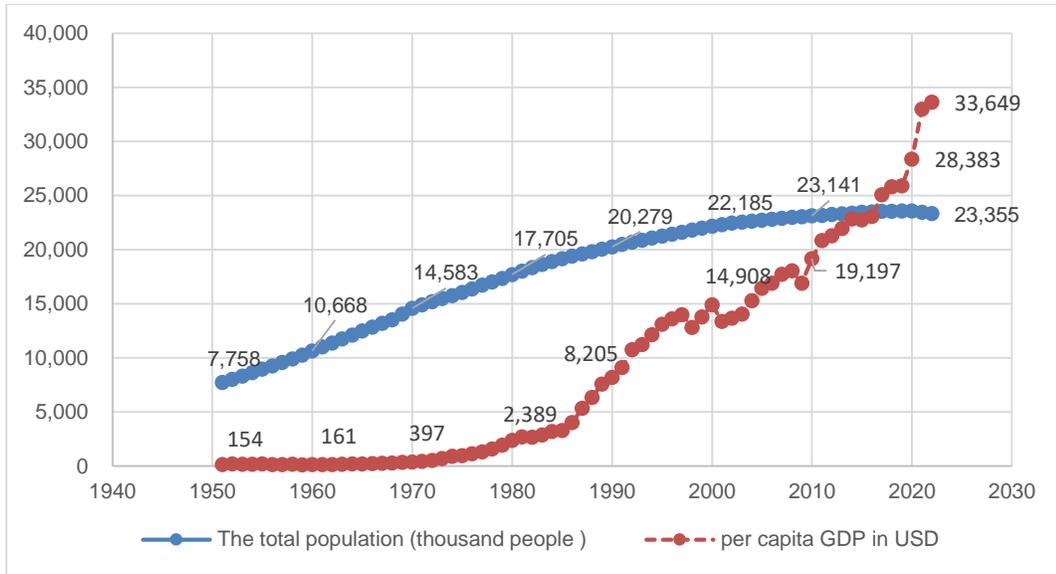
Figure 1: Taiwan's population and GDP/capita in USD (Source: MOI, 2021)

Figure 2 shows the total amount of MSW generated and the trend in disposal methods. Until the 1990s, landfills were the primary means to dispose of waste in Taiwan, with over 90% of the generated waste being disposed of in landfills. The proportion of MSW disposed by incineration accelerated after the 2000s. In 2020, there were 24 incineration plants and 11,776 garbage trucks in Taiwan (EPA, 2021).
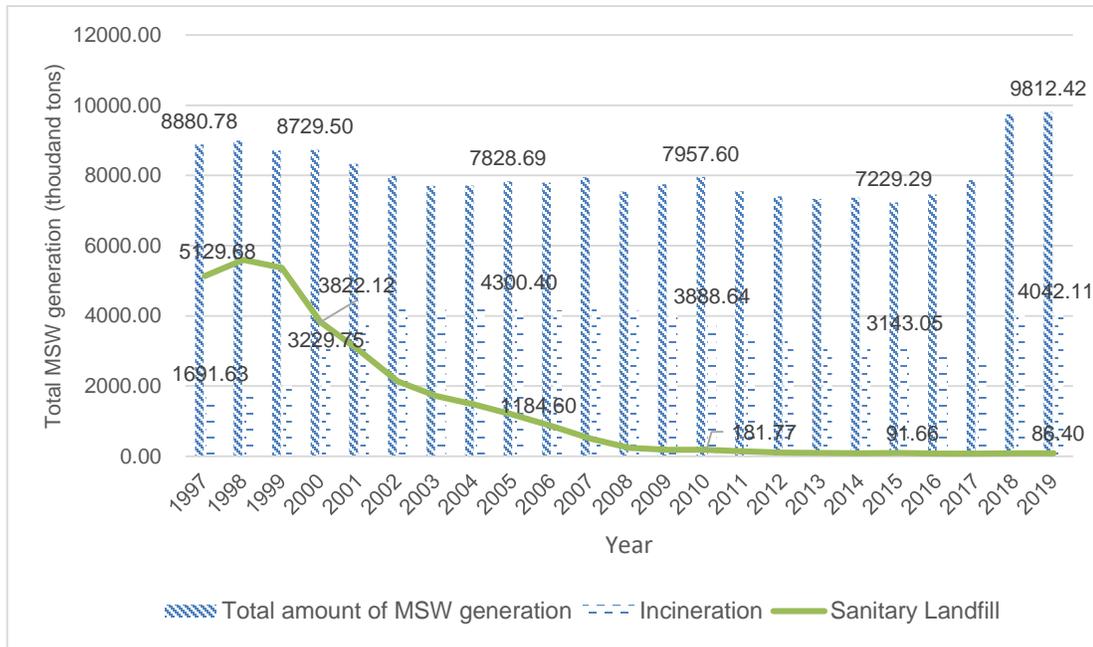
Figure 2: Amount of MSW generation and disposal methods (Source: EPA (2021)

Data mining

In this study, updated data on the statistics and status of MSW management in Taiwan were obtained from the official yearbook, the Solid Waste Statistics (EPA), and a literature review, which was utilized to systematize the fragmentary knowledge and provide the latest information about regulatory measures on MSW and the results of its implementation in Taiwan. A comparative status of MSW generation and composition among several selected countries is also discussed based on a literature review and Organisation for Economic Cooperation and Development (OECD) reports. In addition, an analysis of the implementation of plastic and food waste management in Taiwan is provided.

Results and Discussion

The current MSW situation in Taiwan

As described above, Taiwan had serious urban waste problems, as some media reports referred to Taiwan as "Garbage Island" in the 1970s–1980s. During this period, Taiwan lacked safe and proper MSW management systems to correctly dispose of the large amounts of MSW generated. Today, Taiwan has the second-highest effective waste recycling rate, following Germany (Eunomia, 2018). Figure 3 shows the trends of the MSW disposal and recycling rates in Taiwan. Taiwan's MSW recycling rate has exceeded 50% since 2010. A review of the relationship between GDP per capita and MSW generation rate in several selected countries reveals that Japan, Korea, and Taiwan have a similar tendency, while Malaysia, Indonesia, and Thailand may be classified into the same group. Figure 4 shows the relationship between GDP per capita and MSW generation rate, 2016. The composition of the MSW in Taiwan is presented in Table 1; paper, food, and garden waste comprised the highest proportion. A comparison of the composition of MSW in Taiwan with MSW compositions in other countries is also shown in Table 1. The results indicate that the contribution of plastics in Taiwan was higher than that in other countries. To reduce these wastes, Taiwan has implemented a series of waste polices since 2002, as described in the next section.

MSW management in Taiwan

Figure 5 shows the MSW management strategy in Taiwan. Taiwan's Waste Disposal Act was enacted in 1974, and the Municipal Waste Disposal Plan was formulated in 1984 to manage waste disposal effectively. Source minimization and resource recovery are two major concepts for waste disposal. Since 1990, the MSW policy has been transformed from landfill disposal to incineration with proper garbage sorting. Simultaneously, the initial MSW recycling program "Resource Recycling 4-in-1 Program" was promoted in 1997, which includes the public community, local government agencies, recycling enterprises, and recycling funds. The budget costs of recycling, clearance, and disposal fees were collected from manufacturers and importers to establish a recycling fund. This recycling fund is used to support the recycling disposal system and extend the producer responsibility (EPR). This recycling system also provides economic incentives to encourage the development of recycling and reuse industries. These regulations and implementations comprise the recycling system in Taiwan (EPA, 2021). In 2020, 96.9% of the waste was properly disposed, and the resource recovery rate (including resources, kitchen waste, and bulk waste) reached 62.7% (EPA, 2021). In addition, the amount of waste generated per capita per day was less than 1 kg in 2000, while the amount in other OECD countries exceeded 1 kg (Lu, 2006).

Owing to effective waste management, Taiwan's achievements in reducing and recycling MSW have been remarkable. Simultaneously, Taiwan can report accurate waste generation data, indicating a well-managed waste collection, transportation, and storage system. However, a review of the

composition of MSW in Taiwan shows that the contribution of plastics was higher than that in other countries (Table 1). In addition, organic matter (food and garden waste) comprised the largest portion. To promote recycling and reduction of plastic and food waste, Taiwan has implemented a series of policies to reduce single-use plastic products since the 2000s. Although the number of single-use plastic bags consumed was reduced by 200 million annually after banning plastic bags at retail establishments, the plastic composition of the garbage slightly increased in recent years, and plastic bag consumption
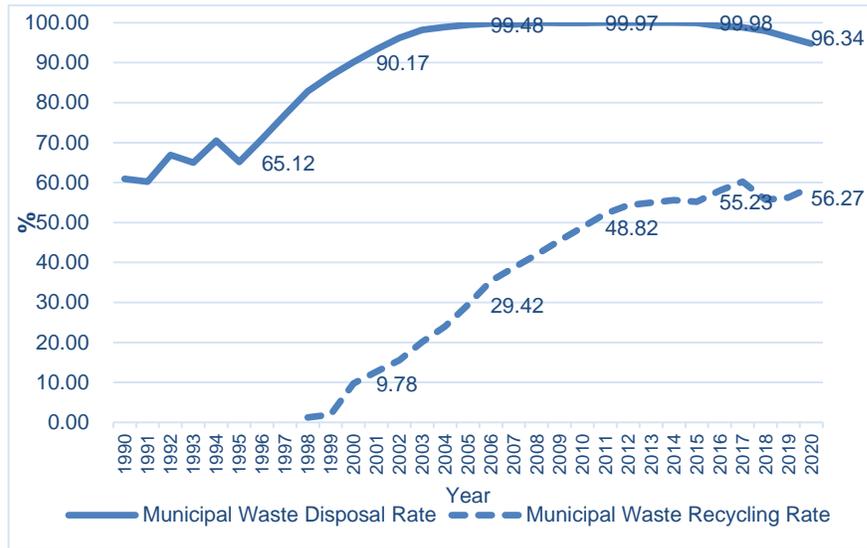
Figure 3: MSW disposal rate and MSW recycling rate of Taiwan   Source: EPA (2021)
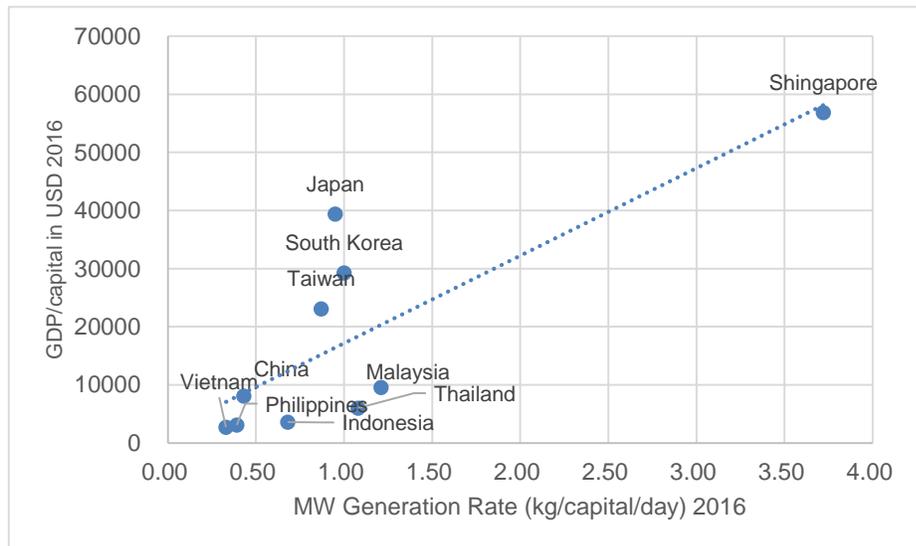
Figure 4: Relationship between GDP per capita and MSW generation rate, 2016
Source: MOI (2021); EPA (2021); Kaza et al.(2018)

Table 1: Comparison of the MSW composition in Taiwan and other countries

	Year	Paper	Organic matter	Plastic	Glass	Metals	Wood	Textiles and others	References
USA	2015	25.9	28.3	13.1	4.4	9.1	6.2	12.8	USEPA (2018)
Japan	2015	32.8	36.1	10.5	4.8	3.8	4.4	7.6	MOEJ (2015)
Korean	2000	26.0	25.0	7.0	4.0	9.0	N.A	29.0	OECD (2002)
Malaysia	2005	16.0	44.8	15.0	3.0	3.3	N.A	17.9	Periathamby et al. (2009)
Taiwan	2018-2019	37.6	33.0	18.3	0.9	0.7	N.A	7.8	EPA (2020)

remained high. Taiwan consumes approximately 15 billion single-use plastic bags annually. To keep pace with the global trends of reduction in plastic waste, the Taiwanese government has expanded restrictions on single-use plastic products since 2018. Taiwan aims to achieve a complete ban on all plastic bags, disposable cups, utensils, and straws by 2030. To achieve this goal, measures and support for the traditional market, food, and beverage businesses will be key factors, as described in Section 3.3. For food waste management, the central government has developed recycling systems for food waste from general and industrial waste and provided subsidies for local governments to establish their food waste collection programs (Tsai, 2020). Taiwan has a specific waste collection system for general waste. Yellow garbage trucks visit garbage pickup spots and take garbage directly from citizens. Every garbage truck has a set of bins used to collect recyclable materials, such as raw and cooked food waste. This waste collection system allows the food waste generated by households to be collected and recycled. According to official statistics, the amount of food waste was 168,601 tons in 2003 compared to 834,541 tons in 2012. The raw food waste was utilized as fertilizer for farmers, and cooked food waste was used as food for farm animals, such as pig feed (EPA, 2021). However, the amount of collected food waste has indicated that a decreasing trend exists due to the limitation of the composting treatment capacity and collection systems in some cities and the lack of economic incentives for recycling enterprises. Figure 6 gives an indication of plastic and food waste composition in the garbage.
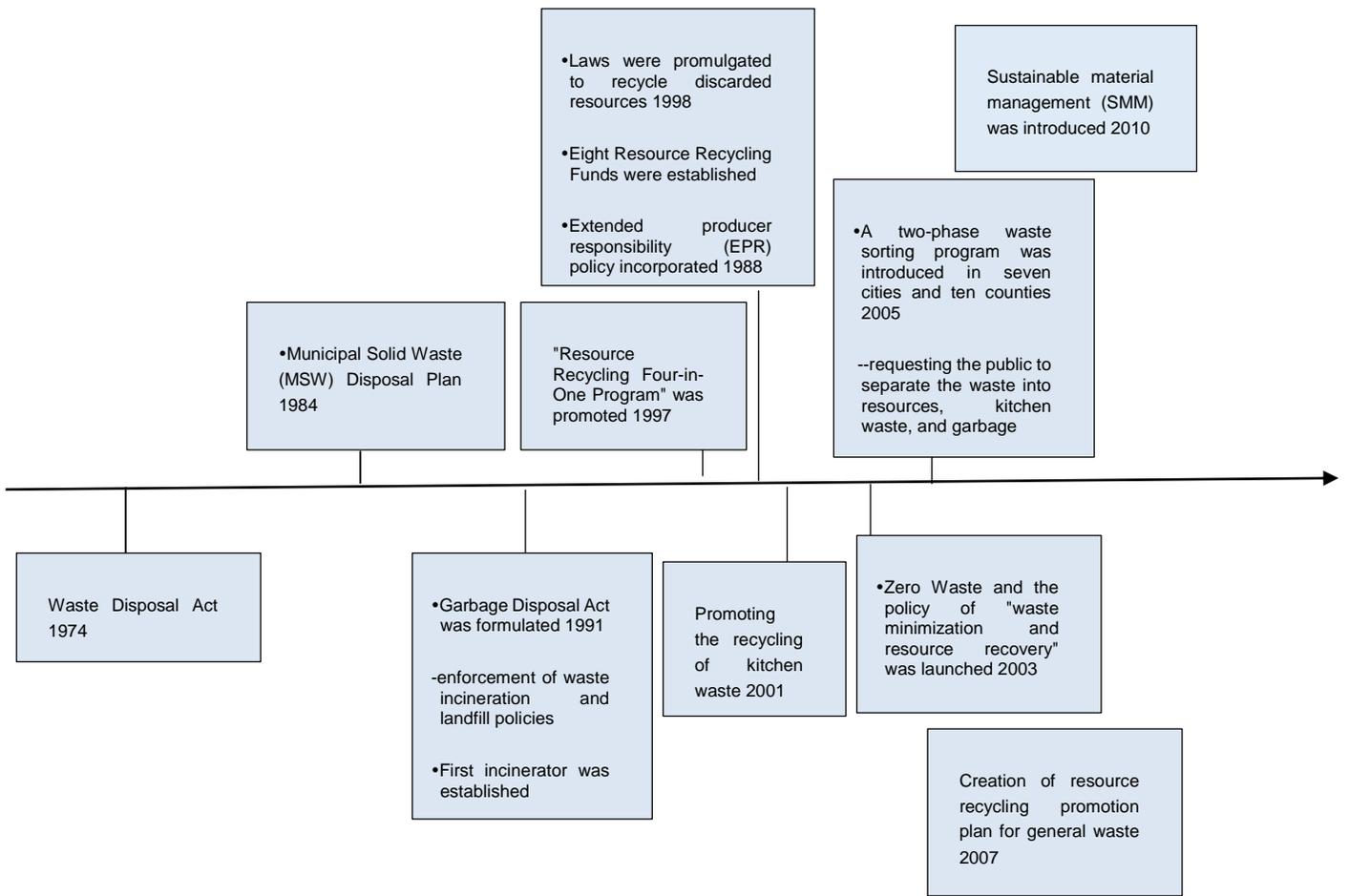
Figure 5: Taiwan roadmap towards sustainable MSW management

Source: EPA (2022), Lai and Lee (2021), Wu et al. (2021),Tsai (2021)
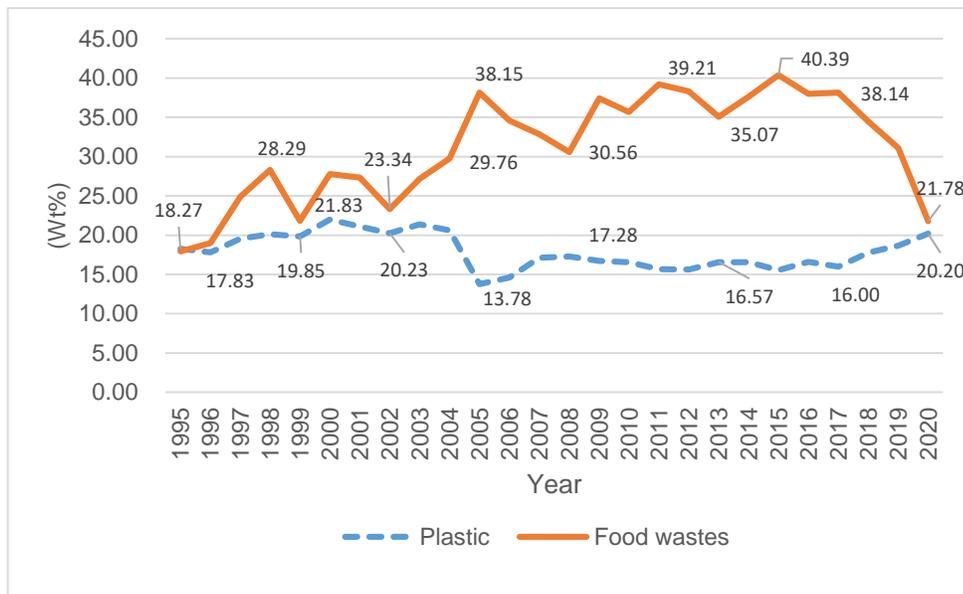
Figure 6: Plastic and food waste composition in the garbage (Source: EPA 2021)

In summary, MSW management in Taiwan can be divided into three phases. Before 1990, over 90% of garbage was disposed of in landfills and there were no specific measures or policies on MSW reduction or recycling (the first phase of MSW management). From 1991 to 1998, the MSW method was transformed from landfill disposal to incineration, and an initial waste recycling policy was implemented (second phase, the first step of MSW recycling). The daily per capita amount of MSW generated increased dramatically during this period in accordance with rapid economic growth. After 1998, MSW generation began to decrease and regulatory measures for plastic waste and food waste were implemented. In addition, modification of the EPR is involved in the MSW recycling system (Lu, 2006). This provides economic incentives to encourage the development of recycling and reuse industries.

Regulatory Measures and Plans for Restriction on the Uses of Plastic Products

As described above, the Taiwanese government has implemented several regulatory measures and plans to reduce and recycle plastic waste since 1998. The following measures have been implemented to support these efforts:

(1) Resource recycling system

As described in Section 3.2, the Resource Recycling 4-in-1 Program is one of the most important waste policies for implementing Taiwan's recycling system. The roles of residents, local governments, recycling companies, and recycling funds were clearly defined. Citizens should take the responsibility of garbage separations, while local governments should properly manage waste collection and disposal systems. Recycling enterprises should encourage development of private recycling industry and purchase recyclable waste from communities and governments; responsible producers should pay the fees for recycling as a Recycling Fund. Additionally, since 2005, the EPA has promoted a two-phase waste sorting program that requests citizens to separate waste into resources, kitchen waste, and garbage. In the first phase, the program was conducted in seven cities and ten counties, and in the second phase, the program was applied to all cities in 2006 (EPA, 2021). Taiwan's specific waste collection system for general waste also facilitates the collection of resource waste, including regulated recyclable plastic containers. Figure 7 summarizes the quantities of recycled paper and plastic containers between 1998 and 2020. The number of recycled plastic containers has increased steadily in recent years, and the number of recycled paper containers in 2020 was over 400% that in 2018. The increasing number of online shopping and food deliveries during the COVID-19 pandemic was the main reason for the large numbers of recycled paper containers and cutlery. In addition, the restriction of water supply in some cities due to water shortages was one of the factors that affected the use of disposable containers.

(2) Restriction on the use of single-use plastic products

Since 2002, a two-phase approach that restricted the use of plastic shopping bags and plastic products was promoted (Figure 8). In the first phase, the EPA requested governmental agencies, public and private schools, government-run enterprises, and public hospitals to stop providing plastic shopping bags and disposable plastic tableware. The targets in the second phase were department stores, shopping malls, supermarkets, convenience stores, restaurants, and food and beverage stores with a shop front. The main enforcement method was to restrict targets from offering free plastic bags, and consumers must pay 1–3 Taiwan dollars (US$ 0.034–0.1) for each plastic bag. Furthermore, the thickness of the charged plastic shopping bags was restricted to less than 0.06 mm to encourage consumers to reuse plastic bags for future shopping trips (Tsai, 2019). However, according to an official survey, the reduction rate of the number of plastic shopping bags in restaurants and food and beverage stores with a shop front was 33%,

and the reduction rate of the quantities of plastic bags was -74% (EPA, 2005). To solve this unexpected issue, the Taiwanese government revised the regulations to cancel the restrictions on the thickness of the charged plastic bags in 2017. As described earlier, as a result of this measure, the consumption of single-use plastic bags was reduced by 200 million annually after plastic bags were banned at retail establishments. However, plastic bag consumption is still higher than that in other countries, such as the EU. The main reason is that the restricted targets do not include fresh markets and diners such as traditional markets, night markets, and food stands. In 2022, Taiwan had 1,195 markets (including traditional and night markets), and many plastic bags were consumed in these markets every day. Moreover, the plastic bags used for raw or cooked food are usually difficult to reuse owing to hygiene issues. The Taiwanese government implemented several measures to address this issue, such as the promotion of "green night markets" that use reusable tableware or set an eco-box for used plastic bags, which can be provided to the next consumer for free in traditional markets. To address the issue of increased online shopping packages or food delivery services (e.g., containers or plates), the EPA proposed a new approach designed to set pickup sites for consumers to return their used cutlery. This type of approach can encourage reuse or make recycling easier and overcome the awareness-behavior gap. The other programs/regulatory programs are shown in Figure 8.
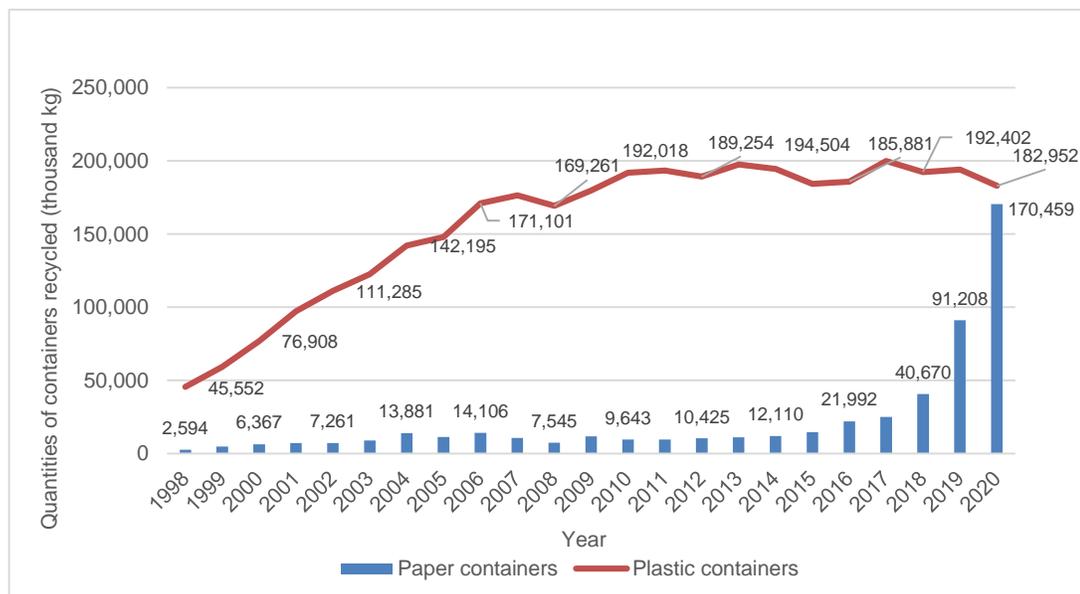
Figure 7: Quantities of paper and plastic containers recycled in Taiwan   Source: EPA (2021)

56

A first phase of restriction on the uses of plastic shopping bags and plastic products was promoted 2002

The EPA requested government agencies to stop using disposable tableware, and the same ban has been imposed on all schools 2006

• The EPA commenced the "5 + 2" program, which underscores the nation's commitments towards circular economy and environmental sustainability 2019

• Banning on manufacturing, import and sale for cosmetics and personal care products containing plastic microbeads

2001

2011

2021

A second phase of restriction on the uses of plastic shopping bags and plastic products was promoted 2004

• Restaurants in department stores, shopping malls, and hypermarkets have been prohibited from providing disposable tableware in any material type for consumers eating 2019

• Single-use plastic straw restriction targets and implementation

Figure 8: Taiwan roadmap towards reduction on the uses of single-use plastic products

Source: EPA (2022), Lai and Lee (2021), Wu et al. (2021), Tsai (2022)

Conclusion

Waste management in Taiwan has developed for the better since the 1990s, and Taiwan's achievements in reducing and recycling MSW are remarkable. In addition, Taiwan can report accurate waste generation data, indicating a well-managed waste collection, transportation, and storage system. However, the increasing number of paper containers, declining recycling rate of food waste, and issues related to the reduction of plastic waste, especially in traditional markets, remain important challenges that are still unresolved. Conducting environmental programs such as the setting of recycling boxes or pick-up sites could help overcome the awareness-behavior gap. In addition, the promotion of eco-campaigns that incorporate economic incentives, such as reusable beverage cups, could be adopted.

Acknowledgement

Conflicts of Interest

There are no conflicts of interest in this study.

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COMMUNITY KNOWLEDGE, ATTITUDE, AND PRACTICE ON THE PREPAREDNESS OF EARTHQUAKE DISASTER IN RANAU, SABAH

Joanita, J.[1], Haliza A. R [2*] and Azrin S.A.B[1]

[1] Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.
[2] Institute for Social Science Studies, Putra Infoport, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.
*Correspondence: dr.haliza@upm.edu.my

Abstract

Globally, the occurrence of natural disasters has become a major concern due to the increasing number and severity of catastrophic events. Earthquake is a disaster that can cause the highest total loss for the community and that particular country. For countries located outside the Pacific Ring of Fire such as Malaysia, they should theoretically be free from this disaster, but in reality, there have been some episodes of quakes recorded, including in 2015 Ranau and Bukit Tinggi, Pahang, back in 2007. Therefore, this study aims to assess the community's knowledge, attitude, and practice towards the preparedness for earthquake disaster in Ranau, Sabah. A cross-sectional study was conducted among 104 respondents in Ranau, Sabah. The data were collected using self-administered questionnaires including socio-demographic, knowledge attitude and practice about earthquake. The majority of the respondents had moderate level of knowledge, attitude, and practice about the preparedness for earthquake disaster. Based on the Spearman correlation test, there is no significant correlation between knowledge, attitude, and practice on the preparedness of earthquake disaster among the community in Ranau, Sabah. Our findings suggest that all parties should take part and play their roles in earthquake preparedness in order to reduce earthquake disaster losses in their life in the near future.

Keywords: Community, Knowledge, Attitude, Practice, Earthquake Preparedness, Sabah

Introduction

The World Health Organization (2007) defined disaster as a severe disruption in an active community or society resulting in widespread human, property, economic and environmental losses that over-limit the ability of the affected community or company to deal using their resources. It can be categorised into natural disasters and human made disasters (Rahman & Suppian, 2018).

Earthquake is an example of the most dangerous natural disaster on earth as it may lead to tsunami, landslide, and soil liquefaction (Adnan, Ramli, & Sk Abd Razak, 2015). It is known as the shaking of earth due to the movement of waves under the earth's surface and resulting tremors vibration, surface faulting, landslide, liquefaction aftershocks and/or even tsunami (WHO, 2016) and it has been proven as the most terrifying and high-cost disaster which contribute to serious threat of a country's infrastructure, population, economy, and social structure (Baytiyeh, 2014). The introduction section should provide readers with the background information of the studied/researched topic. Besides that, authors should summarize the literature and state the research problem/issue/gap clearly. Please make sure your citations are well balanced, relevant and up-to-date. As example, a strong earthquake with magnitude Mw 7.6 shook the Kashmir (Himalayan region) on 8 October 2005, causing wide spread destruction and casualties. The earthquake destroyed approximately 400,000 houses and

over 86,000 people lost their lives (Sengar et al., 2013). The earthquake has destroying many residential, public, religious and cultural heritage buildings and roads due to intense shaking, surface fissures and landslides. This phenomenon has provided a perspective on the widespread lack of preparedness even when the seismic hazard of the Himalayan region is well established (Rai, Singhal, Raj S, & Sagar, 2016). In China as well, according to the Yunnan Earthquake Administration, 617 people were killed, 112 were missing and 3143 were injured, about 1,088,400 people living in the area were affected and 229,700 people became homeless in the Ludian earthquake by the end of 8 August, 2014 (Haichun Hong, Jie You & Xuemei Bi, 2016). The poor construction practices that are followed in the Kathmandu valley region which make the built environment vulnerable to unacceptable levels of damage under expected design levels of shaking.

Asia Pacific countries are the most vulnerable for geological hazards such as earthquake and other disasters (Shaful & Ahmadun, 2006) and Malaysia is not spared anymore even though the country sits outside of the pacific ring of fire (Marto, Kasim, Soon, Zurairahetty, & Yunus, 2013). There have been few cases recorded such as the 5.9 magnitude of Ranau earthquake in 2015 killed 18 climbers and 3.2 magnitude of Bukit Tinggi earthquake in 2007 (Majid, Adnan, Adiyanto, Ramli, & Ghuan, 2017; Tongkul, 2017). Moreover, Malaysia is still lacking in public awareness program, disaster warning system and earthquake subjects offered in secondary or higher education (Adnan et al., 2015). Therefore, the preparedness measures should be formulated to reduce the total loss (Taghizadeh et al., 2012) because some disaster might not only emerge from this country but also from nearby countries such as the 2004 Sumatran earthquake where 68 people died in Malaysia (Adnan et al., 2015).

Therefore, this study is important to access the level of knowledge, attitude and practice (KAP) of community on the preparedness of earthquake. Hence, it can provide the baseline data to develop an effective risk communication strategies and education programs to the public. In this study, samples of community respondents collected at Ranau because it is well known as earthquake prone area and the community is usually the most affected group the bear the losses during earthquake.

This study aims to determine the level of the community's knowledge, attitude, and practice (KAP) towards the preparedness for earthquake disaster and   correlation between the knowledge, attitude and practice among the community in Ranau, Sabah.

Materials and Methodology

Study design and location

A cross-sectional questionnaire survey was conducted in Ranau between January-February 2019. Ranau is a rural district in Sabah located on the Southern flank of the magnificent Mount Kinabalu (4, 101m). The area is one of the most active seismic activity in Malaysia (Indan, Roslee, Tongkul, & Simon, 2018). Hence, the questionnaires were distributed among the community in that particular villages through convenient sampling. Convenience sampling is described as non-probability sampling in which people are sampled because they are the easiest to reach.

This research was conducted by distributing questionnaires that have been modified from Taghizadeh et al., 2012 and Kamarudin, Che Hasan, & Razak, 2016. It consists of 5 sections with 53 questions altogether. Pretest was done on the questionnaire with Cronbach alpha obtained was 0.73.

The respondents were required to fill in the socio demographic information. They were assessed in their knowledge and attitude level about earthquake as well as their preparedness practices for earthquake.

Statistical Analysis

Data was analyzed using SPSS version 25.0. Descriptive and Spearman's correlation was used in data analysis. Significant level; P value < 0.05 was applied.

Results

Socio-Demography Characteristics of Respondents

Table 1 shows the socio-demographic data of the subjects. Result from the Table 1 found that most of the respondents were in the category of youth, age 15-30 years old with a total of 46 (44.2%) respondents and only 5 (4.8%) senior citizen were sampled. Meanwhile, the respondents' gender is almost equal where by 50 (48.1%) males and 54 (51.9%) females. The educational background was classified into 4 groups whereby 5 (4.8%) do not have formal education and 60 (57.7%) respondents completed their education up to secondary school. Regarding the duration of residency, only 5 (4.8%) respondents stayed at Ranau for 6-10 years, however, 87 (83.7%) of them stayed in Ranau for 10 years and above and most of them have been living there since birth. The last socio-demographic characteristic is the prior experience of earthquake where 6 (5.8%) respondents have experienced earthquake once and 88 (84.6%) of them have felt the quake for 3 times or more. In the results section, simply describe the major research findings that you discovered.

Table 1: Socio demographic characteristics (n=104)

Demographic characteristics	Number (n)	Percentage (%)
Age (years old)		
15-30	46	44.2
31-40	26	25.0
41-50	13	12.5
51-60	14	13.5
≥ 60	5	4.8
Gender		
Male	50	48.1
Female	54	51.9
Education background		
No formal education	5	4.8
Primary school	14	13.5
Secondary school	60	57.7
Tertiary school	25	24.0
Duration of residency		
1-5 years	12	11.5
6-10 years	5	4.8
≥ 10 years	87	83.7
Earthquake experience		
1	6	5.8
2	10	9.6
≥ 3	88	84.6

Level of KAP on the earthquake preparedness

As shown in Table 2, the level KAP on the earthquake preparedness are at moderate of 49 (47.1%), 77 (74%) and 69 (66.3%) respectively.

Table 2: Level of KAP on earthquake (n= 104)

Variables	Frequency	Percentage (%)
Knowledge		
High	34	32.7
Moderate	**49**	**47.1**
Low	21	20.2
Attitude		
High	14	13.5
Moderate	**77**	**74.0**
Poor	13	12.5
Practice		
High	19	18.3
Moderate	**69**	**66.3**
Poor	16	15.4

Association between KAP on earthquake preparedness

Shown in Table 3 is the Spearman's correlation obtained and it was found that all the variables are not correlate with each other. The p-values are also >0.05 that shows no significant association among the variables.

Table 3: Association between KAP on earthquake preparedness

	Knowledge		Attitude		Practice	
	r	p-value	r	p-value	r	p-value
Knowledge	-	-	0.163	0.098	0.156	0.114
Attitude	0.163	0.098	-	-	0.139	0.160
Practice	0.156	0.114	0.139	0.160	-	-

$P < 0.05$ is considered significant

Discussion

The knowledge level of the respondents as overall is at moderate. The people of Ranau might have the information about the disaster but they have less exposure on the specific detail about it. Knowledge is a crucial component on environmental awareness to understand more and identify the consequences of the public to the ecosystem (Gambro et a., 1996). Rahman & Suppian (2018) defined earthquake as the sudden movement of the Earth's surface. Hence, the answer for the statement should be true where 91.3% of the respondents get it right. A number of 72.1% respondents answered correctly that the Malaysian National Security Council Directive No. 20 is responsible for earthquake occurrence in this country (Majlis Keselamatan Negara, 2012). Earthquake is the most horrifying disaster that can contribute to the highest human life loss (Baytiyeh, 2014) and most of the respondents also aware of this when 76.9% of them answered this question correctly. However, respondents seem to miss the fact that dam construction can also lead to the occurrence of earthquake since dam can alter the surface and the water pressure in the micro-cracks of the Earth (International Rivers, 2018).

The level of attitude among the respondents is at moderate of 74%. Some knowledge about environment can further their strength on the attitudes and their practice on the environmental-friendly habit (Awang et al., 2013). Therefore, the level of knowledge in the previous part influence a little bit on the attitude of the respondents toward earthquake. Moreover, series of earthquake strikes Ranau area for years but with low magnitudes. Since they have grown up with weak earthquake around them, they become immune with the quakes. This makes them believe that the phenomenon is normal for them, hence, it makes them convince that earthquake is a fate and nothing can be done to avoid earthquake. Besides, most of the respondents have an average tradition belief of the local community about the sacred Mount Kinabalu and its ancestors (Kadazan Homeland, 2018).

Theoretically, a well-informed individual are more thoughtful on the disaster preparation (Adem, 2014). In Malaysia, since earthquake is a rare disaster, the awareness program, disaster warning system and subjects related with earthquake is still far from a deep implementation to the public (Adnan et al., 2015). Hence, the preparedness practice on earthquake based on the result is also at moderate level of 66.3%.

Other than that, based on the results obtained among the Ranau community, there are poor correlation between knowledge and attitude, knowledge and preparedness practice. Moreover, this is determined by the p-values obtained where all the values were >0.05 which shows no significant among the variables. According to Dancey and Reidy (2004), if the value is 0 to 0.2 between the variables, there is no relation. In order to determine the preparedness practice among local communities, it must come from the basic awareness about the earthquake disaster from education programs, campaign, trainings or other resources to increase their knowledge level regarding the issue concerned (Adem, 2014). The knowledge was the effect of the public's self-learning, surrounding awareness, managing behaviour and decision making (Lorenz et al., 2015).

As a guide, this section should answer the questions of what your results mean. Compare your results with those from other similar studies, and discuss the similarities and differences of your results with those of other studies. What are the new findings? Please provide reasons your statements. In addition, you can also include limitations of the current work and some suggestions for improvements in future research.

Conclusion

The findings have discussed the level of KAP on the preparedness of earthquake disaster among community in Ranau where it has been indicated a moderate level for each variable and the KAP has no relationship with earthquake preparedness. Therefore, there is a need to improve the awareness level on earthquake among public so that they can be more knowledgeable and possess a better attitude and be more prepared for the unpredictable earthquake. Public by now should realise of the episodes of earthquake in Malaysia and it is no longer an unusual destructive events happening especially in Ranau. Hence, all parties should take part and play their roles or else, they should prepare for a bigger consequences of loss in their life by the destructive earthquake. This section should summarize the findings as simple as possible. Authors do not need to include statistical values that have been mentioned previously in the results section.

Acknowledgement

Conflicts of Interest

The authors declare no conflict of interest.

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UNDERSTANDING THE URBAN HEAT ISLAND EFFECT IN THE SEMI-ARID REGIONS

Ladan, T.A.[1], Ibrahim, M.H.[2*], Ismail, M.I.M.[2]
[1], Kashim Ibrahim College of Education Maiduguri, Nigeria.
[2] Department of Geography and Environment, Faculty of Human
Sciences, University Pendidikan Sultan Idris (UPSI), 35900, Tanjong Malim, Perak, Malaysia.
*Corresponding Author: hairy@fsk.upsi.edu.my

Abstract

Effective and pragmatic techniques, policies, and technological responses to increased temperatures in urban heat islands (UHIs) to meet sustainable development of towns and cities rely heavily on proper planning and implementation of these processes, as well as stakeholders' understanding and perceptions of the phenomenon. A significant amount of study has been conducted to minimize its influence on the urban environment and its inhabitants in the global north and south. However, few studies exist on the impact of urban heat islands in the semi-arid regions. Data for this study were gathered through a search of reputable existing scholarly journals and books, with a focus on semi-arid regions. The review was carried out in accordance with scholarly best practices. In the midst of the climate crisis, 1.1 billion people live in the already dry and hot semi-arid environment, making them among the world's poorest and most vulnerable. A thorough understanding of the concept of UHIE is crucial. Modern cities and towns are at a critical moment. With rapid population growth and urbanization, energy inefficiency and scarcity, and global and micro-climate change, which can lead to the formation of UHI, there is an urgent need to enlighten the urban populace about the threats of these challenges. This review aims to educate key stakeholders and the urban dwellers about the mechanisms that lead to the emergence of the urban heat island phenomenon and its consequences in order to develop and implement a mitigation strategy via research and continuous engagement and communication among all stakeholders.

Keywords: Urban Heat Islands, Semi-Arid Regions, Warm Drylands

Introduction

The global community has recently seen an unprecedented increase in urban population due to anticipated socioeconomic prospects in cities, resulting in fast urbanization. The worldwide population in urban centers has surged from 1.731 billion people (39.35 percent) in 1980 to 3.968 billion (53.91 percent) in 2015 and is expected to exceed 9.725 billion (68 percent) by 2050 (Koko et al., 2021). In addition, the number of high-profile cities with populations of more than 5 million people is growing, with over 30 "megacities" with populations over 10 million (Miccoli et al., 2016; Saaroni et al., 2018). According to a forecast, Africa and Asia would account for 35% of global growth over the next three decades (Koko et al., 2021). Similarly, a study by Azunre et al., (2019) showed that, by 2020, Africa, Asia, and Latin America will account for almost three out of every four urban dwellers, as well as eight of the world's nine megacities. The consequence of this growth is the tremendous changes in land use/land cover (LULC) pattern and the alteration of various biophysical climatic conditions, particularly the formation of Urban Heat Island (UHI) (Koko et al., 2021). This phenomenon, (UHI) is a global challenge that compromises the functionality and comfort of our cities and urban environs. The UHI concept has been extensively investigated and documented, although knowledge of the subject is limited. This has improved in recent years as a result of a growing emphasis on global warming and climatic effects, the increased predominance of hotter cities, and advancements in analytical techniques (Abbas Mohajerani et al., 2017; M. Santamouris et al., 2015; Weng, 2018; Zhou et al.,

2019). Therefore, Maskooni et al., (2021) argue that, In an urban century with anthropogenic climate change leading to significant consequences such as the heat island effect, making cities cool has become a growing priority for human health, energy-saving, and greenhouse gas abatement. Dryland urban areas, particularly semi-arid zones, experience more difficulties than cities in wetter climes.

UHIs Liu et al., (2020) maintains can have a considerable impact on building energy consumption. Previous research examined the effects of UHIs on building energy consumption and found that they can result in a 19.0 percent increase in cooling energy usage. As a result, UHIs are a serious challenge since they increase building energy usage. If this concern is left unchecked, rising cooling demand caused by UHIs will raise Emission of carbon dioxide to five times in 2050 for buildings in city centers compared to 2000. Extensive studies have been conducted in recent decades to examine the influence of wind, cloud cover, albedo, soil moisture, anthropogenic heat, and plant cover on UHIs. But, it is important to highlight that the climate conditions in different parts of the regions do have a significant impact on UHIs. In general, a variety of procedures are used to assess UHI, including weather station observation, fixed measurements or mobile traverse methods, remote sensing, and simulation analysis, Methods of Studying UHI (Naserikia et al., 2019)

Cities and communities as (Mancebo, 2018) claims, must create effective and pragmatic measures to minimize urban heat island (UHI) during hot seasons if they are to thrive in the face of climate change and in an urban century. Meanwhile, community perception and the understanding of the concept during the planning and implementation phases can have a highly significant impact on the success of UHI mitigation strategies that could be employed or adopted. Therefore, the researchers argue that, if this phenomenon is left unchecked, the hot and dry semi-arid environment, that is already fragile and vulnerable to the complex interplay of human activity and climate extremes, would deteriorate and intensify the detrimental impacts of the local climate change. Hence, understanding the phenomenon, its causes and impact will be the first steps in addressing the challenges pose by the urban heat island in the semi-arid climate.

As a result, this research aims to educate the urban inhabitants of the semi-arid regions of Nigeria and strengthen the understanding of the concept of UHI, the mechanisms that ultimately led to its formation, its impact on urban dwellers and the natural environment, and also some of the mitigation strategies used for the sustainability of urban centers, thereby arming the inhabitants in the fight against UHI, which has to be a collective effort of the urban planners, scholars, public health officials, students, and all stakeholders that are concern with the urban microclimate.

Methods

In order to review and analyze the available scientific information on UHI studies in the semi-arid regions (Figure 1), a literature survey was conducted in this paper. The search was limited to the last ten years. Related UHI papers used for this review is retrieved or sourced from scholarly work. The academic work searched for this review spans through the field of Geography, Engineering, Agricultural science, and other Environmental discipline in the last five years. About 30 articles were explored. The database majorly used was google scholar using the search word "semi-arid region", "urban heat island", and "warm dryland". In addition, to the above, the information used were irrespective of countries or the continent. All sources are acknowledged in accordance with best practices. The conclusion was drawn based on the author's disposition derived from the perusal of past articles/publications. This study will help all stakeholders in understanding the phenomenon. For efficient urban planning and development, clear information on the hazards associated with rising temperatures in the fragile semi-arid urban ecosystem is critical for the sustainability of our cities and communities.

Results and Discussions

The Semi Arid Environment
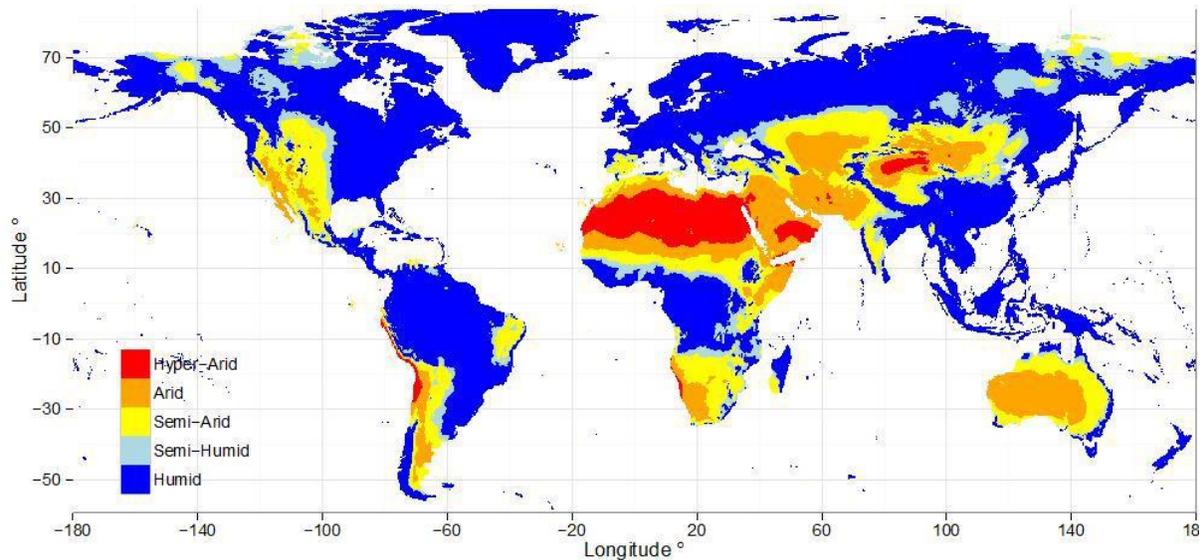
Figure 1: *G*lobal distribution of climatic zones.

Source: Adopted from (Ma, 2016)

The warm semi-arid region which is already hot and dry with its fragile ecosystem is seriously threatened amid the climate crisis. The regions cover about 15% of the Earth's natural land surface and sustained more than 14% of the global human population in 2000. These environments are very fragile and vulnerable to intense interactions between anthropogenic activity and climate variability (Huang et al., 2016). A total of 48 developing countries are included in the semi-arid zones. Most of India, parts of Southeast Asia, Sub-Saharan Africa, much of southern and eastern Africa, and a few sites in Latin America are affected. Semi-arid regions are typified by variable weather, prolonged dry seasons, intermittent rainfall, and nutrient-depleted soils (Krishnamurthy et al., 2011).

This region is defined as areas of the planet where yearly precipitation amounts to one-fifth to one-half of potential evapotranspiration. This amounts to 60 to 180 days of plant growth period on average. This is just enough for certain fast-growing seasonal crops at the bottom end. In most years, it supplies a relatively consistent yearly crop yield at the top end. (Scholes, 2020). In an urban century with anthropogenic climate change leading to significant consequences such as the heat island effect, making cities cool has become a growing priority for human health, energy-saving, and greenhouse gas abatement. Dryland urban areas, particularly semi-arid zones, experience more difficulties than cities in wetter climes. (Maskooni et al., 2021)

Cities are typically always warmer than their surroundings as a result of continuous urbanisation which is known as urban heat islands (UHIs) (Figure 2). Urbanization has resulted in an increase in the urban population. Cities presently house more than half of the world's population, and this figure is anticipated to rise to 60% by 2030. As a result, urbanization will affect an increasing number of people, and the key to tackling these global challenges is understanding the changing hazards that may threaten cities and urban inhabitants (Liu et al., 2020).

UHIs can have a considerable impact on building energy consumption. Previous research examined the effects of UHIs on building energy consumption and found that they can result in a 19.0 percent increase in cooling energy usage. As a result, UHIs are a serious challenge since they increase building energy usage. If this concern is left unchecked, rising cooling demand caused by UHIs will raise Emission of carbon dioxide to five times in 2050 for buildings in city centres compared to 2000. Extensive studies have been conducted in recent decades to examine the influence of wind, cloud cover, albedo, soil moisture, anthropogenic heat, and plant cover on UHIs. But, it is important to highlight that the climate conditions in different parts of the regions do have a significant impact on UHIs. (Liu et al., 2020).

The Concept of UHI
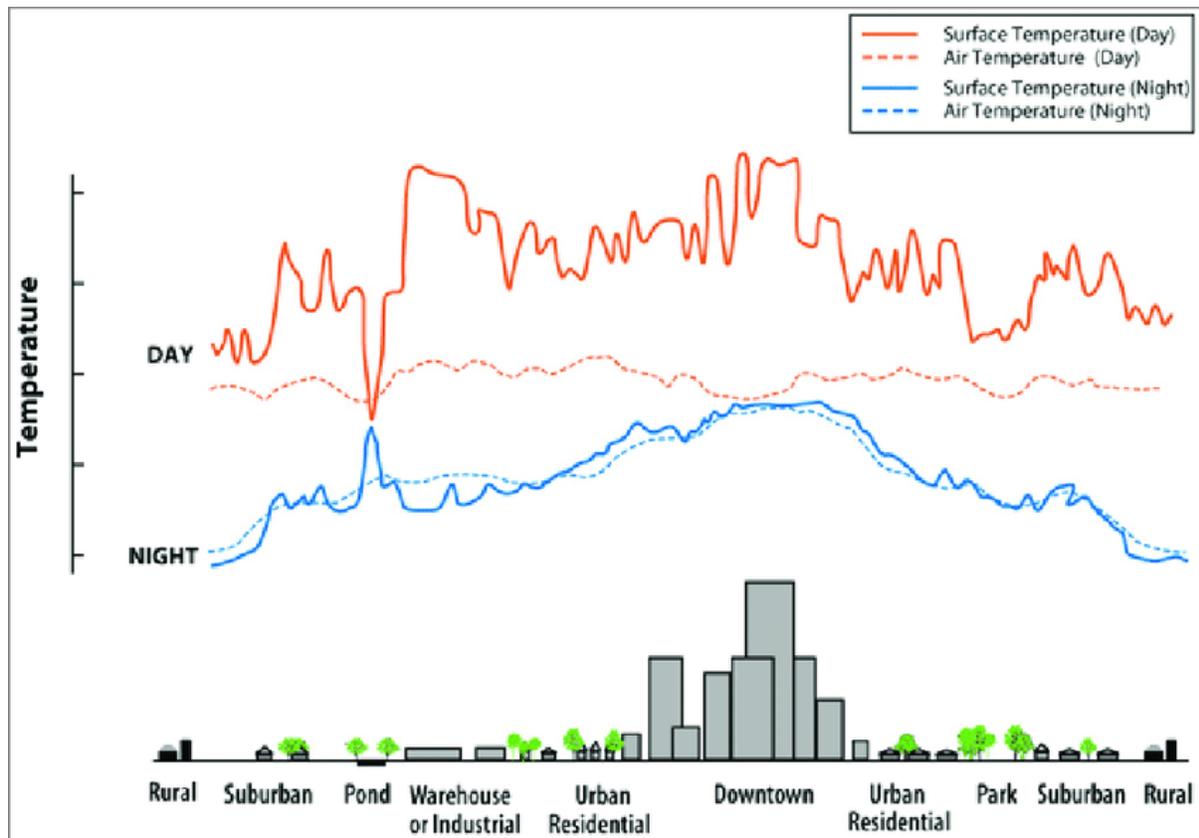
Figure 2: Graph demonstrating surface and air temperature differences during the day and night across different land use areas. Adopted from U.S. Environmental Protection Agency.

Source: Retrieved from *(https://www.epa.gov/heatislands/learn-about-heat-islands)*

The most heavily influenced meteorological variable by urban growth is temperature. Temperature rises within cities and their environs have been thoroughly established, and the concept "urban heat island," which was first coined by Manley in 1958, (Aflaki, A. et al, 2017) is now universally accepted. The urban heat island has been examined in multiple cities since it was initially conceived, and it has been demonstrated to cause temperature variations of several degrees between urban and rural area. The urban heat island (UHI) is the most reported climate change event. It refers to a rise in air temperature in dense urban areas relative to compared to rural locations nearby. In more than 400 towns throughout the world, urban overheating has been extensively observed using different techniques. The intensity of the phenomena could be greater than 5 degrees Celsius, and in certain

circumstances, urban heat island intensities of more than 10 degrees Celsius have been documented (Mattheos Santamouris et al., 2019).

It has been reported by numerous scholars that the most significantly influenced meteorological variable by urban growth and development is temperature. The temperature rise within cities and their environs have been well established (Iain D. Stewart & Mills, 2016; M. Santamouris, 2020; M Santamouris, 2013; Stewart, I. D., & Oke, 2012). Moreover, modeling predicts that the temperature differential between urban and adjacent rural areas in some cities could reach 8 degrees Celsius by 2050. The extent of the urban heat island effect is determined by a variety of factors, including area climate, but it is projected to be greater in dry climates than in cold humid ones.

According to the World Meteorological Organization, the UHI effect can raise the air temperature in a city by 2 to 8 degrees Celsius (Abbas Mohajerani et al., 2017). Conversely, Santamouris, (2013) found that a more accurate range is between 5 and 15°C. The heat island effect is the result of a decline in vegetation and evapotranspiration, an increased frequency of dark surfaces with low albedo, and greater anthropogenic heat output as our cities continue to grow and develop. In their study on heat island mitigations Mattheos Santamouris et al., (2019) presented results of hundreds of cities, details on the magnitude and characteristics of the urban heat island are provided. The magnitude of UHI varies between 0.5 and 11°C, with an average value close to 4.1^{o}C, according to data obtained through mobile traverses in 101 Asian and Australian cities. A similar record of data from 110 European cities revealed that the magnitude of UHI varied between 1 C and 10 ^{o}C, with an average maximum value around 6°C. Looking at the findings of the above studies from West, Asia, and Australia that studies on heat island in Africa is lacking. Hence, there is the need to embark on such investigation to identify and proffer sustainable solutions to one of the most challenging climatic phenomenon of the twenty first century to keep abreast with rest of the world for the sustainability of our cities and communities, which is one of the cardinal points of the UN sustainable development goals

Types of urban heat islands

UHI can be divided into two main categories, according to Rasul et al., (2016), these include atmospheric urban heat islands and surface urban heat islands. The first takes into account UHI effects in the canopy or boundary layers, while the latter takes into account the change in radiative temperature at the surface. In general, in situ sensors (weather stations or towers), radiosondes, drones, and aeroplanes are used to monitor and model atmospheric urban heat islands. Surface UHI is becoming more prominent, with satellite-based surface UHI being used for consistent spatiotemporal assessments at local, regional, and global level. Surface UHI is also crucial in thermal anisotropy. Surface UHI varies according to season, sun intensity, land cover, and weather. Additionally, surface UHIs vary substantially between day and night. Because of the incoming solar radiation, daytime surface UHI is higher than night time surface UHI.

Causes of urban heat islands

Several factors contribute to the development of UHI in urban centers. The principle reasons for the thermal difference in night time warmth is that thermal structures (e.g., buildings) in urban centres absorb and store shortwave radiations received during the day and release the stored energy during the night via longwave radiations. According to Aflaki, A. et al, (2017) the use of materials designed to store shortwave radiations in urban settings, as well as a lack of evapotranspiration (e.g., a lack of natural vegetation), contribute to the formation of UHI. According to Taslim et al., (2015) the key drivers of urban heat island include, but are not limited to land surface material, the increased emissivity from the sky and wind speed, High buildings, and Anthropogenic activities.

This was further explained, which (Aflaki, A. et al, 2017; Karlessi et al., 2013; Tian et al., 2021) also corroborates, that the main component influencing UHI is land surface material. Solar energy is stored in the urban structures throughout the day and discharged back into the environment at night. The heightened radiance from the sky as well as wind speed will reduce the size of the urban heat island, which means that the highest urban-rural temperature variations will happen during calm and cloud free nights. High-rise structures. Skyscrapers with continuous concrete structures can restrict airflow and wind circulation while also providing different materials for levels to reflect and absorb solar radiation, making city centers warmer. Anthropogenic activities such as building air conditioning, automobile traffic, and manufacturing output all have an impact on the climate.

Impact of UHI

Climatic condition, elevation, the physical structure of the built environment, and short-term weather conditions all influence the urban heat island phenomenon. The urban heat island is one of the most significant climate change events in urban areas, with significant negative consequences for biodiversity, pollutant concentrations, air quality, energy and water resources, human and animal health, environmental and socioeconomic implications, and even global warming (Weng, 2018). The UHI phenomena have had many adverse effects on the urban social ecosystem, including increasing building energy consumption, reducing thermal comfort, affecting the health of urban residents, and decreasing urban air quality (Tian et al., 2021). Similarly, studies have revealed that, the adverse impacts of climate change are substantially exacerbated by the increased frequency of urbanisation. Energy consumption, on the other hand, increased by 14% in the recent decade, owing primarily to growing urbanisation. At least 61 percent of the world's population will live in cities by 2030, according to projections. Cities in emerging nations will accommodate 95 percent of all population expansion, sheltering about four billion people (80 percent of the world's urban inhabitants). Conversely, increased urbanisation may present an opportunity for a climate-friendly urban rehabilitation or reconstruction. The following are some of the primary factors that contributed to the rise of UHI in urban centers (Taslim et al., 2015).

Furthermore, the impact of urban heat island has always been associated with anthropogenic heat emissions and changes in energy transfer among urban land surfaces and the atmosphere, which are mostly produced by increased pavements substituting evaporative vegetation covers (Zhou et al., 2019). However, it is important to highlight that one positive impact this phenomenon which is reported by (Aflaki, A. et al, 2017) that, heat islands can also be beneficial in reducing heating loads in high-latitude cities with colder climates, while in mid- and low-latitude cities, heat islands contribute to summer discomfort and much higher air-conditioning demands.

Under a warming climate and an increasingly urbanised world, the UHI effect and its impacts are anticipated to be more severe. This is especially true for China, India, and Nigeria, which are expected to account for 35% of world urban population between 2018 and 2050. As a result, UHI has sparked the interest of researchers and has been the focus of substantial investigation, notably in the last decade. (Zhou et al., 2019). It's worthy to note that, in contrast to UHI, a "Surface Urban Cool Island" (SUCI) is exhibited in dry locations, and is defined as an urban area with lower surface temperatures than non-urbanised dry environments. It's typically seen in arid and semi-arid climates (Rasul et al., 2016).

The adverse impacts of climate change are substantially exacerbated by the increased frequency of urbanisation. Energy consumption, on the other hand, increased by 14% in the recent decade, owing primarily to growing urbanisation. At least 61 percent of the world's population will live in cities by 2030, according to projections. Cities in emerging nations will accommodate 95 percent of all population expansion, sheltering about four billion people (80 percent of the world's urban

inhabitants). Conversely, increased urbanisation may present an opportunity for a climate-friendly urban rehabilitation or reconstruction. The following are some of the primary factors that contributed to the rise of UHI in urban centers (Taslim et al., 2015).

Conclusion

Our cities, cities and towns, are at a critical crossroads, the most pressing issues of our time. Rapid population growth and massive urbanisation, energy inefficiency and scarcity, increasing air and water pollution, global and micro climate change, and economic decline, unsustainable growth of the built environment at all levels, and the relentless destruction of natural habitats, all of which are execrated by rising urban temperatures and subsequently leads to degrade the quality of urban ecosystem and total wellbeing of the urban dwellers. Some of the theoretical and practical concepts established to combat these processes and steer development toward more sustainable forms include sustainable urbanisation, green urban environments, and smart growth. All these are down to knowledge sharing which ought to be understood first.

Conflict of Interest

"There is no conflict of interest in this study"

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A REVIEW OF FLASH FLOODS AND ITS EFFECTS ON THE HUMAN ENVIRONMENT IN MALAYSIA

Shafii, H.[1], Seow, T.W.[2], Yassin, A.M.[3] and Masram, H.[4]

[1,2]Department of Construction Management, Faculty of Technology Management and Business
Universiti Tun Hussein Onn Malaysia, Batu Pahat, Johor

[3,4] Department of Real Estate, Faculty of Technology Management and Business, University Tun Hussein Onn Malaysia, Batu Pahat, Johor.

Correspondence: haryati@uthm.edu.my

Abstract: Flash floods are some of nature's most dangerous phenomena, often resulting in deaths and significant damage to infrastructure, human environment and the environment itself. Globally, flash floods have become one of the most common natural disasters in recent decades, with an upward tendency on a global scale. In Malaysia, incidence of flash floods is frequently experienced every single year, normally occurring in cities such as Kuala Lumpur, Batu Pahat, Johor, Klang, Bandar Kuching, Sarawak and others. The methodology of this study is based on an analytical study using critical literature review on flash floods and effects on the human environment in Malaysia. Results show that a lot of factors have influenced flash floods in Malaysia and negatively affected both the natural and human environment. These include climate change, which is predicated to increase extreme rainfall and heavy river discharge, human activities, rapid urbanisation, low-lying topography and poor drainage systems. This paper focuses on the effects of flash flood to the human environment in Malaysia. The results show that flash floods cause severe damage and negative effects on property and the agricultural industry, delay of construction projects and minor injuries as well as hypothermia and others. Increasingly, mitigation is seen as a solution to manage the efficiency of drainage system in a city with the aim of reducing excessive surface runoff. In conclusion, this study contributes to increase of awareness among residents in flood-prone areas and proposes comprehensive guidelines and solutions for sustainable urban drainage systems in town planning.

Keywords: Flash flood, effect, Human environment, Malaysia

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Introduction

Globally, flooding is a major disaster affecting almost all countries, including Malaysia. Increasingly, this phenomenon is exacerbated by climate change which is considered one of the most pervasive environmental changes currently affecting human society and human environment, especially in urban areas. In Malaysia, climate change has intensified two already deadly hazards, viz. urban heat islands (UHIs) and urban flooding (Chan et. al 2019). In Malaysia, deforestation followed by rapid land use change from forests into agriculture and then later into urban landscapes and urban sprawl over the last half a century has resulted in increased stormwater flow into receiving waters. This has increased flood magnitudes and frequencies, as conventional urban open drainage systems such as concrete monsoon drains fail to address flash floods which also cause degradation of stormwater quality (Chan et. al. 2019).

Flash flood has become one of the most common natural disasters in recent decades, with an upward tendency on a global scale. In Malaysia, strong and continuous rain occurs every year, resulting in severe and extreme floods (Chan, 2012). Flash floods are caused by high-intensity rainfalls in a short period of time. It occurs in small areas such as large urban areas and takes a short time to disappear. This phenomenon occurs due to the carrying capacity of drainage systems in the city such as rivers, ditches, drains that cannot accept the high volume of surface water runoff due to heavy rainfall. High surface water runoff in the city occurs because the earth's surface in the city has been covered by

bitumen, asphalt and concrete which impedes the process of water infiltration into the soil. As a result, rainwater is abundant in the low-lying areas of the city. This phenomenon refers to the flash floods that commonly occur in cities.

Flash flood is a common occurrence in urban areas including Batu Pahat, Johor, Kuala Lumpur, Butterworth and Kota Bharu, Kelantan. However, despite this development, Negeri Sembilan has experienced a rapid urbanization that has caused flash floods (Mosthaffa, A. A. (2021). The flash floods occurred due to the increase in saturated built -up areas which reduced the rate of water infiltration and increased runoff during heavy rains. Consequently, flash flood has been causing the disruption of daily activities of community, traffic congestion, properties damage and loss of human life (Apriliyanti, 2022).Thus, this paper focus on flash flood effect to human environment and solution to minimise the effect.

Definition of Flash Flood

Flooding occurs in known floodplains when prolonged rainfall over several days, intense rainfall over a short period of time, or an ice or debris jam causes a river or stream to overflow and flood the surrounding area. Melting snow can combine with rain in the winter and early spring; severe thunderstorms can bring heavy rain in the spring and summer; or tropical cyclones can bring intense rainfall to the coastal and inland states in the summer and fall.

Flash floods occur within six hours of a rain event, or after a dam or levee failure, or following a sudden release of water held by an ice or debris jam, and flash floods can catch people unprepared. You will not always have a warning that these deadly, sudden floods are coming. So if you live in areas prone to flash floods, plan now to protect your family and property.

As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. Urbanization increases runoff two to six times over what would occur on natural terrain. During periods of urban flooding, streets can become swift moving rivers, while basements and viaducts can become death traps as they fill with water.

Several factors contribute to flooding. Two key elements are rainfall intensity and duration. Intensity is the rate of rainfall, and duration is how long the rain lasts. Topography, soil conditions, and ground cover also play important roles. Most flash flooding is caused by slow-moving thunderstorms, thunderstorms repeatedly moving over the same area, or heavy rains from hurricanes and tropical storms. Floods, on the other hand, can be slow- or fast-rising, but generally develop over a period of hours or days (https://www.disastercenter.com/guide/flood.html 2022).

Background of study and Issues

Malaysia has an equatorial climate with constant high temperatures and a high relative humidity. The climate is influenced by the northeast and southwest monsoons. The former, prevailing between November and February, brings heavy rainfall (as much as 600 mm in 24 hours in extreme cases) predominantly to the east coast of Peninsular Malaysia and to Sabah and Sarawak. Rain bearing winds also come with the southwest monsoon from April to September though rainfalls during these periods are generally less than during the northeast monsoon. There are, in addition, two transitional periods between the monsoons (inter monsoon) when convectional thunderstorms are common.

The annual average rainfall is 2420 mm for Peninsular Malaysia, 2630 mm for Sabah and 3830 mm for Sarawak, with heavier precipitation recorded in the east coast of Peninsular Malaysia and the coastal regions of Sabah and Sarawak.

There are two basic types of rainfall causing flooding viz, (i) moderate intensity, long duration rainfall covering a wide area; and (ii) high intensity, short duration localised rainfall. In addition, flood records indicate that there is a seasonal pattern of flood occurrences. The east coast and the southern part of Peninsular Malaysia, Sabah and Sarawak are mainly affected by floods during December to January when the northeast monsoon is prevailing. Flooding occurs due to widespread prolonged heavy rainfall resulting in a large concentration of runoff which is very much in excess of the capacities of streams and rivers (https://www.water.gov.my/jps/resources/auto%20download%20images/584130f6ea786.pdf 2022). Extensive areas are often inundated.

The west coast of Peninsular Malaysia on the other hand is mainly affected from September to November during the inter monsoon period when convectional thunderstorms become prevalent. Such storms bring short but very intense rainfall which severely overloads the drainage systems, causing localised "flash" floods.

According to Bari et. al. (2021), flooding refers to an overflowing of water onto dry land. In terms of technical terminology and hydrology, a flood is a contribution of unusual rainfall that cannot be accommodated by a river basin and causes it to overflow the banks or floodplains. In general, a flood is river water that overflows its banks, or a phenomenon caused by rising water levels of major rivers and tributaries that overflow land that is not normally inundated with water. In other words, floods are closely related to extreme river discharges.

In Malaysia, the risk and human exposure to the dangers of flash flood especially in large urban areas with dense population distribution and high construction rates has increased significantly in recent years. This is proven by the incidents of serious flash flood around major cities of country such as Kuala Lumpur, Georgetown, Ipoh, Kota Bharu and others (Chan 1996). In September 2018, Batu Pahat, Johor is reported hit by a flash flood which forced 105 people from 42 families to seek temporary shelters on Friday (September 7). Johor Civil Defence Force claimed that the flash flood was caused by a high tide and continuous rain (The Star online 2018).

In low-land areas, rainwater will flow quickly into the river. The water that flows in will cause the river to overflow so that the lowland area is filled with water. Floods are becoming much more difficult to prevent, with population and development concentrated in basins and ravines that are quickly flooded. This incident occurs every year during the rainy season, as seen by the flood incident recorded by the National Disaster Management Agency in Terengganu in 2016 (NADMA 2016).

The Department of Statistics Malaysia (DOSM) has conducted a survey and published "Special Report on Impact of Floods in Malaysia 2021". The survey aimed to evaluate the total losses and damage during the flooding at the end of 2021 till early 2022. According to the report, 54 deaths were recorded and estimate the total of losses in terms of properties were reached RM 6.1 billion. From Figure 1, the terms of public assets and infrastructure recorded the highest losses of RM 2.0 billion (33%); while the agriculture recorded lowest losses of RM90.6 million (2%).
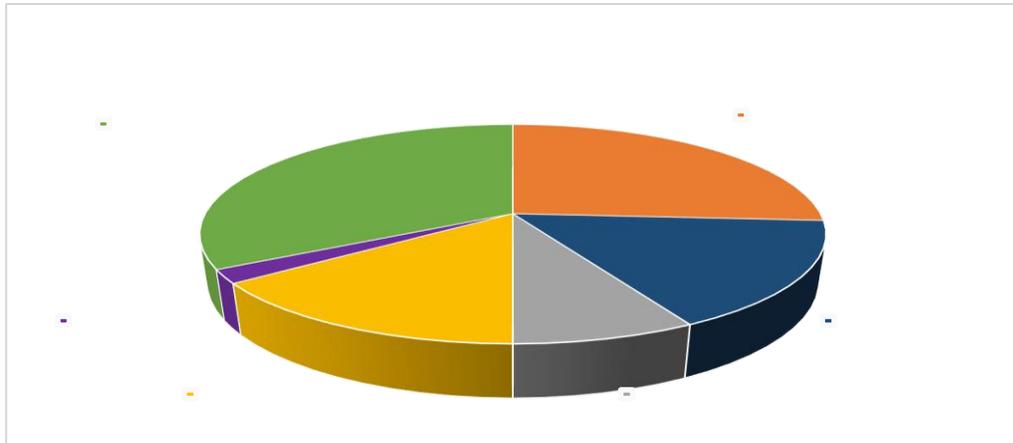
Figure 1: Total Losses due To Floods in term of Properties in Malaysia 2021
Source: Report from Department of Statistics Malaysia (DOSM) in 2022

Referring to Figure 1, the maximum losses from the flood 2021 (including the flash flood) is public assets and infrastructure with Rm 2.0 billion or 33% of losses. The second is living quarters which is RM 1.6 billion with 26% and minimum low losses is premises which is RM 0.5 billion or 8%. From the report, we can clearly see the effects of flood to human environment.

Bangladesh is one of the most flood-affected countries in the world (World Bank 2013; Gain et al. 2017). National policy instruments, such as the National Plan for Disaster Management (2016–2020) (MoDMR 2017), seventh 5-year plan (2016–2020) (GED 2015) and the Delta Plan 2100 (GED 2018), have placed a bold emphasis on building livelihood resilience of flood-affected communities in this country (Ranjan Roy et. al 2020).

Critical Literature Review of Factors contributing to flash floods in Malaysia

From the previous research, there are several factors that contribute to flash flood in Malaysia. The factors are water overflow from drainage system or poorly maintained drainage system, drainage pollution issues, lack of water permeable surface, redeem wetland, high population in urban area, changes land use and all element that contribute to flash flood in metropolitan environments.

Inefficient of Drainage system

According to Samsuri et. al. (2018), the unirrigated old sewage system is one of the best examples of improper drainage system. Apart from that, the research raised a concern regarding the design of irrigation and drainage that did not take into consideration of environmental changes. As a result, during the heavy rainfalls, the constructed of sewers and drains have been failed to accommodate the water surface runoff that causing flooding.

Lack of water permeable surface

Samsuri et. al. (2018) has traced that the development of city has been totally changing the natural landscape into manmade landscape. In fact, more than 80% of the terrain of urban areas, especially large cities such as Kuala Lumpur, Johor Bahru, and Kuching are covered with impermeable surfaces covered with bitumen, cement, and asphalt. This coverage reduces the infiltration rate and increases the surface flow rate. When it rains heavily, more water will stagnate on the surface than the amount water seeping into the ground. Therefore, the potential for water overflow on the surface is very high.

Restoration of wetlands

Ismail & Shareh Musa (2021) highlighted that the soil type, topography and land use patterns are the physical factors that contribute to flooding. Originally, the land of UTHM's main campus was geared towards commercial cultivation of oil palm, where the land was swampy and peat. However, the construction of the UTHM main campus building has destroyed the natural water catchment area due to land redemption (cut and fill) and resulted in flash floods in the area of G3 building.

Population factors

According to Samsuri et. al. (2018), the increasing population in a city has contributed to flooding due to the rapid development of housing and commercial buildings. Apart from that, the public irresponsibility such as throwing rubbishes into the drain has been causing clogging and stressing on drainage system. The negative attitude of the residents has caused drainage systems such as rivers, drains and drainage to be clogged with garbage, domestic waste and housing project waste that are blocking the flow of water. The shallow riverbed is also unable to accommodate the "volume" of water flowing in the drainage system, thus the water overflows and flood occurs.

Methodology

This study using critical analysis literature review, for discussion and conclude the factor and effects flash flood to human environment in Malaysia. Knowledge production within the field of business research is accelerating at a tremendous speed while at the same time remaining fragmented and interdisciplinary. This makes it hard to keep up with state-of-the-art research and to be at the forefront, as well as to assess the collective evidence in a particular research area. This is why the literature review as a research method is more relevant than ever.

A literature review can broadly be described as a more or less systematic way of collecting and synthesizing previous research (Baumeister & Leary, 1997; Tranfield et. al 2003). An effective and well-conducted review as a research method creates a firm foundation for advancing knowledge and facilitating theory development (Webster & Watson, 2002). By integrating findings and perspectives from many empirical findings, a literature review can address research questions with a power that no single study has.

Results and Discussion

Refer to analytical literature review, this study showed of critical analysis about flash flood effects to human environment in Malaysia. From the analysis, overall flash floods effects to economy, environment and human society. A lot of loses, accident, physical effects and mental of victims needed to support system especially from government and Non-governmental Organization (NGO), treatment and others to survive and development new chapter in the life.

Flash flood and its effects to the human environment: a review in Malaysia

Generally, flash flood has devastating consequences and it can affect the economy, environment and society. During the flash floods, houses, offices, hospital, transportation, construction projects, roads, bridges and water tanks are destroyed. The big effect is that people become homeless. In addition, the government deploys firemen, police and other emergency apparatuses to the affected area. It usually takes years for effected communities to be rebuilt and resettled in order to be back to normal. The environment also affected when flood occurs. Chemical and other hazardous substances built up in water and eventually contaminate the water bodies that floods end up in. In addition, flooding can

destroy the natural balance of the ecosystem. According to new article from newspaper (Mahani & Faris 2022), the river has breached the warning level in Sungai Batu, Sungai Klang and Sungai Gombak, as well as the danger threshold in Jalan Tun Razak and Sungai Gombak, Selangor. NADMA take an action with notice to general public to constantly exercise care and be aware of their surroundings such as care about family safety first.

Effect to human health

Flash flood brings a lot of diseases and infection such as conjunctivitis, waterborne and foodborne disease, dengue, diarrhea and others. According to the Ministry of health of Malaysia, human health is the worst affected by flash flood because they can easily contagious during and after the flash flood (Norashikin Samsuri et. al 2018). They can easily be infected from drinking and eating food that contaminated with disease germs.

In addition, as this disaster phenomenon often occurs every year, a comprehensive management must be planned by involved parties in order to overcome the post-flood problems because it has a psychological and mental impacts on flood victims. Catastrophic events have a physical impact and long-term traumatic psychology among victims (Nadirah H. Rodzi, 2022). A psychological symptom experienced by victims include sadness, fear, anxiety, worry, somatic, physical, emotional instability, trauma, nightmare/bad dream and unwillingness to communicate with surrounding people (Ehrenreich 2001).

The second effect in human health is disease-related death. Dengue fever and leprosy are two illnesses spread by flash flood. Furthermore, cholera and malaria are spreading as a result of the sewage reservoirs overflow and the flash flood water overflow.

Effect to agricultural industry

Large-scale agriculture losses were among the numerous consequences of flash flood. Crops will be destroyed as a result of flash flood. This occurs when water stagnates in agriculture regions for an extended period of time, killing the crops. Rubber plants, oil palm trees and paddy fields are examples of crops that are easily affected by flood (Md Noorazuan 2001). According to the Prime Minister, Department of Statistics Malaysia 2021 flood effect special report, the overall loss caused by flood in Malaysia for agriculture sector was 2% or RM 90.6 million for this year. The losses are very high as there is no method to prevent flood water from entering the agriculture region. Crop farmers suffer huge losses when crops are destroyed and livestock farmers also face great losses due to deaths of their animals. With the exception of ducks, most animals drown as farmers are unable to intervene to save them. Thus, the agriculture industries have been severely impacted by flash floods in Malaysia.

Effects on property in the area involved affected the urban community

Flash flood has affected properties too much. The structure of houses are damaged; the roofs are torn off, doors and windows are broken, the roof frames are drifted, house walls collapsed and more. The case can be seen on wooden type of house. The less sloping stone house suffered great damage to the structure of the house. Moreover, the rising water level also destroyed other properties in the affected area. The houses would be flooded and this would cause damage to the belongings in the house. Electrical stuffs, furniture, document, clothing, books and other items would be submerged and damaged. This will make a goods unusable if the goods are submerged for a long period of time (Mstar 2022). This will cause losses among the urban communities involved. What makes it worser is that motor vehicles such as cars and motorcycles that are often a problem for victims when they cannot save them from flash flood. The cost to repair them are expensive and complicated.

Construction - project delay at site

Effect from flash flood it become to project delay at site. A lot of construction project delay because of flash flood at site such as Kuala Lumpur area, Kuching, Sarawak, Klang Valley, Selangor and others (http//.Malaysia News. 2022) One an example is a flood mitigation project in Kuala Lumpur due for completion this year has been delayed again to 2024 due to contractor troubles. This is because a second flash flood hitting the capital in three months.

Another project was delay is Pulapol flood retention pond in February 2021. The Drainage and Irrigation Department revealed that the Pulapol flood retention pond had been facing delays after the original contractor was removed for failure to abide by the terms of the contract. At that time, the project was only 66 percent completed, and the department assured that a contractor would be appointed by June 2021 to finish the project by June this year (http//.Malaysia News.2022).

Risk of injuries and incidence of hypothermia

The other effect of flash flood is injured victims. Flood victims would be harmed, either due to the consequence of the flood or as a result of being injured by floating wood, iron or trash. Injuries can also occur when flood victims return to their homes and do the cleaning. Sharp things including furniture can be extremely dangerous to victims (Knocke et. al 2007). At the same time, any injuries received as a result of the floods are dangerous because it is prone to infection. There are many things in flood water that are not apparent to the human eye. It might contain soil, urine or even germs which could lead to an infection on the wound.

Water does not have to be as a cold as ice for hypothermia to occur. In fact, most of flood water has a lower temperature than body temperature which is enough to lead to a hypothermic attack. Being in the water for too long will cause the victims to develop hypothermia (Knocke et al. 2007). This is a bad situation among children who are not controlled by their parents. This is because they feel that flash flood is not dangerous and they are having fun playing in the water with friends while waiting for the rescuers or help to arrive.

Solution and Mitigation to reduce flash flood Our Government

In Malaysia Department of Town and Planning (DTP), Department of Irrigation and Drainage (DID) and Local Government (PBT) is important and has responsibility for planning, construction and maintenance of drainage system in town. Maintenance is very important to make sure the drainage system is running and function smoothly. During heavy rains, inefficient drainage systems will not be able to cater to the large volume of water. The PBT also has the responsibility of managing their facilities and drains by using the annual revenue of PBT, which consists of tax revenue and non-tax revenue such as assessment rates, rental rates, license fees and proceeds of money or charges payable.

In Malaysia, drainage system is under the jurisdiction of local government (PBT) and Department of Irrigation and Drainage (JPS). According to Act 171 – Local Government Act (1976), it is a responsibility of PBT to make a maintenance on ditches and drains by using the annual revenue Generally, PBT is responsible for the construction and maintenance of drainage systems which largely consist of drain trunks and secondary drains. In fact, floods caused by contaminated drains and clogged sewers are under the responsibility of PBT.

According to an annual report published by DID named Kompedium Jabatan Pengairan & Saliran Malaysia 2020, JPS's mission is providing an expert engineering and water resources management services including river basin management, coastal zones as well as integrated flood and drought management to improve the quality life of people by ensuring water security and environmental sustainability.

In Malaysia, Acts and Legislation to reduce flash flood and related to irrigation and drainage are as following:

i.   Drainage Works Act 1954 (1988)
ii.   Local Government Act (1976)
iii.   Earthworks by Laws
iv.   Street, Drainage and Building Act 1974 (1994)
v.   Town and Country Planning Act 1976

Flood Control Measures

Following the disastrous 1971 flood, the Government took several positive steps to deal with the flood problem. Among these were:

(a)   establishment of the Permanent Flood Control Commission;
(b)   establishment of flood disaster relief machinery;
(c)   carrying out of river basin studies and preparation of drainage master plans for major towns;
(d)   implementation of structural measures;
(e)   implementation of non-structural measures;
(f)   setting up of flood forecasting and warning systems;
(g)   setting up of a nation-wide network of hydrological and flood data collection stations.
(https://www.water.gov.my/jps/resources/auto%20download%20images/584130f6ea786.pdf 2022).

Based on the experience accumulated over the years in implementing flood mitigation works, DID is today more conscious of the need to carry out such projects on a river basin basis rather than on a piecemeal approach. This kind of approach will involve a shift from the traditional thinking in terms of controlling flooding through expensive engineering structures to the more comprehensive approach of viewing the solution in terms of managing flooding by incorporating structural as well as nonstructural measures.

Conclusion

Flash flooding has become one of the most dangerous disasters in Malaysia. Year by year, the incidence of flash flooding has continued to escalate, especially in urban areas which are experiencing rapid urban sprawl such as Johor Bharu, Batu Pahat, Putrajaya, Kuala Lumpur and George Town. Flash floods are caused by water overflow from drainage system, river or steam, largely due to impervious surfaces. In impervious urban areas, rainwater will flow quickly into the river. Many things are affected and destroyed after flash flood, including damaged properties, infection to human health and losses of living things.

Flash flood can have devastating consequences on the economy, environment and society. Human health is the worst affected by flash flood because they can easily contagious during and after flash flood. Catastrophic events leave physical impacts and a long-term traumatic psychology problem among victims. There are various pressures that occur to flood victims resulting in severe psychological effects on flood victims. Economic activities could not be carried out as usual causing

the source of income to be cut off. Flood victims are suffering losses and high costs are required to replace all of the damaged goods.

In conclusion, flash flood is most frequently occur when monsoon season comes. The effects of flash flood are often catastrophic and it depends on development and land use in the effect basins, it is resulting to a large loss of life because of the sudden onset of the flood events.

Conflict of Interest

"There is no conflict of interest in this study"

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SOCIO-ECONOMIC AND ENVIRONMENTAL CHALLENGES FACING WATER VILLAGES IN SEMPORNA AND KUDAT, SABAH, MALAYSIA

Yusoh, M.P.[1], Mapjabil, J.[1] and Chan, N.W.[2]
[1]Borneo Institute for Indigenous Studies (BorIIS), Universiti Malaysia Sabah, Sabah, Malaysia
[2]Geography Section, School of Humanities, Universiti Sains Malaysia, Penang, Malaysia,
Corresponding Author: nwchan@usm.my

Abstract

Water villages are a unique form of traditional settlement found scattered along the coastlines, islands and estuaries in the state of Sabah, Malaysia. These settlements have strong historical and cultural importance and are attractive to tourists for their unique history, socio-cultural and scenic physical environment. However, communities living in these settlements faced mounting socio-economic and environmental challenges that are associated with negative issues such as illegal squatting, high crime rate, unhealthy conditions, environmental pollution and poor management, alien intrusion, smuggling and other socio-economic problems. The objectives of this paper are to identify the main socio-economic and environmental problems facing water village communities, find appropriate ways to address them and suggests ways on how they can achieve sustainable livelihoods. The methodology is largely based on observation research, a qualitative research technique whereby the researchers observe, record, document and analyse the target respondents' environment, their activities, ongoing behaviour, willingness to engage with strangers, and other phenomena. The study also uses secondary data and published materials. Results show that the majority of inhabitants in the water villages are poorly educated, with most villagers facing difficulty in making a livelihood in the informal sector. Furthermore, water and electricity supply are poor and frequently disrupted. There are also issues related to citizenship and the unavailability of schools for the village children, leading to high incidence of dropouts. To exacerbate matters, various negative social stigmas are associated with water village inhabitants. These include smuggling of goods (cigarettes, drugs and groceries from neighbouring countries), theft and burglary, drug abuse (especially Methamphetamine), serious crime (e.g. murder), gambling and prostitution, among others. Results also indicate that the structure of water villages with houses packed closely together connected by small bridges, has also exacerbated the above issues. In terms of the water village environment, results show that environmental management is poor, especially solid waste and sewage disposal, garbage disposal, seawater and beach pollution, odour pollution and destruction of scenic view. In conclusion, water villages are important historically, culturally and socio-economically. Hence, they should be preserved and their problems addressed. It is recommended that a small police post be established to curb smuggling, drug abuse, thefts, burglaries, gambling, prostitution and other crimes. Public amenities such as water, sewerage, solid waste disposal, electricity and tele-communications need to be improved in water villages. Homestays should be encouraged to boost tourism and provide villagers with extra income. A small school should also be set up to ensure proper education for village children.

Keywords: Water Village, Socio-Economic Issues, Environmental Management, Poverty, Tourism

Introduction

Water villages are a unique form of traditional settlement found lining most of the coastlines and river estuaries in almost all Asian countries. Water villages are also common along islands and river estuaries in Borneo, especially in the state of Sabah, Malaysia (Amaluddin et al., 2004). Water village settlements have a long history and have existed many centuries ago. These large water villages were formerly the city for many previous maritime governments. Among them are the Maguindanao Sultanate, Makassar Sultanate, Sambas Sultanate, Brunei Sultanate and Sulu Sultanate (Amaluddin,

2002). Water villages have survived till modern times, and some iconic current examples are in Brunei (Jones, 1977), Borneo (Evers, 2015), Thailand (Ghisleni, 2021), Vietnam (Trang, 2016) and Malaysia (Alias et. al., 2014; Ismail et. al., 2015). These villages are often viewed as iconic destinations and are considered "must visit" tourism sites by foreign tourists who have not seen them before. These villages are largely attractive due to their rich historical background, vibrant cultures, unique characteristics and their architectural adaptations to the water environment. In Malaysia, the country's maritime nature actually fosters such settlements and it is therefore not surprising that it is home to a huge number of these "floating villages", from the clan jetties in George Town, Penang (George Town World Heritage Incorporated, 2019) to the picturesque fishing villages of Pulau Ketam, an almost entire village built on water (Cao, 2016), the Bagan Hailam village on the banks of the Klang river and the enchanting Bajau Laut (Sea Gypsies) settlements off the coast of Borneo (Hakim, 2019).

Living in houses along a river estuary, at the beach or on top of the sea is common for early settlers in the history of Malaysia, and the state of Sabah is especially well known for its water village settlements that are littered along its coasts constructed with wooden houses standing on wooden stilts in the coastal shallow water (Alias et. al., 2014). However, a combination of poor socio-economic and environmental conditions as well as negative social stigma have tarnished their image. Negative misconception about such settlements also did more harm than good to these villages. For example, in Malaysia, the misconception that *"…life on the water and the way of the floating villages were outdated and no longer fits the image of a progressive and modern nation that Malaysia strives to become"* (Hakim, 2019), has brought more negative connotations than positive potentials to these villages. Today, many of these historical water villages still exist but most of them have fallen from grace and are relegated to being considered as problematic squatter areas. To make it worse, many of these communes are blacklisted as black areas for they are associated with various criminal activities such as smuggling, gambling, drugs and prostitution. Furthermore, water villages are always associated with environmental issues such as illegal disposal of solid wastes and sewage, sea pollution and odour (Alias et. al., 2014). This is because wastes and raw sewage are untreated and directly discharged into receiving rivers or the seas, causing unpleasant smell, unsightly scenes and gross environmental pollution (Mohammad Raduan, 2000; Alias, 2014; Alias et. al., 2014). Consequently, because of all these problems associated with water villages, most people view water villages to be similar to squatter settlements. According to Nik Juliana et al. (2014), some of water villagers choose to live in water villages as squatters because they do not want to be burdened with having to pay rent or mortgage, even though they have to put up with many social problems and be deprived of facilities and amenities.

Gradually, as water villages continue to operate like squatter areas, they are neglected by the authorities and left behind in the tide of progress and development. As water villages expand and grow as squatter settlements, the squatter issue correspondingly becomes more and more serious. One example is Pulau Gaya in Sabah, a well-known water village which is a squatter colony. This squatter settlement grew exponentially because it was located just offshore and settlers had relatively easy access to Kota Kinabalu. Apparently, in this settlement most inhabitants were illegals or aliens (non-Malaysians) who worked in the service and construction sectors. Gradually, Pulau Gaya not only became a self-contained settlement with its own social order and infrastructure complete with a mosque and school for their young and chosen leaders to oversee their family and community affairs. When locals realised the advantage of having residence on the island, they too moved into Pulau Gaya (http://dailyexpress.com.my/news.cfm?NewsID=101837 27 July 2015. Retrieved 12 Aug 2021). Since 2005, Malaysia has launched a 'Zero Squatter 2005' policy under the 5th Malaysia Plan. However, the number of squatters in Malaysia has not diminished but has in fact increased. For example, in 2015, there were a total of 68,861 squatter families in Malaysia, an increase of 4,732 squatter families from 64,129 in 2013 (Jabatan Perancangan Bandar dan Desa, 2013). Of all the

states in the country, Sabah had the highest number of squatters with a total of 28,087 families and 133,059 squatters (Source: Ministry of Urban Wellbeing Housing and Local Government, 2015).

In an effort to control the growth of squatter settlements, the government has implemented a relocation scheme of water village settlers to move them from the water margins to the land. In the case of Sabah, a relocation program effort was carried out at Kampung Tanjung Kapor, Kudat (Jabil et al. 2020). The squatter relocation scheme was implemented through the Kota Kinabalu City Hall (DBKK) by the enforcement of The Site and Services Scheme for Squatters Settlements. At the end of 1989, under the relocation scheme, 190 land lots were provided to the qualified occupants (Kota Kinabalu City Hall Yearly Report, 2000-2001). However, the squatter issue in Sabah remains unresolved because the root problem is the entry of illegal immigrants into Sabah from neighbouring countries. More and more illegal immigrants enter Sabah because of better job opportunities requiring low skills, as well as business opportunities (Mohd Salleh et. al., 2018). In a news report, Sabah was highlighted as the state with the highest number of illegal immigrants in Malaysia as 1.2 million or 30.8 % of the state's 3.9 million population are foreigners. It was further reported that one of the main reasons for the large numbers of immigrants entering the state was the existence of syndicates smuggling foreigners in as cheap labourers to work in oil palm plantations (Miwil, 2020).

Aim and Objectives

The general aim of this paper is to showcase historical water villages as a unique form of settlement built in a unique physical setting in Sabah State, Malaysia, including assessing the current socio-economic and environmental quality status of selected water villages. The specific objectives include the following: To identify the main socio-economic and environmental problems facing water village communities; To find appropriate ways to address the main socio-economic and environmental problems facing water village communities; and to suggest ways on how inhabitants of water villages can achieve sustainable livelihoods.

Methodology

This study uses the method of observation research, a qualitative research technique whereby the researchers observe, record, document and analyse the target respondents' environment, their activities/events, ongoing behaviour, willingness to engage/communicate with strangers, and other phenomena in their natural settings. Depending on the objective of a study, the researcher can choose varying levels of observer participation in the study. Often the researcher will insert himself/herself into the respondents' environment, such as live in the study area for a period of time, observing much like an insider. However, at other times, the researcher may choose to sit back, refrain from intervening in the setting and observe from a distance, often without being noticed at all by respondents. The main purpose of observation research is to gather first hand, reliable and actual phenomena occurring naturally as they would in the real world. Via observation research, the researcher can capture data on what participants do naturally as they would in their day to day life, as opposed to what they say they would do if they were put in an interviewed situation. Observation research requires the researcher to be in the field or study area to observe and record what they aim to study. According to Merriam (1998), the observation method is the best way to collect original data as a "first-hand encounter". Observation research is an effective way to critically analyse a situation in the field such as behaviour, the ways of doing something, the quality of the actual environment and other phenomena. Tannenbaum and Spradley (1980) have highlighted the characteristics of observation research based on the aim, carried out with suitable timing and specific norms such as recording, taking photographs and videos, voice recording, etc. Observation research as the main research method used in this study in the two water village study sites in Sabah. The research was carried out in two phases. For phase 1, observation research was carried out in Kampung Tanjung

Kapor, Kudat twice, i.e. between 15 to 16 July 2018 and between 23 to 25 November 2018. In phase 2, observation research was moved to three villages in Semporna District, viz. Kampung Air, Kampung Simunul and Kampung Bangau-Bangau. The data collection was carried out twice between 13 to 14 March 2019 and between 7 to 8 July 2019. During both phases of the research, various methods of observation research were employed including taking photographs, recording videos, casual talking (interview) with respondents regarding various socio-economic and environmental issues in the water villages. Besides observation data, this study also uses secondary data such as government reports, journal papers, NGO reports, news reports, and other published materials related to water villages.

Conceptual Highlights and Working Definitions

Settlement

According to Katiman (1990), a settlement encompasses the area of dwelling and its surroundings. Settlements consist of various types and shapes, namely temporary settlement, semi-permanent, permanent settlement and planned settlement. A settlement can be built in various forms and shapes such as a circle, square, oval, star, grid, or even in the shape of the letters T, Y and X. However, the types and shapes of settlement should not be confused with patterns and distribution concepts. Pattern and distribution usually refer to the order and arrangement of a settlement which is seen as a union of either within a village or a region. Other than the arrangement element, settlement patterns may contain other elements such as density and uniformity. The settlement pattern in terms of order and arrangement for a dwelling will form a union of either clustered, scattered, arrayed or even centralised pattern. In line with that, the aim of settlement sustainability is based on three main indicators, namely economics, social and the environment. This also includes the ability of the population in securing all the necessities and the facilities in order to become sufficient and be able to sustain the quality of life of the population (Yazid Saleh et al., 2020).

Water Village

Water village is a settlement that can be observed in most towns in the state of Sabah (Fatma, 2012). According to Kota Kinabalu City Hall (2011-2015), there are 34 water village areas with 11,760 houses and 69,936 people from 70% of the population in Sabah living near the coastline zones. Generally, water villages are built on tall wooden stilts at the river mouth (estuary) and coastal areas. Being considered as squatter settlements, water villages have no water and electricity supply, and are without sanitation or solid waste disposal facilities. Hence, they are often considered as filthy places with poor environmental conditions such as polluted seas, foul smell and unsightly scenery with garbage and all kinds of wastes and sewage dumped straight into the sea (Jikur, 2020). This scenario is a major problem leading towards environmental pollution. According to Mohammad Raduan (1998), the design and building material for water village settlements are often made from materials that can be obtained from the surrounding area. The house foundation such as the pillars, house frames and stairs are made from logs obtained from the forests (including mangrove forest) or bought from wood and sawmill factory. Hence, in a way, one can say that the architecture of the water villages is highly sustainable and represents a sensible adaptation to the water (flood) environment.

Environment

The environment is a treasure that should be cared for and its sustainability preserved. A healthy and safe environment is important for all life on this earth including human beings. The Environmental Quality Act 1974 defines the environment as the physical factors of the surroundings of human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants and the social factor of aesthetics. The environment offers and provides sites, resources and

natural materials for humans so that they can carry on living on this earth (Haliza, 2005). According to Raman (2003), the environment is all the elements surrounding us. Environment is the overall external condition that influences human life, which determines the quality and its life and death. For continuity of life, humans need natural resources such as land, water and air. However, the availability of the required natural resources is limited. In this regard, good management, being responsible and wise utilisation of resources is necessary. This is because the environment always affects the viability of human activities (Iskandar Zainuddin et al., 2018). Generally, human interactions with the environment influences human behaviour and affects human well-being (Khairos Md Saini et al., 2019). In water villages, the environment plays an important role, both positive and negative. While communities living in these settlements depend positively on the environment for its rich resources (e.g. fisheries, rainwater, seawater for boat transport, etc), the water villagers are faced with deteriorating environment such as polluted seas, floating solid wastes, diseases, strong winds and strong waves, foul smell and other negative effects. Other than the physical environment, the socio-economic environment also exerts tremendous challenges that are associated with negative issues such as illegal squatting, high crime rate, smuggling, prostitution, drug use and abuse, poor educational attainment, high school drop-out rate, malnutrition amongst the children, poverty and countless other socio-economic problems (Santos, 2019; Lee, 2019).

Major Challenges, Discussion and Results

Background of Water Village Settlements in Semporna: Kampung Air, Kampung Simunul and Kampung Bangau-Bangau

Kampung Air is a settlement on sea in Semporna town area. It is situated next to the town mosque. Houses are well arranged in rows as there is a main footbridge from land towards the sea, and it is divided into 9 housing lots with each having its own footbridge. The basic infrastructures provided are electricity and water supplies, road infrastructures on the land area of the village, mosque and primary school. According to an indirect interview with one of the villagers, the problems they often face are water and electricity supply cuts as well as break-ins. Based on an interview with the Head of Kampung Air JKKK, the majority of dwellers in Kampung Air is made up of Malaysian citizens from the Bajau, Brunei, Suluk and Bugis tribes. Via observation research using personal observation, taking field notes, photograph taking and video-recording, the researchers found that the surrounding areas especially at the village shorelines are experiencing major waste pollution problems (Figure 1).

Figure 1: Kampung Air, Semporna

Kampung Bangau-Bangau (Figure 2) is a water village situated less than a kilometer from Semporna town. Houses are closely built and connected to one another by small footbridges. Majority of the village settlers are from the Bajau Laut and Suluk tribes. Facilities available in the village are electricity and water supply, with roads on the land area of the village, mosque and primary school. Based on direct observation and informal interview with the residents, it was found that the major social issues in this water village are predominantly thefts, break-ins and drug pushing (mostly methamphetamine).

Figure 2: Kampung Bangau-Bangau, Semporna

Kampung Simunul (Figure 3) is situated less than a kilometre from Semporna town and is nearby to a mangrove forest. Majority of the settlers consists of Suluk and Bajau tribes. Similar to Kampung Bangau-Bangau, the houses on sea in this village are scattered, closely built, and some of the houses are connected using small footbridges only. Among the facilities available in the village are electricity and water supply, road infrastructures on the land area of the village, mosque and primary school and a marine police station. Villagers say there are illegal immigrants (PATI) living here.

Figure 3: Kampung Simunul, Semporna

Background of Water Village Settlements in Kudat: Kampung Tanjung Kapor

Kampung Tanjung Kapor (Figure 4) is a settlement located in an area near the city of Kudat within two kilometres distance. Majority of the settlers consists of the Bajau Ubian, Sungai, Suluk and Bugis tribes. According to the Village Head, Arman bin Majud, Kampung Tanjung Kapor is divided into two divisions, namely Tanjung Kapor 1 and Tanjung Kapor 2. Each division has its own village head and JKKK, however, they will still work together in one village. Most of the villagers in Kampung Tanjung Kapor are more focused on fishing and trading activities.

Figure 4: Kampung Tanjung Kapor, Kudat

Socio-Economic Challenges in Water Village Settlements in Semporna and Kudat

The Poverty Challenge

Squatters are usually associated with the lowest income groups in Malaysian society (Devaraj, 2019)**.** Hence, it was no surprise that the researchers found that the water village near Semporna town is a poverty-stricken settlement whereby its inhabitants are mostly comprised of the poor. The village itself portrays that the socio-economic abilities of the residents are low as most inhabitants make just enough to survive. The majority of the inhabitants work as fishermen and engage in informal sector activities such as selling fish, vegetables, cakes, kitchen utensils, clothes and other household items either by the footbridge, from their homes or in the nearby town. Residents use the source of income from these jobs to support themselves for the whole household. Generally, poverty is not only limited to material aspects such as money and ownership of gadgets and personal assets, but it also involves poor attainment of formal education and poor access to healthcare. Residents build their settlement at the water villages because they do not own any private land or property. When their children have poor access to good schools, and the drop-out rate is high, the vicious circle of poverty continues from generation to generation. When inhabitants of water villages such as these in Kudat cannot break free from the circle of poverty, then the issue of poverty becomes a major problem for the country. In these water villages, the lack of home ownership, lack of access to education, health, financial management and other facilities have become the driving forces that suppress the poor household groups in their struggle to break free from poverty (Mohd Sahrul et al., 2019). For the people living in these water villages, money is very scarce and extremely difficult to come by. Most inhabitants generally earn between RM500 to RM1,500 a month from fishing, collecting cockles and other shellfish and doing petty businesses. Whatever little they have is spent on daily subsistence of food, household necessities, and the journey in and out of the water villages to the land (and towns) for visiting clinics to treat sickness and other emergencies. As the seas are getting more and more polluted, and fishes becoming depleted, life has also become harder and harder to make ends meet. In the past, fishermen could afford to sell half their catch and save some money, but now, most of the catch is consumed by their families as the catch is becoming less and less. One fisherman remarked *"In the past, on a good day, I would be able to catch about 10 kilograms of fish, crabs, prawns and other seafood, but now I would be lucky to get 3 kilograms!"*

Based on data and results from observation research, Kampung Tanjung Kapor, Kudat the majority of this village's inhabitants are also poor, as indicated by their dilapidated houses (Figure 5). Most of the Kampung Tanjung Kapor residents carry out fishing activities as their main source of income.

Some residents also run petty informal sector businesses such as selling basic necessities to residents. Observation also confirms the poor conditions of the village houses and their contents. There was hardly any furniture in all the houses as inhabitants sleep on the floor. There is no television, no refrigerator and certainly no air-conditioner or fan. All these point to the fact that residents of Kampung Tanjung Kapor are largely poor and survive only on a day to day basis with little savings and little hope to forge a better life for themselves and their families. Consequently, many youths in the village have migrated to the land areas to look for greener pastures (Allerton, 2014).

Figure 5: Structure of villagers' houses and toilets in Kampung Tanjung Kapor, Kudat.

The Low Education and Limited Work Option Challenge

Most residents living in the water villages are Malaysian citizens or those with permanent resident status. However, due to immigration, there is increasingly many without any valid documents, including illegal immigrants who have permanently resided in these settlements. The level of education amongst the residents is generally low as only a few receive secondary education. Most, in fact, only have primary school education and some did not even receive formal education. This is the case of those who previously migrated from the islands in the south of the Philippines and subsequently lived in with relatives in this village. Hence, without formal education and having only studied at primary and secondary schools, good job opportunities and the chance to move ahead are slim. Hence, sources of employment of these lowly educated residents are only limited to self-employed jobs such as fishermen and doing petty businesses in the informal sector such as working as boatman, operators of illegal taxis, shop and restaurant assistants, small-scale tailor and barber shops, working in supermarkets as sales promoters and as unskilled labourers in the construction sector. Low education levels are often associated with communities in rural areas such as these water villages. This is because such areas have constraints in terms of education opportunities, job opportunities and high income jobs (Siti Masayu Rosliah & Narimah, 2018). This represents a "Catch-22" situation as on the one hand the low levels of education had limited their work options, and on the other hand their children do not have good education opportunities and the high drop-out rate reinforces the low level of education. This situation means the water village communities cannot break free from the circle of poverty as they remain trapped inside it. Radical changes would have to be made in terms of education to enable them to break free.

Figure 6 shows some examples of the informal sector activities engaged by residents in Kampung Air. In this context, many residents who are illegal immigrants with low income cannot afford to send their children to private schools as being non-citizens, their children are not eligible for free education in Malaysian schools. The implications of this would be parents continue to hand down their jobs to their children to continue working as fishermen and be involved in informal sector activities. Low level of education in parents tends to result in low education achievement of their children as well.

Furthermore, the water village environment does not encourage education at all. Schools are far away, there is no electricity at night for the children to study, and the swimming and other water activities are a distraction to the children. Hence, it can be said that poverty in the water villages creates a poor environment that discourages conducive learning. These include a noisy environment battered by hot temperatures, heavy rains, rough seas and strong winds. Children also have to help parents in fishing or household chores which take away much of their free time (Siti Masayu Rosliah & Narimah, 2018).

Figure 6: Small-scale Business Activities (Informal Sector) in Kampung Air, Semporna

Residents of Kampung Tanjung Kapor, Kudat are no different from their counterparts in the other water villages as most earn their main source of income from fishing and fisheries activities. Although most of their grown-up children have migrated elsewhere and are with careers working with the government or private sector, the older generation of residents still continue their lives as fishermen in their current location. Based on the researchers' observation, the residents of Kampung Tanjung Kapor are hard working as they put in more efforts on fishing activities and running their own businesses when to make up for their diminishing incomes. Yet, this is not enough for them to escape from poverty unless they get a better education.

Poor Basic Facilities and Infrastructure Challenge

The greatest challenge for inhabitants of water villages is arguably their struggle to live and survive without basic amenities and infrastructures. Since the beginning of these villages, and until now, the water villages have been denied running water and electricity despite being located just offshore and a few minutes boat ride from the mainland. Ironically, water villages in some islands share the location with international class hotels as well as local hotels that have all these amenities. Despite the water village residents showing support for the ruling political parties and the government of the day, their application for water and electricity have been unsuccessful. As a result, water villagers have to either harvest rainwater or depend on expensive potable/bottled water sold by vendors. Water villagers are also forced to pay exorbitant prices for diesel or gasoline-powered generators for electricity. As most families in these villages already struggle to make ends meet, they are hard-pressed to pay for their water and electricity. Water villages are considered squatter settlements. As such, they lack all the basic resources such as government hospital or clinic, school, mosque, dental clinic, barber, sundry shop, etc. For these services, the residents have to go to the mainland in town and the transportation costs them money as well. Consequently, residents of water villages, both Malaysian citizens as well as illegal immigrants, have over the years been systematically marginalized socially and economically for decades (Krauss et. al., 2014).

In Semporna, despite the lack of basic amenities and infrastructures, water village settlements still receive some assistance from the government. This is a good sign that government is gradually changing towards a more accommodating approach towards water villages. The reason is that these villages are now comprising a significant number of Malaysian citizens who qualify for government assistance. For example, fire victims were given temporary communal homes and tents. Based on researchers' observation, residents of Kampung Air affected by fire disaster were given aid for repair of houses and footbridges (Figure 7). However, assistance on basic facilities like garbage bins and piping systems for clean water source to homes is not provided. According to Abdullah Sani (2009), a request to make Kampung Air settlement as a heritage settlement has been made as well as demanding for the village infrastructure to be repaired and arrangement for housing lots to be implemented. Request for aid was agreed by Bugaya Assemblyman Datuk Haji Ramli Marhaban, by giving assistance in providing fire hydrants and water supply generators for the villagers' needs. Social infrastructure is an important infrastructure requirement in human life today. This refers to the facilities for the society, services, including network of assistance for individuals, families, groups and the communities in fulfilling their social needs. Provision of social infrastructure which is a necessity of every social group is not something to be taken lightly no matter where we are. These necessities are essential for the water village communities in order to pursue a good life (Kamal Solhaimi, 2016).

Figure 7: Repair Assistance for Footbridge Facilities and Electricity Supply in Kampung Air

In contrast, however, the basic facilities in the water village settlement of Kampung Simunul were found to be less taken care of, and have deteriorated to such an extent that the bridges and narrow footbridges connecting the houses to the land area are dangerously dilapidated and damaged (Figure 8). This is a sorry sight very common in most water villages as there are no funds or responsible authorities to repair them. Such broken bridges give rise to dangerous accidents, and is fairly common amongst unsuspecting children.

Figure 8: Deteriorated Footbridge in Kampung Simunul Settlement.

One good sign for the water villages is that the local government, state and municipal, have taken an interest in these settlements of late. The main reason is that these water villages are no longer solely occupied by foreigners but a significant number of inhabitants are now Malaysian citizens. Furthermore, water villages are attractive tourist destinations and the government needs to ensure that they are safe for tourists. Hence, in recent years, government has been involved in providing some assistance to these communities. For example, in the case of Kampung Bangau-Bangau, assistance for temporary house constructions in the form of a longhouse (Figure 9) was provided by the government to the victims of a fire that occurred a few years ago.

In the case of the water village of Kampung Tanjung Kapor, various basic facilities have been provided by the government. Among the facilities available in the village are bus stops, preschools, places of worship, playgrounds and roads. Nevertheless, the overall condition of this village and its structures remain deplorable. For example, although the bridge (footbridge) at the shoreline is in a fairly good condition, some of the toilets are in a rather deteriorating state and located far towards the end of the shore (Figure 10). For that matter, the provision of facilities with high accessibility rates is a necessity that can no longer be taken lightly. Local authorities should play an important role in preparing action plans and mechanisms to ensure good accessibility are provided in the future, especially if tourists are visiting the place (Syahrizal & Syed Ahmad, 2019).

Figure 9: Assistance of Temporary Settlement for Fire Victims in Kampung Bangau-Bangau.

Figure 10: A Footbridge in Good Condition and a Dilapidated Public Toilet in Kampung Tanjung Kapor

Fire Disaster Challenge

The architecture of the houses (made of wood and packed closely) and structures (wooden bridges and pathways) are a fire hazard, to say the least. As such, water village settlements in Sabah are often faced with fire disasters that turn into tragedies destroying properties and lives. As water villages are considered as squatter settlements, they do not have fire safety Standard Operating Procedures (SOPs). Hence, it is not a question of whether there are adequate fire safety measures in such settlements because there are none. Consequently, water villages in Sabah have long been considered potential sites for fire hazards. Fires have occurred in various areas including Kampung Pangkalan in Kunak, Kampung Pondo' in Pulau Gaya, Kampung Tanjung Kapor in Kudat and Kampung Air in Semporna. For example, a large fire that broke out at the Kg Bangau water settlement in the security sensitive zone of Semporna just ten days after a fire there left 2,000 people homeless, with some 50 wooden stilt houses damaged and left 500 people homeless (Vanar, 2015) (Figure 11 Top-Right). In this same village the on 25 March, a 17-year-old is believed to have torched his family home, with the fire spreading and subsequently destroying about 400 homes. In 2003, hundreds of houses were destroyed when a fire swept through the same settlement (Vanar, 2015).

Figure 11: Fire in Kampung Bangau-Bangau

Figure 12 illustrates the temporary settlement provided to fire victims after the Kampung Bangau-Bangau fire disaster. On 31st July 2018, Kampung Air situated near the town of Semporna was engulfed in a large fire. More than 100 houses were gutted in a fire that swept through two areas at a floating village here, displacing hundreds of its residents. Sabah Fire and Rescue Department Operations Chief Katizah Rahaban said 48 firemen from Semporna, Kunak and Tawau were despatched to the scene after a distress call was received at about 6pm Tuesday (July 31st). The first responders arrived within four minutes of receiving the alert. Katizah said other agencies involved in quelling the raging fire and assisting the victims were the police, Civil Defence Department, Water Department, Sabah Electricity Sdn Bhd (SESB) as well as members of the public. "The blaze spread to one acre, and razed more than 100 homes in Kampung Air Hujung and Kampung Air Tengah (Joibi, 2018). In other incidents, two water villages in Sabah were destroyed by fire within the space of a week. On 1st August 2018, 302 houses in a water village at Kampung Air Hujung in Semporna were destroyed in a massive fire, leaving more than 2,000 people homeless. In another incident on July 24, more than 700 people lost their homes after a fire torched 150 houses in a water village near Kampung Cenderamata 2, Likas. In another incident on June 27, some 100 houses in a water settlement at Kampung Gas, Sandakan, were destroyed in a fire. The Sabah Fire and Rescue Department statistics showed that since 2014, there had been 41 cases of fire involving water villages in the state that resulted in the destruction of 1,585 dwellings. In 2014, nine such fires destroyed 49 houses. In 2015, seven fires destroyed 380 houses, and in 2016, 12 fires destroyed 392 units, and in 2017, nine fires destroyed 364 houses (https://www.thestar.com.my/metro/metro-news/2018/08/03/water-villages-are-fire-traps-several-factors-contributed-to-incidents-involving-settlements Retrieved 13 Aug 2021).

On 25th June 2016, 400 people were made homeless when fire destroyed about 80 wooden houses at a squatter area in Kampung Tanjung Kapor in an early fire (Figure 13) (https://www.theborneopost.com/2016/06/26/400-lose-homes-in-kudat-squatter-fire/ Retrieved 13 Aug 2021). Fires will remain a big challenge for water villages if nothing is done to increase fire safety. Because it involves the lives of Malaysian citizens and foreigners, the government (via the fire and rescue department) must step in to implement safety measures in all water villages.

Figure 12: Temporary Settlement for Fire Victims in Kampung Bangau-Bangau

Figure 13: The Settlement Embroiled in Fire in Kampung Tanjung Kapor

Criminal and Other Social Challenges

Water village settlements are often associated with various criminal activities such as drug abuse, smuggling, gambling and prostitution (Amaluddin et al, 2004). In Kampung Air, Semporna it was found that smuggling, gambling and burglary were among the crimes committed. In fact, the water village settlements become the focal location for illegal immigrants when they enter the state. The invasion incident in Lahad Datu also brought about a shooting incident in Kampung Sri Jaya, Simunul, Semporna which claimed the lives of six police officers while they were raiding the village. Houses arranged in close proximity and unorganised made it easier for terrorists to hide. This situation added to the difficulties and risk of being ambushed by terrorist when police forces conduct house-to-house search in the settlement. Whereas in Kudat, based on an interview with Mr. Haji Jainal Abidin the

JKKK of Kampung Tanjung Kapor, he stated that the village area is also involved with criminal problems like activities of selling and smoking methamphetamine. This is still happening to this day. Unemployment issue is one of the factors for the occurrence of criminal cases. With the dismal behaviour and discipline, this group finds it difficult in getting employment even in support or low entry occupations (Rosniza Aznie et al., 2016). The water village of Kampung Bangau Bangau had also became known as a hideout for criminals including cross border kidnapping (Vanar, 2015).

Environmental Challenges in Water Village Settlements in Semporna and Kudat

Solid Waste and Sewage Dumping and Odour Pollution Challenges

In water villages, there is no proper solid waste disposal facility and sanitation facilities. As a result, solid wastes are disposed haphazardly and sewage is dumped straight into the sea. As houses are constructed on the sea, kitchens, bath rooms and toilets are also built on top of the sea, and their wastes discharged straight into the receiving sea water. These are major challenges faced by water villages. Increasingly, this environmental issue has become very critical in most of the settlements on sea including in all the villages under this study, namely Kampung Air, Kampung Simunul and Kampung Bangau-Bangau, Semporna as well as Kampung Tanjung Kapor in Kudat. The problem is further compounded by the residents' apathy when they dispose food and domestic wastes as well as toilet sewage straight into the sea. During high tide, food and domestic wastes as well as raw sewage will float and pollute the entire village turning it into an extremely ugly sight. Considering that the villagers use the sea water for washing and bathing, it becomes a health issue. When many villages are located near to each other, not only wastes from one village is washed ashore but wastes from the other water villages, wastes from residents' activities as well as Wstes from traders working along the coasts are also dumped into the nearby sea (Figure 14). In recent years, household solid waste segregation has been advocated by the authorities and campaigns to encourage practice conducted according to the waste composition category such as recycled waste and residual waste. For example, waste separated campaigns are conducted and wastes collected every week in accordance with a set schedule (Department of National Solid Waste Management, 2018). However, residents of water villages are poor and waste separation is far from their priorities. Making a living and working form money to stay alive and to feed their families are the priorities. Hence, the waste separation campaign did not bring much success in the case of water villages. Another reason is that Sabah still does not have specific regulations with regards to segregation of waste at source. Therefore, the state government is facing issues of recycled waste accumulation. As a result, the situation has escalated into a very serious problem in solid waste management as public apathy and poor attitude of the community continues. The absence of regulations, guidelines or laws makes waste management using conventional management method (Mohammad Tahir et al., 2019).

Figure 14: Accumulation of Garbage at Shoreline of Kampung Tanjung Kapor, Kudat.

To the inhabitants of water villages, the dumped wastes in the seas will eventually be washed away by the waves and the tides. This has been going on for centuries. Over time, the wastes will be taken far out to sea, eaten by fishes or deposited in the deep oceans. That was in the past when settlements were small and populations also small. When water villages have multiplied and the population of residents also exploded, the huge amount of solid wastes and sewage will take a long time to be washed away. In fact, these wastes end up being washed away to nearby shores, beaches and all along the coasts where the water villages are located. These wastes then accumulate and remain stagnant in the places where they are deposited, and discharge a foul stench and pollutes the scenery which is very unsightly for tourists and visitors of Semporna town (Figure 15). Moreover, the water village especially, is a settlement on sea that is located right inside the town area. Recycling is one of the initiatives that can be done. This good move will not only take care of the environment but also generate alternative income for the local residents. There are lots of plastic bottles found at the research area that can be recycled and sold by residents. These and other recyclables such as aluminium cans, tin cans, and other household items can be collected and recycled, and generate an extra source of income for the residents. A study in Negeri Sembilan found that about 60% of respondents sell recycled items such as metal, aluminium cans, paper, plastic materials and glass bottles to recycling traders or operators (Sakawi et al., 2017).

Figure 15: Solid Waste and Garbage at Shoreline of Kampung Air, Semporna

Waste Disposal and Sea Pollution Challenge

In water village settlements, litter from inside the houses are usually swept straight into the sea. Similarly, for domestic wastes such as plastic bags, food packaging, empty bottles, cans, wrapping papers including unused or broken household items like broken dishware and others are usually discarded directly from the houses into the sea. During the survey, researchers observed that all residents sweep their floors and whatever litter on it into the sea. There is no garbage can or litter bin to put their litter into. Moreover, if one's house is located far out to the sea, it will take a while to walk inland with the litter via the narrow footbridges. Therefore, dumping litters and domestic waste into the sea is the easiest solution. It is a really bad habit of most residents in water village settlements. Based on the researchers' initial observation of the water village, a dedicated garbage disposal area is not available at the land side before entering the water village. In other words, settlements on water becomes synonymous with waste disposal problem and its poor management. Waste is defined as unwanted items and other materials including materials from industrial and commercial waste, agriculture and community activities but does not include solids or solutes in domestic sewers, or traces of water contaminants such as silts and suspended solids in industrial waste (Shamsuddin, 2016). The water village communities need to be educated, sensitized and instilled with good waste

management practices. Waste management is defined as a discipline of knowledge related to the control of generation, storage, collection, transfer, transportation, processing and disposal of waste at landfills with a method appropriate to the public's health, economics, engineering, conservation, aesthetics and considerations towards the environment (Nur Ain, 2018). Without the understanding and commitment of village residents, wastes disposal will continue to be a big problem for water villages.

Kampung Tanjung Kapor, Kudat is also facing a similar waste disposal problem similar to Kampung Air in Semporna. This is because the Tanjung Kapor settlement is also located near the coast line, thus the residents also dump waste direct into the sea since there are no waste disposal sites available. However, the situation in the land area of Tanjung Kapor village is different as there are piles of waste not disposed properly at the waste disposal site. As a result of this dumping, residents are more inclined to just dump at the land area instead of disposing at a waste disposal site. Such a situation is caused by public apathy of residents who are just too lazy to make changes thus causing this irresponsible littering practice to become a culture. Lack of environmental education and awareness will result in lack of awareness among the community on the importance of caring for the environment. Poor understanding of the environment will perpetuate waste dumping directly into the sea and sea pollution will continue. Caring for the environment requires a collective role from all stakeholders, including water village residents, before it can become a success. All stakeholders must abide by the environmental regulations and laws. Any action aimed at intruding and violating the boundaries of these regulations will not only threaten the stability of the existing ecosystem, it will potentially bring degradation the environment and this will eventually affect the well-being of human life. This means, any human action and behaviour destroying the environment will have a chain effect that will eventually return to haunt human beings. On the other hand, any good action or commitment to protect and look after the environment will result in a healthy environment that benefits humans.

Addressing Socio-Economic and Environmental Challenges towards Sustainability of Water Villages

Amongst the socio-economic challenges facing water villages in this study, the poverty challenge remains the most pervasive as it is a cross-cutting issue touching upon every facet of the social, economic and environmental challenges. When people are poor economically, it is unlikely that they will attain good social and environmental goals in their lives. When putting food on the table becomes a real struggle, people will not have the luxury of pursuing any social or environmental goals. Hence, it is of paramount importance that the poverty challenge be addressed first. As the majority of the inhabitants work as fishermen and engage in informal sector activities such as selling fish, vegetables, cakes, kitchen utensils, clothes and other household items, they need retraining to equip them with better skills to widen their options for better-paying jobs. Re-training for skilled jobs such as masonry, carpentry, boat engine and body maintenance and repairs, aquaculture and tour-guiding are some of the potentially doable training. Government or the private sector (via their CRS) can engage NGOs and specialised trainers to train the residents. Each resident may opt for one or two skills. Armed with the extra skills, the residents will be more flexible in terms of looking for jobs and would stand a better chance of increasing and diversifying their incomes, and eventually getting out of the poverty trap.

Aquaculture appears to have great potentials as water villages are surrounded by seas. Cage-culture or seaweed cultivation would be potentially profitable endeavours. However, the huge initial outlay of investment may be beyond the reach of most water villagers. What they can do is pool their resources together to form cooperatives to start small scale aquaculture farms. Or they villagers can come into partnership with private companies, or work for the companies as the local experts. Since the villagers live in the water village, locating the aquaculture farms in the adjacent sea would suit them well as the farm is just next to their home. It would be easy for them to manage and monitor the farms.

Tourism is another area that water villagers can move into. Water village design and architecture is an attraction in itself. Arguably, such a unique design is considered as heritage and visitation to water villages is a form of heritage tourism. The importance of local heritage tourism is reflected in the reasons for visiting (Bahauddin, 2014). The clan jetties water villages in Penang are must visit destinations in the UNESCO World Heritage destination of George Town, Penang (George Town World Heritage Incorporated, 2019). Considering the attractiveness of water villages for tourists, villagers can offer their boats for touring the water villages, island hopping, snorkelling, scuba diving and sport fishing. Tourists seldom visit a place for one purpose. Usually, it is for a variety of purposes. So, if villagers can offer tourists a package deal covering a combination of these activities, the chances of success in the tourism sector would be good. But of course, the villagers need to be trained in tour-guiding, learn to speak English, and be able to talk about the history, culture, socio-political issues of the place, the unique biodiversity and ecosystems, etc. They need to at least be trained in some of these aspects before venturing into tour-guiding. For example, villagers can also engage in heritage tourism, whereby they need to look at the motivations of tourists to visit certain sites. For example, the Kudat area is considered as a site with natural charms. Tourists coming for heritage tourism would likely be attracted to the pleasure of viewing, learn about a place (tourism education), gather information, look for relaxation, seek entertainment, exotic seafood, and sports/exercise. Villagers need to be trained to understand the background of visiting tourists from different countries and what they are looking for. For example, if they are from cold countries like the UK, they would be looking for hot sunny beaches and warm seas. The experienced tour guide should know where to bring them. If they are from Hong Kong, it is likely that they are looking for exotic food. Villages should know where to bring the tourists to savour exotic Malaysian cuisines.

The education challenge is closely tied to poverty. The low educational achievements of water villagers severely limit their work options. Hence, it is of paramount importance that their children be assured of a good education. Stopping their children from dropping out of school is also very important. Education will not only give their children better opportunities in life, but also change the way they understand the issues of the water villages and make them better global citizens, starting with their own villages. One suggestion is for the government to set up a school in each of these villages. If this is not possible, then a few nearby villages can share a school. With a school within a water village, it makes it easier for village children to get an education, and makes it more difficult for them to drop out of school. Teachers can easily track the absentees and visit their houses easily to find out why they are absent as house and school are within the same water village. The children also do not have to waste time commuting to a school that is located far away. With a better education, it is likely that water village communities will be able to break free from the circle of poverty as they secure better job opportunities. Education is certainly the key to unlock the chains of poverty to set the villagers free.

To address the fire disaster challenge in water villages, it is vital that the fire-fighting department send its staff to audit the fire safety of each and every water village. This department has qualified staff that can do the audit and suggests ways to enhance fire safety. The department should work closely with the villagers towards certifying that a water village is fire safety compliant. Fire hydrants that can pump sea water for use should be installed in strategic locations within the water village. These hydrants should be connected to electricity or to a generator. Although the architecture of the houses (made of wood and packed closely) and structures (wooden bridges and pathways) are a fire hazard, villages can be advised to use treated wood that is non-combustible. To suggest setting up a mini-fire station in the water village would not be sensible, but at the very least some of the villagers should be sent to the fire department for fire-fighting training. The fire department can also call on these trained villagers if needed. They form an unofficial voluntary unit of the fire department.

Addressing the criminal, smuggling, prostitution, gambling and drug pushing offenses would surely need the help of the police department. Perhaps a small police unit can be set up in one water village amongst a group of villages. If a school is already set up, the police unit can be housed in the school. It can be manned by just one or two police personnel. If this is not possible, then a voluntary police unit can be set up. In many housing areas all over Malaysia, voluntary police units have been set up to safeguard the peace and safety of housing residents. With either a police unit or a voluntary police outfit, the incidence of various criminal activities such as drug abuse, smuggling, gambling and prostitution would be controlled.

Solid waste pollution in water villages can be controlled by a number of ways. The first thing is to create greater awareness of the dangers of dumping solid wastes and sewage into the seas. Residents should be made aware that they and their families can be affected by these polluting wastes, since they can cause diseases. School teachers should hold special classes for children in their schools on the dangers of solid wastes and raw sewage dumping. The children can then bring the message home. The village should also set up a small committee to deal with this issue. The state government needs to continue popularising their wastes segregation and recycling campaign. Regulations should be put up on sign boards on fines if caught littering. The government with the participation of private companies (through their CSR programmes) and NGOs, can sponsor mini-sanitation systems, communal garbage bins for collecting garbage, and hold public forums regularly to educate the villagers. All these will prevent the solid wastes situation from escalating into a very serious problem. The local government should send in their garbage collection units to collect the solid wastes every few days. In the case of sanitation, there are many options of mini-portable sanitation systems for water villages such as those supported by the United Nations Environment Programme (UNEP), whereby portable sewage treatment tanks are installed under the houses and the school. The tanks can treat sewage from a family of five using just 15 watts of electricity (https://www.unep.org/es/node/29574 Retrieved 13 Aug 2021). These portable sewerage tanks are designed to be transportable by boat, easy to install on timber columns below toilets as they are made of fibre-reinforced plastic that can withstand long exposure to seawater. Each tank has a capacity of 360 litres and can easily serve a family of five. The system not only collects the raw sewage but also treats it and discharge the treated wastewater into the ocean after seven hours of treatment time.

Conclusion

Water villages are a unique form of traditional settlement in Sabah, Malaysia. They have strong historical and cultural importance and are part of the country's cultural heritage. However, they are facing daunting challenges for survival. Communities living in these settlements are now a mixture of Malaysian citizens and foreigners, and they face mounting socio-economic and environmental challenges that are associated with illegal squatting, high crime rate, unhealthy conditions, environmental pollution and poor management, alien intrusion, smuggling and other socio-economic problems. This paper managed to identify the main socio-economic and environmental problems facing water village communities, and appropriate ways to address them were recommended. The finding confirmed that the majority of inhabitants in the water villages are poorly educated, and trapped in the poverty circle. Water villages also lack regular water and electricity supply. There are also issues related to citizenship and the unavailability of schools for the village children, leading to high incidence of dropouts. To exacerbate matters, various negative social stigmas are associated with water village inhabitants. These include smuggling of goods (cigarettes, drugs and groceries from neighbouring countries), theft and burglary, drug abuse (especially Methamphetamine), serious crime (e.g. murder), gambling and prostitution, among others. Results also indicate that the structure of water villages with houses packed closely together connected by small bridges, has also exacerbated the above issues as well as being a potential fire hazard. In terms of the water village environment, results show that environmental management is poor, especially solid waste and sewage disposal, garbage disposal,

seawater and beach pollution, odour pollution and destruction of scenic view. In conclusion, water villages are important historically, culturally and socio-economically. Hence, they should be preserved and their problems addressed. It is recommended that a small police post be established to curb smuggling, drug abuse, thefts, burglaries, gambling, prostitution and other crimes. Public amenities such as water, sewerage, solid waste disposal, electricity and tele-communications need to be improved in water villages. Homestays should be encouraged to boost tourism and provide villagers with extra income. A small school should also be set up to ensure proper education for village children. Finally, in the light of development and achieving SDGs, the government cannot leave water villages as they are to suffer the never-ending socio-economic and environmental problems. It is also not a sensible option to relocate water villages to the land area as the country would lose these historical and culturally unique heritage. Hence, the only sensible option is to initiate plans to ensure more structured and well-planned water villages, via provide basic amenities and facilities and also ensuring safety from social and environmental hazards. Water villages, just like other settlements in the country, have every right to be conserved and sustainably developed towards achieving the SDGs.

Conflict of Interest

"There is no conflict of interest in this study"

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FACTORS AFFECTING THE USE OF ONLINE FOOD DELIVERY SERVICES DURING THE COVID-19 PANDEMIC AMONG RESIDENTS IN PENANG, MALAYSIA

Said, J.A.[*], Samat, N. and Tilaki, M.J.M.
Geoinformatic Unit, Geography Section, School of Humanities, Universiti Sains Malaysia, 11800 USM, Penang.
*Correspondence: agilahsaid95@gmail.com

Abstract: The spread of COVID-19 has changed people's lifestyles, encouraging more online purchases. There are several ways to ease people's lives, and one of the ways is the use of online food delivery services, which has been used extensively since the COVID-19 pandemic hit Malaysia. Although the use of food delivery services has been increasing in the country, there is a lack of research studying this service during the pandemic. Therefore, in this study, we aimed to identify the factors affecting the use of food delivery services among Pulau Pinang residents and to explore the effectiveness of these services on the residents. This study employed a quantitative research method and involved 110 respondents who have used food delivery services in the state of Pulau Pinang. The findings show that the factors affecting the use of food delivery services are location, service quality, safety, health, and lifestyle changes. Using the min-score option, the result indicate that the effectiveness of food delivery service is based on the users, food delivery agents, and restaurants. The current study also finds that the residents chose to use food delivery services because they are easy and fast. Besides, safety is guaranteed when the movement to the physical location is limited. The study results benefit the food delivery service agencies to design and plan a comprehensive strategy to increase the quality of food delivery services.

Keywords: COVID-19, health, food delivery, technology, lifestyle

Introduction

The spread of COVID -19 disease testifies to a shift in human lifestyles toward the use of digital technology. It is also visible in the lifestyles of Penang residents (Government of the State of Penang, 2021). Traffic congestion, limited parking spaces, and tight work schedules are among the direct impacts of urbanization (Rostam et al., 2017). This is evidenced by the statistics of the Malaysian population, which shows an increasing trend. Although the total population recorded was 32,365,999 in 2019, the total population has continually increased to 32,619,400 in 2020 (Malaysia Bureau of Statistics, 2020). According to the report, the current population is projected to reach approximately 32.7 million in 2021, with annual growth of 0.2% (DOSM, 2021). Penang is second smallest state in northwest of Malaysia with a high population density (1,659 inhabitants per square kilometer) (Samat & Mahamud, 2017; JPM, 2021). With 1.7 million population in 2021, the Penang urbanization growth rate is consistent with the country's statistics showing similar rates of 0.2% (DOSM, 2021). This situation indicates that a drastic increase in population contributes to the problem of traffic congestion and traffic congestion.

However, with the development of information and communication technology (ICT), e-commerce has been introduced to facilitate people's daily affairs (Nanehkaran, 2013). E-commerce refers to buying and selling of goods, products, or services over the internet. One of the applications of the e-commerce concept is the online food delivery service (OFDS), which orders products through mobile applications or computers without geographical boundaries (Leong, 2016). Generally, delivery services are defined as services and products delivered to consumers using distance, time, and

cyberspace (Ledimo & Martins, 2015; Lovelock & Wright, 1999). With the progress and development of ICT, the food and beverage industry is undergoing a new transformation through the use of OFDS (Chai & Yat, 2019).

Background of the study

In Malaysia, OFDS is increasingly well known among the population, especially in urban areas, and is also used in rural areas (Gao et al., 2020). This fast-growing business shows an increasing trend in its usage. This is evidenced by Adroit Market Research (2022), which stated that this business brought in $6.3 million in revenue in 2017, grew to $12.5 million in 2021, and is estimated to grow further to $24.7 million in 2025 (see Figure 1). Tan (2019) stated that OFDS is becoming increasingly accepted due to its ease of use, time savings, and a variety of food procurement options.

Figure 1: Malaysia Online Food Delivery Market, 2017-2025

Source: Adroit Market Research (2022)

According to Li et al., (2020) and Yeo et al. (2017), there are two types of businesses that are using OFDS. First, OFDS is offered by restaurants, especially fast-food restaurants. These include Kentucky Fried Chicken (KFC), McDonalds, Pizza Hut, and Domino's Pizza. Second, OFDS is a third party in the process of consumers getting food from various restaurants, for example, FoodPanda and Grab Food. However, fast food restaurants also face a shortage of employees, so OFDS is used with the involvement of third parties to meet consumer demand (Li et al., 2020). OFDS is therefore increasingly accepted and used by various restaurants. Several factors influence the use of OFDS: location, services offered, health safety, and changes in residents' lifestyles (Li et al., 2020).

On the other hand, the location of retail food stores, restaurants, and food pick-up/delivery services are crucial to make it as easy as possible for customers to access the place. Since the COVID-19 emerged, location has been considered one of the essential factors influencing the use of OFDS, especially for restaurants that were badly affected by the COVID-19 pandemic.

Essentially, consumers investigate several items to choose the restaurant like the diversity of the product, food price, availability of the product at the required location, and much more. A review of literature indicated that ten variables have an influence on restaurant selection: food type (71%); food quality (59%); value for money (46%); image and atmosphere (33%); location (32%); speed of service (15%); recommended (11%); new experience (9%); and opening hours. Regarding the location factor,

consumers consider the geography location, accessibility, distance, and parking lot when looking for a restaurant (Chai & Yat 2019). For example, a non-strategically located dining area leads to residents wasting time in the dining area, such as waiting for the parking area and the long distance between the business establishment and the parking lot (Pigatto et al., 2017). However, the prevalence of COVID -19 resulted the restaurants were not allowed to accept any dine-in customers during lockdown and restriction measures. Thus, people stayed at homes, and the number of dine- in customers of the restaurant reduced (Li et al., 2020). These limitations led residents to choose OFDS to facilitate food procurement and save time. Within the OFDS application, various information about restaurants, such as the variety of food types and prices, can be advertised so that consumers can more easily make comparisons of food types and prices no matter where they are located (Alreck & Settle, 2002).

From a quality of service perspective, the quality of the information provided by OFDS applications plays an essential role in influencing OFDS usage. A study by Flavian & Guinaliu (2006) explains that confusion in providing information influences consumer behavior toward OFDS. The study found that consumers have difficulty trusting the information presented, especially when making payments, due to the confusing nature (Hoffman et al., 1999; McKinney et al., 2002). OFDS is one of the online businesses that require consumers to have a high level of trust, especially when consumers make payments through online banking (Friedman et al., 2000; Nabila et al., 2018). For example, the price of goods is not displayed as a fixed price, and even consumers need to communicate online to obtain information about the price of goods. Because of the trust shown by users, OFDS has become an option (Shih, 2004).

However, according to the distribution of COVID -19, these businesses are in high demand among those who want to eat quickly and safely (Liza Mohtar & Nurul Riduan, 2020). OFDS is an initiative to ensure economic survival and public welfare. From an economic perspective, OFDS is a new industry with a market value of millions of ringgit. Statista.com (2020) states that the most significant market segment is the restaurant-to-consumer delivery segment, which has a value of US$137 million. This is further reinforced by the number of restaurants entering into agreements with the Foodpanda service, which has over 18,000 restaurants with 8,000 food suppliers.

In comparison, Grab Food has signed an agreement with 5,000 restaurants for a total of 10,000 food suppliers (Suhaimi Ab Rahman 2020). The government has introduced Movement Control Orders (MCOs) for residents, resulting in movement restrictions in one location. The introduction of MCO prompts residents to use OFDS as an alternative for food procurement (Nicola et al., 2020). Health and safety factors are highly emphasized in the delivery to the consumer. Therefore, OFDS is very important for economic balance during the spread of the COVID -19 epidemic, and the population's development of digital technology is increasingly known (Suhaimi Ab Rahman, 2020).

Indeed, the OFDS business is considered as a part of the Gig economy, which has grown based on the concept of digitalization (Hasimi Muhammad, 2020). The concept of digitalization is the result of the social impact of the rise of computer technology, new media, and communication platforms. At the macro level, there are two studies: digital media infrastructure includes communication platforms, while the social structure includes community networks in terms of management and knowledge. This concept includes the relationship between community activities, culture, and information and is used to organize social life under different aspects of life (Schumacher, Sihn, & Erol, 2016). Thus, the indirect use of OFDS indicates a change in lifestyle toward more digital. The use of OFDS is changing people's lifestyles toward a digital society. This aligns with the Malaysian Communications and Multimedia Commission (MCMC) objectives in the 11th Malaysia Plan, namely using the internet in daily life (MCMC, 2017). Therefore, this study investigates the factors of OFDS usage and its effectiveness.

Study Area

The study was conducted in Penang, which has an area of 1,031 km². The state includes part of the island of Seberang Perai. The island consists of two districts: the northeast and the southwest. Seberang Perai in turn consists of Seberang Perai Utara, Seberang Perai Tengah and Seberang Perai Selatan. The coordinates of this state are at latitude 50 8 'U to 50 35' U and longitude 1000 8 'B to 1000 32' U (see Figure 2).

Figure 2: Study area-Penang
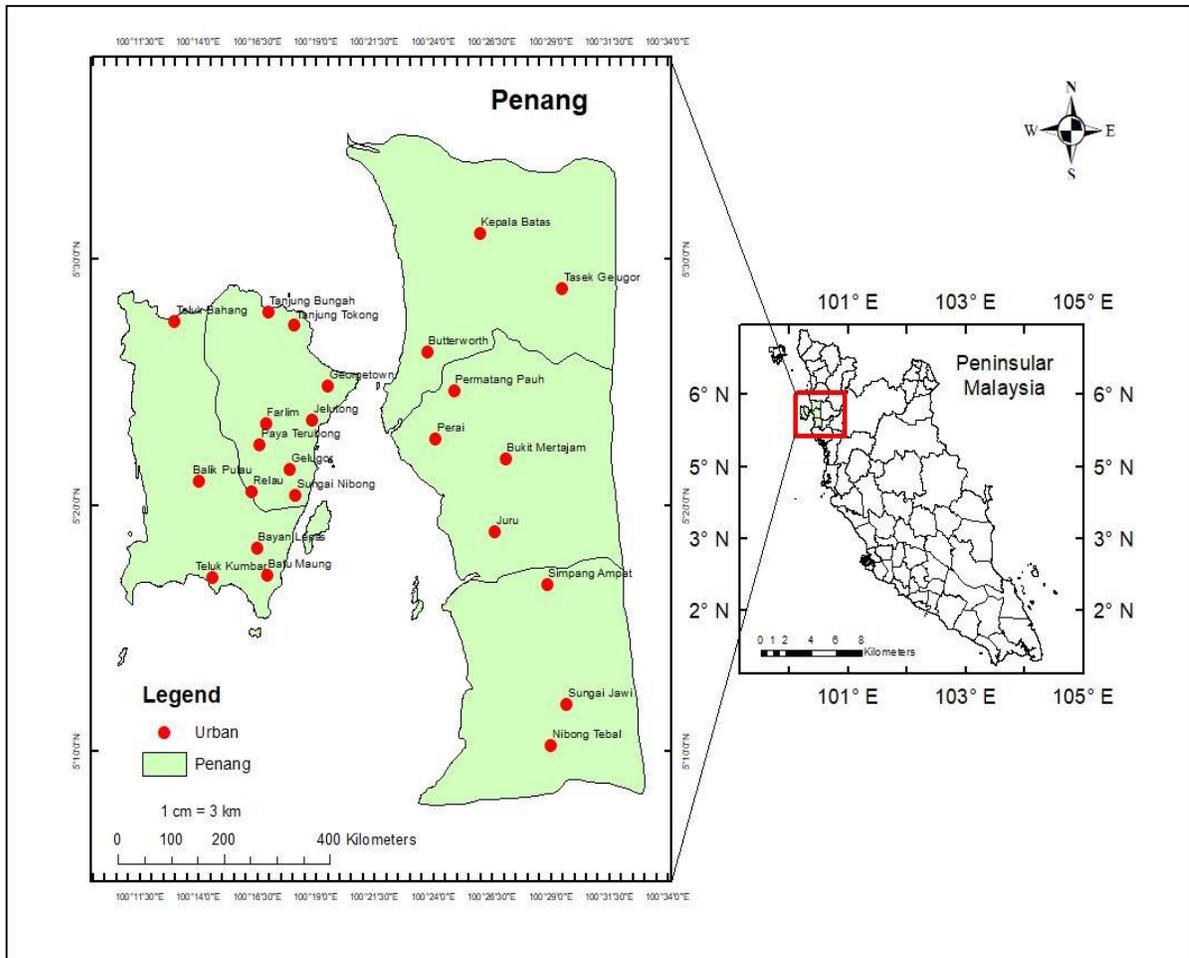
Materials and Methodology

The current research conducted using quantitative approach and two methods of data collection were used in this study. Data collection through primary and secondary sources to obtain more in-depth information related to the study. Next, this study employed a questionnaire instrument to collect respondents' information. The questionnaire was distributed online via Google Docs due to the outbreak of the disease COVID -19. The several social media platforms have been also used for questionnaire distribution such as: Facebook, Whatsapp, Instagram, and email. The form was distributed to the residents of Penang who have used OFDS. A total of 110 respondents were recruited for this study. The questionnaire uses a five-Likert scale, namely "strongly disagree,"

"disagree, "neutral," "agree," and "strongly agree," to identify the factors of OFDS usage among the residents.

After completion of data collection, data processing and analysis were performed using Statistical Package for the Social Sciences (SPSS) version 26. The software, descriptive statistical analysis, and cross-tabulation analysis were conducted to determine the factors of OFDS use in the population. In addition, this study also uses the mean value, which ranges from 1.00 to 2.33 and has a mean value at a low level, a mean value from 2.34 to 3.66 at a medium level, and finally a mean value from 3.67 to 5.00 at a high level (Suan 2003).

Conceptual framework

The conceptual framework is depicted in Figure 3.

Figure 3: Conceptual framework
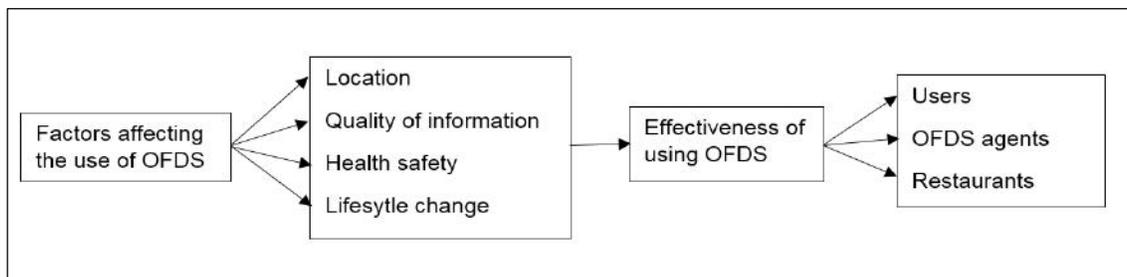
Results and discussion

Demographic profile

All variables were analyzed using frequencies and percentages as shown in the tables. Table 1 shows that 110 people responded, of which 36 males and 76 females. The majority of those who answered the questionnaire were women, 67.3 percent. The percentage of males, on the other hand, was 32.7 percent.

Table 1: Respondents by gender

Demographic	Respondents profile	Frequency	Percentage
Gender	Male	36	32.7
	Female	74	67.3

The age of respondents in this study shows a high percentage of young people aged 21-30 years of 63.6 percent, followed by those aged 31-40 years, who make up 24.5 percent (Table 2).

Table 2: Respondents by age

Demographic	Respondents profile	Frequency	Percentage
Age	20 years and below	6	5.5
	21-30 years	70	63.6
	31- 40 years	27	24.5
	41-50 years	5	4.5
	51 years and above	2	1.8

The majority of Malays who participated in this study were 101 individuals, representing 91.8 percent. Among the Chinese, there were five people or 4.5%, and among the Indians, there were four people or 3.6% (Table 3).

Table 3: Respondents by race

Demographic	Respondents profile	Frequency	Percentage
Race	Malay	101	91.8
	Chinese	5	4.5
	Indian	0	0.0
	Others	4	3.6

Table 4 shows the educational levels of respondents. The highest level of qualification or education shows that higher education has the highest percentage of 66.4 percent with 73 people, followed by STPM/Diploma level with 26 people, which is 23.6 percent. At the secondary school level, as many as ten people with 9.1 percent and non-formal education, only one person followed this study, which is 1.0 percent.

Table 4: Respondents by education

Demographic	Respondents profile	Frequency	Percentage
Education	Non-formal education	1	1.0
	Primary school	0	0.0
	Secondary School	10	9.1
	STPM/Diploma	26	23.6
	Higher Education	73	66.4

The highest number of people who participated in this study was the professionals, with 59 people, which corresponds to 53.6 percent, followed by a group of 43 students, which corresponds to 39.1 percent. A total of 7 people looking for work participated in the study, 6.4 percent, and one housewife, 1.0 percent (Table 5).

Table 5: Respondents by Working Status

Demographic	Respondents profile	Frequency	Percentage
Working status	Working	59	53.6
	Looking for work	7	6.4
	Housewife	1	1.0
	Students	43	39.1

This study found that the respondent's income category of RM 3000 and below is 35.5 percent, which is a total of 39 people. Meanwhile, whom the question was not applicable (no income, such as students) showed the highest number of 58 people, 52.7 percent. This is followed by a total of 9 people with an income of RM 3,001 - RM 6,000, which is 8.2 percent, and those with an income of RM 6,001 - RM 13,000, RM 13,001 and above, each a total of 2 people, which is 1.8 percent (Table 6).

Table 6: Respondents by Income

Demographic	Respondents profile	Frequency	Percentage
Income	RM 3000 and below	39	35.5
	RM 3001- RM 6000	9	8.2
	RM 6001- RM 13000	2	1.8
	RM 13001 and above	2	1.8
	Others (students)	58	52.7

Factors affecting the use of OFDS

The study analyses the factors influencing on using OFDS among the residents. As shown in Table 7, the lifestyle change factor has the highest overall mean of 4.57. This is followed in second place by the location factor with a mean of 4.21, the safety factor with an overall mean of 3.91, and the information quality factor with a mean of 3.79. With increasingly sophisticated technologies, urban lifestyles are evolving into smart cities.

In this study, the location factor consists of traffic congestion, limited parking, accident risk, and crowded restaurants. Analysis of the overall factors revealed that the parking space limitation factor had the highest mean score of 4.34, compared to the traffic congestion factor of 4.32, the risk of traffic accidents factor of 4.10, and the crowded restaurants' factor of 4.08. Thus, users use OFDS due to a lack of parking.

In addition, in this study, the quality of the information provided by the restaurant to consumers through the OFDS applications includes consistent sales menus, listed prices, menu variety, and a variety of restaurants. The study found that diverse restaurants had the highest mean score of 3.94, compared to a consistent sales menu of 3.69, displayed prices of 3.60, and menu variety of 3.92. Thus, the variety of restaurants in the app allows users to compare other restaurants to ensure the desired food quality.

Furthermore, the use of OFDS was emphasized by consumers due to their concern about health safety factors during the spread of COVID -19 disease. Health safety factors consider several restrictions measures during MCO, changes in travel habits, and limiting the number of patrons in the restaurant. The study results show that the highest mean value limits the number of restaurant guests, which is 4.08, indicating the factor of using OFDS. The next item, changing a person's travel routine to a place, shows a mean of 4.04 and a PKP period of 3.61, indicating that health safety plays an essential role in using OFDS.

In addition, the lifestyle of city dwellers is changing toward a sustainable city through digital technology. In this study, the lifestyle changes were related to using OFDS applications, smartphones, and internet connections. The highest mean score is smartphone use (5.16) compared to OFDS application (4.61) and internet connection (3.95). This indicates that smartphone use is essential for OFDS use.

Table 7: Factors affecting the use of OFDS

Factor	Variable	Mean	Overall mean
Location	Traffic congestion	4.32	
	Limited parking spaces	4.34	4.21
	Risk of road accidents	4.10	
	The crowd at the restaurant	4.08	
Quality of information	Consistent menu	3.69	
	Exhibited prices	3.60	3.79
	Various types of menus	3.92	
	Variety of restaurant	3.94	
Health safety	MCO period	3.61	
	Travel routine changes	4.04	3.91
	Customer limitations in restaurant	4.08	
Lifestyle change	OFDS application	4.61	
	Smartphone	5.16	4.57
	Internet connection	3.95	

OFDS is becoming increasingly well known, especially in urban areas. The study found that the factors associated with the use of OFDS are due to lifestyle changes. Residents have to move to get something to eat at the restaurant physically. However, the development of the OFDS application has made it easier for residents to get food without having to go to a physical location. Several variables play a role in lifestyle change, such as OFDS applications, smartphones, and internet connections.

First, the highest mean is given by the smartphone variable. According to Ilham (2018), most users use OFDS on their smartphones. In Malaysia, the number of smartphone users is increasing among residents. This is evidenced by statistics from the Malaysian Communications and Multimedia Commission (MCMC) (2020), which show that 98.7 percent of users own smartphones. Various online activities, such as text communication, social media, watching videos, voice communication, and obtaining information, are performed. In 2018, the percentage of smartphone users was 75.6 percent in urban areas and 24.2 percent in rural areas.

Further, Pigatto et al. (2017) describe the increasing number of smartphone users and their reliance on online services as an essential factor in the rise of OFDS use. In addition, residents voluntarily use

smartphone facilities with OFDS applications to obtain food during the spread of COVID -19 (Gavilan et al., 2021). The use of smartphones makes it easier for consumers to make comparisons when making purchasing decisions. Thus, this indirectly proves that smartphone technology changes residents' access to food.

Second, OFDS applications are user-friendly, easy to use, and have good usability (Venkatesh et al., 2003). According to Gentry and Calantone (2002), technology can facilitate the procurement of goods and services. For example, orders are placed only through the application on the smartphone. Similarly, Troise et al. (2021) found that new technologies that are easy to understand and use influence the purchase of goods by saving time. Consumers do not have to wait in line to pay or go to the store. In addition, the OFDS application system users trust to make payments influence the use of OFDS (Nabila et al., 2018). One of the online payment systems is electronic wallets such as bank cards, Touch n Go, and e-Cash (Teoh et al., 2013; Lai, 2016). Another study by Sim et al. (2007) explained that residents increasingly accept easily understood and learned technologies. The convenience of OFDS applications allows residents to obtain food easily and quickly (Yeo et al., 2017). Therefore, the easy-to-use, user-friendly, and reliable OFDS application makes OFDS an essential platform for food procurement.

In addition, the OFDS ordering system requires Internet access. Mohamad Izwan Hafiz and Norhaida (2016) stated that smartphones allow users to access the internet so that orders can be placed online. Quevedo-Silva et al. (2016) explained that the current trend requires restaurants to have internet connectivity to place orders. In addition, consumers increase their purchasing power through online purchases with the availability of an Internet connection (Ramli et al., 2021). Therefore, users rely on the availability of an Internet connection to place orders through the PPM application.

The effectiveness of using OFDS

The study also examined the effectiveness of OFDS use among consumers, OFDS agents, and restaurants (Table 8). Consumers were concerned with time savings, lower transportation costs, no traffic congestion, and no limitations in finding parking lot. In addition, the study results show that users use the OFDS application to buy food when they know or guess the parking lot is not available. The highest mean score is 4.34, compared to saving time (4.23), reducing transportation costs (4.10), and avoiding traffic congestion (4.32). Thus, users use OFDS because of the parking problems they face.

In the context of OFDS agents, the study explored the issues of communication, delivery, fees, and location of OFDS agents. After conducting the analysis, the study found that good communication, with a mean of 4.05, had the most significant impact on the effectiveness of OFDS use, followed by agent location, with a mean of 3.98, on-time delivery, with a mean of 3.95, and reasonable fee, with a mean of 3.47. Therefore, OFDS agent communication with users is vital to the effectiveness of OFDS use.

Aside from OFDS users and agents, the study also assessed the effectiveness of OFDS use through the services offered by the restaurant. Items studied included food packaging, restaurant variety, prices, and sales menus. The highest mean score was 4.00 for good packaging. The sales menu had a mean of 3.96, the restaurant variety of 3.94, and the discount of 3.87, indirectly showing that the guaranteed food quality influences the effectiveness of consumption against continuous OFDS.

Table 8: Effectiveness of using OFDS

	Item	Mean	Overall mean
Users	Time-saving	4.23	
	Reduce transportation costs	4.10	4.25
	Not dealing with traffic congestion	4.32	
	No parking search	4.34	
OFDS agents	Good communication	4.05	
	On-time delivery	3.95	3.86
	Reasonable charges	3.47	
	Location agent OFDS can be trace	3.98	
Restaurants	Good packing	4.00	
	Variety of restaurant	3.94	3.94
	Discount	3.87	
	Sales menus	3.96	

The study showed that all items showed positive results regarding the effectiveness of using OFDS. However, the highest mean score was reported by users with a mean value of 4.34. Consumers use OFDS to avoid searching for parking spaces at restaurant locations. This situation is supported by Timor and Sipahi (2005), who explain that parking spaces at restaurant locations are limited due to dense development in urban areas. For example, the location of commercial spaces near residential areas, colleges, universities, business parks, and roadside stands (See-Kwong et al., 2017). The resulting spatial constraints lead users to face the problem of finding a parking space. This situation causes consumers to search for a platform that is easy to use to obtain food. Thus, it is clear that searching for a parking space at distant restaurants leads consumers to use OFDS (Correa et al., 2019).

Overall, this study aims to investigate the factors influencing the use of OFDS among Penang residents. The study results show that the inhabitants uses OFDS depending on the development of ICT to modify their lifestyle. The change is evident when residents use OFDS as a new alternative to obtain food using technology. The emergence of digital technology is supporting cities to push sustainability through reducing consumption of natural resources. The use of OFDS shows that the Malaysian's cities are on its way toward sustainability, i.e., a city that can achieve social, economic, and physical development success. Generally, sustainable cities include cities that use ICT to improve quality of life, increase operational efficiency, and create competitive cities that meet the needs of current and future generations (UN, 2017). Apart from lifestyle changes, the increase in OFDS use is due to physical factors of the restaurant location. The study results found that finding a car park is a

factor in the effectiveness of using PPM, especially for consumers. Thus, consumers indirectly choose OFDS to save time in getting food immediately.

Therefore, the study contribution is to share information related to OFDS to certain parties to maintain the quality. Not only that, but the limitations of the study are also known as the study only involves OFDS users and focuses on urban areas. In addition, the study suggests further suggestions to refine the theme of this research further. Among them is to compare the use of PPM in urban and rural areas and to identify the entire PPM application available in Malaysia that is the choice of the population.

Conclusion

The findings of the study show that the factors influencing the use of OFDS are location, quality of information, health safety, and lifestyle change. The strongest factor influencing OFDS use is lifestyle change. The representation of lifestyle of the population changes with the development and innovation of technology. One of these factors is the ease of use of OFDS application. As for the context of effectiveness of OFDS use, it shows that users play an important role in OFDS being increasingly recognised and used. Therefore, there are several suggestions to increase the use of PPM among residents such as easy options, create a clear and concise online menu, deliver attractive food packaging, and remarkable customer service, and push notifications and new marketing materials (Mushahid Khatri, 2022).

In conclusion, the advancement of digital technology has simplified people's daily lives. The effects of the spread of COVID-19 that hit the world caused the technology to become increasingly well known to the residents. This study discussed that how changes in the lifestyle of the residents affected on the use of OFDS. This is because the community increasingly uses online technology. The effectiveness of the use of OFDS involves all three parties: consumers, OFDS agents, and restaurants. Users are more dependent on parking space limitations. Meanwhile, OFDS agents emphasize consumer communication, and restaurants emphasize food quality in packaging to ensure continued use. Essentially, the OFDS platform is one of the sustainability smart cities that obtain goods and services via internet connection. If it is well regulated and efficient, this industry can help generate revenue for the country.

Acknowledgment

Conflicts of Interest

No potential conflicts of interest were reported by the authors.

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THE POTENTIAL OF HUBS AS SECONDARY TOD IN JAPAN

Omori, F. and Suzuki, N.
Yokohama City University
Correspondence: omori.fum.te@yokohama-cu.ac.jp

Abstract

The COVID-19 pandemic caused not only global travel restrictions, but also greatly reduced the frequency of daily commuting trips due to the widespread of telecommuting. On the other hand, daily short-distance moving for life in the neighbourhood of one's home has become relatively important. In Europe, the use of public transportation is being recommended and the TOD (Transit Oriented Development) method, which combines the construction of public transportation with the urban development, is being promoted in order to reduce the environmental impact by decreasing automobile traffic. In Japan, Toyama City is moving toward becoming a compact city with a low environmental impact by redeveloping the LRT (Light Rail Transit) network to induce people to live in the city center. In addition, large cities such as Tokyo and Osaka, have long been formed by the integration of railroad construction and suburban development. Therefore, the importance of public transportation will not change in the future. Under these circumstances, it is becoming more important to develop a basic function base that seamlessly connects public transportation and micro mobility. Ole B. Jensen et al. called such bases as "HUBs" and have been studying the functions and management of HUBs. In Japan, since around the time of the beginning of the pandemic, there have been cases of facilities combining transportation and other multi-uses being built in the middle of radial railroad lines or far from railroad stations, which is similar to the HUB concept. This is a new trend in Japan, where TOD has already completed and matured, and can be called a secondary TOD or a Japanese unique HUB. In this paper, we would like to share the case studies and management of such movements that can be called secondary TOD or Japanese HUBs and discuss about its impact to the next generation urban transportation.

Keywords: Transit Oriented Development (TOD); HUB Concept, Short Distance Transit, Public Transportation

Introduction and Background

The COVID-19 pandemic caused not only global travel restrictions, but also greatly reduced the frequency of daily commuting trips due to the widespread of telecommuting. In Japan, the number of passengers using railways decreased by the widespread of the infection of the COVID-19 virus (Figure 1). Some experts in railway companies predicted that the number of passengers will be regularly 20% less than before pandemic.
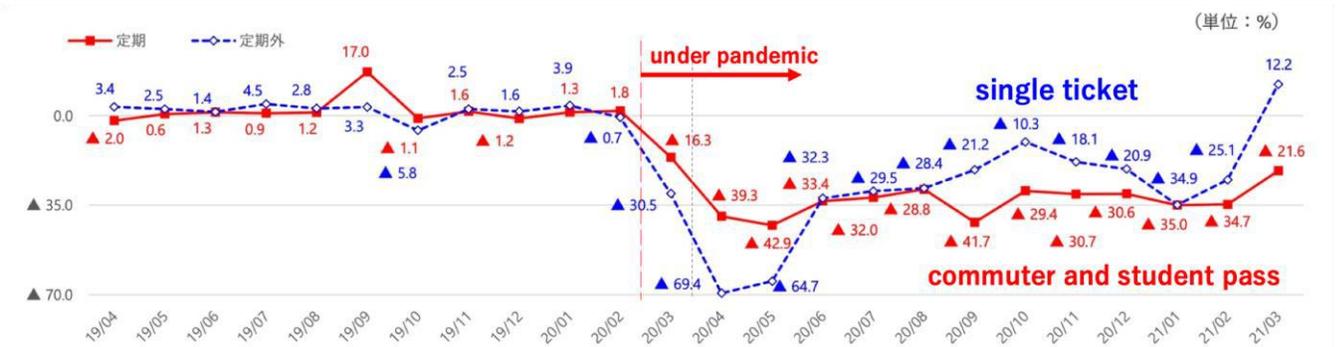
Figure 1: Number of passengers in a certain rail line in Tokyo (compared to the same month in last year)

On the other hand, daily short distance moving for life in the neighborhood has become relatively important. In Paris, the 15-minutes city was proposed by the former mayor in 2014. The number of car parking is going to be reduced (60 thousand in 2024) and the bicycle lane will be constructed (350 million Euros). These trends mean that people gradually will not move to one direction by mass transit, and small mobilities such as bicycle will be more important for their short trip in their daily life.

Purpose

This research aims to find appropriate transfer points for short distance travel through site examples. Prof. Jensen (Aalborg Univ. Denmark) suggested that "HUB" (Figure 2) concept for the daily short trip[1]. He advocated that there should be the node point for transition of various modes of mobilities and they should be distributed in the area distant from the mass transit such as train stations. In other words, this suggestion promoted to develop appropriate urban space to accommodate transfers between various modes of transportation. However, this suggestion has been just concept yet.

In Europe, the use of public transportation is being recommended and the TOD (Transit Oriented Development) method, which combines the construction of public transportation with the urban development, is being promoted in order to reduce the environmental impact by decreasing automobile traffic. In Japan, Toyama City is moving toward becoming a compact city with a low environmental impact by redeveloping the LRT (Light Rail Transit) network to induce people to live in the city center (Figure 3). In addition, large cities such as Tokyo and Osaka, have long been formed by the integration of railroad construction and suburban development. Therefore, the importance of public transportation will not change in the future.
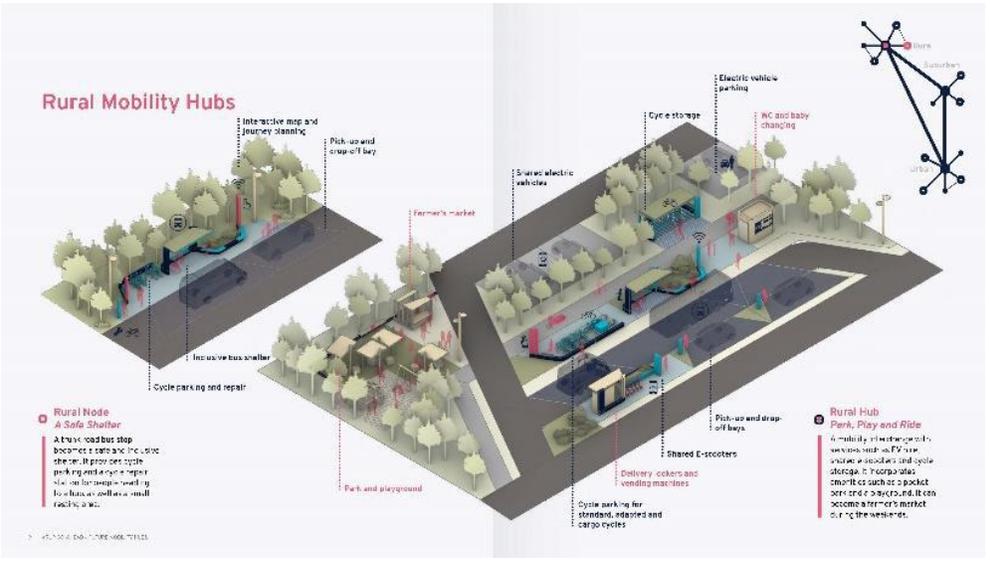
Figure 2: The concept of HUB[2)]

Figure 3: Light rail transit in Toyama

Methods

For achieving this purpose, we research the potential HUB in Japan. Since around the time of the beginning of the pandemic, there have been the cases of facilities combining transportation and other multi-uses being built in the middle of radial railroad lines or far from railroad stations, which is similar

to the HUB concept. This is a new trend in Japan, where TOD has already completed and matured, and can be called a secondary TOD or a Japanese unique HUB.

Figure 4: First case by a bus company

Figure 5: Second case by a railway company

Results and Conclusion

Based on these two cases (Figure 4 and Figure 5), it could be summarized that it is important to have multiple purposes and usages in the site. In addition, it is also significant that they have shared space for everyone to relax, rest and communicate. This gives an incentive for non-transportation users to visit the location casually. It will promote people to get on the transportation. These conceptual spaces have the potential to be spread as the secondary nodal point to transit from mass transit to short distance private mobilities.

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None.

Conflicts of Interest

No potential conflicts of interest were reported by the authors.

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SPATIAL DYNAMICS OF THE MAKASSAR CITY LAND USE BASED ON REMOTE SENSING IMAGERY AND GEOGRAPHIC INFORMATION SYSTEMS (GIS)

Nganro, S. [1,*], Trisutomo, S. [2], Barkey, R.A. [3], and Ali, M. [2]

[1] Urban Management, Postgraduate School, Hasanuddin University, Makassar, Indonesia.
[2] Laboratory of Waterfront City, Engineering Faculty, Hasanuddin University, Makassar, Indonesia.
[3] Laboratory of Planning and Forestry Information System, Forestry Faculty, Hasanuddin University, Makassar, Indonesia.

*Correspondence: doktorarsitek@gmail.com

Abstract

Urbanization is the migration of rural populations to urban areas with the aim of finding employment, education, and living in cities. Makassar City experienced population growth of 1.41 percent in 2014-2015. Population growth will have an impact on urban land use. One of the most effective tools for monitoring land use change is remote sensing. The resulting images of 1997, 2002 and 2017 can be analyzed using software based on Geographic Information Systems (GIS). By using the supervised classification method and maximum likelihood classification in interpreting the image, land use and land cover of Makassar city can be identified. In this study, land use is grouped into 5 classes, namely business, housing, agriculture, forests and water bodies. The results showed that in 2002, the business class increased 492.86 Ha, housing class of 765, 48 Ha, forest class of 1,054.96 Ha, water bodies covering 404.14 Ha, and for agricultural class reduced by 2,702.45 Ha. While in 2017, the business area increased 252.59 Ha, housing class 2,324.53 Ha, and the class that was reduced was agriculture covering 601.23 Ha, forests covering 1,215.11 Ha, and water bodies covering 736.28 Ha. The relative change in land use in Makassar City in the 1997-2002 period, the highest was the settlement class, which increased by 58.59 percent, while the lowest is the water bodies class, which is 18.48%. The period 1997-2017, the settlement class increased to 236.50% and the agricultural class decreased to 69.50%.

Keywords: Spatial Dynamics, Land Use, GIS, Makassar City.

1. Introduction

Sensing is an attempt to identify objects by using sensors, either naturally or artificially. Sensors are in the form of eyes, ears and skin. Artificial sensors include cameras, sonar, and scanners. Several studies have demonstrated the effectiveness of remote sensing imagery for monitoring land use and land cover changes (Potdar, 2016).

Land use change analysis can be done by interpreting images using the supervised classification method in GIS (Hermon, 2014, Catur et al., 2015, Sampurno & Thoriq, 2016, Wibowo et al., 2017). GIS is a computer-based system used to store, manipulate, and analyze data. The system provides complete data on the earth's surface, namely topography, soil types, and land cover (Puturuhu, 2015, Thakkar et al., 2016).

The population of Makassar City in 2015 reached 1,449,401 people, population growth rate in Year 2014 to 2015 was 1.41 percent with an area of 175.77 sq km. (Abdul Hafid, 2016). Urbanization is caused by

socio-economic factors, which show the movement of people from one place to another which causes an increase in population. This will have an impact on increasing the need for housing in urban areas, resulting in the conversion of agricultural land into residential areas (Demirkaya dan Artvinli, 2011; Dontsov, 2013; Zope, Eldho, dkk, 2016; Coulter et al., 2016; Tolessa, Senbeta, dkk, 2017, Mcconnell et al., 2015).

This study aims to analyze the dynamics of land use and land cover in Year 1997, 2002, 2017 at Makassar City. Changes that occur will affect the infiltration ability of the soil, water is difficult to seep into the ground and will cause flooding (Rismalinda, Ariyanto, dkk, Sudirman, 2017; Aurdin, 2014).

Study Area

The object of research is the coast of Makassar City which has a coastline, namely Biringkanaya, Tamalanrea, Tallo, Ujung Tanah, Wajo, Ujung Pandang, Mariso and Tamalate sub-districts, shown in Figure 1.
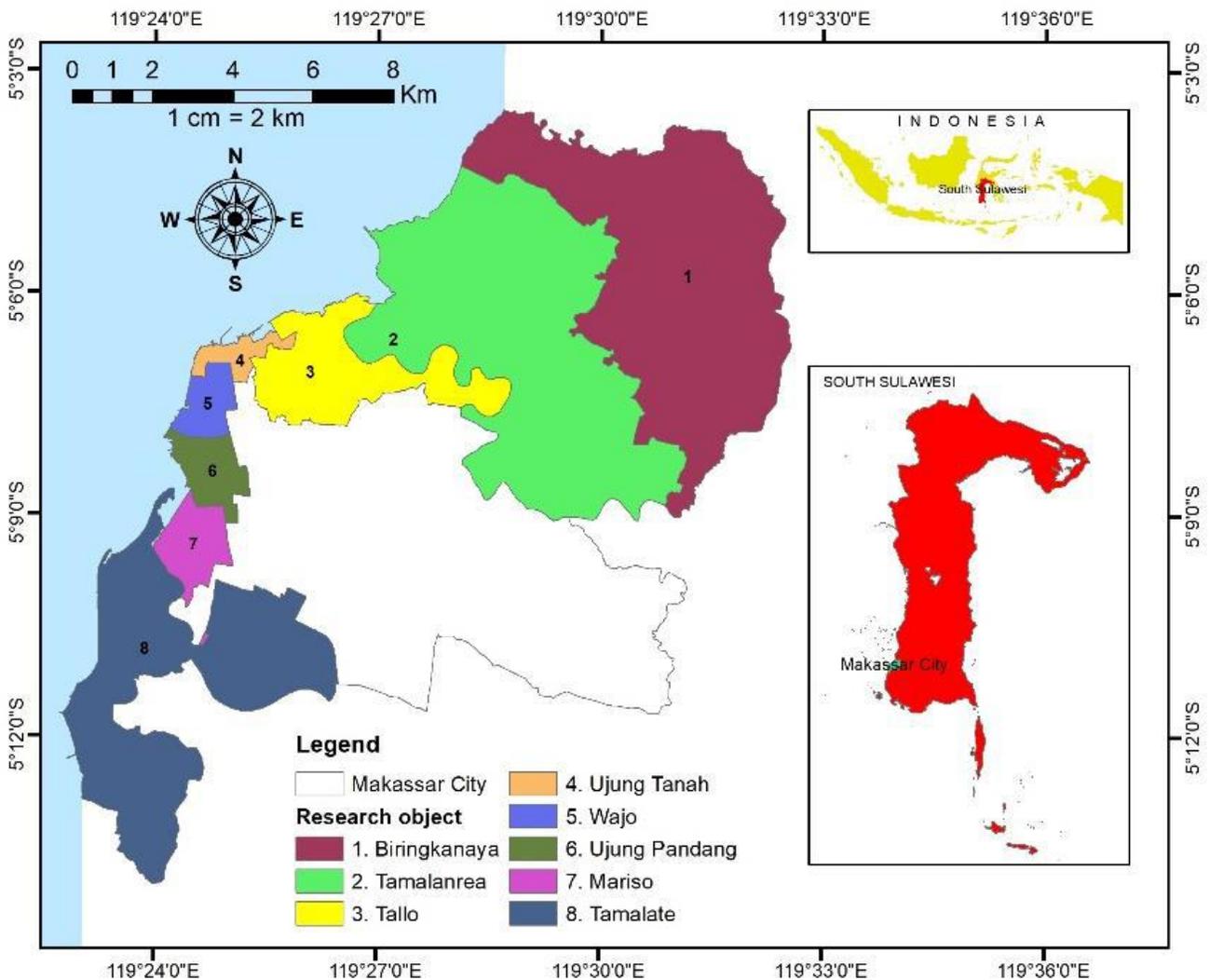
Figure 1: The study area of the coast of Makassar City.

Materials and Methodology

Materials

The research data is sourced from remote sensing images in Years 1997, 2002 and 2017. To provide information about the images used, it is shown in Table 1.

Table 1: Images data

Acquisition	Satellite	Path/row	Sensors	Pixel size (m)	Source
29/7/1997	Landsat	114/64	L5_TM	30 x 30	USGS
28/9/2002	Landsat	114/64	L7_ETM	30 x 30	USGS
8/5/2017	Landsat	114/64	L8_OLI	30 x 30	USGS

The image data for 1997, 2002 and 2017 in Table 1 are Landsat products which are separated by layers according to their respective bands. For the needs of supervised classification analysis, a composite band process is carried out. The results of the composite band are shown in Figure 2.
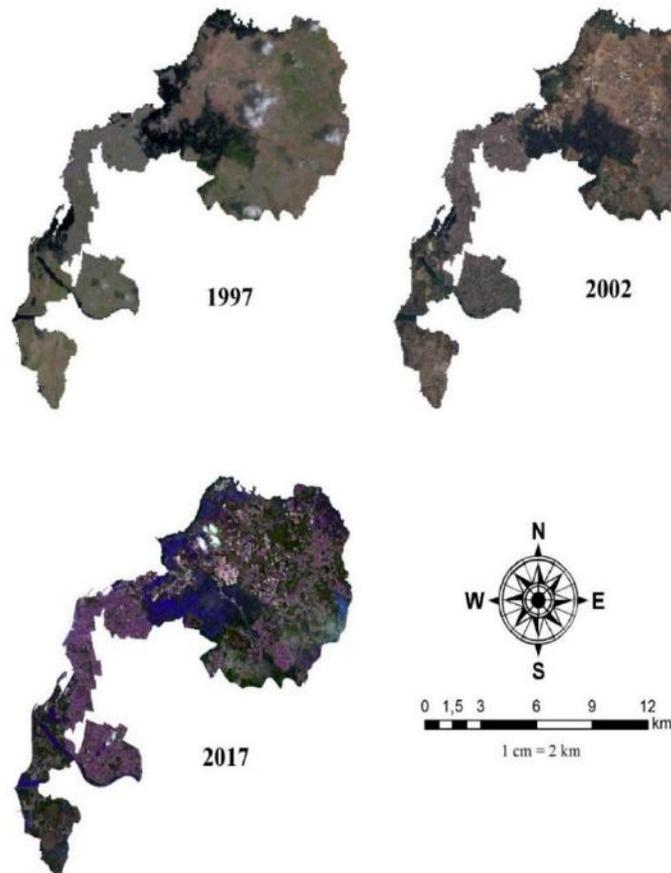
Figure 2: Images Data

Methodology

Land Use and Land Cover Classes, The main function of classification is to separate a complex population into groups called classes. Classes are considered as homogeneous units for a particular purpose, so that each class can describe a land use and land cover entity (Rusdi, 2005; Choudhary, Singh, & Kupriyanov, 2017). In this study, land use and land cover were divided into 5 classes. Generalization of land use and land cover types is shown in Table 2.

Table 2: Land Use and Land Cover Classes

No.	Class name	Generalization
1.	Forest	Big tree, small tree, bush
2.	Agriculture	Rice fields, vegetable gardens, open ground
3.	Business	Commerce, urban, suburban, highway
4.	Settlement	Residential, industrial
5.	Water bodies	Ponds, retention ponds, water basins, rivers, irrigation canals

Supervised Classification, is a classification carried out under the direction of an analyst (supervised). The class grouping criteria are determined based on the class signature obtained by the analyst through the creation of a training area. Making this sample area is an activity to identify prototypes (clusters) of a number of pixels that represent each desired class or category. The number of classes taken is adjusted to each area of the sighting. Theoretically, the number of pixels taken to represent each class is N+1, where N is the number of bands used.

Validation and Accuracy Test, validation is carried out by conducting a field survey of observation points on an interpreted image map, these points are marked with attributes and coordinates (X,Y). While the accuracy test is used to see the level of error that occurs in the classification of the sample area so that the percentage of mapping accuracy can be determined (Mihai, 2016; Sampurno, 2016). The accuracy test uses the overall accuracy method.

Results

The results of image interpretation in 1997, 2002, and 2017, informing land use and land cover in 5 classes, namely business, housing, agriculture, forest and water bodies, are shown in Figure 3.
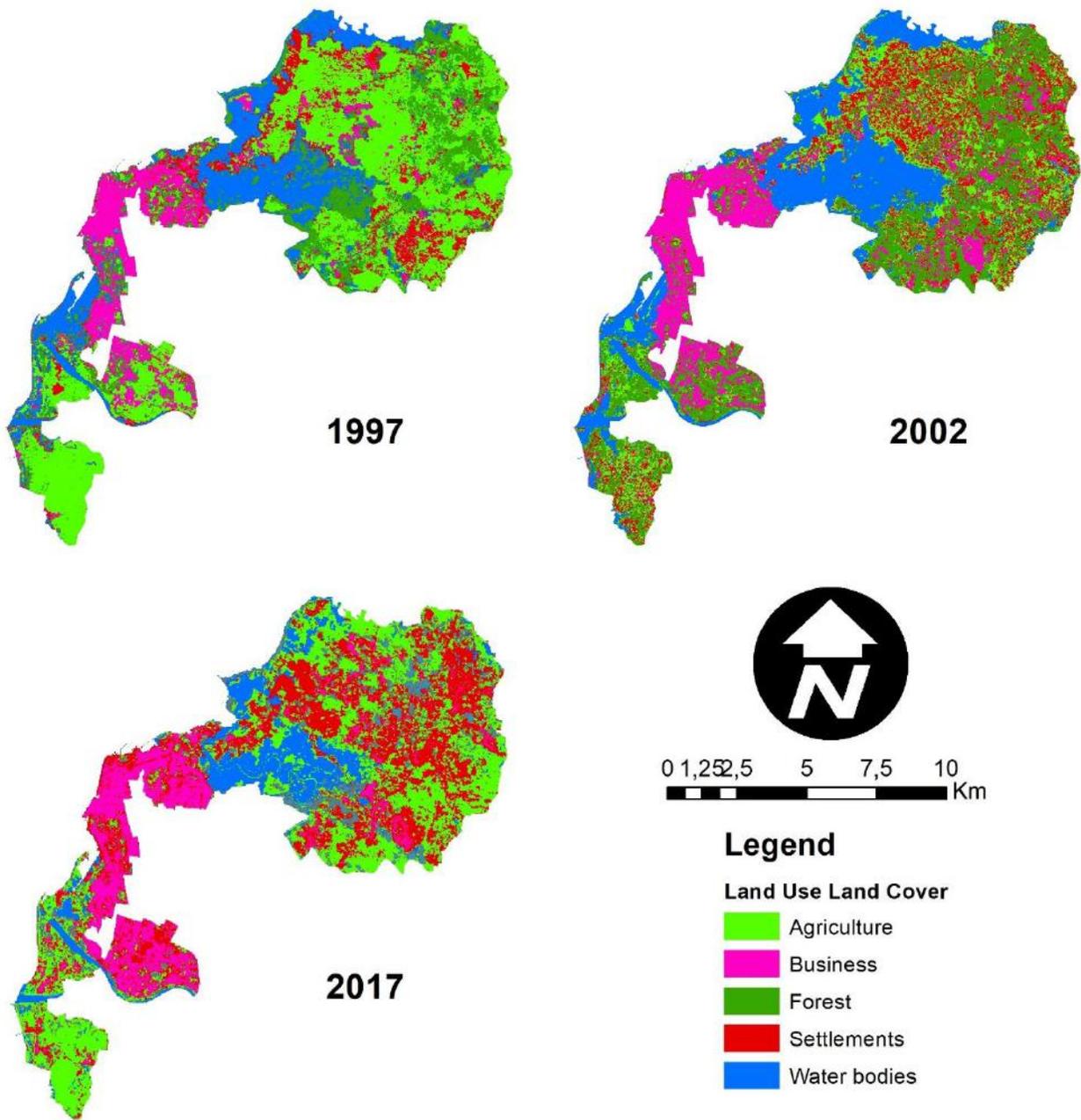
Figure 3: Image interpretation

Data of the dynamics of land use and land cover in Years 1997, 2002 and 2017 based on the results of the analysis in Figure 3, informed in Graph 1.

	1997	2002	2017
■ Business	1,416.37	492.86	252.59
■ Settlement	1,306.57	765.48	2,324.53
■ Agriculture	4,753.50	(2,702.45)	(601.23)
■ Forest	2,157.43	1,054.96	(1,215.11)
■ Water Bodies	2,186.49	404.14	(736.28)

Graph 1: Trend of changes

Based on Graph 1, 2002 data shows that the trend of changes occurred in the agricultural class (decrease in area of 2,702.45 Ha) and forest class increased by 1,054 Ha, while in Year 2017 the most significant trend of change occurred for the settlement class, which increased by 2,324.53 Ha. The graph means that if the area increases, the direction of the bar graph is upwards, while if the area decreases, it means that the bar graph is directed downwards (-).

Validation was carried out on the 2017 land use map, 18 observation points were spread out, shown in Figure 4.
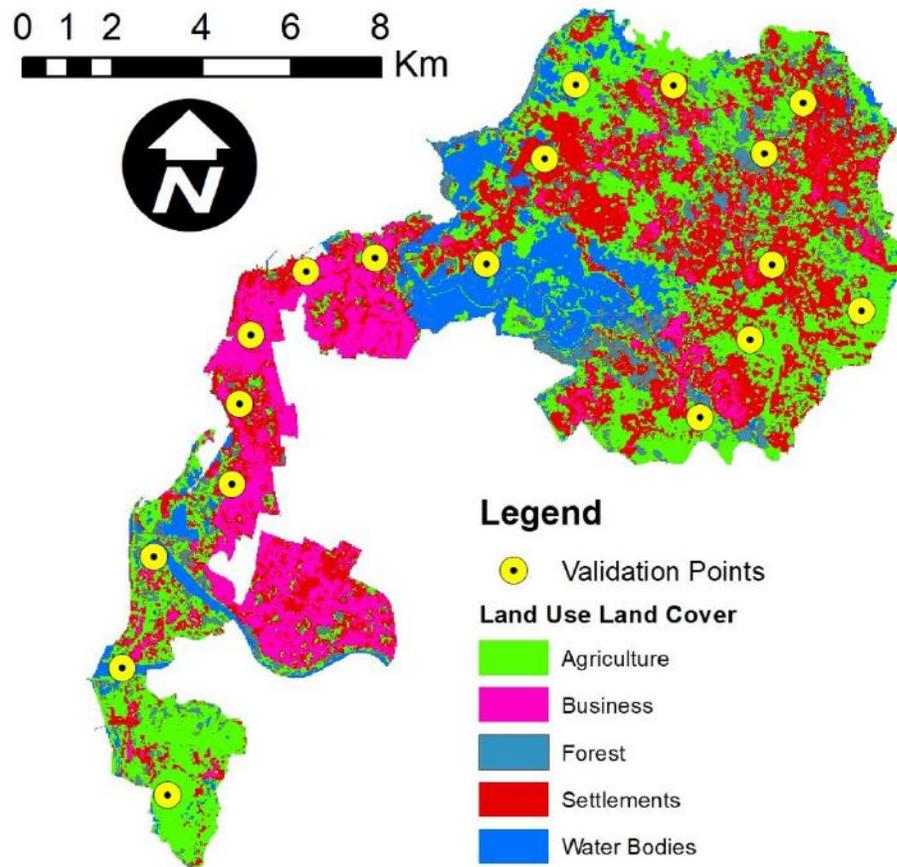
Figure 4: Validation points

Based on Figure 4, it can be informed of the results of the validation in the field, as shown in Table 3.

Based on Table 3, an accuracy test was carried out to see the level of accuracy of the image interpretation results. The accuracy test uses the Overall Accuracy method, where C1 = agricultural class, C2 = business class, C3 = forest class, C4 = settlement class and C5 = water body class. The results of the analysis of Overall Accuracy = 94.74%. If the accuracy is more than or equal to 85%, then the classification result is acceptable (Thakkar et al., 2016), the overall accuracy shown in Table 4.

Table 3: Validation data

Point	Coordinate		Image interpretation	Field validation	Description
	Axis (Y)	Axis (X)			
1	119,3951370	-5,2185010	Agriculture	Agriculture	Correct
2	119,3858800	-5,1928990	Water body	Water body	Correct
3	119,3921640	-5,1703470	Agriculture	Agriculture	Correct
4	119,4077800	-5,1555080	Business	Business	Correct
5	119,4093650	-5,1393600	Business	Business	Correct
6	119,5121820	-5,1259540	Agriculture	Agriculture	Correct
7	119,4116020	-5,1253610	Business	Business	Correct
8	119,4225730	-5,1125490	Business	Business	Correct
9	119,4589140	-5,1108330	Agriculture	Agriculture	Correct
10	119,4365150	-5,1096990	Settlement	Settlement	Correct
11	119,4707100	-5,0895520	Settlement	Settlement	Correct
12	119,5149200	-5,0882330	Forest	Forest	Correct
13	119,5226070	-5,0779440	Settlement	Settlement	Correct
14	119,4965520	-5,0746020	Settlement	Settlement	Correct
15	119,4768770	-5,0745340	Water body	Water body	Correct
16	119,5346180	-5,1199870	Agriculture	Agriculture	Correct
17	119,5021590	-5,1417930	Agriculture	Agriculture	Correct
18	119,5330590	-5,1212250	Settlement	Agriculture	Incorrect

Table 4: Analysis of overall accuracy

		Reference					
		C1	C2	C3	C4	C5	Total
	C1	6			1		7
	C2		4				4
	C3			1			1
classification as class	C4				5		5
	C5					2	2
	Total	6	4	1	6	2	19

Overall Accuracy (O.A) = 94,74%

The results of the analysis show that agricultural land is reduced in 2017, while the residential area increases. There was a conversion of agricultural land into residential areas in the period 2002-2017.

Discussion

Classification of land use in this study, grouped into 5 classes, namely agriculture, business, forest, settlements and water bodies. Classification can be grouped into 2 classes such as built and non-built areas in further research. The variation of land use grouping begins with generalizing the class name.

Conclusion

The results showed that in 2002, business class increased to 492.86 hectares, housing area to 765.48 hectares, forest area to 1,054.96 hectares, water bodies to 404.14 hectares, and agriculture class decreased to 2,702.45 hectares. While in 2017, the business class increased to 252.59 hectares, settlements covered an area of 2,324.53 hectares, and the reduced class was agriculture with an area 601.23 hectares, forests covering an area 1,215.11 hectares and water bodies covering an area 736.28 hectares. The relative changes that occurred in 1997-2002 were business class 34.80%, housing 58.59%, agriculture 56.85%, forest 48.90%, and water bodies 18.48%. For the period 1997-2017, namely business class 52.63%, residential 236.50%, agriculture -69.50%, forest -7.42%, and water bodies -15.19%.

Acknowledgement

Conflict of Interest

"There is no conflict of interest in this study"

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A REVIEW ON THE SMART CITY CONCEPT

Wahab, N.S.N. [1,*] and Seow, T.W. [1]
[1] Department of Construction Management, Universiti Tun Hussein Onn Malaysia, 86400, Batu Pahat,
*Correspondence: nsnwbs@gmail.com

Abstract

Over the past few decades, there has been a shift towards the development of smart cities to tackle the problems arising from the process of urbanization. Cities were developed with the intention to incorporate the use of technological advancements as well as the use of big data to facilitate the operations of the systems of the cities. However, this concept is deemed to be still in its infancy stage and thus, this concept can be further explored to provide planners with a better understanding. Previously, researchers had explored the challenges and the success factors of smart cities. The methodology is based on existing literature, as this paper aims to provide a brief discussion on the attributes of the smart city, including the most frequent definition and the characteristics of a smart city. Further, this paper discusses the results on the issues that arise when incorporating the concept into actual projects. Lastly, the paper discusses the potential of Malaysia in developing smart cities effectively. The paper concludes on the potential of new areas related to smart cities to be explored by the industry as well as by academia with regards to the establishment of the new Malaysia Smart City Framework.

Keywords: Smart City, Urbanization, Digitalization, Innovation

Introduction

City planners, authorities and policy makers of cities across the globe have been integrating the smart city concept into city development to provide solutions to problems such as traffic congestions, decreased in the availability of clean water, inequality issues, and inadequate social cohesion. The smart city aims in developing urban environment which incorporates ICT and other technologies to enhance the regular city operations and quality of services which are provided to the city dwellers (Silva, Khan, & Han, 2017). This concept is said to be the evolution from the fourth industrial revolution or the cyber physical revolution (Baltac, 2019). Thus, in general, this concept was first introduced with the rise of information and communication technologies in the urban planning activities (Yigitcanlar, 2016).

Over the past few years, more studies have been done regarding the implementation of this concept based on actual projects. It is a concern that whether the organizations of the city key players are able to adapt to the concept, and the city governments would potentially fail in employing and regulating new technologies to capture their benefits (Baltac, 2019). Furthermore, Donnellan (2019) argued that the implementation of the smart city is challenging but the problem is not about the technology itself, but it is clearly seen during the process of making the idea into a reality. Therefore, it is important to understand the fundamentals of the concept and also to consider the experiences from past smart city developments as lessons to improve the future smart city development.

In this paper, the concept of the smart city is briefly discussed and the issues arise from past smart city developments is reviewed. Further, this paper relates the smart city concept in the context of the

Malaysian perspective. The potential and opportunities for Malaysia smart city key players to adopt and make use of Malaysia's Smart City Framework are briefly discussed in this paper.

Smart City Concept

The Definition of Smart City

Although the concept has been introduced and has been widely discussed for some years now, it is said that this concept is still ambiguous and there is a lack of consensus in establishing the definition of the concept (Achmad, 2018; Anthopoulos, 2017; Cugurullo, 2018; Wahab, Seow, Radzuan, & Mohamed, 2020). Many definitions and conceptualizations have been introduced, but this also shows that there is still a general lack of agreement on the definition of smart city. Table 1 summarizes the common definitions of smart city which have been derived from three main researches by Lara, Da Costa, Furlani, & Yigitcanlar (2016), Schipper & Silvius (2018) and Yigitcanlar et al. (2018).

In general, the term 'city' can be defined as "an inhabited place of greater size, population, or importance than a town or village" (Merriam-Webster, 2019b). City can be further explained in the current global knowledge economy, and can be viewed as a center of knowledge and culture where it produces and enhances knowledge as well as having a major role in the governance of knowledge by incorporating different types of knowledge in order to protect the values of local and regional contexts (Yigitcanlar, 2016).

Meanwhile, the term 'smart' is noted as 'intelligent' (Merriam-Webster, 2019a). The 'smart' term could be further explained according to different perspectives. For example, smartness in marketing could be seen focusing on the user perspective which appeals to the community members, where it shows that they have a quick mind and are responsive to feedbacks (Nam & Pardo, 2011). Nam & Pardo (2011) further explain that smartness in technology involves innovation such as intelligent-acting products, artificial intelligence and machines. It further signifies the smartness in automatic computing such as self-configuration, self-healing, self-protection and self-optimization. Under the urban planning field, however, it involves smart growth of the urban area with strategic planning which involves policies, strategies and programs by the government and public agencies to accommodate the growth of the economy as well to provide the citizens with a better quality of life (Nam & Pardo, 2011).

Currently there are many definitions that have been introduced to define the 'smart city' term. According to Table 1, it shows that the most prominent element in this set of definitions is the role of ICT and innovations. From the definitions, the role of technology is very important as one of the drivers to develop a city. For instance, Hall (2000) stated that a smart city monitors and integrates conditions of all its critical infrastructures where these integrations are mainly supported by the use of instrumentation. Instrumentation, or indirectly meaning the use of ICT, is important in sourcing real-time data from physical and virtual sensors which are interconnected with multiple processes, systems and parties (Nam & Pardo, 2011).

Table 1: Common Definition of Smart Cities

Author	Definition
Hall (2000)	A city that monitors and integrates conditions of all of its critical infrastructures including roads, bridges, tunnels, rails, subways, airports, sea-ports, communications, water, power, even major buildings can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens.
Odendaal (2003)	A city that capitalizes on the opportunities presented by ICTs in promoting its prosperity
Giffinger et al. (2007)	A city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living which built on the smart combination of endowments and activities of self-decisive, independent and aware citizens.
Caragliu, A., Del Bo, C., and Nijkamp (2009)	A city that monitors and integrates conditions of all of its critical infrastructures including roads, bridges, tunnels, rails, subways, airports, sea-ports, communications, water, power, even major buildings can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens.
Bélissent (2010)	A city that uses ICTs to make the critical infrastructure components and services of a city-administration, education, healthcare, public safety, real estate, transportation and utilities – more aware, interactive and efficient.
Alkandari, Authority, Education, & Alkandari (2012)	A city that uses a smart system characterized by the interaction between infrastructure, capital, behaviours and cultures, achieved through their integration.
Piro, Cianci, Grieco, Boggia, & Camarda (2014)	A city that intends as an urban environment which supported by pervasive ICT systems, which able to offer advanced and innovative services to citizens in order to improve the overall quality of their life.
Yigitcanlar (2016)	An effective form of sustainable cities of the 21st century in the case that a balanced and sustainable view on economic, societal, environmental and institutional development is realized.
Lara et al. (2016)	A community that systematically promotes the overall wellbeing for all of its members, and flexible enough to proactively and sustainably become an increasingly better place to live, work and play.

Bélissent (2010) directly claims that the interaction between the critical infrastructure components as well as the city services (i.e. administration, education, healthcare, utilities, transportation, public safety, etc.) will be effective and efficient by the use of ICT. As shown in the Table 1, almost all the authors stress the element of ICT and technology as a bigger perspective for a city to work and deliver efficiently. This

element is being used and integrated in the system to produce a smarter system in order to improve the interactions within the city system towards ensuring better decision-making for the city's performance.

Other definitions highlight different aspects. Caragliu, A., Del Bo, C., and Nijkamp (2009) and Yigitcanlar (2016) pointed out the definition of smart city with the specific perspective of sustainability. Sustainable development in general is an interrelated process which balances the human needs while protecting the environment for the future generations (Ismail, 2016). Sustainability is commonly related to the triple bottom line where it explains that the three elements (i.e. economy, society and environment) would have the same priority in order to achieve the level of sustainability (Aigner & Fenner, 2014). Thus, the incorporation of sustainability with smart city development ensures that the city would be able to fulfill the balance of the three elements of sustainability with the aid of ICT technologies.

Therefore, the smart city concept can be viewed holistically where it manages through ICT technologies of the human and social capital while at the same time ensures the resources are being used wisely and having a systematic governance system with infrastructures which could support economic growth in order to enhance the quality of life of its inhabitants.

Characteristics of Smart City

A smart city comprises of multiple attributes or characteristics. Each developed smart cities are said to have different elements of attributes which are depending on the city's focus (Mohanty, Choppali, & Kougianos, 2016). Some authors proposed smart cities with different characteristics, which include sustainability, quality of life, urbanization, smartness, knowledge and intellectual capital, institution. Thus, Table 2 is the summary of the characteristics of smart city based on a few studies that have been done for the past few years.

Table 2 below shows that most of the authors outlined the same characteristics, for example the most prominent elements are sustainability, quality of life and technology. Although different authors had named the characteristics differently, but based on the discussion provided in the studies, most of the characteristics could be categorized under the same element. Silva, Khan, & Han (2018) through the discussion has categorized the elements systematically and being viewed holistically. As such, in their overview, they had summarized four main characteristics which are sustainability, quality of life, urbanization and smartness, similar to Mohanty et al. (2016).

Table 2: Characteristics of Smart Cities

Author	Characteristics
Nam & Pardo (2011)	technology, people and institution
Lara et al., (2016)	infrastructure & ICT, creative economy, sustainability and human infrastructure
Mohanty et al. (2016)	sustainability, quality of life, urbanization and smartness
Silva et al. (2018)	sustainability, quality of life, urbanization and smartness
Desdemoustier, Crutzen, & Giffinger (2018)	technology, human, institution and sustainability
Schipper & Silvius (2018)	environmental sustainability, life quality and wellbeing, knowledge & intellectual capital and participation

Silva et al. (2018) under the sustainability attribute, there are other elements which contributes to it, where it concerns issues such as the infrastructure and governance, pollution and waste, energy and climate change, social issues, economics and health. Meanwhile, under the quality of life attribute, it concerns about the emotional and financial well-being of the people. Urbanization attribute is being viewed widely, as it is contributed by the transformation of rural environment to urban environment with taking consideration of technological, economical, infrastructural and governing aspects. While the smartness attribute is explained by the city's aim in improving the living standards of urban community.

Sustainability has been considered as one of the prominent elements in urban planning since the 1970s. It is important for modern cities to approach the urban challenges on issues such as the climate change, energy, pollution, globalization as well as urbanization itself (Elgazzar & El-Gazzar, 2017). Besides, Lara et al. (2016) explains that sustainability is also related in promoting green economy and high social awareness to achieve an environmentally sustainable lifestyle. In a study done by Elgazzar & El-Gazzar (2017), they explained that cities need to deploy smart solutions by the means of integrating smart technology in order to achieve sustainability. However, they also stated that cities which use smart ICT does not necessarily make them sustainable, or the usage of ICT in the cities may not fully lead to sustainable development. The cities could be considered as smart cities when they utilizes smart ICT with the goals to make them more sustainable (Elgazzar & El-Gazzar, 2017).

Another goal of the development of smart cities is to improve the quality of life (QoL) of the people living in the cities. It is closely related to the social well-being concept and also monetary factors such as the life costs (Cvetic & Arsic, 2017). Smart cities integrate innovative solutions to improve the QoL, in which could lessen the restrictions on social learning as well as the limitation of social participation (Silva et al., 2018). Through these, it is said that the government will be able to implement social policies that could produce skilled citizens to enhance their QoL as well as their financial stability (Silva et al., 2018).

Rapid urbanization had influenced smart cities to be looked upon as the ideal solution to manage the urban challenges. Urbanization can be categorized as industrialization-led urbanization and entrepreneurial-led urbanization, in which these are important in management purposes (Silva et al., 2018). Entrepreneurial urbanization is mainly focusing on the formulation and implementation of policies that could improve the economic growth (Silva et al., 2018). Furthermore, urbanization is seen as the core for smart cities, as it influences the need for better infrastructure development, efficient management on congestion and the environment, improvement on public services as well as better management on socio-economic aspect (Khanna, 2015). Caragliu et al. (2011) also explained that the correlation between urbanization and smart cities is mainly focusing on factors such as the environment, level of education, accessibility to ICT, infrastructure and also the implementation of ICT for governance. Thus, with these factors being established, this could positively enhance the urban prosperity.

Smart cities revolve around the incorporation of ICT and data with the goal to improve the QoL of people as well as the surrounding (Silva et al., 2018). Therefore, smartness here, is closely related to the integration of smart technologies in the city system, in which requires a well-functioning infrastructure to properly deploy the system (Desdemoustier et al., 2018). Woetzel et al. (2018) mentioned in their report that 'smartness' in the city involves three layers; technology base, application and public usage. They explained that the smartness involves the networks of connected devices and sensors, in which could provide real-time data and the data provided will be able to be analyzed and translated into alerts, insights and actions, as lastly it will serve as information that could be adopted in applications for public users (Woetzel et al., 2018). Thus, with these applications, people will be able to make more intelligent and sustainable decisions in their daily activities (Desdemoustier et al., 2018).

Challenges and Opportunities of Smart City Development

According to EasyPark Smart Cities Index 2019 (ESCI, 2019), to date there are more than than 500 smart cities worldwide. Over the past few years, many studies have been done to understand the challenges and the success factors in implementing smart city projects. One of the prominent topics is the issue regarding the challenges in implementing the idea of smart city concept on actual projects. It was argued that most of the work presented belongs to the category of experimental test benches (i.e. pilot cities), in which the transforming a test bench experience into real world is a very difficult task (Saba, Sahli, Berbaoui, & Maouedj, 2020). Thus, it is important to review and understand the challenges faced by the past development of smart cities so that it will able to help the key players of the future smart cities to learn and improve their strategies.

In the study done by Mahesa, Yudoko, & Anggoro (2019), they had emphasized on that there are three elements that should be focused on in order to develop smart cites; structure (i.e. human capital, financial capital, and governance capital); infrastructure (i.e. physical, digital and social); and superstructure (i.e. regional regulations, institutional and implementation development based on smart city aspects). The issue arises when some of the cities has the potential to develop the smart cities as they have been equipped with sufficient structure and infrastructure readiness but are still lacking in the superstructure area. Donnellan (2019) also argued that the implementation of the smart city is challenging but the problem is not about the technology itself, but it is clearly seen during the process of making the idea into a reality.

In one of the studies done by (Izzuddin & Arifin, 2019), it was shown that one of the most prominent issues regarding the challenges in implementing smart cities is the governance. They further explained that there are a few elements under the governance, including the organizational culture for stakeholders, leadership support, management support from technology providers, procurement and maintenance budgets, and standardization of information security management (Izzuddin & Arifin, 2019). The Table 3 below shows a few issues that have been highlighted by a few studies regarding the challenges in implementing the smart city concept into actual projects.

Table 3: Highlighted Issues Regarding the Challenges in Implementing Smart City Concept

Challenges	References
Lack of clarity in setting the goals	Argento, Grossi, Jääskeläinen, Servalli, & Suomala, (2019); Ojo, Curry, Janowski, & Dzhusupova (2015); Rautiainen (2010)
Unclear alignment of interest	Argento et al. (2019); Mahesa et al. (2019); Ojo et al. (2015)
Unclear commitment plans	Argento et al. (2019); Gunawan (2019); Ojo et al. (2015)
Lack of resource management	Gunawan (2019); Izzuddin & Arifin (2019); Mahesa et al. (2019)
Lack of leadership	Argento et al. (2019); Izzuddin & Arifin (2019); Ojo et al. (2015)
Unclear standardization of information management	Izzuddin & Arifin (2019); Ojo et al. (2015); Zheng & Sieber (2019)

According to Argento et al. (2019), many of the practitioners were taking actions and steps to convey the smart cities strategies. However, especially the public sector, they were not able to fulfil the strategies as the goals set were ambiguous. Thus, it remains difficult to assess the performance of the actions that has been taken. Rautiainen (2010) explains that without having a clear goal, it is not easy to identify what should be done or measured. Besides that, other studies found that some of the cities were not able to fully perform on the strategies due to issues such as the lack of clarity on setting the goals, the unclear alignment of interests and commitment plans of the cities' key players, the lack on resource management, the lack of leadership to adhere the implementation plan and also the lack of involvement of planners in smart city initiatives (Argento et al., 2019; Ojo et al., 2015; Zheng & Sieber, 2019).

The use of framework as a guideline or a benchmark in the development smart cities are important. The issue however can be seen from the past development of smart cities where most of the projects were developed by using self-congratulatory framework. In which this means that the cities were built on a set of self-regulated elements and aims. Taking consideration of the Malaysia's perspective, the past few years there have been the rise of smart cities projects in this country. For example, the development of Iskandar Malaysia region, the Smart Selangor, Greater Kuala Lumpur, Mukah and a few other. In the opening ceremony of Cities 4.0 Conference in 2019, the former Prime Minister Tun Dr. Mahathir Mohamad had stated that there are large numbers of city players which are working individually with silo mentality which could be a challenge in the smart city development as a whole (TheStar, 2019). He further stated that to overcome this issue, there is a need of the establishment of a framework that can aid the key players to successfully implement smart city strategies into actual projects (TheStar, 2019).

Malaysia has the potential to transform the cities in this country taking consideration of smart city concept. The government has envisioned to develop smart cities which are integrating sustainable technologies in the services of the city, such as the 5G connection, cashless community, autonomous transportation, drone delivery, energy-efficient buildings, smart treatment of water and waste management which could improve the public safety and the quality of life of the citizens (TheStar, 2019). Therefore, on 23rd September 2019, the Ministry of Housing and Local Government Malaysia had launched the Malaysia Smart City Framework in which it aims to serve as a guideline for key players in Malaysia to develop smart cities (Loo, 2019).

The implementation roadmap of the Malaysia Smart City Framework involves three phases; Phase 1 (Foundation Stage) from 2019 to 2020; Phase 2 (Development Stage) from 2021 to 2022; and Phase 3 (Advanced Development and Monitoring Stage) from 2023 to 2025 (KPKT, 2018). According to the framework, it stated that five cities in Malaysia will be tested as pilot cites, which are Kulim, Kuala Lumpur, Johor Bahru, Kota Kinabalu and Kuching. These pilot cities are chosen to implement the smart city strategies, initiatives and indicators at the city level and according to the blueprint, these cities will be monitored to evaluate the sustainability of smart city solutions and initiatives, as well as to increase the quality and efficiency of city management through the smart city approach (KPKT, 2018). It is expected that through this framework, it will serve as a catalyst for the implementation of smart city in Malaysia while specifically focusing on the parties involved in city development (i.e. the Local Authorities), the policy makers, practitioners, as well as the academia (Loo, 2019). The government has also stated that it is important for Malaysia to develop cities into smart cities in a planned, integrated and holistic manner to ensure Malaysia will be able to follow the global urban development trends. One of the important aim of smart city is to ensure that it can contributes to the achievement of the Sustainable Development Goals (SDGs). Thus, if the cities are able to efficiently convey the smart city concept into the actual projects, this will help the nation to move towards the success of the SDGs.

Conclusion

This study reviews the attributes of smart city. The extensive number of definition shows that to date, there is no definite consensus on the actual description of the term 'smart city'. It could however be seen that most of the definitions agrees that technology plays an important role which drives the city to be smart. The technological advancements will aid in the effective implementation of the modern city systems to enhance the quality of everyday life of the citizens. Further, the smart city concept can be looked into its characteristics. It is important to understand what area to be focused on while developing the smart cities. According to the past studies, the prominent characteristics of smart city are the sustainability, quality of life, urbanization and smartness. It focuses on how smart city, through the technology, is able to achieve sustainability; the enhancement of the quality of life of the citizens living in the cities; the solutions to tackle urbanization challenges; and the effective development of technological infrastructure to function properly for the technology base layer, the operational layer, as well as the public user layer.

The large number of smart cities that have been developed over the years have been studies and one of the most prominent issues with regards to the challenge of implementing smart city projects is the way how they were governed during the implementation phase. Most studies argued that it was challenging to develop these projects due to the level of preparedness of the city key players in conveying the smart city goals. Moreover, the use of self-congratulatory framework and working in silo mentality have been found as challenges to properly develop smart cities. Thus, there is the need to establish a uniform, comprehensive and holistic framework in order for it to be used as a benchmark or a guideline for the city key players.

Malaysia has move towards the smart city developments. Thus, with the launch of Malaysia Smart City Framework, it is expected that the key players in this country to be able to develop more smart cities efficiently. However, since the framework is still in its early stage, this area can be further being explored in the future. For example, future study may focus on the challenges faced by the key players on implement smart city projects with the aid of this framework; or more study can be done on the effectiveness of this framework; and the potential improvements that can be done for the framework to work efficiently.

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Conflicts of Interest

There are no conflicts of interest in this study.

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KNOWLEDGE, ATTITUDE AND PRACTICE ON THE IMPORTANCE OF GREEN AREA AMONG YOUTHS IN PUTRAJAYA

Ahmad, F.F.[1], Haliza, A.R. [2*] and Azrin, S.A.B [3]
[1] Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.
[2] Institute for Social Science Studies, Putra Infoport, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.
*Correspondence: dr.haliza@upm.edu.my

Abstract

Green areas are increasingly considered to be vital to citizens in terms of balancing their urban living by providing areas for restoration and addressing mental exhaustion. This study assessed the level of knowledge, attitude and practice and to compare the difference of knowledge, attitude and practice on the importance of green area between of youths residing of Precinct 8 and Precinct 9 in Putrajaya. This was a cross-sectional study conducted among youths residing in Putrajaya. A total 176 youths participated in this study. The questionnaire consists of social-demographic characteristic and KAP on the importance of green area. Data were analyzed using descriptive statistics and Mann-Whitney U test. The findings showed there is a moderate level of knowledge, attitude and practice towards the importance of green areas of youths in Putrajaya. The study also found that there was a significant difference between knowledge of youths residing of Precinct 8 and Precinct 9, while there was no significant difference of attitude and practice between both of the Precinct in Putrajaya. This study indicates that the respondents have moderate level of knowledge, attitude and practice towards the importance of green areas and there was a significant difference between the knowledge of youths residing of Precinct 8 and Precinct 9. Further education and health promotion intervention is required to improve knowledge, attitude and practice on the importance of green area among youths.

Keywords: Green area, knowledge, attitude and practice (KAP), Youths, Putrajaya.

Introduction

The importance of urban nature and green spaces in promoting residents' health and well-being has long been recognised (Jalkanen, J. et al., 2020). It is increasingly considered to be vital to citizens in terms of balancing their urban living by providing areas for restoration and addressing mental exhaustion and pressure or stress by assisting to mitigate for the negative psycho- physiological results of working and living in dynamically constructed in urban settings (Nath, T. K. et al., 2018; Braubach et al., 2017).

Chiabai et al. (2020) study revealed that there was association involving environmental and seminatural ecosystems, on the present side, and human health and welfare, on the other, has been studied not only by scientists but also by organisations responsible for health promotion and environmental protection. While, Braubach et al. (2017) highlighted that offering green areas is therefore a solution centred on biodiversity with a range of identified health and medical advantages. Similarly, Hunter et al. (2019) has also identified that despite the increasing interest in and support for urban green space, nevertheless, the existing information on environmental, health, well-being and equity-related interventions is relatively limited. Therefore, the present study aims to assess the difference between knowledge, attitude and practice (KAP) on the importance of green area of youths residing of Precinct 8 and Precinct 9 in Putrajaya.The introduction section should provide readers with the background information of the studied/researched topic. Besides that, authors should summarize

the literature and state the research problem/issue/gap clearly. Please make sure your citations are well balanced, relevant and up-to-date.

Materials and Methodology

Setting and participants

A cross-sectional study has been conducted in this study. Putrajaya is selected because it has been announced as Pioneer Township of Green Technology as a model for establishment of other townships or to be called as a model for showcase to be set as an example for other cities, said by Prime Minister in 2010 Budget (Putrajaya Corporation, 2013) and Putrajaya has become bureaucratic capital that displays nature-inspired designs which are both practical and also effective which is perfect for this research. The sampling population was among youths residing in Putrajaya. Only youths aged 18-30 will be the respondents for this study. The first or initial method was purposive sampling where Putrajaya has been purposively selected to be included as the main location in this study due to several criteria that related with the importance of green area. In particular, there have been two precincts that are selected due to their specific criteria which were Presint 8 and Presint 9. They were chosen for this research because both precincts are bordered by the same lake, but with various names, and because both precincts have various recreational spaces surrounding them where people can engage in outdoor sports such as cycling, running, socialising, and many other activities. Subsequently, systematic random sampling has been used which every 4th person found is selected to be the respondent and consecutively continued for the 8th person until total of sample sizes are achieved in Presint 8 and also Presint 9 in Putrajaya.

By using proportion for one group with 95% of confidence interval which has 1.96 of standard errors and 10% of desired precision. However, 10% drop out rate is needed to be taken into consideration just in case of any likelihood for drop out respondents. Hence, the total estimated sample is 108 respondents.

Questionnaire

The level of KAP on importance of green area among youths in Putrajaya has been evaluated by using self-administered questionnaire. The questionnaire includes of four components which are Section A (Socio-demographic traits), Section B (General questions), Section C (KAP on the importance of green area) and Section D (Recommended suggestions). The questionnaire has been pre-tested to ensure good content validity is achieved. The reported Cronbach-alpha obtained was 0.70 which was considered as acceptable.

Statistical analysis

The questionnaire has been examined by using Statistical Package for Social Sciences (SPSS) version 25.0. Descriptive analysis was used to identify the socio-demographic status and level of KAP towards the importance of green area. While, Mann-Whitney U test was used to see the difference between the variables.

Results

Socio-demographic Characteristics

This research was conducted among youths in Precinct 8 and Precinct 9 of Putrajaya. In this research, there was a total of 176 respondents which were among youths in Precinct 8 (n=92) and Precinct

9(n=84) were involved to assess their knowledge, attitude and practice on the importance of green area. The findings of the study were displayed in Table 1.

Table 1. Socio-demographic Characteristics of Respondents (N=176)

Socio-demographic Profile	Presint 8 (n=92) N (%)	Presint 9 (n=84) N (%)
Age		
<24 years old	46 (50.00)	38 (45.23)
≥24 years old	46 (50.00)	46 (54.76)
Gender		
Male	53 (57.61)	42 (50.00
Female	39 (42.39)	42 (50.00)
Race		
Malay	63 (68.48)	57 (67.86)
Non-Malay	29 (31.52)	27 (32.14)
Level of Education		
Primary	4 (4.34)	6 (7.14)
Secondary	21 (22.83)	19 (22.62)
Tertiary	67 (72.83)	59 (70.24)
Household Income		
B40 (<RM4,850)	37 (40.22)	33 (39.29)
M40 (RM4,850 – RM10,959)	42 (45.66)	40 (47.62)
T20 (>RM10,959)	13 (14.13)	11 (13.10)
Years of Living in Putrajaya		
1-5 Years	35 (38.04)	31 (36.90)
5-10 Years	35 (38.04)	39 (46.43)
>10 Years	22 (23.91)	14 (16.67)

From the total of 176 youths that had participated, 92 of them are from Precinct 8 and 84 of them are from Precinct 9. Next, about half youths from Precinct 8 have age of below 24 years old (50.00%) and another half is 24 years old and above. For Precinct 9, there are 38 youths who have age of below 24 years old (45.23%) and 36 for youths who have age of 24 and above (54.76%). Besides, majority of respondents from Precinct 8 are males (57.61%) and half number of respondents from Precinct 9 are males (50.00%). Most of the youths from both Precinct 8 and Precinct 9 are Malay with the percentage of 68.48% and 67.86%, have tertiary level of education which are 72.83% and 70.24%, and also are coming from household income of M40 which are 45.66% and 47.62% each. Last but not least, respondents from Precinct 8 have an equal percent- age of years of living in Putrajaya for two groups which are 38.04% of them have been living for 1-5 years, another 38.04% have been living for 5-10 years while the last group is more than 10 years which is made up of 23.91% of respondents from Precinct 8. Precinct 9 has majority of 46.43% of youths that have been living in Putrajaya for 5-10 years.

Knowledge on the Use of Green Areas

Table 2. Level of Knowledge on the Importance of Green Areas

Variables	Presint 8		Presint 9	
	N	(%)	N	(%)
Knowledge				
Low	5	5.43	6	7.14
Moderate	74	80.43	75	89.29
High	13	14.13	3	3.57

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Majority of the youths from Precinct 8 and Precinct 9 had moderate knowledge level which was 74 (80.43%) and also 75 (89.29%) respectively (Table 2). Whereas, only 13 (14.13%) youths from Precinct 8 and 3 (3.57%) from Precinct 9 had high knowledge on the importance of green areas. Meanwhile, 5 (5.43%) and 6 (7.14%) of respondents from both Precinct 8 and Precinct 9 respectively had poor level of knowledge on the importance of green areas.

Attitude towards the Importance of Green Areas

Table 3. Level of Attitude on the Importance of Green Areas

Variables	Presint 8		Presint 9	
	N	(%)	N	(%)
Attitude				
Low	7	7.61	16	19.05
Moderate	73	79.35	56	66.67
High	12	13.04	12	14.29

Majority of the youths from Precinct 8 and Precinct 9 had moderate attitude towards the importance of green areas which were 73 (79.35%) and 56 (66.7%). Besides, 12 (13.04%) of respondents from Precinct 8 and 12 (14.29%) of respondents from Precinct 9 had high attitude level. Other than that, 7 (7.61%) and 16 (19.05%) youths from Precinct 8 and Precinct 9 respectively had low level of attitude (Table 3).

Practice on the Importance of Green Areas

Table 4. Level of Practice on the Importance of Green Areas

Variables	Presint 8		Presint 9	
	N	(%)	N	(%)
Practice				
Low	17	18.48	9	10.71
Moderate	61	66.3	68	80.95
High	14	15.22	7	7.61

Majority of the youths from Precinct 8 and Precinct 9 had moderate practice towards the importance of green areas which were 61 (66.3%) and 68 (80.95%). Besides, 14 (15.22%) of respondents from Precinct 8 and 7 (7.61%) of respondents from Precinct 9 had high practice level. Other than that, 17 (18.48%) and 9 (10.71%) youths from Precinct 8 and Precinct 9 respectively had low level of practice (Table 4).

Comparison Knowledge, Attitude and Practice on the Importance of Green Areas between Youths of Precinct 8 and Precinct 9

Comparison of Knowledge, Attitude and Practice on the Importance of Green Areas

Table 5. Comparison of Attitude on the Importance of Green Areas (N=176)

Precincts	n	Median	z	p-value
Presint 8	92	59.5	-1.298	0.194
Presint 9	84	58.5		

N=176, Mann-Whitney Test, *significant at p<0.05

There was no significant difference in attitude level between youths of Precincts 8 and 9 (Table 5).

Table 6. Comparison of Practice on the Importance of Green Areas (N=176)

Precincts	n	Median	z	p-value
Presint 8	92	72	-0.143	0.886
Presint 9	84	71		

N=176, Mann-Whitney Test, *significant at p<0.05

There was no significant difference of practice between youths of Precinct 8 and Precinct 9 (Table 6).

Discussion

The main objective of this study is to study the level of knowledge, attitude and practice on the importance of green area as well as comparison knowledge, attitude and practice on the importance of green area between of youths residing of Precinct 8 and Precinct 9 in Putrajaya. In this study, Precinct 8 and Precinct 9 in the city of Putrajaya were used to pick the respondents from a total of 176 people who answered the survey's questions. Other than that, this study only focused on youths as there was a study that shows an outcome, claiming that younger groups perform better in their KAP (Yezli et al., 2019). Therefore, the subjects in this research were only youths between the ages of 18 and 30 years old.

A total of seven questions have been given to individuals who answered the survey questions. Specifically, the goal of this subsection is to determine their level of general aware- ness of the significance of green areas. When comparing two separate precincts, a descriptive statistic was used to deter- mine the frequency and proportion of respondents that answered the same responses. The vast majority of responders from both precincts (100 %) are aware of and knowledgeable about green areas. Furthermore, the majority of respondents (87.5 %) properly answered the question about the concept of green areas, and the overwhelming amount of youths (99.4 %) are aware that green areas are essential for a high quality of life. In addition, the majority of youths (55.68 %) believe that green areas may help to decrease or cool the temperature of their surroundings, and social media has been identified as the most effective source of information for gaining awareness about the value of green areas by interviewees (43.75 %). A large percentage of respondents (32.95%) also opted for the internet as their preferred social media medium for learning about the value of green areas and most of youths (39.8 %) opted that they engage with green areas on a continuous basis in about one to two times weekly.

The large percentage of youths from Precinct 8 and Precinct 9 seemed to have a moderate level of knowledge. Better comprehension of public perceptions of green spaces, as well as the benefits supplied by green spaces, can be used to improve the design, administration, and aesthetic appeal of existing green spaces (Muratet et al., 2015). In addition, one study pointed out that the gain in knowledge is more concerned with the changes in behaviour and practices than with the increase in information itself (Al-Binali et al., 2010). A study by Muratet et al. (2015) has stated that the preservation and restoration of biodiversity is not the only challenge involved in green area management in cities, and notably in open green spaces, where the connection between human beings and nature is crucial for healthy living.

In addition, the most of youths from Precinct 8 and Precinct 9 had a moderate attitude toward the value of green spaces. A study by Arbiol et al. (2016) stated that a positive attitude must be matched by strong understanding or good knowledge in order to maximise an individual's ability to put preventive actions into practice as effectively as possible. The findings of a study conducted by Tolvanen et al. (2011) revealed that knowledge influences behaviour, but that it did so mostly through attitudes. An attitude is the possibility that a person will respond positively or negatively to a particular object, person, circumstance, or idea (Yun Ai Wong et al., 2019). As a result of these reactionary tendencies, influencing attitudes with enough positive and accurate knowledge results in the development of beneficial practices. In addition, some study found a link between knowledge and a positive attitude, which lends credence to this assertion. As a result, a gain in knowledge is inversely related to an increase in positive attitude (Aminrad et al., 2013).

Other than that, the majority of youths from Precinct 8 and Precinct 9 had a moderate level of practice regarding the value of green areas. A study by Awang Besar et al. (2013) stated that the higher the practice level, the greater the possibility for the success to be achieved. Other than that, an article by Arbiol et al. (2016) claimed that in order to maximise an individual's ability to put preventive activities into practice as successfully as possible, a positive attitude must be accompanied by strong understanding or good knowledge. In addition, on the basis of past studies, they concluded that changing a practice is a process that may take time and may not result in a change in practice overnight. Growing up (growth, skill development), learning, conditioning, and extrinsic and intrinsic rewards are some of the variables that might lead to changes in health- related behaviour. These modifications are regarded as part of a process. This process can be influenced by a variety of internal elements, such as knowledge, attitudes, intention, and stress, as well as external factors, such as social support and the environment in which one lives (Tolvanen et al., 2011).

Finding from Mann-Whitney U test found that in terms of knowledge, the difference between Precinct 8 and Precinct 9 was statistically significant. This may due to several green programs that have been implemented in the precinct. For an example, there were 123 plants or trees planted in two locations (Sisiran tasik & monorail bridge area) which were both in Precinct 8 under a program that is called 'Pledge and Plant a Tree Programme' in 2017, organised by Malaysian Institute of Planners which Putrajaya Corporation was in line to participate in making Putrajaya as a low carbon and green city (Putrajaya Corporation, 2018). However, there was no significant difference of attitude between youths of Precinct 8 and Precinct 9. In terms of practice, the p-value obtained from the test was 0.886 which is more than 0.05. Hence, there was no significant difference of practice. These findings were aligned with previous research by Johar and Razak, (2015) claim that in terms of environmental knowledge and attitude, there is no statistically significant difference between the two neighbourhoods. In addition, the research also indicates that similar socio-economic and demographic factors between the two green neighbourhoods may result in a similar level of environmental knowledge be- tween the two communities and when compared to other study sites, some sites have a more positive attitude toward the environment, which may be related to the neighborhood's status and attributes (Johar & Razak, 2015).

Conclusion

In conclusion, majority of youths from Precinct 8 and Precinct 9 have moderate level of knowledge, attitude and practice towards the importance of green areas. To improve the knowledge and practice of this generation, it is recommended to increase their understanding.

Furthermore, in order to provide urban residents with locations for recreation, social, and leisure activities, it is necessary to plan green spaces in an appropriate manner. Parks, open space, gardens, and urban woods, among other things, give tourists, neighbours, and children with a variety of chances for physical activities such as walking, running, and cycling, as well as opportunities for social contact and nature observation. In addition, boosting environmental education in schools, especially for the next generation, is critical since it can help students learn how to better care for and protect the environment for future generations. Consequently, more emphasis should be placed on educating children about the need of protecting the environment for the long-term viability of their lives. In light of the well-documented benefits of urban green spaces for health and well-being, as well as the positive responses from residents, the promotion and support for the use of green spaces by Malaysians should be seen as a significant public health intervention. This would have a favourable impact on society, as well as on the economy and the environment of the country.

In addition, this study had some limitations, including the probability that members of the community specifically youths were not telling the truth when completing the questionnaire, particularly when responding to questions about attitudes and practices, and that this could make a contribution to a bias in the results based on social preferences. Instead, by assuring people that their anonymity would be held in strict confidentiality, they will be able to get around this limitation. Although just two precincts were used to collect the data, it is possible that the results may not correctly reflect the population of Putrajaya as a whole, as would be expected. As a result, the research setting should be enlarged to encompass numerous regions from different precinct in order to provide a more variety sample that is representative of the target population of Putrajaya. Moreover, because the findings of this study data analysis are based on cross-sectional data, it is not feasible to draw general conclusions from the findings.

Acknowledgement

Conflicts of Interest

The authors declare no conflict of interest.

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CONTENT VALIDITY OF ONLINE GLOBAL EDUCATION PROGRAM SCALE

Shoji, Y[1]., Peii, T. [1], Omori, F. [1], Onishi, A. [1], Nakanishi, M. [1], Ochiai, R. [1], Seta, M. [1], Yoshinaga, T. [1], Ota, R. [1], Chan, N.W. [2], Huong, D.N.T. [3], Irwan, A.M. [4], Ngoc, P.T.B. [3] and Imura, H. [1]

[1]Yokohama City University
[2]Universiti Sains Malaysia
[3]Universiti of Social Science and Humanities
[4]Hasanuddin University

*Correspondence: shoji.yay.du@yokohama-cu.ac.jp

Abstract

The outbreak of COVID-19 has led to the rapid adoption of online classes on digital platforms worldwide. Under these circumstances, global education, which until now was being conducted face-to-face, has moved online. While online global education helps reduce cost and travel time, there are certain challenges such as facing difficulty while interacting with other students online and the need to become proficient in online tools. "Global competence is the capacity to examine local, global and intercultural issues, to understand and appreciate the perspectives and worldviews of others, to engage in open, appropriate and effective interactions with people from different cultures, and to act for collective well-being and sustainable development"(PISA, 2018). However, there is no scale to evaluate online education programs based on the concept of global competence. Accordingly, this study aims to develop a standardized scale based on global competence to evaluate students' learning experiences and perceptions in online global education programs and test its validity and reliability. We also aim to use the scale to assess the distinctive aspects of online global education, such as whether students are experiencing alternatives to onsite visits, having sufficient interaction, and effectively using online tools. We are currently working with faculties from IACSC member universities to develop the scale. In this presentation, we would like to share the results of our research on the content validity of the scale.

Keywords: Online Global Education, Digital Platform, Global Competence, Evaluation Scale

Background

The outbreak of COVID-19 has led to the rapid adoption of online classes on digital platforms worldwide. As of March 13, 2020, 61 countries in Africa, Asia, Europe, the Middle East, North America, and South America had announced or implemented school and university closures, with most universities having limited regional closures (UNESCO, 2020). While COVID-19 infection rates differed by country, globally, as of April 2022, more than 1.2 billion children in 186 countries had been affected by school closures due to the pandemic. As a result, there has been a rapid global adoption of online classes that provide distance education, typically via digital platforms (World Economic Forum, 2020).

Global education, which had been conducted face-to-face, was forced to move online. The concept was first discussed at the European Conference on Global Education held in Maastricht, the Netherlands, in 2002. Global education concerns opening the eyes and hearts of all people to the realities of the world and to the need for greater justice, equality, and human rights for all; thus, it entails development education, human rights education, education for sustainable development, peace and conflict prevention education, and intercultural education. In addition, Collaborative Online International Learning (COIL), an online-based international interactive educational method, is

attracting attention worldwide. COIL promotes virtual, interactive educational opportunities by connecting faculty and students through shared experiences across international borders. In this way, the use of online education is gaining momentum worldwide. Online global education has the advantages of lower cost and less travel time. Conversely, it has disadvantages such as difficulty in visiting sites and interacting with other students and the need to master online tools.

The Organization for Economic Co-operation and Development (OECD) promoted an international survey on academic achievement called Programme for International Student Assessment (PISA). PISA covers students aged between 15 years and three months and 16 years and two months. PISA is a triennial test that assesses proficiency in three areas: reading, mathematical literacy, and scientific literacy. The 2018 PISA introduced the Global Competence Survey, which evaluates students' understanding of international issues, values, and attitudes toward culture. Global competence is "the ability to examine local, global, and cross-cultural issues; understand and appreciate the perspectives and worldviews of others; interact openly, appropriately, and effectively with people from different cultures; and act for the collective well-being and sustainable development" (PISA, 2018). Although previous studies have demonstrated the need to develop global competencies, there are no scales to assess the efficacy of online global education based on the concept of global competencies.

Prior to the global spread of COVID-19, students traveled freely between countries. Each institution used existing assessment instruments to evaluate the learning effectiveness and classroom satisfaction of international and Japanese students as well as their global education, cross-cultural understanding, and study-abroad experience. In online global education, group work and fieldwork have become more difficult; thus, alternative methods using Zoom breakout rooms, video, virtual reality (VR), and e-Learning are being utilized. However, while online global education is becoming more widespread, evaluation methods to verify its efficacy have not been established. It remains unclear how these methods can achieve effective learning outcomes.

Purpose

This study aims to develop a scale for evaluating learning effectiveness in online global education based on the global competence concept in order to examine its content validity. The current study is significant in that the development of this scale will enable evaluation to determine which alternative methods of online global education (e.g., lectures, group work, and fieldwork using video and VR) are more effective for students in each country.

Methods

Reliability and validity must be assessed when developing scales. The COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) Study Design Checklist guides the evaluation. It provides points for researchers to keep in mind as they consider the characteristics of each scale.

The target population of the scale will be undergraduate or graduate students participating in online global education programs. To extract the scale items, four researchers from Yokohama City University who specialized in law, education, and public health and had experience in online global education reviewed the extant literature and had several brainstorming sessions. The draft scale was then reviewed by collaborating researchers from four universities in three countries. In addition, experts involved in online global education will evaluate the Content Validity Index (CVI).

Results

We extracted 41 items equivalent to the components that PISA 2018 indicates: "knowledge and understanding of global issues," "intercultural knowledge and understanding," "analytical skills," "critical thinking," "openness," "global-mindedness," and "responsibility to the international community." For instance, "knowledge and understanding of global issues" consisted of items such as "I was able to understand the common challenges faced by the international community." Likewise, "analytical skills" included items such as "I learned how to analyze data on issues common to the international community," and "responsibility to the international community" section was assessed through items like "I now have a clearer Figure of my future studies and activities on issues common to the international community."

Further discussions with the collaborating researchers resulted in the addition of some items regarding "linguistic abilities," "digital skills," and "time management skills." For example, "linguistic abilities" consisted of items such as "I was able to understand what the other participants and the faculty were talking about." "Digital skills" were captured through items like "I was able to utilize presentation materials, chat functions, and translation software to help communicate my ideas to others."

In the presentation, we would like to report on the CVI of the scale, which is currently in progress.

Conclusion

We developed a 41-item scale that is in line with the global competence concept as proposed in PISA 2018, as well as with the realities of faculties engaged in the online global education. We plan to use this scale in global online collaborative education projects in which Yokohama City University will participate and continue to assess this way its face validity, factorial validity, and reliability.

Conflict of Interest

"There is no conflict of interest in this study"

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SOCIO-ECONOMIC CARRYING CAPACITY MODELLING OF THE SEVEN LAKES OF SAN PABLO CITY, LAGUNA, PHILIPPINES

Natuel, F.A.[1,6*], Macandog, D.B.M.[2], Pleto, J.V.R.[2], Campang, J.G.[2], Predo, C.D.[3], Perez, M.G.L.D.[5], Cabillon, Y.C.A.[2], Quiñones, S.G.L.[2], Laruya, J.M.[4], and Larida, N.J.A.[2]

[1]Laguna State Polytechnic University, San Pablo City, Laguna 4000, Philippines
[2]Institute of Biological Sciences, University of the Philippines Los Baños, College, Laguna 4031, Philippines
[3]Institute of Renewable Natural Resources, University of the Philippines Los Baños, College, Laguna 4031, Philippines
[4]College of Forestry and Natural Resources, University of the Philippines Los Baños, College, Laguna 4031, Philippines
[5]University of the Philippines Rural High School, University of the Philippines Los Baños, College, Laguna 4031, Philippines
[6]School of Environmental Science and Management, University of the Philippines Los Baños, College, Laguna 4031, Philippines

*Correspondence: fatnatuel@gmail.com

Abstract

San Pablo City, known as the "City of Seven Lakes", is an ecotourism spot and a channel for livelihood through aquaculture systems. However, the integrity of its lakes has been compromised due to illegal squatting, overcrowding fish cages, illegal fish pens, and establishment of a number of commercial infrastructures nearby the lakes. Thus, it is necessary to determine whether the lakes' ecological carrying capacity (ECC) has been exceeded or not. ECC is the maximum capacity a particular ecosystem can support on the premise of maintaining its sustainability. In this study, the sustainability of the lakes was assessed using the socio-economic carrying capacity (SECC) model, one of the key criteria of ECC modelling. Various stakeholders and experts were asked to rank different socio-economic indicators like the population living around the lake, annual income from aquaculture and tourism, area occupied by fish pens and recreational activities, and number of fish pens or cages based on importance. SECC was then calculated by obtaining the summation of the product of such indicators, multiplied by its calculated weight. Results revealed that aquaculture lakes Bunot and Mohicap have high SECC. Meanwhile, the negative SECC values of the other aquaculture lakes including Palakpakin, Calibato, and Sampaloc is attributed to the high exceedance of the number and area covered by fish cages over the maximum threshold values. Results of this study could serve as an instrument in the sustainable and effective policy planning of the local government of San Pablo City to address issues on food security and sustainability.

Keywords: Socio-economic carrying capacity modelling, seven lakes, aquaculture, ecotourism, sustainable lake management

Introduction

San Pablo City, known as the "City of Seven Lakes", is located at the tip of the province of Laguna, 83.8 km away from Manila, in the Island of Luzon, Philippines. This first income class city has 80 *barangays* (the smallest administrative division in the Philippines), of which 44 are classified as urban and 36 as rural. It remains an ecotourism spot and a channel for livelihood through aquaculture systems as it showcases its seven magnificent lakes. These lakes consisting of Lake Bunot, Lake Calibato, Lake Palakpakin, Lake Sampaloc, Lake Mohicap, Lake Yambo, and Lake Pandin were

formed through phreatic eruption, a unique process whereby lava from Mt. San Cristobal intersected the groundwater and created a steam-heated eruption forming crater-like depressions, which were then filled up with rainwater. Since these lakes are all volcanic in origin, it shows the uniqueness of the city – its traditions and culture (City Planning and Development Office – City Government of San Pablo, 2015-2025; LLDA, 2008).

Interestingly, three of the seven crater lakes cater to ecotourism services. These are Sampaloc and the twin lakes Yambo and Pandin. Lake Sampaloc is located at the heart of the city, and considered as the largest lake in terms of surface area. Tourists enjoy biking, jogging, fishing, and many aerobic activities such as Zumba and yoga around this lake. Increasingly, Lake Sampaloc has experienced the most tourist arrivals since 2015 according to the Tourism Office of San Pablo. The twin lakes Yambo and Pandin cater to bamboo rafting services, picnicking, fishing, Figure-taking, and even swimming, since the waters of both lakes were classified as Class B waters, intended for recreational activities. These amenities and services offered by the twin lakes could be experienced by tourists and guests for about PhP 360 to 400 per person only. Indeed, these lakes have been serving as a source of income and livelihood for the nearby communities. Lake Mohicap has also been opened to the public recently, and is being conserved to be another ecotourism spot in San Pablo (City Planning and Development Office – City Government of San Pablo, 2015-2025; LLDA, 2008).

In the Philippines, aquaculture has a long history and involves many species and farming practices in diverse ecosystems. Most of the production which contributes significantly to the country's food security and employment comes from the farming of seaweed, milkfish, tilapia, shrimp, carp, oyster, and mussel aquaculture in its freshwater lakes (FAO, n.d.). It is an important food production industry, and is one of the fastest developing sectors contributing about 50% of the world's fish used for food (FAO, 2022). In the city of San Pablo, aquaculture first began in Lake Bunot in 1976 after the successful introduction of tilapia cage culture in Laguna de Bay by the Laguna Lake Development Authority (LLDA) in 1974. After some time, tilapia cage farming spread to other lakes including Sampaloc, Palakpakin, Calibato, and Mohicap (Brillo, 2015). By the late 1980s, fish pens and cages have become a common feature among the seven lakes. Tilapia farming extensively expanded and reached its peak in the late 1990s to the early 2000s, where the 10 percent area limit for aquaculture structures pursuant to the Fisheries Code of the Philippines (Republic Act [RA] 8550, section 51) was breached in most lakes (Brillo, 2017). In the 1990s, illegal construction of fish cages sprouted in Lake Sampaloc, covering approximately 70% of the total lake surface area during a certain period (Global Nature Fund, 2014). As a result, the lake has become extremely threatened. Removal of illegal constructions was already done in the early 2000s but the increasing number of illegal fish cages became a problem again in 2012. Overcrowding of fish cages and overfeeding have resulted in eutrophication, massive growth of green algae, and occasional fish kills. Because of this, rehabilitation efforts were initiated by environmental organizations in order to conserve and protect the lake along with the other six lakes. At present, Lakes Sampaloc, Palakpakin, Calibato, and Bunot are principally exploited for aquaculture, particularly commercial tilapia and milkfish production via floating fish cages. While Lakes Pandin, Yambo, and Mohicap are principally used for ecotourism, few fish cages have been built in the lakes for the culture of the same species – tilapia and milkfish. Approximately 3,500 to 5,000 fingerlings of Nile tilapia usually sourced from Bureau of Fisheries and Aquatic Resources (BFAR) are reared in 10 m x 10 m fish cages and fed with commercial feeds until marketable size is reached (Guevarra et al., 2020).

While the lakes remain an ecotourism spot and a source of livelihood through aquaculture systems, the integrity of the lakes is compromised. In fact, these lakes were proclaimed by the Global Nature Fund (GNF) as the "Threatened Lakes of the Year 2014" due to anthropogenic activities such as illegal squatting along the shores and its resulting pollution; illegal fish pens; overfeeding and crowding fish cages; as well as the establishment of a number of commercial infrastructures nearby the lakes.

According to LLDA (2008), the practice of intensive feeding of fish stocks in cages; untreated domestic wastes from the surrounding area; and improper waste (solid and liquid) management in the lakes, most especially in Lake Sampaloc, have been contributing to the pollution of the lakes. Indeed, the different activities in the lakes such as aquaculture and tourism pose a threat to the degradation of the environmental quality of the seven lakes. Thus, it is necessary to examine the current condition and determine if it already exceeds the carrying capacity.

Ecological carrying capacity (ECC) is the maximum capacity an ecosystem can support on the premise of maintaining its sustainability. Lake ecological carrying capacity includes self-maintenance, self-regulation, supply capacity of the lake, and human activities such as tourism, fishing, aquaculture, and living within the nearby areas (Song et al., 2020). The ecological carrying capacity will identify the magnitude of aquaculture production each lake can support without leading to significant changes to ecological processes, services, species biodiversity, populations, or communities in the environment, as well as the threshold limit for visitor use and consequent damage the lake can sustain without being degraded. ECC can be used as a reliable basis for environmental-economic decision-making (Wang et al., 2018). Estimating and illustrating the recreational and aquaculture carrying capacities of the lakes can provide the LGUs' constituents and policymakers a comprehensible overview of the potential consequences of the unrestricted proliferation of the various activities that the lakes are currently hosting.

Water Ecological Carrying Capacity (WECC), as one of emerging carrying capacity concepts, is the capacity to support the largest population and economic scale while meeting the demand of natural ecological systems for water and under the premise of sustainability (Wang et al., 2011; Zuo et al., 2014). In previous studies on urban lakes, WECC is shown to consist mainly of water quality carrying capacity (WQCC) and water resources carrying capacity (WRCC) (Wang et al., 2004; Huang et al., 2013). While the WQCC deals with the biophysical aspect of ECC, the WRCC practically refers to the socio-economic indicators, which could be carried by water resources. Specific socio-economic indicators can be represented by social indicators (population nearby), economic indicators (number of fish pens, area occupied by fish pens, and annual income from aquaculture) (Zhao et al., 2008; Wang et al., 2014), and tourism indicators (area for recreational activities and income from tourism) (Saveriades, 2000; Simon et al., 2004). As urban lakes are mainly influenced by rapid social economic development, understanding the impact of socio-economic development on water quality is urgently needed (Ding et al., 2015). In this study, a socio-economic carrying capacity (SECC) model was used to determine the water resources carrying capacity (WRCC) of the seven lakes. The compiled data on the socio-economic indicators affecting the lakes' ecosystem will then help in the generation of the threshold limit estimates for recreational infrastructures and visitor use of ecotourism lakes, the total area suitable for aquaculture and magnitude of aquaculture production without significant effect to the lakes' ecosystem, and the value of stakeholder involvement and capacity of the lake to tolerate presence of tourists.

Study Area

This study was conducted in San Pablo City, Laguna, Philippines (Figure 1). This city has a total land area of 19,756.04 hectares occupied by its 285,348 residents (Philippine Statistics Authority [PSA], 2020). It has been an ecotourism destination in the Philippines offering serene panoramas, various outdoor activities, such as trekking and biking, as well as numerous food choices with its line-up of dining places and food stalls. It prevails as a go-to vacation spot for nature lovers as it is only two (2) hours away from Metro Manila. Additionally, it has seven majestic crater lakes which offer livelihood programs to the locals by means of aquaculture or the breeding, raising, and harvesting of fish, algae, shellfish, and other aquatic organisms (National Oceanic and Atmospheric Administration, n.d.).
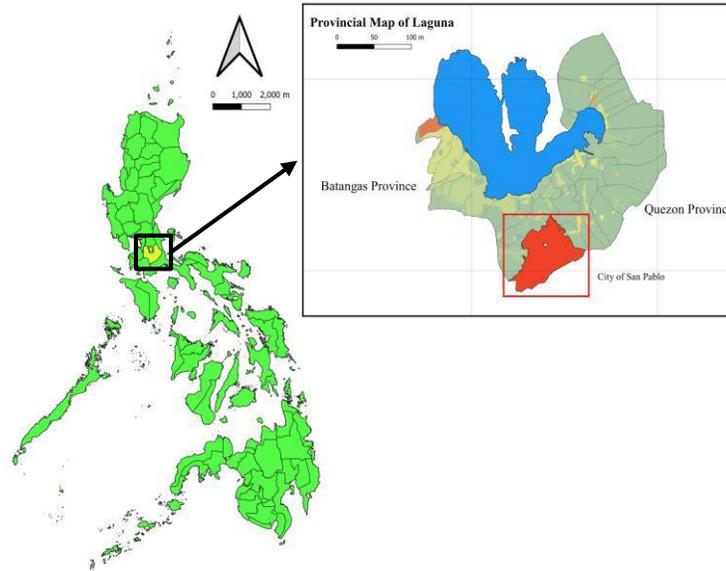
Figure 1: Location map of San Pablo City.

Lake Sampaloc is the largest among San Pablo's seven crater lakes. Located in the nearest proximity from the city proper, it is considered one of the prime tourist spots in the city. Aquaculture is the major human activity and source of livelihood in the lake, with Nile tilapia as its main farmed fish. Lake Bunot, the closest to Lake Sampaloc, is used mainly for floating cages operation and aquaculture where most of the locals derived their source of income. Lake Yambo and Lake Pandin are known as "The Twin Lakes". Both lakes are considered oligotrophic because of their deep clear lakes with low nutrient supplies, high dissolved oxygen level, and little organic matter. As San Pablo's best kept lakes, both are suitable for recreational activities such as swimming, picnics, and outings but not so much for aquaculture. Consequently, Lake Mohicap is the smallest lake and the lowest lake in terms of elevation. It is a major source of tilapia for Metro Manila and suburbs. Lake Calibato, as the deepest among the seven lakes, has the greatest volume of water in storage. Also, it is the highest lake in terms of elevation. Abundant fishes in the lake supply both the city of San Pablo and the municipality of Rizal. Lake Palakpakin is the shallowest among the seven lakes but second largest next to Lake Sampaloc. It is utilized mainly for fishing and aquaculture activities (City Planning and Development Office – City Government of San Pablo, 2015-2025; LLDA, 2008).

Materials and Methodology

This study draws concepts and ideas from previous international reports, which estimated the carrying capacity of ecosystems to derive effective management systems, and apply it in the local setting of San Pablo City, Laguna. As this study aims to harmonize the sustainable management of the lakes with the anthropogenic activities mainly aquaculture and ecotourism that provide livelihood opportunities to the local communities, this paper mainly focuses on the social aspect of ecological carrying capacity (ECC) modelling. Socio-economic carrying capacity (SECC) model, as the social component and one of the key criteria of ECC modelling, would help determine the amount of aquaculture that can be developed without adverse social impact, and ultimately quantify the value of stakeholder involvement. Additionally, this aspect would help portray the lakes' capacity to tolerate the presence of locals and tourists while ensuring customer satisfaction.

Model Framework

This study aimed to derive a model of the socio-economic carrying capacity (SECC) of the seven lakes of San Pablo City. The model will provide the stakeholders with a comprehensible framework of the overall condition of lakes' ecosystem, and an assessment of their sustainability due to continued stress from aquaculture systems and recreational infrastructures and activities.

The results of the socio-economic carrying capacity (SECC) modelling will be used to assess the sustainability of the lakes. The sustainability index ranking of each lake will be used in the crafting of management strategies toward the sustainable management of the lakes.

Indicators for Determining the Socio-Economic Carrying Capacity

The socio-economic criteria include the following purposively selected indicators: population living around the lake, annual income from aquaculture, income from tourism, area occupied by fish pens, number of fish pens, and area allocated for recreational activities. The various sources of data for the limited and actual values were derived from San Pablo City ecological profile; Google Earth; field measurements; and conduct of Focus Group Discussions (FGD) and Key Informant Interviews (KII) with various stakeholders and experts (Table 1). Various stakeholders include Fisheries and Aquatic Resources Management Council (FARMC) members, Local Government Units (LGUs), tourism officers, bantay-lawa, fisherfolks, civic groups, women groups, and senior citizens.

The actual and limited values of previously mentioned socio-economic indicators were inputted in the SECC modelling. The table below shows the indicators used to determine the socio-economic carrying capacity of the lakes as well as the sources where the limited and actual values were obtained.

Table 1: Indicators used to determine the socio-economic carrying capacity.

Indicator	Limited Value	Actual Value
Population living around the lake	Number of houses that can occupy the circumference of the lake multiplied by the average household size of San Pablo which is 4.	Number of houses around the lake observed on Google Earth and multiplied by the average household size of San Pablo which is 4.
Income from aquaculture (annual)	Obtained from San Pablo City Ecological Profile	Obtained from San Pablo City Ecological Profile
Income from tourism	Based on FGD and KII	Based on FGD and KII
Area occupied by fish pens (ha)	Obtained from San Pablo City Ecological Profile	Obtained from San Pablo City Ecological Profile
Number of fish pens	Obtained from San Pablo City Ecological Profile	Obtained from San Pablo City Ecological Profile
Area for recreational Activities (ha)	Obtained and measured during the field visit	Obtained and measured during the field visit

Mathematical Model

The mathematical model used in the study was based on Ding et. al (2015). The calculation of the SECC utilized the following equations below:

Equation 1**:** $CS_i = CC_i / CC_{imax}$

Equation 1 is used to represent the model of the carrying capacity level of each indicator. CC_i is the actual value of the indicator and CC_{imax} is the carrying capacity limit value of the indicator. CS_i, the capacity level of the indicator, was derived using Equation 1. After obtaining the carrying capacity level of each indicator, equation 2 was used to compute the socio-economic carrying capacity of the lakes.

Equation 2**:** $CC = \sum CS_i * W_i$

W_i is the weight of each indicator which was obtained from the results of the Rank-Sum method conducted. Various stakeholders and experts were asked to rank the different indicators based on importance. The resulting weights from all respondents were normalized and the average normalized weight for each indicator was obtained. The Socio-Economic Carrying Capacity (SECC) was computed by getting the summation of the product of each indicator's carrying capacity level (CS_i) and average weight (Equation 2).

The calculated SECC was compared with the sustainability index (Table 2) to assess the level of sustainability of each lake. Table below shows the sustainability index used in the study.

Table 2: Sustainability index used in determining the sustainability of the seven lakes.

ECC value	Sustainability Status
Below 0	Unsustainable
0 - 0.33	Low
0.34 - 0.67	Medium
0.68 - 1.00	High
Greater than 1	Very High

Results

Actual Value of Carrying Capacity Level (CCi) and Carrying Capacity Limit or (CCimax)

The actual value of carrying capacity level (CCi) and the carrying capacity limit value (CCimax) of each indicator are presented in Table 3. These values were obtained from various sources as discussed in the Methodology section.

Table 3: Actual and limited values of socio-economic indicators for the seven lakes of San Pablo.

Indicators	Bunot		Calibato		Palakpakin		Sampaloc	
	Limited Value (CCi max)	Actual Value (CCi)	Limited Value (CCi max)	Actual Value (CCi)	Limited Value (CCi max)	Actual Value (CCi)	Limited Value (CCi max))	Actual Value (CCi)
Population living around the lake	1,024	208	884	20	1,067	60	958	400
Income from aquaculture (annual)	14,580,000	4,762,800	20,412,000	40,678,200	20,898,000	24,854,040	50,544,000	24,173,640
Income from tourism	-	-	-	-	-	-	101900	118,300
Area occupied by fish pens (ha)	3	0.98	4.2	10	4.3	9	10.40	12.60
Number of fish pens	300	98	420	837	430	511	1,040	126.00
Area for recreational activities (ha)	-	-	-	-	-	-	104	9.09

Table 3: continuation…

Indicators	Mohicap		Yambo		Pandin	
	Limited Value (CCi max)	Actual Value (CCi)	Limited Value (CCi max)	Actual Value (CCi)	Limited Value (CCi max)	Actual Value (CCi)
Population living around the lake	607	12	582	12	725	32
Income from aquaculture (annual)	6,804,000	4,082,400	9,720,000	1,020,600	9,720,000	3,013,200
Income from tourism	0	0	38,520	8,640	73,600	16,200
Area occupied by fish pens (ha)	1.4	0.23	2	0.21	2	0.23
Number of fish pens	140	23	200	21	200	23
Area for recreational activities (ha)	14	0.5	20	0.50	20	1.67

Calculated Carrying Capacity Level (CSi)

After the actual and limited values of each socio-economic indicator were obtained, the equation 1 was then used to get the carrying capacity level (CSi) of each indicator. Table 4 below shows the calculated CSi of each indicator for the seven lakes.

Table 4: Carrying capacity level (CSi) of socio-economic indicators for the seven lakes of San Pablo.

INDICATORS	CARRYING CAPACITY LEVEL (CSi)						
	Bunot	Calibato	Palakpakin	Sampaloc	Mohicap	Yambo	Pandin
Population living around the lake	0.20	0.02	0.06	0.42	0.02	0.02	0.04
Income from aquaculture (annual)	0.33	1.99	1.19	0.48	0.6	0.11	0.31
Income from tourism	-	-	-	1.16	-	0.22	0.22
Area occupied by fish pens (ha)	0.33	2.38	2.09	1.21	0.16	0.11	0.12
Number of fish pens	0.33	1.99	1.19	0.12	0.16	0.11	0.12
Area for recreational activities (ha)	-	-	-	0.09	0.04	0.03	0.08

Indicator Weights (Wi)

The calculated average weights of the socio-economic indicators are shown in Table 5. The summation of weights of all indicators is equal to 1.00. The weights of the indicators vary among the seven lakes.

Table 5: Calculated average weights of the different socio-economic indicators used.

INDICATORS	CALCULATED AVERAGE WEIGHTS						
	Bunot	Calibato	Palakpakin	Sampaloc	Mohicap	Yambo	Pandin
Population living around the lake	0.292	0.225	0.329	0.188	0.119	0.064	0.095
Income from aquaculture (annual)	0.302	0.330	0.287	0.187	0.164	0.218	0.142
Income from tourism	-	-	-	0.091	-	0.282	0.266
Area occupied by fish pens (ha)	0.204	0.206	0.130	0.153	0.188	0.140	0.154
Number of fish pens	0.202	0.239	0.254	0.153	0.149	0.154	0.134
Area for recreational activities (ha)	-	-	-	0.147	0.143	0.142	0.208

Calculated Carrying Capacity (CC) for each Socio-Economic Indicator of the Seven Lakes

Table 6 below shows the carrying capacity for each socio-economic indicator of the seven lakes. Each indicator's carrying capacity was obtained by multiplying the calculated carrying capacity level (CSi) with the average weight of indicator.

Table 6: Calculated carrying capacity (CC) for each socio-economic indicator of the seven lakes.

INDICATORS	CARRYING CAPACITY (CC)						
	Bunot	Calibato	Palakpakin	Sampaloc	Mohicap	Yambo	Pandin
Population living around the lake	0.059	0.005	0.019	0.078	0.002	0.001	0.004

Table 6: continuation…

INDICATORS	CARRYING CAPACITY (CC)						
	Bunot	Calibato	Palakpakin	Sampaloc	Mohicap	Yambo	Pandin
Income from aquaculture (annual)	0.099	0.658	0.341	0.090	0.098	0.023	0.044
Income from tourism	-	-	-	-0.105	-	0.063	0.059
Area occupied by fish pens (ha)	0.067	-0.490	0.272	-0.186	0.031	0.015	0.018
Number of fish pens	0.066	-0.476	-0.371	0.018	0.024	0.016	0.015
Area for recreational activities (ha)	-	-	-	0.020	0.005	0.004	0.017

Socio-Economic Carrying Capacity (SECC) of the Seven Lakes of San Pablo

Figure 2 below shows the calculated SECC per lake which was obtained using Equation 2. After calculating the SECC using Equation 2, the SECC was compared with the sustainability index in Table 2 to assess the sustainability level of each lake.
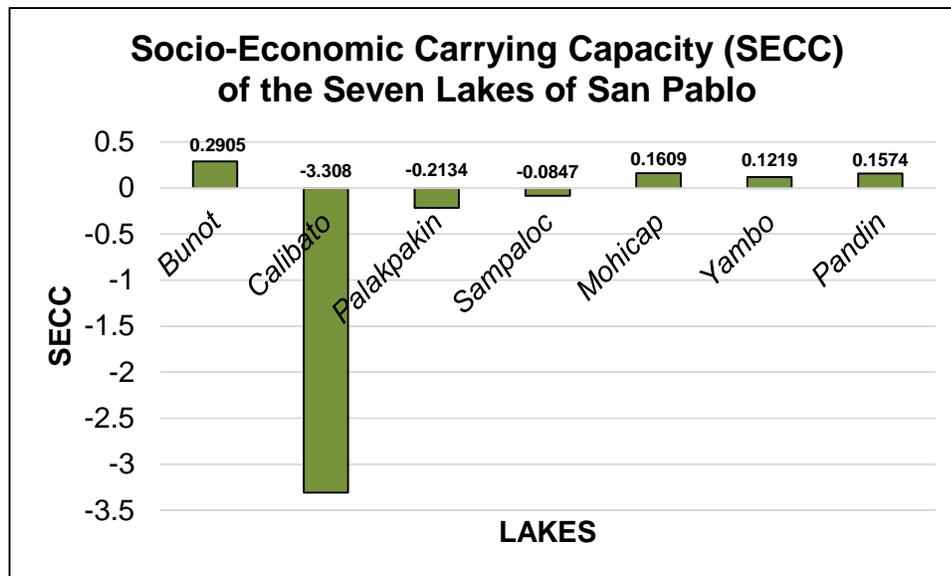
Figure 2: SECC of the seven lakes of San Pablo.

Discussion

Actual Value of Carrying Capacity Level (CCi) and Carrying Capacity Limit or (CCimax)

Results showed that Lake Sampaloc has the highest actual value of people (400) living around the lake. The lake is located at the heart of the city and is surrounded by residential and commercial establishments. In all the seven lakes, the actual number of people living around the lake is way below the maximum values (Table 3). The income from aquaculture in Lakes Calibato and Palakpakin exceeded the maximum value of income based on the 10% of lake area covered by fish cages. Lake Sampaloc has the highest actual income from tourism compared with Lakes Pandin and Yambo. The areas occupied by fish pens in Lakes Calibato and Palakpakin exceeded the maximum area that can be covered by fish cages. Lake Sampaloc has the highest actual value of tourists that visited the lake. In all the tourism lakes, the tourists spend about 2 hours of recreation activities in the lake.

Indicator Weights (W)

The weight of the indicator "population living around the lake" is highest in Lake Palakpakin (0.329) and lowest in Lake Yambo (0.064). The weight of the "income from aquaculture" is highest in Lake Calibato, followed by Lakes Bunot and Palakpakin. These three are among the four aquaculture lakes in San Pablo City. On the other hand, among the ecotourism lakes, Lake Yambo has the highest weight for the indicator "income from tourism" followed by Lake Pandin. The weights of the "area occupied by fish pens" were highest in the aquaculture lakes Bunot and Calibato. The weight of the "area used for recreational activities" was highest in Lake Pandin. Comparing the values of the weights among the socio-economic indicators, "income from aquaculture" was highest in aquaculture lakes Bunot and Calibato. In Lakes Palakpakin and Sampaloc, "population living around the lake" has the highest weights. In ecotourism lakes (Mohicap, Pandin, and Yambo), the weight of "income from tourism" is highest among the indicators.

Calculated Carrying Capacity (CC) for each Socio-Economic Indicator of the Seven Lakes

Results revealed that Lake Sampaloc has the highest calculated carrying capacity in terms of the population living around the lake, followed by Lake Bunot. Lake Sampaloc and Lake Bunot are considered urban lakes as they are located within and near the city proper, respectively. Many people live near the city of San Pablo as it is surrounded by many residential and commercial areas. Continuous increase in the number of populations living around water bodies through time can lead to the swift increase of water demand as well (Chen and Wang, 2009). In terms of annual income from aquaculture, Lake Calibato appeared to have the highest calculated carrying capacity, followed by Lake Palakpakin. Together with the other two aquaculture lakes (Bunot and Sampaloc), these two lakes have a high number of fish production yearly. Meanwhile, Lake Bunot was found to have the highest calculated carrying capacity both in terms of the number of fish pens and area occupied by fish pens (ha). According to a study conducted by Brillo (2015), Lake Bunot is in the worst condition among the seven lakes of San Pablo due to being polluted, oversaturated with aquaculture structures, and high concentration of illegal settlements. This is also the lake with the highest number of flowerhorn found by other researchers with similar study. Although this lake was revealed to have the highest carrying capacity in terms of number of and area occupied by fish pens, the lake is still at risk of being aggravated due to various ecological pressures. Meanwhile, Lakes Calibato, Palakpakin, and Sampaloc showed to have negative carrying capacities in terms of area occupied by fish pens due to the exceedance of the maximum 10% coverage of fish pens areas mandated by the Laguna Lake Development Authority.

In terms of income from tourism, this study revealed that ecotourism lakes Pandin and Yambo have higher carrying capacity. Further, Lake Pandin got the highest carrying capacity in terms of area for recreational activities. Both Lakes Pandin and Yambo were classified as oligotrophic (Zapanta et al., 2008) because of their deep clear waters with low nutrient and organic matter supplies as well as high dissolved oxygen level. Further, Lake Pandin is known as the best kept lake among the seven lakes in San Pablo (LLDA, 2008). Over the past decades, however, data reveal that the trophic status of these ecotourism lakes has shifted to mesotrophic, suggesting that current rehabilitation efforts have not been fully successful. Cultural eutrophication is still happening in these lakes; thus, further efforts should be made to lessen their nutrient loadings (Mendoza et al., 2019).

Socio-Economic Carrying Capacity (CC) of the Seven Lakes of San Pablo

The socio-economic carrying capacity (SECC) shows that Lakes Calibato, Palakpakin, and Sampaloc are unsustainable with -0.3038, -0.2134, and -0.0847, respectively (Fig. 2). Lakes Bunot, Mohicap, Pandin, and Yambo have low sustainability index. Based on the analysis, it showed that the number and area occupied by fish pens affected the socio-economic carrying capacity value for Lakes Calibato, Palakpakin, and Sampaloc which makes it unsustainable. Over the years, aquaculture in these lakes has extensively expanded. By the early 2000s, fish pens and cages have congested the shoreline, breaching the 10% area limit for aquaculture structures in pursuant to the Fisheries Code of the Philippines. The rapid rate of aquaculture and tourism development of the lakes has given its surrounding communities many opportunities by providing food and employment, however, may have also brought about increase in illegal establishments and settlements along and near the lakes (Paller et al., 2021).

While the seven lakes of San Pablo offer ecosystem services to both locals and tourists as they are used mainly for aquaculture and tourism, this has not been without its cost as these relatively small-sized lakes are deemed more vulnerable to environmental pressures and anthropogenic activities than the larger lakes because of their natural absorptive capacity to neutralize pollutants (Mendoza

et al., 2019; Brillo, 2015). Moreover, current aquaculture and fisheries practices in the lakes, especially in Lakes Bunot, Calibato, Palakpakin, and Sampaloc, have been exploiting and degrading the water quality and condition of the lakes. If this continues in a long run, sustainable socio-economic benefits that the people are getting will be disrupted as well (Adu-Boahen et al., 2014).

Conclusion

Anthropogenic activities such as aquaculture and ecotourism have largely contributed to the livelihood of local communities located around the seven lakes of San Pablo City. However, these activities pose threats to the degradation of the environmental quality of the seven lakes. Thus, it is necessary to examine the current conditions and assess the ecological carrying capacity (ECC) of aquaculture and ecotourism activities in the seven lakes. As a key indicator in reflecting the capacity of ecological capital to human's socio-economic activities, ECC is the pre-requisite for evaluating the lakes' ecological security (Zhang et al., 2018; Cheng et al., 2019; Liu et al., 2018). The socio-economic carrying capacity (SECC) model, which was developed by the researchers, can provide the LGUs' constituents and policymakers a comprehensible overview of the potential consequences of the unrestricted proliferation of the various activities the lakes are currently hosting.

Generally, results showed that aquaculture lakes Bunot and Mohicap have high socio-economic carrying capacities (SECC). The negative SECC values of the other aquaculture lakes including Palakpakin, Calibato, and Sampaloc is attributed to the high exceedance of the number and area covered by fish cages over the maximum threshold values. Consequently, ecotourism lakes Mohicap, Yambo, and Pandin revealed to still have low sustainability level. This implies that saturating these lakes with aquaculture and recreational activities could negatively influence their sustainability. In order to make concrete, science-based decisions, it is necessary to expand this study from a single element carrying capacity into an integrated carrying capacity (Yusoh et al., 2021). Hence, this study recommends to integrate its results with the results of studies on biophysical and tourism carrying capacity modelling of the seven lakes. It is also recommended for future researchers to study and analyze the economic carrying capacity of each lake as it will be beneficial for the local government unit to know their potential opportunities and concerns which may be associated with the lakes' ecosystem services.

Acknowledgement

Conflicts of Interest

The authors declare no potential conflict of interest.

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LEVEL OF ENCOURAGEMENT WORKERS' INVOLVEMENT IN SAFETY AT COAL-FIRED POWER PLANT INDUSTRY, MALAYSIA

Ali, M.X.M.[1,2] and Arifin, K.[2,*]

[1] Centre for Research in Development, Social and Environment (SEEDS), Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia (UKM), Malaysia

[2] Department of Occupational Safety and Health Malaysia, Ministry of Human Resources, Government Administrative Centre, Putrajaya, Malaysia

*Correspondence: kadir@ukm.edu.my

Abstract

Workers' involvement in safety and health activities is vital in ensuring the safety management system's effectiveness in reducing accidents rates in the coal-fired power plant industry. This study involved 340 workers comprising executives and non-executives at five coal-fired power plants in Peninsular Malaysia. This study examines the level of practices to encourage workers' involvement in the safety aspects of the coal-fired power plant. The questionnaire method was used as the main instrument to obtain data. The data obtained were analyzed descriptively using frequency, percentage, mean, and standard deviation to identify the implementation workers' encouragement to involve in safety. Further analyses were done to examine any significant perception differences between executive and non-executive respondents. The results show that the practices to encourage workers' involvement are high (M=4.07). The three practices in which employees were rewarded are positive feedback, open communication and resolving safety issues, all of which have significant mean differences. Future studies should include the effectiveness of encouraging workers' involvement practices by determining the correlation of these practices toward safety performance.

Keywords: Workers Involvement, Leading Indicators, Workers Involvement, Safety Management Practices, Safety and Health

Introduction

The accident rate in the utility industry (electricity, gas, water and sanitation) in Malaysia was the second-highest industry in 2019 and the third highest in 2020, with 4.45 and 3.15 accidents per 1,000 employees (DOSH, 2020). Also, this industry recorded the third highest fatal accident rate in 2019 with 8.11 per 100,000 workers and the fifth-highest 1.87 per 100,000 workers in 2020 (DOSH, 2020). Which, electrical utility industry was contributing to the high accident rate and fatalities, with a total of 121 cases (47%) out of 258 cases for utility industry investigated by the Department of Occupational Safety and Health (DOSH) in 2019 (DOSH, 2020). As a result, industrial accidents place a financial and social burden on the wounded person and society, including missed pay and medical bills, the possibility of lifelong disability, and a lower quality of life (Fordyce et al., 2016). Even with various programmes implemented by government authorities and organizations at the national level, the number of accidents at work is still high, showing that the effort implemented to control unsafe actions and conditions in the workplace is insufficient (Clarke, 2006; Ibrahim et al., 2010). Thus, proactive efforts should be implemented by using leading indicators to bring the current safety management system to the desired safety goals (Hollnagel, 2008).

Safety management practices are considered as leading indicators (Hollnagel, 2008; Mousavi et al., 2018; Pawłowska, 2015) and antecedents of safety climate comprising a range of actions and programs (Bottani et al., 2009; Vinodkumar & Bhasi, 2010). An important leading indicator for safety is workers' involvement in safety activities (Shehu Mashi et al., 2016) which is a behaviour-oriented

technique that involves individuals or groups in the organisation's flow of communication and decision-making processes (Vinodkumar & Bhasi, 2010). The effectiveness of safety management systems depending on cognitive and emotional employee engagement that focus on safety can reduce accident rates (Wachter & Yorio, 2014). Employee involvement has been reported as a determining factor in safety management (S. J. Cox & Cheyne, 2000).

Accordingly, it is essential for management to encourage employee involvement in safety. Management can increase employee involvement in safety by providing adequate time and resources (OSHA, 2016). Thus, motivate the involvement of employees in the OSH program due the commitment given is in the working hours and the need for sufficient resources to implement the OSH program. Management needs to give recognition by giving positive feedback to employees involved in safety as an encouragement (Frazier et al., 2013). The practice of open policies by management can encourage employees to work safely (Brown et al., 2000). In addition, an influential OSH committee can encourage employee involvement through employee representatives as a liaison between employees and employers (Crollard et al., 2013).

Thus, this study aims to measure encouragement employee involvement practices in the coal power plant electrical utility industry using leading indicators and bridge the gap between implementation of safety management practices in electrical utility industries. A safe and healthy workplace will contribute to a productive workforce, improved financial performance and low health care (Cornelissen et al., 2017).

Study Area

There are three main divisions in the electricity utility industry in Malaysia, namely generation, transmission lines, and electricity distribution networks (TNB, 2020). The generation division selected as the study location due to a low injury-time loss rate (LTIF) of 0.42 per million working hours compared to the distribution and transmission network, which recorded 1.12 and 0.66 per million working hours in 2019 (TNB, 2021). Coal-fired power plants are the main electricity generators in Malaysia (Shekarchian et al., 2011). The energy produced by coal-fired power plants contributes 55 per cent compared to gas by 41 per cent, hydro by 3 per cent and solar by 1 per cent of the total electricity generated, which is 26,132MW (STM, 2020). Therefore, it is suitable for use as an OSH benchmark for the electrical utility industry in Malaysia and provides sufficient time for researchers to collect information and data during fieldwork.

However, coal-fired power plants in Sarawak are not involved in this study due to exemption from the Electricity Supply Act 1990 (Act 442) to ensure consistent results and findings of the study. In addition, coal-fired power plants in Peninsular Malaysia generate 12,066MW of electricity, 46.2 per cent of the total energy generated in Malaysia in 2019 (STM, 2020). In this regard, this study focuses on power plants in Peninsular Malaysia.

Materials and Methodology

The study involved executive and non-executive workers of five coal-fired power plants in Peninsular Malaysia, as shown in Table 1. This study is a quantitative study using statistical analysis on leading indicators on encouraging workers' involvement in safety management based on executive and non-executive characteristics. Questionnaires were used as a data collection instrument and distributed to the coal-fired power plants consisting of 2,880 workers with 340 respondents as the sample. Questionnaires were prepared in Likert scale format with a single measurement scale of five for respondents stating the degree of value on each of the questions submitted. The Likert scale used to obtain feedback from respondents is 1 = Very Low (VL) to 5 = Very High (VH).

The questionnaires were distributed through a stratified random sampling technique, which the sample is divided according to the ratio of the total population to the desired total sample (Kadilar & Cingi, 2003). A reliability level test on the set of study questionnaires was conducted involving 30 selected respondents. Results of analysis using the Software the Statistical Package for the Social Sciences (SPSS) indicates that the level of reliability of the questionnaire set of this study was at a high level with a Cronbach Alpha value of 0.858.

Table 1: Population and sampling coal-fired power plants workers in Peninsular Malaysia.

No	Coal-Fired Power Plant	Population			Sample		
		Exec	Non Exec	Exec	(%)	Non Exec	(%)
1	Tanjung Bin Power Plant	139	342	16	4.71	40	11.76
2	Kapar Energy Ventures Sdn. Bhd.	131	292	15	4.41	34	10.00
3	Jimah Energy Ventures Sdn. Bhd.	147	441	17	5.00	52	15.29
4	Jimah East Sdn. Bhd.	171	417	21	6.18	50	14.71
5	Tnb Janamanjung Sdn. Bhd.	160	640	19	5.59	76	22.35
	Total	748	2,132	88	25.88	252	74.12
	Overall	2,880			340		

The implementation of practice to encourage workers' involvement in safety in coal-fired power plants were assessed based on their perceptions through five indicators. Data obtained from the questionnaires were analyzed using Statistical Package for the Social Sciences (SPSS) software. Descriptive data analysis methods i.e. frequency, percentage, mean (M) and standard deviation (SD) were used to explain the results of the study. Inferential data analysis using t-test were then used to determine if there is significant difference between the means score of executive and non-executive respondents.

Results

Distribution of Respondent Demographic Social Data

Out of 340 respondents, the majority of respondents were male (98.24%) compared to female (1.76%), aged between 21 to over 50 years, with the majority of respondents in the age range of 31 - 40 years (58.24%). The majority of respondents are at the education level of Diploma (64.71%) and Degree (20%), while the highest level of education of respondents is Doctor of Philosophy Degree (0.59%). Most respondents served between 5 to 10 years (42.9%) in the coal-fired power plant. Table 2 shows the information on the study respondents' social demographic characteristics.

Table 2: Respondents Social Demographic Characteristics.

Respondent's information	Executive		Non Executive		Overall	(%)
	Frequencies	(%)	Frequencies	(%)		
Gender						
Men	83	24.41	251	73.82	334	98.24
Women	5	1.47	1	0.29	6	1.76
Age						
21 – 30 years	12	3.53	46	13.53	58	17.06
31 – 40 years	44	12.94	154	45.29	198	58.24
41 – 50 years	27	7.94	37	10.88	64	18.82
> 51 years	5	1.47	15	4.41	20	5.88
Education Level						
SPM	1	0.29	7	2.06	8	2.35
Skill Certificates	1	0.29	26	7.65	27	7.94
Diploma	7	2.06	213	62.65	220	64.71
Degree	63	18.53	5	1.47	68	20.00
Master	14	4.12	1	0.29	15	4.41
PhD	2	0.59	0	0.00	2	0.59
Period of Services						
< 5 years	11	3.24	42	12.35	53	15.59
05 – 10 years	17	5.00	105	30.88	122	35.88
11 – 15 years	32	9.41	49	14.41	81	23.82
16 – 20 years	12	3.53	31	9.12	43	12.65
21 – 25 years	9	2.65	18	5.29	27	7.94
> 25 years	7	2.06	7	2.06	14	4.12

Descriptive Analysis

The frequency distribution and percentage of executive respondents' perceptions on encouragement of workers' involvement in safety and health at the workplace are shown in Table 3. It is found that management in coal-fired power plants highly encourages workers to involve with safety and health at the workplace, with a mean score of 4.20. The practice that received the highest mean score of 4.34 is "management always open to employees to communicate on safety issues", with 92% of respondents valuing this practice as high and very high. Followed by the practice of "safety activities are carried out during working hours with adequate resources", with a mean score of 4.23 valued as high and very high from 85.2% of respondents. "OSH Committee works effectively to encourage employees actively involved in safety" was valued by 87.5% of respondents as high and very high, with a mean value of 4.19. Then, "OSH issues and problems are resolved involving employees or representatives", with a mean score of 4.18 rated as high and very high by 82.9% of respondents. The lowest mean score of 4.08 was received by the practice of "employees involved in safety activities are rewarded with positive feedback", which was rated as high and very high by 85.2% of the non-executive respondents.

Table 3: Frequency Distribution and Percentage of Executive Perceptions on Encouragement of Workers Involvement.

Leading Indicators		VL	L	M	H	VH	M (SD)
Safety activities are carried out during working hours with adequate resources.	(K)	0	0	13	42	33	4.23 (0.69)
	(%)	0	0	14.8	47.7	37.5	
Employees involved in safety activities are rewarded with positive feedback.	(K)	0	2	11	53	22	4.08 (0.68)
	(%)	0	2.3	12.5	60.2	25.0	
Management always open to employees to communicate on safety issues.	(K)	0	0	7	44	37	4.34 (0.62)
	(%)	0	0	8.0	50.0	42.0	
OSH Committee works effectively to encourage employees actively involved in safety.	(K)	3	0	8	43	34	4.19 (0.87)
	(%)	3.4	0	9.1	48.9	38.6	
OSH issues and problems are resolved involving employees or representatives.	(K)	0	0	15	42	31	4.18 (0.70)
	(%)	0	0	17.0	47.7	35.2	
						Average Mean	4.20

The frequency distribution and percentage of non-executive respondents' perceptions of encouraging workers' involvement in safety and health at the workplace are shown in Table 4. The analysis found that practices encouraging workers to be involved with safety and health at the workplace are high, with a mean score of 4.02. The highest mean score of 4.15 is "management always open to employees to communicate on safety issues", with 84.9% of respondents valuing this practice as high and very high. Followed by the practice of "safety activities are carried out during working hours with adequate resources", with a mean score of 4.09 valued as high and very high from 80.6% of respondents. Next, the "OSH Committee works effectively to encourage employees actively involved in safety" was valued by 77.4% of respondents as high and very high, with a mean value of 4.04. "OSH issues and problems are resolved involving employees or representatives" with a mean score of 3.97 rated by 73.4% of respondents as high and very high by the executive respondents. The lowest mean score of 3.87 was received by the practice of "employees involved in safety activities are rewarded with positive feedback", which was rated as high and very high by 67.5% of the executive respondents.

Table 4: Frequency Distribution and Percentage of Non-Executive Perceptions on Encouragement of Workers Involvement.

Leading Indicators		VL	L	M	H	VH	M (SD)
Safety activities are carried out during working hours with adequate resources.	(K)	0	2	47	129	74	4.09 (0.71)
	(%)	0	0.8	18.7	51.2	29.4	
Employees involved in safety activities are rewarded with positive feedback.	(K)	0	14	68	108	62	3.87 (0.85)
	(%)	0	5.6	27.0	42.9	24.6	
Management always open to employees to communicate on safety issues.	(K)	0	4	34	135	79	4.15 (0.70)
	(%)	0	1.6	13.5	53.6	31.3	
OSH Committee works effectively to encourage employees actively involved in safety.	(K)	0	2	55	125	70	4.04 (0.73)
	(%)	0	0.8	21.8	49.6	27.8	
OSH issues and problems are resolved involving employees or representatives.	(K)	0	0	67	125	60	3.97 (0.71)
	(%)	0	0	26.6	49.6	23.8	
						Average Mean	4.02

This study found that the average mean score perception on encouragement of workers involvement practice for executives is 4.20 and for non-executives 4.02, as shown in Table 3 and Table 4. Thus, both respondents' average overall mean score is 4.07 with a standard deviation of 0.47, which is high in coal-fired power plants.

Inferential Analysis

The t-test analysis results obtained through the SPSS program are shown in Table 5. The analysis found that the test results were a significant difference in mean scores for "employees involved in safety activities are rewarded with positive feedback" (t=2.376, df=187.92, p<0.05), "management is always open to employees to communicate on safety issues" (t=2.297, df=338.00, p<0.05), and "OSH issues and problems are resolved involving employees or representatives" (t=2.399, df=153.27, p<0.05). The test result also shows that there were no significant mean scores for "safety activities are carried out during working hours with adequate resources" (t=1.579, df=155.99, p>0.05) and "OSH Committee works effectively to encourage employees actively involved in safety" (t=1.447, df=131.93, p>0.05).

Table 5: Respondents' Differential Perceptions on Encouragement of Workers Involvement.

Exec (n=88) M (SD)	Non-Exec (n=252) M (SD)	Mean Differences	t	df	Significant Value	
					Sig. (2-tailed)	p
1. Safety activities are carried out during working hours with adequate resources						
4.23 (0.690)	4.09 (0.711)	0.136	1.579	155.99	0.116	p>0.05
2. Employees involved in safety activities are rewarded with positive feedback						
4.08 (0.682)	3.87 (0.850)	0.214	2.376	187.92	0.019	p<0.05
3. Management is always open to employees to communicate on safety issues						
4.34 (0.623)	4.15 (0.702)	0.194	2.297	338.00	0.022	p<0.05
4. OSH Committee works effectively to encourage employees actively involved in safety						
4.19 (0.869)	4.04 (0.727)	0.150	1.447	131.93	0.150	p>0.05
5. OSH issues and problems are resolved involving employees or representatives						
4.18 (0.704)	3.97 (0.711)	0.210	2.399	153.27	0.018	p<0.05

Discussion

Coal-fired power plants have shown their commitment to improving safety and health by encouraging workers to be involved in safety. Overall practices encouraging workers' involvement in safety management were high based on respondents' perception measures using leading indicators. Workers' involvement in safety is important as it has been reported as a determining factor in effective safety management (S. Cox et al., 2006). It is due to individuals with a strong exchange ideology being more likely to feel responsible for reciprocating benefits toward safety (Saks, 2006). Thus, the high involvement of workers in safety will indirectly benefit the safety and health performance at coal-fired power plants, leading to improved workplace safety and a healthy environment.

The analysis found that coal-fired power plants managements highly show open communication towards safety issues, thus encouraging workers to involve in safety based on the perception of executive and non-executive feedback. Open communication can impact a positive safety climate and encourage employees to work safely (Brown et al., 2000). However, the level of employees involved with safety getting positive feedback from management is low. It's crucial because people who have

a high level of self-awareness will seek criticism, learn from their mistakes, and cooperate with others who have complementary abilities (Zou & Sunindijo, 2013). Therefore, management needs to increase positive feedback to encourage employees to engage in safety (Frazier et al., 2013).

Based on t-test analysis, practices on employees rewarded with positive feedback, open communication and resolving safety issues have significant differences between executive and non-executive, showing that the coverage and involvement of safety in this aspect did not involve all of the workers. On the other hand, the aspect of safety activities in working hours with resources and resolving OSH issues and problems have no significant differences, thus showing the awareness of workers on this matter is high. Accordingly, all levels in the organisation should be involved in safety as a cultural strategy to develop a strong climate of trust and performance (Frank et al., 2004; Saks, 2006).

Limitations of this study focus on the level of implementation in encouraging workers to involve in safety in terms of adequacy and quality of activities done. However, these activities should be measured with their effectiveness by measuring their influence or correlation towards safety performance. It is important to measure safety antecedents' influence on safety knowledge and motivation as determinants of safety performance; and safety compliance and safety engagement as components of safety performance (Griffin & Neal, 2000; Neal et al., 2000). Thus, it will help the researcher determine whether these practices help improve the safe and healthy environment in the workplace.

Conclusion

This study indicates that the practices of encouraging workers' involvement in coal-fired power plants are high based on the average mean respondents' perception of its implementation. Analysis showed that the highest mean score was contributed by open communication by management and the practice of positive feedback is the lowest mean score. The t-test analysis found that three practices have significant differences in the mean score. The other two practices have no significant differences in the mean score, indicating opportunities for improvement to involve safety at all levels in the coal-fired power plants. Future studies should emphasize the correlation between leading indicators and safety performances to determine the effectiveness of practices to encourage the worker to involve in safety.

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Conflicts of Interest

The authors declare there are no conflicts of interest in this study.

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SAFETY COMMUNICATION ANALYSIS BASED ON PERCEPTION AMONG SITE WORKERS IN MASS RAPID TRANSIT (MRT) CONSTRUCTION

Rashid, N.[1] and Arifin, K[1,*]

[1]Enviromental Management, Center for Research in Development, Social and Environment, Faculty of Social Sciences and Humanities, National University of Malaysia 43600 Bangi, Selangor

*Correspondence: kadir@ukm.edu.my

Abstract

The basics of safety communication are interaction between employees, involving superiors, supervisors and subordinate employees, especially at Mass Rapid Transit (MRT) construction sites. Safety communication have its own importance as it able to influence occupational safety and health element in the context of interaction at the construction site. This safety communication includes verbal (verbal and written), non -verbal (non -verbal) and digital information of safety communications. This study analyzes and discuss of safety communication practices level among workers at MRT construction sites. The study was conducted through the safety communication level which includes verbal (verbal and written), non -verbal (non -verbal) and digital information based on the perceptions of workers at the MRT construction site. The study used 400 respondents selected based on stratified random selection according on 17 MRT stations. This descriptive study that used quantitative methods to analyzing the safety communication level among workers at construction sites (MRT). The results of the analysis showed that two dimensions were at a high level, namely the level of verbal dimension (M = 7.92, SP = 0.925), and non -verbal dimensions (M = 8.08, SP = 0.89,). While the digital information level dimension at moderate level that (M = 6.54, SP = 1.310 However, the overall safety communication is at high level (M = 7.56, SP = 1.69) among the workers at MRT construction site. The findings of this study can be used as a guideline for safety communication researchers as an effort to improve the potential of occupational safety and health practices at a good level. This study also shows that safety communication practices have their own values and strengths in the communication arena in the workplace.

Keywords: safety communication, Perception, Construction, Mass Rapid Transit (MRT)

Introduction

Safety communication among workers is seen as a basic interaction skill in the context of safety management especially in safety behavior at Mass Rapid Transit (MRT) construction sites (Berenger et al 2016; Vakulenko & Leukhin 2017a; Zhong & Pheng Low 2009; Zitty Sarah 2019). Workers' safety communication skills in the context of safety and health at construction sites are also considered as networking involving human interaction with the environment by adding value in shaping workers capability of coping with accident issues at the construction sites (Berenger et al. 2016; Vakulenko & Leukhin 2017a;). At the same time, safety communication skills aspect involves the use of language and practices as well as a more secure and effective safety culture (Ochieng & Price 2010; Mohd Nordin et al. 2012; Nurul Sakina et al. 2015; Rosli et al. 2015; Jason 2012).

The element of employee safety communication demonstrates its ability to be practiced characterized in the forms of organizational safety communication, cultural safety communication and interpersonal safety communication (Vakulenko & Leukhin 2017a). The influence of worker safety communication at Mass Rapid Transit (MRT) construction sites becomes a platform in dealing with language differences, non -compliance issues and cultural clashes based on safety communication barriers, thus influencing safety behaviors including compliance and engagement (Agarwal 2015; Tobergte &

Curtis 2013; Berenger, Yembi & Justus 2016). The effectiveness of safety communication among workers at MRT construction sites is also seen to have its own strengths and importance in other construction industries. The influence of this safety communication also makes the human resource workforce at a construction site entitled to its environment which requires a safe environment (Aguikre 2003; Jaafar et al 2018; Kadir et al 2015).

Safety communication skills in the context of relationships involving employees should be placed in a fair place given their capabilities in a variety of environments including cultural, health, social and economic. This diversity makes the safety communication element has a branch and space between a work environment and human resources, including in the construction industry. Accidents at construction sites show the weakness of interaction through safety communication practices among workers in the country's construction sector. An unskilled workforce coupled with communication problems between a challenge in delivering messages or messages as well as precise instructions on safety aspects that need to be observed at all times (Mohd Nordin et al. 2012; Nurul Sakina et al. 2015; Rosli et al. 2015; Kadir. 2006). Communication impairments are often a major problem in the construction industry as they are risky towards resulting in physical injury, permanent disability, psychological trauma and death (Pawthaisong et al. 2019). Efforts to develop effective safety communication in the construction industry especially involving foreign workers are necessary in improving the safety scenario towards a more positive and healthier atmosphere in an organization (Abdul-Rahman et al. 2012a; O'Toole 2002; Kadir 2006).

Study Area

The concentrated study area at the station has multi -storey parking. The stations involved are 15 multi-storey stations, namely Damansara Damai Station, Sri Damansara West Station, Damansara East Station, Kepong Station, Metro Prima Station, Jinjang Station, Kentomen Station, Taman Naga Emas Station, SG Station. Iron, Serdang Raya North Station, Serdang South Station, UPM Station, Equine Park Station, Cyberjaya North Station and Putrajaya Sentral Station. While the 2 underground stations are Bandar Malaysia South and Kuchai Lama. The proposed line for the SSP Line from Sungai Buloh to Putrajaya, via Sri Damansara, Kepong, Batu, Jalan Sulan Azlan Shah, Jalan Tun Razak, KLCC, Tun Razak Exchange, Bandar Malaysia (still under construction), Kuchai Lama, Sungai Besi, Seri Kembangan and Cyberjaya.

The construction of the Sungai Buloh-Serdang-Putrajaya MRT (SSP Line) has routes involving the construction of tunnels, underground works involving the construction of 11 stations including the most challenging, Chan Sow Lin Station with a record depth of 40 meters (Daily 2019). Gamuda MMC Station Manager, Abdul Wakil Hasbi, described the construction of the station at Chan Sow Lin providing a series of major challenges that could slow down the project from the original schedule if not addressed. The construction of tunnels is at high risk and requires high expertise to avoid defects in the construction of the MRT. Therefore, the study locations that have been selected for this study are all construction sites of the Sungai Buloh-Serdang-Putrajaya MRT (SSP Line) as shown in Table 1. This is because the location has a multi-storey and underground line.

Table 1: Sungai Buloh-Serdang-Putrajaya (SSP) Route

No.	Location	Route	Kind
1.	Damansara Damai	Multi-Storey	Parking lot
2.	Sri Damansara West	Multi-Storey	Parking lot
3.	Sri Damansara East	Multi-Storey	Parking lot
4.	Kepong Sentral	Multi-Storey	Parking lot
5.	Metro Prima	Multi-Storey	Parking lot
6.	Jinjang	Multi-Storey	Parking lot
7.	Kentonmen	Multi-Storey	Parking lot
8.	Bandar Malaysia South	Underground	Parking lot
9.	Kuchai Lama	Underground	Parking lot
10.	Taman Naga Emas	Multi-Storey	Parking lot
11.	Sg. Besi	Multi-Storey	Parking lot
12.	Serdang Raya North	Multi-Storey	Parking lot
13.	Serdang Raya South	Multi-Storey	Parking lot
14.	UPM	Multi-Storey	Parking lot
15.	Equine Park	Multi-Storey	Parking lot
16.	Cyberjaya North	Multi-Storey	Parking lot
17.	Putrajaya Sentral	Multi-Storey	Parking lot

Source: Mass Rapid Transit Corporation Sdn Bhd (MRT) (2018)

Materials and Methodology

The method of data collection is through quantitative methods, as for primary data sources is collected through survey forms. A survey form is a formal tool used to obtain data and information directly from respondents on a subject studied (Abdul Ghafar 2003). The resources obtained to develop the survey form were the result of reading some examples of survey forms used by other researchers. The main step in the creation of the survey form by viewing and examining documents related to aspects of occupational safety and health applied at the construction site of the Sungai Buluh-Serdang-Putrajaya (SSP) MRT line. The sample size in the study was determined based on Krejcie and Morgan's (1970) sample size determination table, including a population of 1923 people of the local work community with only 320 people needed as the study sample. However, the researchers increased the total study sample to 400 people.

This addition coincides with the recommendations of Cohen et al. (2011) and Creswell (2014) who said that larger sample size is better for avoiding errors in sampling, improving reliability, anticipating the probability of questionnaires not being returned and studies involving questionnaire methods preferably require a larger sample. Sampling is the process of selecting elements in a population for the purpose of representing the population in a study. The selection of the sample in this study went through two stages.The first stage is based on stratified random sampling according to 17 MRT stations.The number of samples was determined using the technique of proportion or proportion (Chua 2006). In the second stage, a simple random sampling procedure is used to select the sample to ensure that each subject in the population has an equal chance of being selected as the study sample. This simple random sampling is based on the number of samples set in the first stage. The framework of the study was formed to assist the study in the best course of conduct. The study focused perception on the use of security communications including verbal, non-verbal communication and digital information communication. Figure 1 shows the framework of the study of safety communications based on the perception of workers at the construction site of Mass Rapid Transit (MRT).
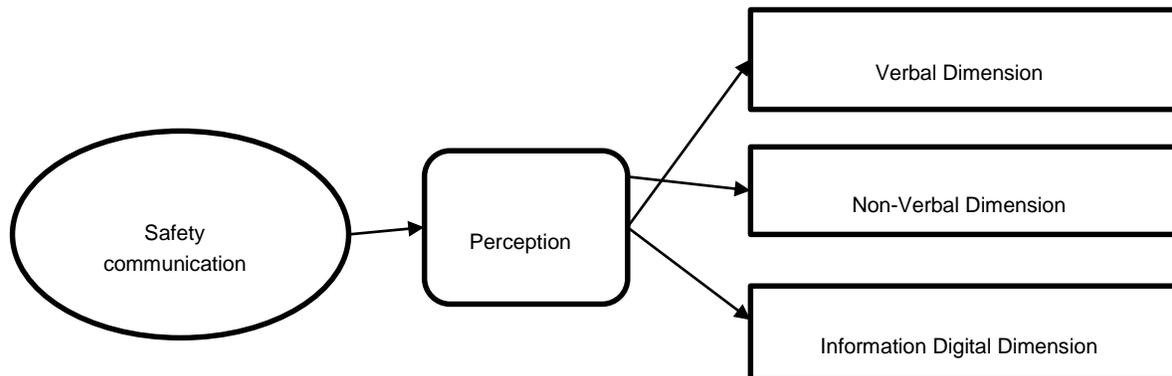
Figure 1 Framework of the study safety communications based on the perception of workers at the construction site of Mass Rapid Transit (MRT)

Research Findings

Respondents' Demographic Profile

The study sample profile was analysed using descriptive analysis by looking at frequency and percentage. A total of 382 workers at the construction site were involved as the study sample at 17 Mass Rapid Transit (MRT) stations in the Sungai Buluh-Serdang-Putrajaya (SSP) line. Table 2 shows the number of study samples by workplace, gender, age, teaching experience and frequency of accidents at work. Bandar Malaysia South recorded the largest number of samples at 27 people (7.1%) each, followed by Metro Prima and Kentonmen workplaces which each recorded 26 people (6.8%). Kuchai Lama, Kepong Sentral, and Jinjang workplaces have the same number of samples, which is 25 people (6.5%) each. Meanwhile, the workplace in Equine Park and Taman Naga Emas were 24 people (6.3%) each. Next for Sg. Iron 22 people (5.8%) and followed by Sri Damansara West 21 people (5.5%) and Sri Damansara East 21 people (5.5%). Serdang Raya South, Putrajaya Sentral, Serdang Raya North and Cyberjaya North each numbered 20 people (5.2%). UPM as many as 19 people (5.0%). Damansara Damai is the least number of samples at 17 people (4.5%).

Based on the entire study sample, a total of 329 people (86.1 %) were male, and a total of 53 were female (13.9 %). Next, based on the age factor, it was found that 17 people (4.5%) of the sample were aged 16 -24 years, 76 people (19.9%) were aged 25 to 34 years, and 223 people (58.4%) were in the age category of 35 to 44 years. While the sample aged 45 years and above were 66 people (17.3%). In terms of work experience, a total of 55 people (14.4%) had experience for 0 to 5 years, followed by 195 people (51.0%) for 6 to 10 years and 107 people (28.0%) for 16 to 20 years.

Table 2: Analysis of Sample Distribution by Place of Work, Gender, Age, Education, Work Experience and Frequency of Accidents

Respondent Information	Frequency	Percentage (%)
Working Place		
Damansara Damai	17	4.5
Sri Damansara East	21	5.5
Metro Prima	26	6.8
Kentonmen	26	6.8
Kuchai Lama	25	6.5
Sg. Besi	22	5.8
Serdang Raya South	20	5.2
Equine Park	24	6.3
Putrajaya Sentral	20	5.2
Sri Damansara West	21	5.5
Kepong Sentral	25	6.5
Jinjang	25	6.5
Bandar Malaysia South	27	7.1
Taman Naga Emas	24	6.3
Serdang Raya North	20	5.2
UPM	19	5.0
Cyberjaya North	20	5.2
Total	382	100
Gender		
Male	329	86.1
Female	53	13.9
Total	382	100
Age		
16 -24 years	17	4.5
25 – 34 years	76	19.9
35 – 44 years	223	58.4
45 above	66	17.3
Total	382	100
Work Experience		
0 – 5 years	55	14.4
6 – 10 years	195	51.0
11 – 15 years	107	28.0
16 – 20 years	25	6.5
Total	382	100

Verbal Dimension Level

The verbal dimension is the second dimension under the safety communication construct. This dimension has 7 items and is labeled as VE1 to VE7. This study found that the highest mean score value was item VE3: verbal discussion is necessary to make a decision (M = 8.09, SP = 1.13) followed by item VE4: instructions given in the form of memos or time -saving notes (M = 8.04, SP = 1.08). Next item VE5: security posters are better at conveying security -related information (M = 8.03, SP = 1.09). High levels were also noted by item VE2: one -way verbal communication was easier to make instructions (M = 7.93, SP = 1.11). Item VE1: two -way verbal communication easier to reach consensus (M = 7.85, SP = 1.16) was also at a high level. In addition, items VE6: instructions delivered using memos were poorly understood (M = 7.80, SP = 1.19) and VE7: instructions given by shouting less attention showed values (M = 7.77, SP = 1.22) were also at high levels. As shown in Table 3.

Table 3: Dimension Level on Verbal Based on Higher Mean Score

Item	Min	Standard Deviation	Interpretation
VE1	7.85	1.166	High
VE2	7.93	1.111	High
VE3	8.09	1.139	High
VE4	8.04	1.082	High
VE5	8.03	1.097	High
VE6	7.80	1.190	High
VE7	7.77	1.229	High

Non-Verbal Dimension Level

The non-verbal dimension level has four items and is labelled as BV1 to BV7. This study found that all items were at a high level, namely for item BV7: signalling thumb lift was highly agreed and had the highest mean score value (M = 8.69, SP = 1.19). Next item BV6: shaking head indicates disapproval shows the total mean is at a high level (M = 8.73, SP = 1.18), followed by item BV4: communicates by standing upright when able to show respect to others (M = 8.08, SP = 1.10). item BV5: smile practice is necessary in making instructions and actions (M = 7.98, SP = 1.10). next, BV2: the act of frowning indicated instructions not being understood accurately (M = 7.60, SP = 1.22). Finally, item BV3: the act of using the hands is required to help convey instructions clearly (M = 7.66, SP = 1.23). As shown in Table 4.

Table 4: Dimension Level on the Non-Verbal Based on Higher Mean Score

Item	Min	Standard Deviation	Interpretation
BV1	7.83	1.118	High
BV2	7.60	1.227	High
BV3	7.66	1.234	High
BV4	8.08	1.107	High
BV5	7.98	1.109	High
BV6	8.73	1.189	High
BV7	8.69	1.199	High

Information Digital Dimension Level

The dimension information digital dimension level third dimension of safety communication construct. This dimension has four items and is labeled as MD1 to MD7. This study found that all items were at a high level, i.e. for item MD6 (I think discussing through online is easier): had the highest mean score value (M = 7.54, SP = 1.14). Next is item MD7 (I think speaker usage is more obvious): (M = 6.99, SP = 1.63), followed by item MD5 (I feel commands via the WhatsApp's app are more acceptable): (M = 6.82, SP = 1.68). item MD2 (I believe conveying information using short message service (SMS) is easier to accept): (M = 6.45, SP = 1.99). Next, MD4 (I find instructions via Facebook difficult to understand and less clear): (M = 6.03, SP = 2.04) and MD3 (I think instructions via phone call are easy to understand):. (M = 6.02, SP = 1.94) Finally, item MD1 (I believe delivering information using email saves time): (M = 5.92, SP = 2.10) Table 5 shows the level of digital information dimension according to the highest mean score.

Table 5: Dimension Level on the Digital Information Based On Higher Mean Score.

Item	Min	Standard Deviation	Interpretation
MD1	5.92	2.101	Medium
MD2	6.45	1.990	High
MD3	6.02	1.943	Medium
MD4	6.03	2.041	Medium
MD5	6.82	1.683	High
MD6	7.54	1.417	High
MD7	6.99	1.638	High

Discussion

A high -risk on construction site must not only provide a safe working environment but also be equipped with quality human resources, including the safety communication (Md Zain et al, 2007). Workers on construction sites need to be exposed the importance of safety communications that cover almost the entire workflow. Failures in communication expose many to the risk of accidents at construction sites, including at Mass Rapid Transit (MRT) construction sites. At the same time, the lack of skills in security communication especially involving the basics of communication such as verbal, non -verbal communication and digital information affects the reception and delivery of information and instructions in Hassan 2002's workplace; Male 2005; Mokhtar 2006 & Ismail 2012). This study found that the highest mean score value was item VE3: verbal discussion is necessary to make a decision (M = 8.09, SP = 1.13). This study found that employees are more likely to discuss orally in making a decision. Such a thing also agreed by Abd. Halim et al (2004) who stated that the practice of verbal discussion is very important in decision making. The practice of non -verbal communication showed that all items were at a high level. However, item BV7 i.e. signaling thumb raising as a sign of agree or good had the highest mean score value (M = 8.69, SP = 1.19). The basic safety communication including non -verbal communication is essential given the work environment that disrupts verbal communication. Through symbols and body language gestures help in information on a construction site. In addition, employees also need to understand every gesture, body posture and body language in non -verbal communication. The study of Nordin Halias (2016) also found that non -verbal communication gives maximum effect during the process of presenting and receiving information. Furthermore, employees with communication skills are able to detect and understand the behavior of other employees through non -verbal responses as well as interactions occurring throughout the communication process at the MRT construction site. Digital security communications, on the other hand, showed that the MD6 item (I think discussing online is easier) had the highest mean score value (M = 7.54, SP = 1.14). The use of mobile technology and networks assists in the practice of effective communication at construction sites. The use of telephones to make calls more easily accepted by employees than other social applications to convey information or instructions. The use of email is at the lowest value of M = 5.92, SP = 2.10 although its used to save time. In conclusion, hoped that all parties encourage employees of basic security communication skills, especially involving the basics on digital communication that require other ancillary skills. In addition, all parties involved must also pay attention and take effective measures in efforts to develop employee safety communication skills, especially in high -risk workplaces to provide a workforce and future and take occupational safety and health in fair.

Conclusion

The main conclusion is that safety communication practices are an important element in the context of occupational safety and health in the Mass Rapid Transit (MRT) construction sector. Safety communication elements showed high mean score values of verbal, (4.44 min) non -verbal (4.42 min) and digital information (4.12 min) were seen as driving elements to the level of employee awareness in the context of interacting on occupational safety and health. Clearly shows that, verbal, non -verbal and digital information are important in ensuring safety in the workplace where unwanted accidents can be avoided. Awareness from various parties is important in the aspect of safety communication, especially in the high-risk construction sector. This is also used as an indicator or benchmark to increase awareness among employers and subordinate employees on the effectiveness of security communication in organizations in Malaysia.

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Conflicts of Interest

The authors declare there are no conflicts of interest in this study.

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KEY ELEMENTS IN THE IMPLEMENTATION OF ISO 45001 AMONG ORGANIZATIONS IN MALAYSIA

Abbas, N.[1], Arifin, K.[2*]

[1] Environmental Management, Faculty of Social Sciences and Humanities, University Kebangsaan Malaysia, 43600 Bangi, Selangor.
[2] Faculty of Social Sciences and Humanities, University Kebangsaan Malaysia,43600 Bangi, Selangor
*Correspondence: kadir@ukm.edu.my

Abstract:

Malaysia has implemented the Worldwide Standards Organization ISO 45001 which is the first international standard for the management of occupational health and safety, in order to increase the capability and efficiency of the organizations in the management of occupational safety and health in the country. The goal of implementing ISO 45001 is to help businesses to achieve optimal occupational safety performance in terms of workplace injuries and illness. This paper aims to evaluate how the management implemented the ISO 45001 based on six important components known as implementation, leadership, planning, support, operations, performance evaluation and improvement. Organizations in this study are chosen based on whether or not they have implemented ISO 45001 certification in the past. Occupational Safety and Health Officers are the only one that will receive the questionnaire. The results show that the overall level of the element which has the highest mean is implementation. Nonetheless, the element that has the greatest impact on the implementation was improvement, which had mean of 4.46, followed by leadership and operations, with mean 4.35 and 4.34 respectively. As a result, the findings of this research can be used to develop strategies, safety programmes and other suggestions to improve occupational safety and health management systems. The results also provide an overview to the organizations in order to help them enhance their safety and health management systems.

Keywords: Element, Implementation, ISO 45001, Organization

Introduction

Occupational safety and health issues need to be addressed by organizations as these issues influenced workers' creativity and caused a country to lose its competitiveness (Zahir & Fazila 2006). This is because employees are an important aspect in mobilizing and determining the direction of a country to be viable (Ab. Aziz & Intan 2002). Hence, Malaysia has concerned about workers' safety and health in organizations (Ibrahim 2013) by implemented ISO 45001 to substitute OHSAS 18001 which had been used before.

The purpose of ISO 45001 implementation is to enable the organization to achieve optimal health and occupational safety in preventing injuries and ill health. Which means all workers are not injured or having any health problem at work place while their safety and health are at their best level (Lee et al. 2020). In 2020, records from the Department of Occupational Safety and Health (DOSH) showing the rate of accidents at work across the country decreased by 20 percent, while the mortality rate decreased by 45 percent compared to 2019. From that percentage, the total number of occupational accidents was 32 674 cases which 312 were fatal cases. This means that accidents rate in Malaysia in 2020 is 2.18 per 1000 workers, which a decrease of 20 percent compared to 2.71 percent in 2019. While the occupational death rate decreased by 45 percent which is 2.09 per 100,000 workers in 2020, compared to 3.83 in 2019 (DOSH 2020)

Among the factors of the decline is due to the Movement Control Order (MCO) which started since 18 Mac 2020 causing the industrial sector unable to be fully operated. Other than that, the impact of punitive action on employers who fail to comply with the requirements of Occupational Safety and Health legislation as well as effective enforcement and promotion by the Department of Occupational Safety and Health (DOSH) using the new norms approach also causing the decline of accident and death rate in Malaysia. Besides, other contributing factors are employers' and employees' behaviour who well-concerned and followed the standard operational standard (SOP), including health and occupational safety aspects, as well as the long term success plan of implementation of the National OSH Master Plan (DOSH 2020).

Hence, it is crucial for the management to evalute the extent of main elements' influence in the implementation of ISO 45001. Hereby, this study argues that the implementation of ISO 45001 by organizations are influenced by six six key elements namely leadership, planning, support, operations, performance evaluation and improvement.

Key elements in implementation

Durlak and Dupre (2008); Deal L. Fixsen et al. (2005); Fixsen et al. (2005); Love (2004) said that generally implementation is a set of activity that consist of programs that are implemented specifically in accordance with the goals that have been set and have been planned. These planned programs are implemented to achieve the objective that had been set in early stage by the policy maker (Van Meter dan Van Horn 1975). According to Luis (2007), this is because the implementation need an early planning to determine the solution concept that will be used. While Werner (2004) have other opinion which is implementation does not only that implementation not only describes what is happening in a program but also needs to assess and explain, which in the assessment of the implementation involves comparing data on program operations, activities, services and outcomes with standards to create an assessment based on those comparisons.

Based on previous studies, this study focuses on six main elements that influence the implementation of ISO 45001 among organizations in Malaysia. The elements namely leadership, planning, support, operation, performance evaluation and improvement. The first element that influenced implementation is leadership. Leadership element is important because it affect the strength and it became the main driver to increase performance in organization (Peterson et al. 2003; Arslan & Staub 2013). This is because effective leadership will have positive impact on employee behavior and attitudes in reducing injury rates as well as contribute to increase productivity (Diptendu Das 2018; Bel 2010). In addition, the best leadership will result in high commitment, trust and motivation to the organizational environment especially among employees (McShane & Von Glinow 2000). In the leadership element, there are four components that are assessed, namely leadership and commitment, OH&S policy, roles, authority responsibilities, consultation and employee involvement.

The second element that influenced implementation is planning element. This element includes management arrangements such as organizational activities, adequate and appropriate resources, performance measurement and audits (Lee et al. 2016). Through effective planning elements, organizations can develop the capabilities and support mechanisms needed in achieving safety and health policies, goals and targets (Nuruzaihan et al. 2016). With a planning element, a program and procedure can be developed and prioritized based on relative risk, other than to setting goals and performance standards for management action (ILO OSH 2010). As for planning, there are two components that are given focus, namely actions to address risks and opportunities as well as OH&S objectives and planning to be evaluated.

Next the third element that influences implementation is the support element. In this support element there are five components that are assessed namely resources, competencies, awareness, communication and documentation information. Austin (2014) states that adequate resource requirements are important in support elements for continuous improvement including human, natural surroundings, infrastructure (buildings, plants, equipment, utilities, emergency control systems) technological and financial resources that have been identified during the planning stage. Competence is also important because organizations that work efficiently will produce competent employees (Chouhan & Srivastava 2014).

While the fourth element in influencing the implementation of ISO 45001 is the operations element. In this element there are two components that are assessed namely planning and operational control as well as emergency preparedness and response. This operational element is important because the organization is able to determine what is needed for each controlled process and method to ensure employees are protected from harm through operational control (Campailla 2019). Lambert and Schwieterman (2012) stated that planning and operational control achieved includes the identification of criteria for each process, resources required to manage the process including leadership, equipment, time, human aspects (competencies and training) as well as financial needs.
The fifth element is the element of performance evaluation where in this element there are three components that are evaluated, namely monitoring, measurement, analysis and performance evaluation, internal audit as well as management review. smail 2002 stated that with the monitoring, measurement, analysis and evaluation of performance allows an organization to measure the evaluation of OS & H performance over time. Employers need to play a role by conducting continuous monitoring, conducting safety audits from time to time as well as record keeping related to occupational safety and health and the work environment (Benjamin 2008).

Materials and Methodology

Materials

This study is a quantitative study where the instrument is in survey questionnaire form that has being used as the main tool in the data collection process. Quantitative methods are based on objective measurement and statistical analysis of numerical data to understand and explain a phenomenon or issue. The elements in the implementation of ISO 45001 have been divided into six elements arranged according to the clauses in ISO 45001 namely leadership and employee involvement, planning, support, operations, performance evaluation and improvement. All items in this section use a Likert Scale (Strongly Disagree, Disagree, Moderate, Agree and Strongly Agree). The Likert scale was used to express the degree of agreement of each item of the questionnaire into a quantitative form (Boone 2012). The division of questions is the same for each component which is four questions for each component assessed. In this analysis the mean score obtained in the study will be reviewed in the form of interpretation to explain the meaning behind the mean score. The findings are categorized according to Table 1 below. The higher the measurement score obtained indicates the higher the evaluation of key elements by the organization.

Table 1 Measurement score

Description	Mean score	Category
	1 – 2.33	Low
Measurement scale 1-5	>2.33 – 3.66	Medium
	>3.66 – 5.00	High

Methodology

The division of locations is divided into five main parts of states which include the northern part (Perak, Kedah, Perlis and Penang), Central (Selangor, Kuala Lumpur and Putrajaya), South (Johor, Melaka and Negeri Sembilan), East Coast (Pahang, Kelantan and Terengganu) and West (Sabah and Sarawak). Next, the selection of the selected organizations are based on the main focus which are the organizations that have implemented ISO 45001 certification in Malaysia. The selection of organizations includes four types of services, namely electrical and electronics, engineering, scientific and services. Distribution of questionnaires is only given to Occupational Safety and Health Officers as stipulated in the Occupational Safety and Health Act 1994 (Act 514). In this study, all 220 selected respondents throughout Malaysia were involved as sample in this study to obtain data to be analyzed. This number is sufficient to represent an organization that has obtained ISO 45001 certification where the sampling involves only one safety and health manager to represent one organization.

Results

The main elements that influence implementation in this study are identified through six elements namely leadership elements, planning elements, support elements, operations elements, performance evaluation elements and improvement elements. The results of the study shown in the table are a comparative summary of each sub component in each element as shown in Table 2 to Table 7. Data are presented in the form of mean, percentage and mean scale interpretation.

Comparison of sub component assessments in leadership elements

Table 2 shows the a comparison of the evaluation of leadership elements on implementation covering four sub components namely leadership and work engagement; OH&S policies; the roles and responsibilities of authorities and consultation and employee involvement. For the leadership element, the sub component of 'consultation and employee involvement' showed the highest mean score with mean value = 4.37 where as many as 87.35 % of respondents strongly agreed that employee involvement greatly influences leadership in an organization. These findings are very consistent with a study conducted by Collinson and Tourish (2015) who asserted that this leadership will involve teamwork from a network of people and caring for important people in an organization. Overall, the leadership element is at a high level of mean = 4.35 with a percentage of 87.11 %. This explains that the evaluation of leadership elements on the implementation is important to the implementation of ISO 45001 in Malaysia. Effective leadership can create and integrate the vision, goals and objectives of the organization in achieving optimal levels of security (Collin 2001).

Table 2 Comparison of Evaluation of Leadership Element Against Implementation

No	Comparison of Evaluation of Leadership Element Towards Implementation	Mean	Percentage	Mean scale
1	Leadership and work engagement	4.32	86.40	High
2	OH&S policies	4.45	89.00	High
3	Roles and responsibilities of authorities	4.28	85.70	High
4	Consultation and employee involvement	4.37	87.35	High
		4.35	87.11	High

Comparison of sub component evaluation in planning element

Table 3 shows the comparison of planning elements towards implementation which includes actions to address risks and opportunities, OH&S objectives and planning to achieve that objectives. For the planning construct, the sub component of 'OH&S objectives and planning to achieve' showed the highest mean score with value of mean = 4.34 where 87.73% of respondents strongly agreed that OH&S objectives should be set first because it affects planning in an organization. This is because objectives should be aimed and focused on improving overall safety and health performance and should also be supported by specific performance standards and targets (Health and Safety Authority 2006). Overall, the planning construct has high level of mean = 4.28 with a percentage of 87.07%. This explains that the evaluation of planning constructs on implementation is important to the implementation of ISO 45001 in Malaysia because planning means setting priorities, safety objectives and job preparation in achieving organizational goals (Kuusisto 2010).

Table 3 Comparison of Planning Element against Implementation

No	Comparison of Planning Element towards Implementation	Mean	Percentage	Mean scale
1	Actions to address risks and opportunities	4.22	86.41	High
2	OH&S objectives and planning to achieve	4.34	87.73	High
		4.28	87.07	High

Comparison of sub component evaluation in support element

Table 4 shows the comparison of support elements towards impelentation that includes resources, competencies, awareness, communication, and documentation information. For the support element, the sub-components for 'awareness' and documentation information showed the highest mean score with mean = 4.330 respectively where 86.80 % and 86.33 % of respondents strongly agreed that awareness and documentation information greatly influence the support element in an organization. These findings are very consistent with the study conducted by Yule et al. (2007) who stated that through awareness, a person will adhere to work procedures while being able to create a safe work environment. This is because awareness is a key criterion in avoiding the occurrence of accidents because if attitudes are set aside, accidents or injuries are likely to increase (Lin et al. 2008).

Overall, the support element at a high level mean = 4.23 with a percentage of 85.11%. This explains that the assessment of support elements for implementation is important to the implementation of ISO 45001 in Malaysia. This is because it influences effectiveness in occupational safety and health management where it requires commitment to implement and maintainance in order to ensure optimal levels of compliance (Campailla et al. 2019).

Table 4 Comparison of Support Element Evaluation against Implementation

No	Comparison of Support Element Evaluation towards Implementation	Mean	Percentage	Mean scale
1	Resources	4.22	83.40	High
2	Competencies	4.24	84.90	High
3	Awareness	4.30	86.80	High
4	Communication	4.13	84.13	High
5	Documentation information	4.30	86.33	High
		4.23	85.11	High

Comparison of sub component evaluation in operations element

Table 5 shows a comparison of operational elements evaluation against implementation covering two sub-components namely planning and operational control; and emergency preparedness and response. For the operational element, the sub -component of 'planning and operational control' showed the highest mean score with value of mean = 4.38 where as many as 86.20% of respondents strongly agreed that this sub component greatly affects the operations in an organization. This finding is in line with the study conducted by Davies & Tomasin (1996) who stressed that planning and operational control requires management commitment in complying with rules and procedures in order to improve OH&S performance through enforcement to improve safety behavior while preventing accidents.

Overall, the operations element is at a high level of mean = 4.34 with a percentage of 86.18 %. This explains that the assessment of operations elements towards implementation is also important to the implementation of ISO 45001 in Malaysia. There are internal and external factors that need to be taken into account and considered when identifying possible emergency situations either within or outside the organization (Campailla et al. 2019)

Table 5 Comparison of Operations Elements Evaluation against Implementation

No	Comparison of Operations Elements Evaluation towards Implementation	Mean	Percentage	Mean scale
1	Planning and Operational Control	4.38	86.20	High
2	Emergency Preparedness and Response	4.30	86.15	High
		4.34	86.18	High

Comparison of sub component evaluation in performance evaluation element

Table 6 shows a comparison of performance evaluation elements against implementation which includes compliance, measurement, analysis and performance evaluation, internal audit and management review. For the performance evaluation element, the sub component of 'internal audit' showed the highest mean score value of mean = 4.35 where 87.45 % of respondents strongly agreed that internal audit greatly influences performance appraisal in an organization. Kadir et al. (2011) stated that internal audit is used as a tool to monitor and reduce accidents in the workplace. Overall,

the performance evaluation element is at a high level of mean = 4.31 with a percentage of 86.21 %. This explains that the performance evaluation elements towards implementation is important to the implementation of ISO 45001 in Malaysia.

Tablel 6: Comparison of Performance Evaluation Element against Implementation

No	Comparison of Performance Evaluation Element towards Implementation	Mean	Percentage	Mean scale
1	Compliance, measurement, analysis and performance evaluation	4.27	84.52	High
2	Internal audit	4.35	87.45	High
3	Mangement review	4.31	86.67	High
		4.31	86.21	High

Comparison of sub component evaluation in improvement element

Table 7 shows a comparison of improvement evaluation elements against implementation which includes, accidents, inappropriate and corrective actions; and continuous improvement. For the improvement element, the sub component for 'accidents, inappropriate and corrective actions' showed the highest mean score value of mean = 4.47 where 89.55% of respondents strongly agreed that accidents, inappropriate and corrective actions greatly influence improvement in an organization. Overall, the improvement element is at a high level of mean = 4.47 with a percentage of 88.95 %. This explains that the improvement elements evaluation towards implementation is important to the implementation of ISO 45001 in Malaysia.

Table 7 Comparison of Improvement Construct Evaluation against Implementation

No	Comparison of Improvement Construct Evaluation against Implementation	Mean	Percentage	Mean scale
1	Accidents, inappropriate and corrective actions	4.47	89.55	High
2	Continuous improvement	4.45	89.00	High
		4.46	88.75	High

Discussion

The whole study shows that all the elements in the implementation of ISO 45001 are at a high level. This shows that the organizations are very committed in the implementing ISO 45001 in their organization. The organization that cares about the safety and welfare of employees enabling employees to comply with and respect every instruction from the organization. According to the research findings, all sub components in each element are highly influential in the implementation of ISO 45001 as a whole. Based on the evaluation comparison, the improvement element showed the highest mean value followed by the leadership element and the operations element. The improvement element consists of two sub components namely accidents, inappropriate and corrective actions as well as

continuous improvement. The findings of this study support the study conducted by Lee (2003) and Mohd Kamal et al. 2014), which suggests that improvement elements should be based on the value of employee involvement and participation, and corrective actions must be planned to control incidents or other inappropriate actions to eliminate the causes.

The leadership element is the second element that influences the implementation of ISO 45001. The leadership element is divided into four sub -components namely leadership and employee involvement; OH&S police; roles, responsibilities of authorities; consultation and employee engagement. Consistent with a study by Collinson and Tourish (2015), this leadership involves teamwork from a network of people and caring for important people in the organization. The findings of this study also support the definition brought by Diptendu Das (2018) which states that security leadership involves interaction between leaders and followers where leaders can give their influence to followers to achieve security goals in the organization.

While the operational element indicates the third element influence the implementation. Findings from this study support Jovasenic & Stojanovic (2009) who stated that OH&S performance should be assessed based on realistic and appropriate indicators, and success in safety and health management cannot be assessed by simply counting the number of accidents.

Conclusion

The implementation of ISO 45001 is important to be implemented by every organization to improve employee safety, reduce risks in the workplace and be able to address health and safety challenges in the organization. Therefore, managers and employees need to work together in ensuring their organizations achieve the best possible levels of safety and health. The evaluation of the key elements towards the implementation of ISO 45001 provides an overview about the opinions of safety and health officers on their respective organizations. However, this study concludes that all these key elements are at a high level where each of these elements influences the implementation of ISO 45001. As a result, the findings of this research can be used to develop strategies, security programs and recommendations to improve security management systems and occupational health. It can also provide an overview to organizations to help them improve their safety and health management systems.

Acknowledgement

Conflicts of Interest

The authors declare there are no conflicts of interest in this study.

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NDVI AND NDWI: WAY FORWARD TO SUSTAIN THE FOREST COVER QUALITY

Ang, K.H.[1,*], Yusoh, M.P.[2], Gani, P.[3]

[1] Geography Programme, Faculty of Social Sciences and Humanities, Universiti Malaysia Sabah (UMS), 88400 Kota Kinabalu, Sabah, Malaysia.

[2] Borneo Institute for Indigenous Studies, Universiti Malaysia Sabah (UMS), 88400 Kota Kinabalu, Sabah, Malaysia.

[3] School of Applied Sciences, Faculty of Integrated Life Sciences, Quest International University (QIU), 30250 Ipoh, Perak, Malaysia.

*Correspondence: angkeanhua@ums.edu.my[1]; pirdaus@ums.edu.my[2]

Abstract

This research study focuses on the relationship between NDVI and NDWI in assessing and monitoring the vegetation canopy of forest cover in Kota Kinabalu, Sabah, Malaysia. Generally, NDVI applies NIR to detect the health of vegetation based on the wavelength reflected from chlorophyll as green light, while visible RED light should be absorbed by the chlorophyll. Therefore, these circumstances provide advantages in the monitoring of droughts, seasons, production forecasts of agriculture, prediction of fire using zonal technique and responses to desertification through mapping. Continuously, NDWI uses NIR plus SWIR to determine the internal structure and dry matter content in leaves, together with the sensitivity of water content and spongy mesophyll in vegetation canopy. These can be used in monitoring the vegetation canopy during drought season. Results show that when values for NDVI are 50%, NIR 8% visible light is reflect back to indicate the vegetation is in good health. In contrast, when 40% NIR or 30% visible light is detected by sensor when the vegetation is in poor health. When NDWI values are near to +1, this indicate high vegetation water content and fraction cover, and the value near to -1 indicate low vegetation water content and fraction cover. In conclusion, understanding the green forest involving vegetation index is beneficial as it provides early warning about the condition of environmental quality, as well as provides database for prediction and management of the changing environment.

Keywords: NDVI; NDWI; vegetation canopy; forest cover; Sabah

Introduction

NDVI and NDWI are often use in many fields of study, which include land surface study (Yaseen & Khan, 2022), crop study (watershed study (Soriano-González et al., 2022; Satheeshkumar & Venkateswaran, 2022), drought study (Rahmana et al., 2022), climate change study (Gao et al., 2022), and others. The previous study proved that both approach are popular and valuable in the understanding of vegetation health especially spatial distribution of the vegetation water stress and its temporal evolution over longer time periods as well as the land use via remotely sensed data.

In this paper, we will be discussing about NDVI and NDWI in accessing the quality and health of vegetation index in forest canopy, Kota Konabalu, Sabah. To do this, we require Landsat 8 OLI/TIRS in 2022, which consists of 11 bands wavelengths. Among the bands, NIR and RED band will be extracted to carry out NDVI, while NIR and SWIR band is used to conduct the NDWI. In this paper, we will report about the status of vegetation index based on NDVI and the water content in the leaf of forest canopy to determine NDWI.

Materials and Methodology

The image for Landsat 8 OLI/TIRS is obtained from USGS Earth Explorer with the path of 118 and row of 056. This image consists of 11 bands, which dated on 23 March 2022. This paper applies NDVI and NDWI, which consists of equation as stated below:

$$NDVI = (NIR-RED)/(NIR+RED) \qquad \text{Eq. (1)}$$

$$NDWI = (NIR-SWIR)/(NIR+SWIR) \qquad \text{Eq. (2)}$$

Where, NIR is Near infrared band; RED is visible spectrum wavelength of red band; SWIR is Short wave infrared band. The NDVI and NDWI will be employ towards the Landsat 8 data of Kota Kinabalu, Sabah.

Expected results and discussion

Based on theoretical approach, the expected outcome for NDVI that apply NIR to detect the health of vegetation based on the wavelength reflects from chlorophyll as green light, while visible RED light should be absorb by the chlorophyll. In other words, 50% NIR or 8% visible light is reflect back to indicate the vegetation are in good health, while 40% NIR or 30% visible light is detected by sensor when the vegetation is in poor health. Therefore, these circumstances provide advantages in monitor drought season, forecast the production of agriculture, predict fire using zonal technique and react as offensive for desert through mappings.

Meanwhile in NDWI, it is uses NIR plus SWIR to determine the internal structure and dry matter content in leaf, together with the sensitivity of water content and spongy mesophyll in vegetation canopy. This can be proves by NDWI values that near to +1 indicate high vegetation water content and fraction cover, while NDWI value near to -1 indicate low vegetation water content and fraction cover. These can be used in monitor the vegetation canopy during drought season. Both finding will enables in determination of forest cover quality condition by based on the vegetation index as well as water content in leaf.

Conclusion

By adapting the NDVI and NDWI, forest covers can be assessed and monitored in Kota Kinabalu. Understanding the green forest involving vegetation index is beneficial in provide early alarm about the condition of environmental quality, as well as provide database for prediction and management on the environment.

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Conflicts of Interest

Authors should declare any conflicts of interest or state "there are no conflicts of interest in this study".

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SOCIAL RETURN ON INVESTMENT (SROI) IN FLOOD RECOVERY: A FRAMEWORK FOR MEASURING THE SOCIAL VALUE OF "NEW PERMANENT HOUSING" (RKB) PROJECTS IN KG. TELEKONG AND KG. SUNGAI DURIAN, KUALA KRAI, KELANTAN

Teo, W.S.[1,*], Seow, T.W. [2] and Radzuan, I.S.M. [3]

[123] Faculty of Technology Management & Business, Universiti Tun Hussein Onn Malaysia, 86400 Johor, Malaysia.

*Correspondence: weisheteo@gmail.com

Abstract

In the past decades, government, social sector organisations, investors, and other groups, have become increasingly interested in accounting for and reporting social value, especially in western countries. More and more stakeholders are starting to assess the social value that social projects create and this proves that such values effectively impact the life of the people with whom they interact. However, social value is difficult to measure, and subjective judgment may be involved even if they can be measured. For these reasons, assessing the social value has become a time consuming process, resulting in its lack of use by the Malaysian government. In an effort to alleviate the measurement issues, social return on investment (SROI), is introduced as a performance measurement tool, based on social concepts that can be effectively applied to measure social values. This study has looked into the SROI framework for assessing the social value generated by the flood recovery housing restoration plans, known as the "New Permanent Housing" (RKB) project in Kuala Krai, Kelantan. To achieve this goal, a single case study strategy has been chosen. Two different RKB projects located at Kuala Krai, Kelantan - Kg. Telekong and Kg. Sungai Durian, have been assessed in order to monetise their social, economic, and environmental values, using a SROI framework. It is the first time an SROI framework has been used to value the flood recovery at the national level. The qualitative and quantitative data analysis is based on a SROI framework, which involves key informants interview (KII), survey questionnaire (SQ), library search and evidence from existing literature or projects. The SROI analysis resulted in positive social returns, varying between 1.01 and 1.27. The findings show that more than RM 1.0 of social value is created for every RM 1 spent in RKB. This revealed that investment in the RKB projects generates significant social, economic, and environmental returns and provides a range of opportunities to support the sustainable development of communities.

Keywords: Social Return on Investment, Social Value, Flood Recovery, New Permanent Housing

Introduction

A promising investment for a better sustainable future is aiming at achieving higher investment returns without neglecting the importance of social value. Social value serves as an umbrella term for stakeholders or organisations that make a conscious effort to ensure that broader social, economic, and environmental effects are positively viewed as adding value by contributing to the long-term wellbeing and resilience of individuals, communities and society in general (Social Value Portal, 2018). Assessing social value can drive efficiencies to promote social well-being, economic growth and minimise environmental damage (Wigglesworth, 2020). However, it has been long claimed that the real social value generated by most investments in Malaysia remains unknown, due to the lack of applicable tools – SROI to assess social value and the work done by the government is obviously devalued. According to Lombardo et. al (2019), one of the reasons for this is that the government

cannot handle the problems of externalities, including social and environmental impacts, on its own since externalities are difficult to evaluate. Since measuring the social value may not be easy, the Malaysian government aimed to achieve the best of "Iron Triangle" rather than focus on social value creation. Besides, many social investment projects in Malaysia are still being evaluated using cost-benefit analysis (CBA), a traditional economic evaluation tool that relies exclusively on economic costs and benefits, whereas social and environmental costs and benefits are usually considered secondary (Ramli et. al, 2016). In contrast, SROI seems to be a useful tool that provides critical insights and uncovered potentially social value that would otherwise remain undetected.

SROI is a framework produced for stakeholders to assess the social value, by considering the social, economic, and environmental impacts with additional "measurable" indicators (Teo et. al, 2021). SROI is not always purely monetary, but often can only be measured in terms of the value added to society. In support of this, NEF Consulting (2020) shared their opinion on SROI and said it helps the government to determine what social value a project generates in a solid and comprehensive manner, and therefore manages the project to maximize that value. In recent years, SROI has been broadly applied in many organisations and across different fields such as education, health care, and housing since its first use by Robert Enterprise Development Fund (REDF) in 1996 (Emerson & Cabaj, 2000). In the field of flood disaster, SROI started its application with case studies as demonstrated in the study of post-disaster recovery program in Indonesia, shows that the application of SROI method can help to measure the success of a program and assess how much social value is return to the primary target of the program (Putra, 2017). In Malaysia, one piece of SROI research on disaster intervention was carried by Ramli et. al (2016), shows that SROI is a valuable tool for assessing projects' returns by looking into sustainability aspects and can be applied within body of knowledge related to disasters in Malaysia. In this regards, the SROI framework seems to be a useful tool that provides critical insights and uncovered potentially social value that would otherwise remain undetected.

In this study, the researcher employed SROI framework to evaluate the social value of the flood recovery project, known as the "New Permanent Housing" (RKB) project in Kg. Telekong and Kg. Sungai Durian, Kuala Krai, Kelantan. This is the first time SROI has been used to assess the RKB projects' social value, and it is also the first time SROI has been employed on a flood recovery project in Malaysia. Hence, this study provides insights into the SROI framework for flood recovery projects in Malaysia and extends the application of SROI into the flood management body of knowledge.

Study Area

This study was conducted in Kuala Krai, Kelantan, located in the Batu Mengkebang District, which lies at a longitude of 5°31' 51.07" N and latitude of 102° 12" 7.2" E. The Kuala Krai district gets hit by floods almost every year. At the end of December 2014, a catastrophic flood called the "*Bah Kuning*" inundated 85% of the total Kuala Krai area. Since this flood caused a vast population to lose their houses, the Malaysian government implemented a flood recovery project named the "New Permanent Houses" (RKB) project in several districts Kuala Krai, Kelantan, including Kg. Sungai Peria, Kg. Sungai Durian, Kg. Manjor, Kg. Staponal, Kg. Kemubu, Kg. Telekong, Kg. Ulu Keleneh, Tanah Maju Ternak, Tapak ILP Mukim Kenor and Tapak PUSPAKOM (Social Welfare Department, 2014).

In this study, two (2) RKB projects in Kuala Krai, Kelantan were selected as the case study area: Kg. Telekong and Kg. Sungai Durian. The selection of the case study area was based on criteria such as location and governance. To avoid any implications due to both location factor and governance factor, the selected RKB projects are located in Kuala Krai, which was the worst-hit district in Kelantan. Besides, all the new permanent houses for flood victims of these two kampungs were coordinated by

the Malaysian Federal Government (Social Welfare Department, 2014). Figure 1 depicts the location of the study areas in Kuala Krai, Kelantan.
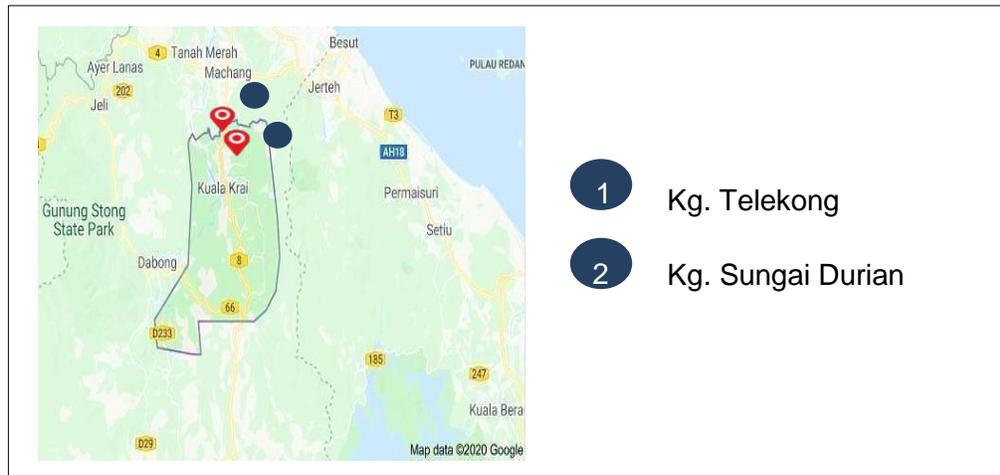

Figure 1: Location of Study Areas in Kuala Krai, Kelantan

Materials and Methodology

The international standardised SROI framework was selected for this study as a credible evaluation method used to measure the social value connected to the RKB projects in Kg. Telekong and Kg. Sungai Durian, Kuala Krai, Kelantan. In this study, SROI was applied to these case study areas according to its five (5) stages methodology. Since the SROI study required validation of results from different methods, a mixed-methods approach will be used in this analysis. This mix existing of qualitative data that capture stakeholders' perspectives on the outcomes and values and quantitative data that depicts the real achievement of RKB would provide a complete social value that the research aims described. Four research instruments include key informants interview (KII), survey questionnaire (SQ), library search, and evidence gathering from literature, were chosen for this study.

Moreover, the parent population of this study is made up of two groups: flood victims and the Malaysian Federal government. For the sample size determination, the sample size of flood victims among two RKB projects is 107, calculated using Krejcie and Morgan's (1970) sample size calculation. For the Malaysian Federal Government, the sample size is 3, as Creswell (2014) indicated that the small-scale sample size for phenomenology research using qualitative interview is typically range from three to ten. Table 1 below clarifies the sample size and sampling design of this study identified by the researchers.

Table 1: Sample size

Sample group	Samples	Number
Flood victims	Kg. Telekong	80
	Kg. Sungai Durian	27
Malaysian Federal Government	Malaysian's National Disaster Management Agency (NADMA)	2
	Public Works Department (JKR)	1

SROI Methodology

Social return on Investment (SROI) is a method for measuring social value, by considering the social, economic, and environmental impacts with additional "measurable" indicators. It draws from Cost-Benefit Analysis, but encompasses a much broader concept of how change is created and assigns a monetary value to the returns using financial proxies. In this study, SROI was applied to two different case study areas – RKB Kg. Telekong and RKB Kg. Sungai Durian, Kuala Krai according to its five stages methodology – Stage 1: Establishing the scope and identifying key stakeholder; Stage 2: mapping outcomes; Stage 3: Evidencing outcomes and giving them a value; Stage 4: Establishing impact; and Stage 5: Calculating SROI. The method enables a ratio of benefits to costs to be calculated. Five stages of the SROI method with practical applications to the RKB projects will be outlined as follows:

Table 2: SROI Stages

Stages of SROI		Details
Stage 1	Establishing the scope and identifying key stakeholder	• *Establish Scope* RKB in Kg. Telekong and Kg. Sungai Durian, Kuala Krai, Kelantan • *Identify Stakeholders* Evidence gathered from literature and project / KIIs
Stage 2	Mapping outcomes	Impact map is developed based on outcomes data collected via KII, SQ, library search and evidence gathered from literature or projects
Stage 3	Evidencing outcomes and giving them a value	• *Evidence outcomes* The outcomes will be verified by the Malaysian Federal Government (NADMA and JKR) and flood victims (Kg. Telekong and Kg. Sungai Durian) through KII and SQ • *Give them a value* Evidence gathered from literature or projects and interview used to identify financial
Stage 4	Establishing impact	Data gathered from KII and SQ used to find appropriate percentage for the SROI model
Stage 5	Calculating SROI	Calculation of the SROI ratio: $$\text{SROI ratio} = \frac{\text{Present Value (Total Financial Value of Outcome)}}{\text{Value of inputs}}$$

Results
Stage 1 - Establishing Scope and Identifying Stakeholders

Based on the evidence gathered from literature or projects, two groups of pre-identified stakeholders, including flood victims and the Malaysian Federal Government (NADMA and JKR) were engaged

through KII and SQ in order to confirm and describe their roles in the RKB projects. After the engagement activities, they were confirmed to play important roles in the RKB. The Malaysian Federal Government played essential roles in the project as they are the funder in charge of planning and coordinating the permanent houses and are keen on improving the RKB outcomes. On the other hand, the flood victims are fully recognized as the main target in the analysis as they are the primary beneficiaries and have experienced the most changes. So, both stakeholders were confirmed to be included in the analysis.

Stage 2 – Mapping Outcomes

It is important to identify the Theory of Change (ToC) by understanding the relationship between inputs, outputs and outcomes that the RKB projects generated once having identified the relevant stakeholders (Teo, et. al, 2021). To present the ToC, an impact map is developed, with the rationale that stakeholders provide resources (inputs), to deliver flood recovery activities (outputs), resulting in changes (outcomes) for the beneficiaries (Teo et. al, 2021). For this study, the mapping outcomes for the RKB were mainly facilitated through a review of existing literature on the impacts of flood management projects and redefined again by the information given by the stakeholders using KII and SQ sessions. A summary of the data considered is presented in the following section.

Inputs

The inputs included in the SROI analysis of each case study were the total direct implementation costs of the RKB project (summarized in the Report of Allocation and Expenditures of the Construction Budget by the RKB project in November 2020). This includes both the cost of permanent houses and the cost of infrastructure work. Based on the report, the financial cost of inputs for the RKB project done in Kg. Telekong was RM 6,362,144.80, followed by RM 2,617,465.32 for the project in Kg. Sungai Durian.

Outcomes

Mapping outcomes for the RKB projects were mainly facilitated through a review of existing literature on the impacts of flood management projects and redefined again by the information given by the stakeholders. Based on the results, RKB projects led to positive outcomes for flood victims and the Malaysian Federal Government. Flood victims from two (2) RKB projects who received new permanent houses had mostly positive opinions about the outcomes that they received. For them, the outcomes or changes expected from the project centred around social and economic aspects. They were happy with the changes brought about by the project, including their moving into RKB houses from rental houses and the resultant increased housing stability (Outcome 1), saving the cost of rebuilding and reconstructing damaged houses (Outcome 2), saving the cost of buying new houses (Outcome 3), reducing household assets or goods damaged or lost (Outcome 4), reducing the number of people suffering from various physical and mental illnesses, (Outcome 5) and reducing losses of monthly income assistance (Outcome 6). These outcomes experienced by flood victims have been reported in the literature and are evidenced by the project data.

Meanwhile, the Malaysian Federal Government (NADMA and JKR) generally addressed their perceptions of the outcomes generated by the RKB projects in terms of three sustainability aspects: social, economic and environmental. All of the officers agreed that the most relevant outcomes were maintaining children's academic performance (Outcome 7), reducing emergency financial assistance for flood victims (Outcome 8), and reducing the amounts of flood waste generated by households and

pollutants flushed into the river (Outcome 9). Furthermore, they opined that the outcomes occurred because the RKB homes were built in strategic locations with a low risk of flooding. Since the outcomes are relevant, they are determined to be materially significant and cannot be excluded from the analysis.

Stage 3 – Evidencing Outcomes by Giving Them a Value

Now that the material outcomes have been defined, a value can be assigned to each. In line with the requirement for SROI stage 3, all the outcomes were determined by financial proxies and assigned with a value through SQ, evidence gathered from the literature and information provided by the Malaysian Federal Government. In researching financial proxies that best fit the SROI analysis, cost-saving and substitute analogy method were used as the main evaluation methods. A cost-saving method allows stakeholders to use input cost in exchange for outcome by capturing their perspective and assessing cost or expenses saved by them. Besides, substitute analogy method was used to obtain financial proxies by exploring similar projects or previous research that has been used in SROI analysis. For example, Outcome 3, 7, 8, and 9 used the data from similar literature or projects already implemented in Malaysia to obtain financial proxies in order to ensure their appropriateness. So, overall, the total outcome value for RKB Kg. Telekong and RKB Kg. Sungai Durian is summarized in Table 3.

Stage 4 - Establishing Impact

For this SROI analysis, the impact will be determined by deadweight only. As this evaluation specifically covers the past six years, there was no reported drop-off, attribution or displacement, and were set at 0%. The KIIs and SQs were used to determine such discount values by asking respondents directly about the impacts the RKB projects have had on them and how beneficial they thought the projects have been.

Deadweight

For this study, the researcher defined the percentage of deadweight as what would happened if the RKB projects had not been implemented in the two investigated Kg. in Kuala Krai, Kelantan. The percentage was determined based on the beneficiaries' level of agreement to the outcomes. This offered the opportunity to ask beneficiaries directly about the project's impact on them and how beneficiaries they thought it was. Applying the deadweight principle to the SROI analysis of the RKB projects is complicated. Without this project, no flood recovery housing project would be implemented, and no beneficiaries would have benefited from the RKB projects. Therefore, no social value would have been generated.

Displacement

According to Nicholls et al. (2012), displacement is not relevant to every analysis. For instance, it is not applicable when analyzing the impact of the built environment. For this study, outcomes resulting from the efforts of the Malaysian Federal Government do not take the opportunity away from other stakeholders to experience this outcome, and others will not displace the outcome. The rationale for this is mostly based on stakeholders" perception that the outcomes experienced by flood victims resulted from a project that would not be replicated elsewhere. Furthermore, it was considered unlikely that the Malaysian Federal Government would have funded a similar post-disaster permanent housing recovery project, given the rarity of this kind of project among flood management projects. Consequently, the displacement of outcomes resulting from the RKB projects is 0%.

Attribution

Based on the results, the beneficiaries were asked whether other local organizations approached the RKB projects. Beneficiaries noted that they have never been approached by any governmental institution or other local organizations contributing to the outcome value. Moreover, the RKB projects were funded solely by NADMA Malaysia, and the project is officially considered under NADMA"s umbrella. Hence, 0% will be attributed.

Drop-off

For this SROI evaluation analysis, questions were included in surveys to collect drop-off data from the beneficiaries. However, this produced an unexpected finding according to the SROI methodology, which is designed to consider diminishing outcomes. All beneficiaries were likely to record that the outcomes of the RKB projects lasted until the present so far. As a result, there is no drop-off in the calculation, and it tends to be calculated as 0%.

Calculation of Impact

When calculating impacts, the researcher followed the precautionary principle by multiplying the quantity of the outcomes by the value of the financial proxies and then deducting the percentage of deadweight of each outcome. Hence, the total social impacts were RM 8,089,193.18 for Kg. Telekong and RM 2,640,444.69 for Kg. Sungai Durian (see Table 3). These values were important for assessing the net social value that the RKB projects had generated.

Stage 5 – Calculating the SROI

After calculating all the impacts of all the identified outcomes, it was finally possible to calculate the SROI of two (2) RKB projects in Kuala Krai, Kelantan. The SROI is obtained by dividing the total present value of the outcomes by the total cost of the stakeholders" inputs. Determining the cost of the inputs was straightforward and retrieved from the project data. NADMA Malaysia invested these funds at a total cost of RM 6,362,144.80 to implement the RKB project in Kg. Telekong, followed by RM 2,617,465.32 for Kg. Sungai Durian. In terms of the present values of outcomes, the total financial valuations were RM 8,089,193.18 for Kg. Telekong and RM 2,640,444.69 for Kg. Sungai Durian. After the calculation, the SROI ratios were 1:1.27 for Kg. Telekong and 1:1.01 for Kg. Sungai Durian. In general, two case studies generated similar results and revealed that all scenarios proved to be value-for-money, with a social value ranging from RM 1.01 to RM 1.27 (see Table 3).

Furthermore, the researchers found that since the outcomes of RKB are mainly focused on flood victims, all the case studies indicated the "value added" is obtained from the social outcomes that new permanent housing generates for flood-affected communities. Therefore, these results are very realistic. The RKB projects have been highly effective and have resulted in substantial positive changes for flood victims who have stayed in RKB projects.

Table 3: Summary of SROI Analysis

Stage 1			Stage 2		Stage 3		Stage 4			
Stakeholder	Inputs		Outcomes	Financial Proxies	Present Value (RM)		Deadweight		Impact (RM)	
	Kg. Telekong	Kg. Sungai Durian			Kg. Telekong	Kg. Sungai Durian	Kg. Telekong	Kg. Sungai Durian	Kg. Telekong	Kg. Sungai Durian
Flood victim	0.00	0.00	Flood victims diverted into RKBs from rental houses and experienced increased housing stability	Cost of monthly house rental fee	240,550.00	49,000.00	12%	10%	211,684.00	44,100.00
			Save the cost of rebuilding and reconstructing damaged houses	Cost of repairing and rebuilding damaged houses	1,642,000.00	557,500.00	27%	22%	1,198,660.00	434,850.00
			Save the cost of buying a new house	Cost of buying a new house	8,200,000.00	2,400,000.00	33%	32%	5,494,000.00	1,632,000.00
			Reduced household assets or goods damaged/lost	Cost of damaged/lost household assets and goods	1,626,837.00	49,000.00	55%	27%	732,076.65	405,186.50
			Reduced number of flood victims suffering from various forms of physical and mental illnesses	Healthcare cost (per family)	13,236.00	557,500.00	45%	37%	7,279.80	828.45
			Reduced the loss of monthly income assistance	Total loss of monthly income assistance (per family)	694,950.00	2,400,000.00	43%	43%	396,121.50	106,134.00
The Malaysian Federal Government	6,362,144.80	2,617,465.32	Maintained children's academic performance	Cost of special schooling aid (per child)	13,400.00	49,000.00	42%	42%	7,772.00	3,306.00
			Reduced the need for emergency financial assistance for flood victims	Cost of emergency financial assistance for flood victims	40,000.00	557,500.00	17%	17%	33,200.00	11,205.00
			Reduced flood waste generated by households and reduced pollutants flushed into the river	Value of flood waste generated (per family)	9,129.60	2,400,000.00	8%	8%	8,399.23	2,834.74
	6,362,144.80	**2,617,465.32**			**12,480,102.60**	**3,771,346.24**			**8,089,193.18**	**2,640,444.69**

Stage 5		
	Kg. Telekong	**Kg. Sungai Durian**
Total Input	6,362,144.80	2,617,465.32
Total Present Value of Outcome	8,089,193.18	2,640,444.69

SROI Ratio	1:1.27	1:1.01
Social Value per RM 1 invested	For every RM 1, nearly RM 1.27 of social value is generated	For every RM 1, nearly RM 1.01 of social value is generated
Value Addedfrom Social Outcomes	**94.60%** (RM 7,651,472.45)	**96.87%** (RM 4,047,080.40)
Value Added from EconomicOutcomes	**5.30%** (RM429,321.50)	**3.05%** (RM 127,595.00)
Value Added from Environmental Outcomes	**0.10%** (RM 8,399.23)	**0.08%** (RM 3,254.70)

Discussion

The results of two different case studies show that when investments are made in developing the flood recovery projects, such as RKB, significant social value is created. This evaluative SROI case study shows that the social value calculated through the SROI analysis produces a considerably greater impact at RM 8,089,193.18 for RKB Kg. Telekong, compared with RM 2,640,444.69 for RKB Kg. Sungai Durian. However, the analysis yielded similar results, showing that the projects guaranteed value-for-money with an SROI ratio of more than 1.0. The results show that the RKB Kg. Telekong showed an SROI ratio of 1:1.27 and 1:1.01 for Kg. Sungai Durian. This means, for every RM 1 invested in the development of the RKB project, between RM 1.27 and RM 1.01 of social value has been created for the flood victims and the Malaysian Federal Government.

Furthermore, the current analysis reveals that investing in RKB projects yields significant social, economic, and environmental returns. Broken down by sustainability aspects, the social outcomes experienced by the beneficiaries received the most value, followed by economic outcomes and, lastly, environmental outcomes. Hence, this result indicates that ongoing investment in flood recovery projects, geared towards sustainable development, particularly in flood-risk communities, generate positive social, economic, and environmental outcomes and directly benefit the Malaysian Federal Government.

This study is the first attempts to value the social value of government flood recovery projects by using an evaluative SROI analysis. It is also one of few studies that have attempted to apply the SROI method on a sector-wide level more generally. In addition, this research successfully outlines a proposed SROI framework that is critical for future SROI analyses of flood management projects by estimating the values associated with investments in two different RKB projects in Kuala Krai, Kelantan. As a result, this study contributed to future studies by estimating the broad benefits the communities receive from investment in flood recovery projects. Ongoing investments like these types of projects are likely to advance positive outcomes and further generate value in communities.

Conclusion

In conclusion, this SROI case study discovered that for every RM 1 invested in the flood recovery project through two different RKB projects, SROIs of more than RM 1.0 in social value have been created for the beneficiaries. The new evidence generated through this study helps to clarify that investing in flood recovery projects like RKB generates significant social value and provides a range of opportunities to support sustainable development of communities, especially those exposed to flooding.

Theoretically, this study provides insight into the SROI framework for government flood recovery projects in Malaysia and extends the application of SROI into the flood management body of knowledge. Continuous research and publications are needed to in society. Therefore, a collaboration between researchers and practitioners would be critical going forward to upscale the robustness of SROI in the flood management area, and more strategic thinking would be required when choosing the SROI tool within the flood management field. Social value measurement approaches such as SROI allow policymakers and other stakeholders to better articulate the case for investing in flood management projects. It also provides stakeholders with a more holistic and transparent framework for demonstrating evidence-based social value to society. Therefore, this study is the beginning of a journey that will provide a platform for improving evidence on the social value of flood management projects. It will also encourage the Malaysian government to conduct SROI analyses, which will help

to reveal, measure, communicate, and appreciate the hidden sustainable value of creating change in communities through social investment.

Acknowledgement

Conflicts of Interest

There are no conflicts of interest in this study.

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META-SYNTHESIS: THE CHALLENGES OF NATIONAL SOCIAL INVESTMENT SCHEME (N-POWER) AND POVERTY REDUCTION IN, NIGERIA

Yakubu, M.S.[1 & 2], Seow, T.W.[2]

[1] Federal College of Education (Technical) Bichi, Kano State, Nigeria

[2] Faculty of Technology Management, University Tun Hussein, Onn, Malaysia.

*Correspondence: muhammadsy.msy@gmail.com

Abstract

The purpose of this study is to review and synthesise the literature on the challenges of N-power program and poverty reduction in Nigeria. Poverty in Nigeria is increasing among the populace at an alarming rate from 85.2 million, to 89.0 million and subsequently 95.1 million (2019, 2020 and 2021) headcounts respectively. Since its inception in 2016, N-power program was intended to reduce poverty among youth via training and providing temporary employments to the beneficiaries with stipends as a form of payment. However, statistics show that there are 13.9 million unemployed youth in Nigeria. Thus, implying that providing employment to 500,000-1million vis-à-vis 13.9 million unemployed youth is unsustainable. Hence, the purpose of this study is to identify the main challenging issues faced by the N-Power programme in reducing its impact on poverty and unemployment. The results show that the N-power program has not contributed meaningfully to poverty reduction among the youth since its contribution is like a drop of water in an ocean. This paper has been able to identify the most challenging issues faced by N-Power programme in terms of poverty reduction. In conclusion, for the N-Power programme to succeed in the long run it has to reduce poverty and unemployment drastically, in order to lead the country towards sustainable development.

Keywords: Social investment scheme, N-power, Poverty, Nigeria

Introduction

The devastating dual impact Poverty and unemployment has always been a headache for regimes and administrations around the world, Nigeria inclusive. The menace has affected the performance of all administrators that governs the country from its independence to date, thus, forcing them to implement various policies and programmes in the country, but with little or no discernible results. These include Operation Feed the Nation (OFN, 1976–1980), Green Revolution (GR, 1980-1983), Directorate for Rural Roads and Infrastructure (DFRRI, 1986), National Directorate of Employment (NDE, 1987), Farm Settlement (FS, 1959), River Basin Development Authority (RBDA, 1979), the 6-3-3-4 Educational Policy (1982), Better Life for Rural Women Programme (BLRWP, 1987), Family Economic and Advancement Programme (FEAP, 1993), National Poverty Eradication Programme (NAPEP, 2001), and National Economic Empowerment and Development Strategy (NEEDS, 2003), Graduate Internship Scheme (GIS, 2013), and Youth Enterprise with Innovative Ideas in Nigeria (You-WIN) programme (You-Win, 2015) (Demefun, Omede& Jacob, 2020).

The grim poverty indices in Nigeria support the necessity for the government and other stakeholders to confront poverty aggressively but effectively, if not for the sake of current generations, then for future generations (Ominyi, Sule & Salifu, 2019). Nigeria has earned the unfavourable designation of "one of the poorest countries in the world" due to poverty. United Nations 2016 assessment on Nigeria's common analysis referred the country is "one of the poorest and unequal countries in the world, with over 80 million people, or 64 percent of the population, living in poverty" (Salisu & Rozita, 2018; Ominyi et al., 2019).

The most recent Social investment Scheme (N-power) started in 2016 with the purpose of addressing rising unemployment, poverty, hunger, inequality, and other problems impacting Nigeria's economic growth. Unfortunately, corruption, nepotism, a lack of a transition plan to permanently employ beneficiaries after their training, bad worker remuneration, weak governance, and underfunding have all been highlighted as flaws in the N-power programme (Chimere & Urama, 2019; Auta, Giwa & Nnajiofor, 2020; Lamidi & Igbokwe, 2021). This therefore makes the issue of poverty in the country to be a subject that will need more rudimentary method to achieve the desired objective.

Assessment of the impact of N-power on poverty reduction in Nigeria

Although N-power has been instrumental in alleviating poverty, its impact is very minimal or better still negligible. According to Figure 1 below, from 2016 when the N-power program began until to 2022, the number of people living below the poverty line has been increasing.

The poor below-poverty line

88,425   86,675   84857   77,900   73,360   71,674   70,024

2022   2021   2020   2019   2018   2017   2016

——the poor under-poverty line
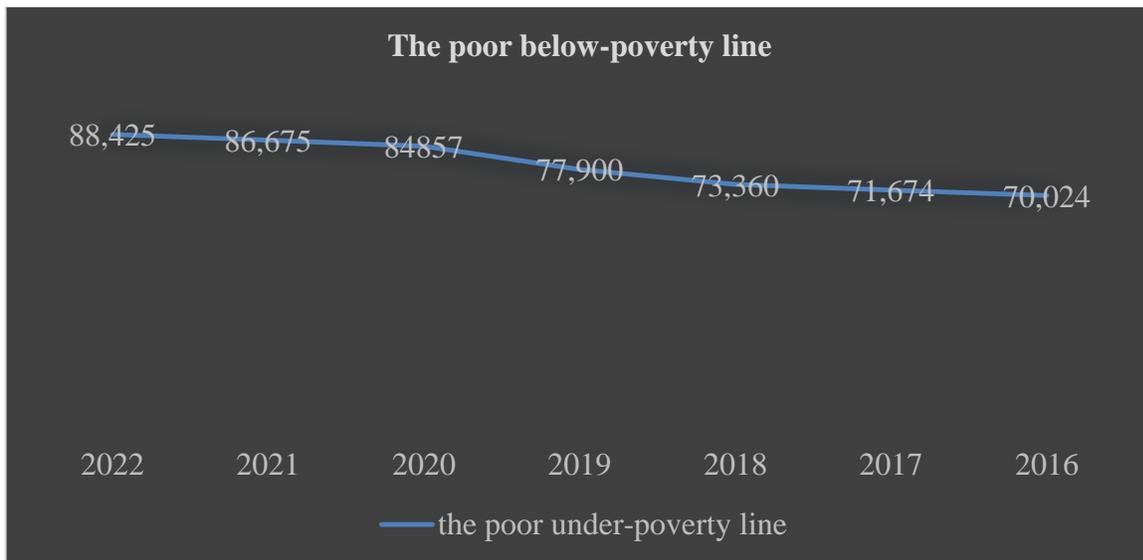
Figure 1: The Number of People below Poverty Line

From these figures, it can be seen that N-power has not done much in alleviating poverty in Nigeria. At best, N-power is a plow to siphon government money by corrupt government officials.

Research Methodology Used in This Study

This study adopted a systematic and integrative literature to identify, evaluate, synthesize, and discussed the existing literature (Tranfield, Denyer, & Smart, 2003; Fink, 2013). This helps in studying the observe phenomenon by enhancing the understanding and guiding ways toward the identification of the unsolved and critical issues, which gives room for further research (Fink, 2013). Hence, in this study, we adopt the methodologies used by different well-known researchers, such as (Hohenstein, Feisel, & Hartmann, 2014; Rashman, Withers, & Hartley, 2009; Soni & Kodali, 2011; Winter & Knemeyer, 2013), with a focus to include peer-reviewed and high-quality articles. Mckinnon (2013) stated that frequently cited papers show its quality.

Kiel, Arnold, Collisi, & Voigt, (2016), stated those relevant journal articles are paramount to gathering information on specific issues. Base on the above, high-quality journal articles were considered in this study. Initially, the database scan and search results identified 362 papers in Emerald Insight, Science Direct, ProQuest and Google Scholar, which shows at least one keyword in abstract or title, which

were published in 2016-2022. However, inclusion and exclusion criteria enclosed as appendix I, which shows detail about the full reviews and selection process.

Finally, the quality and relevancy of the articles were evaluated concerning research goals and their results. Thereby, the high quality and comprehensiveness of the article at hand are ensured. Non-relevant articles were extracted as discussed in the enclosed Appendix, I and only 42 articles were found relevant for the analysis. Figure 2 below further explains the article selection process for transparency, systematic, and reliable review.

Search in Database
- Science Direct
- Emerald
- ProQuest
- Google Scholar

Criteria: Time period, Keywords, Access to full text

3

Reading of Abstract, and conclusion, adding references

Required Criteria: relevance, quality and no duplications

1
2

Reading of high quality, relevance articles entirely

42
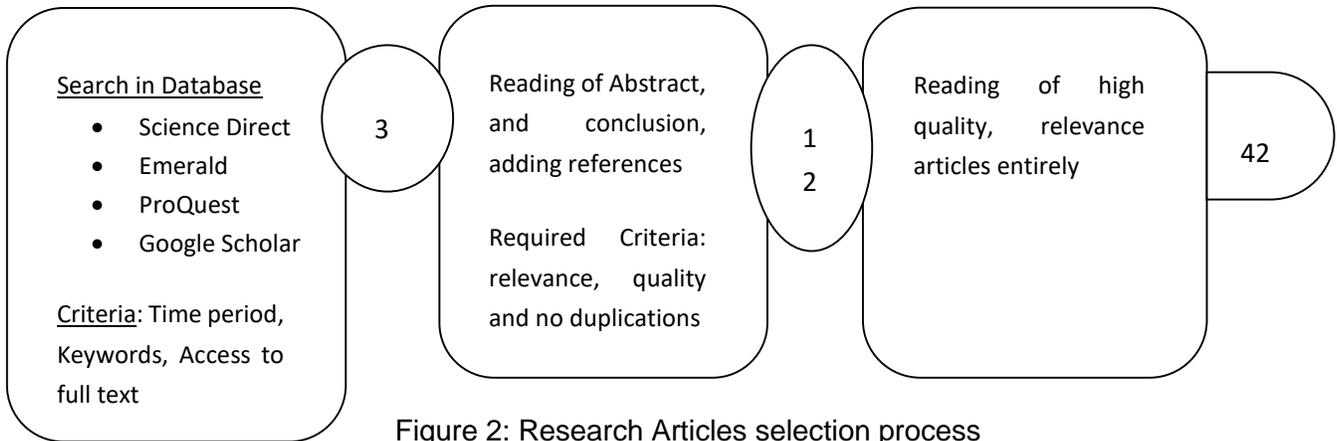
Figure 2: Research Articles selection process

The challenge has been used as a synonym for hindering growth, obstacles, and constraints. The conclusion and abstracts of duplicates and similar articles have been reassessed for the relevancy with the research problem. Furthermore, the bibliographies of relevant articles have been reviewed while use the snowball method to ensure the non-leaving of any relevant articles. The above methodological approach has been adopted and consistent with (e.g., Franke & Knyphausen-Aufsess, 2014; Winter & Knemeyer, 2013; Soni & Kodali, 2011; David & Han, 2004; Webster & Watson, 2002). This resulted in a sample of 42 articles to be subsequently read in their entirety.

Theory of Constraints and N-Power Challenges on poverty Reduction in Nigeria

According to Leach (2010) every organization faces a few constraints preventing its smooth transition to development. Simsit, Günay & Vayvay (2014) views the theory of constraints as interconnected chain of rings that represent a system and should not be split by any stumbling block. The ideal system must face constraints but have to handle them professionally in the best possible way (Mabin, 1999). The theory offers a complete set of tools to achieve overall goals properly. In N-Power Scheme, mostly, the issues are related to institutional development, human resource development and financial development capacity building.

Nigeria, it is believed, will have nothing to do with unemployment and poverty after the programmes are completed (Sani, Salisu & Tijjani, 2020). It was further added that despite its contribution, N-power face many challenges. These opportunities and challenges are many across the country. (Ogunmodede, Ogunsanwo & Manyong, 2020) stated that N-Power scheme in Nigeria faces many problems that constraint their contribution. This argument is also confirmed by numerous authors in their theoretical level studies such as, access to finance, poor infrastructure, inadequate monitoring, poor management skills, poor governmental policies, poor synergy and cohesion amongst the federal,

state and local governments, access to resources, improper exit plan etc., (Chimere &Urama, 2019; Auta, Giwa &Nnajiofor, 2020; Lamidi & Igbokwe, 2021; Yakubu, Seow & Wadood, 2021 & Olawoyin, 2022).

Nigerian government cannot afford the failure of N-Power scheme because it will have negative effects on the administration, unemployment, socio-economic development, security, and increase the ratio of poverty (Daura et al, 2020). The challenges that are identified by different researchers in different parts of the country are preventing N-Power from achieving its intended objective, Nigeria's growth and interfere with its competitive tendencies. Furthermore, it was also confirmed by many studies that N-Power face many challenges, i.e., internal and external; some of them are beyond their control (Odey, & Sambe, 2019).

However, there is no specific theory and clear guidelines as to whether N-Power programme will sustain and maintain its position. However, many scholars have identified essential elements that are hindering N-Power's growth and focus on it will to decrease poverty and will lead towards sustainability (Akujuru, & Enyioko, 2019; Onyekunle, 2020). This is depicted in Table 1 below:

Table 1: Institutional, Human Resource and Financial Development.

Author(s)/ Year	Institutional Development		Human Resource Development				Financial Development	
	Policy & Framework	Facilities & Equipment	Workshop & Training	Accountability	Feedback, Monitoring & Evaluation	Recruitment & Promotion	Financial Budgeting	Financial Control
Waziri, et al (2020)	√		√		√			
Eger, et al (2018)		√	√			√		
Ogundipe, et al (2021)		√	√	√			√	
Ogunmodede, et al (2020)	√	√	√					√
Lamidi & Igbokwe (2021)		√	√			√		
Onah, (2021)	√				√			√
Sani, et al (2020)			√		√	√		
Shabbir, et al (2019)								
Chukwama & Bossert (2018)		√	√	√			√	
Dankumo et al (2019)	√		√					√
Ademefun et al (2020)		√	√		√			
James et al, (2019)			√		√			
Agwu & Kadiri, (2018)		√				√		√

Ekpenyong & Edokpolor (2016)	√		√				√	
Babjaková, et al (2019)		√						
Ashafa & Sidiq (2020)	√			√				√
Abbas, (2016)	√	√	√	√			√	√
Chimere & Urama (2019)	√	√		√				√
Gans-Morse, et al (2018)	√		√	√	√	√		
Fiala, (2018)	√		√					
Li-jian, et al (2021)	√				√		√	
Shao-ping, et al (2021)		√	√					
Fan & Cho (2021)	√		√		√			√
Adi, et al (2020)		√	√	√	√	√		√
Adeyanju, (2017)	√		√			√		
Adegbuyi, et al (2016)	√			√			√	√
Rui & Feng-ying (2021)		√	√		√			
Ingiabuna, (2021)	√		√	√			√	√
Ming-yue, et al (2021)	√		√				√	
Dapel, (2018)	√				√			√
Chao, et al (2021)		√	√		√			
Salisu & Rozita (2019)	√			√				√
Adi & Ngutor (2019)		√			√	√	√	√
Daura, et al (2020)	√				√			
Nwaobi (2019)		√	√		√			
Mohammed, et al (2019)	√		√					√
Akujuru & Enyioko (2019)				√	√			√
Auta, et al (2020)			√		√			
Yakubu & Seow (2021)	√		√			√		
Bloomfield, et al (2018)	√	√	√		√		√	
Oyekunle, (2020)		√	√					√
Bayudan-Dacuycuy & Baje (2017)	√		√			√		

The above table shows that most cited constraints that hindered N-Power's growth and success in Nigeria are poor access workshop/training and default in the policy framework. (Demefun, Mede, and Jacob, 2020; Ashafa & Sadiq, 2020). Subsequently, lacks of proper monitoring/evaluation, inadequate facilities, poor recruitment process, as well as lack of financial budgeting and control are the most common problems hindering the growth of N-Power Programme (Chimera & Urama, 2019). There are also some specific external challenges such as Covid-19, global economic melt-down, poor management, entrepreneur characteristics, deficiencies in marketing strategies, low technological capacity, and low investment in research and development also affect N-Power's role in poverty reduction (Odey & Sambe, 2019; Oyekunle,2020; Akujuru & Enyioko, 2019).

Conclusion and Future Research Guidelines

This systematic literature review identifies the specific constraints N-Power programme faced in reducing poverty and unemployment in its routine operations. The analysis also reveals that research on N-Power constraints/challenges in the areas of institutional development, human resource development, and financial development. The review highlights further lack of coordination in the policy framework, inadequate facilities & equipment that adverse effectiveness of the programme's economic objectives. There are also constrained by underdeveloped capabilities in key areas such as recruitment, training, accountability, monitoring and evaluation, networking, marketing, business planning, and HR, which limits the ability to build more advanced capabilities that could stimulate and support growth. Managerial and business skills, along with better education, facilitate the engagement in more advanced growth-driving business practices, emphasizing management's role in driving growth. Moreover, besides the influence of various external factors, the institutional environment is characterized by deficiencies in budget & financial control, thus, another constrain failing to create conditions supportive of growth-oriented businesses.

Therefore, in the case of N-Power programme, significant growth can be simulated by supporting the development of critical capacity building and the implementation of critical practices, which may highlight growth opportunities and stimulate ambition. How they should have managed those networks, determine the optimum number of networks, and set priorities to different networks are all questions that need further research. Due to various constraints, N-Power is unable to achieve the desired objectives. Further studies may identify which N-Power programme should give its priorities. Therefore, future research may explore how these capabilities are accumulated in N-Power programme as well as their impact on poverty reduction.

Acknowledgement

Declaration of competing interest

The authors declare that they have no conflict of interest.

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THE EFFICIENCY IN ESTIMATING EVAPORATION IN THE REGIONS OF NORTH AND CENTRAL GHOUR USING (SEBAL) MODEL

Al-Salal, S, ALorou, I., Tan, M.L.[*], Samat, N.
GeoInformatic Unit, Geography Section, School of Humanities, Universiti Sains Malaysia, 11800 USM, Pulau Pinang, Malaysia
*Corresponding: mouleong@usm.my

Abstract

Water is a basic necessity to sustain life and a mainstay for its growth and cities development. Evaporation constitutes a large part of the hydrological cycle and is an important factor in the water budget in arid regions. Estimating evapotranspiration is a key element in managing water resources. Traditional techniques for calculating daily evapotranspiration on the basis of field measurements are valid only for standards local. The study aimed at applying (SEBAL) model which uses energy balance equation on the surface to calculate evaporation in North and central Ghour on (13/4/2018) based on (Arcgis) software, the data of (Landsat 8) from the United States Geological Survey (USGS) and the data taken from meteorology. After that, the required calculation processes were performed to calculate the actual evaporation, where the surface albedo, surface reflection, botanic cover indicators, surface temperature, and surface energy outflow, including net solar radiation (Rn), soil heat flux (G), sensible heat flux (H), and latent heat flux (λET) were calculated. The results showed that the momentary evaporation value ranged between (0.09- 0.44) ml/h, and that the value of daily evaporation ranged between (1.33-6.11) ml/ day. Also, the calculated results of (SEBAL) model showed a considerable convergence when compared with the results of the container's evaporation measured in the study area for that day.

Keywords: Evapotranspiration (ET) , GIS, Remote Sensing, SEBAL.

Introduction

With growing attention to climate elements and climatic changes and their effects on the environment and ecological systems, the interesting of evapotranspiration estimation is increased as well, especially with the emergence of various measuring techniques for assessment of climate elements. Recently, remote sensing has become one of the valuable data sources and analysis techniques for implementing such studies (Beg et al ,2016). Apart from precipitation and runoff, Evapotranspiration (ET), which is a key contributor to the water cycle process, provides the primary route for water transport in terrestrial ecosystems(Li et al ,2013 ; Liu et al ,2016) Hence, ET is an important parameter for understanding and studying the water balance and heat balance process in ground and air interactions. ET is also an important indicator of vegetation growth and crop yield (Lv et al, 2018), ET can be measured over a homogenous surface using conventional techniques such as the Bowen ratio, eddy covariance, water balance and at field scale using Lysimeter systems (Bala et al ,2015),these theories have enjoyed relative success, but they still face several limitations when applied on a regional scale. Therefore researchers are focusing on the estimation of ET through RS as it is the unique way to retrieve ET at several temporal and spatial scales, One such method that has been implemented and is based on a physical mathematical procedure is SEBAL (Surface Energy Balance Algorithm for land) The model is developed by Bastiaanssen et al (1998) and has been validated at many locations around the world (Allen, 2002; Bastiaanssen, 2000; Morse et al., 2000).. These techniques provide spatial information from the earth's surface by measuring reflected and emitted electromagnetic radiation. The measurements of thermal infrared, infrared and visible bands of remote sensing data are the inputs for the parameterization of the energy balance components in the calculation of ET (Hailegiorgis, 2006). Bastiaanssen et al. (2005) proved the importance of SEBAL method in establishing a variety of measurements and assessments, including land use and water use for river basin

planning, impact of water conservation, environmental impact assessment, hydrological modeling and more other application. Researchs confirms the robustness of SEBAL and compares experimental results with fluxes For example, compare (Mingxing et al, 2020) the ET estimated from SEBAL model with the ET calculated from the FAO56 Penman-Monteith equation, and a correlation of about 80% was observed (Gobbo et al, 2019) used the SEBAL approach to verify the susceptibility of ET in agricultural crops and compare it with the ground weather data in the Venice Lagoon region in Italy.

Studies conducted to estimate evaporation using the SEBAL method are very rare in Jordan. This paper examined evapotranspiration estimation in the northern and central Jordan Valley, remote sensing data will be the fastest and most reliable source for evaporation estimation. The main objective of the current study is to evaluate the SEBAL model in estimating ET in the study area using Landsat 8 data based on building several analysis models using Arcgis software.

Study Area

The study area is located in the northwestern part of Jordan, as it extends from the western region of Irbid Governorate in the north to Al-Balqa in the middle (Abed, 2000). It is spread between longitudes (35 ˚ 82' 35") (36 ˚ 58' 35") E, and between latitudes (29 ˚ 55' 31") (30 ˚ 39' 32") N, and the area of the study is about 477 km^2 (Figure 1). The northern and central valleys represent a longitudinal landmark that extends over a distance of 105 km, and its width is approximately about 15 km, narrowing by 7 km at Tell al-Qarn located in the middle of the valley. The height of the study area ranges from 389 m below sea level north of the Dead Sea to a height of 338 m until sea level south of Lake Tiberias. The valley penetrates the Jordan River and a group of side valleys that supply the waters of the Jordan River. (Abed, 2000). The study area includes the most important agricultural areas and water resources in Jordan, as they constitute about 70% of the irrigated land area The climate of the study area is several degrees warmer than the surrounding areas The further north we go, the temperature decreases, the rainfall increases, and the soil becomes more fertile (Al-Buhairi, 1998).
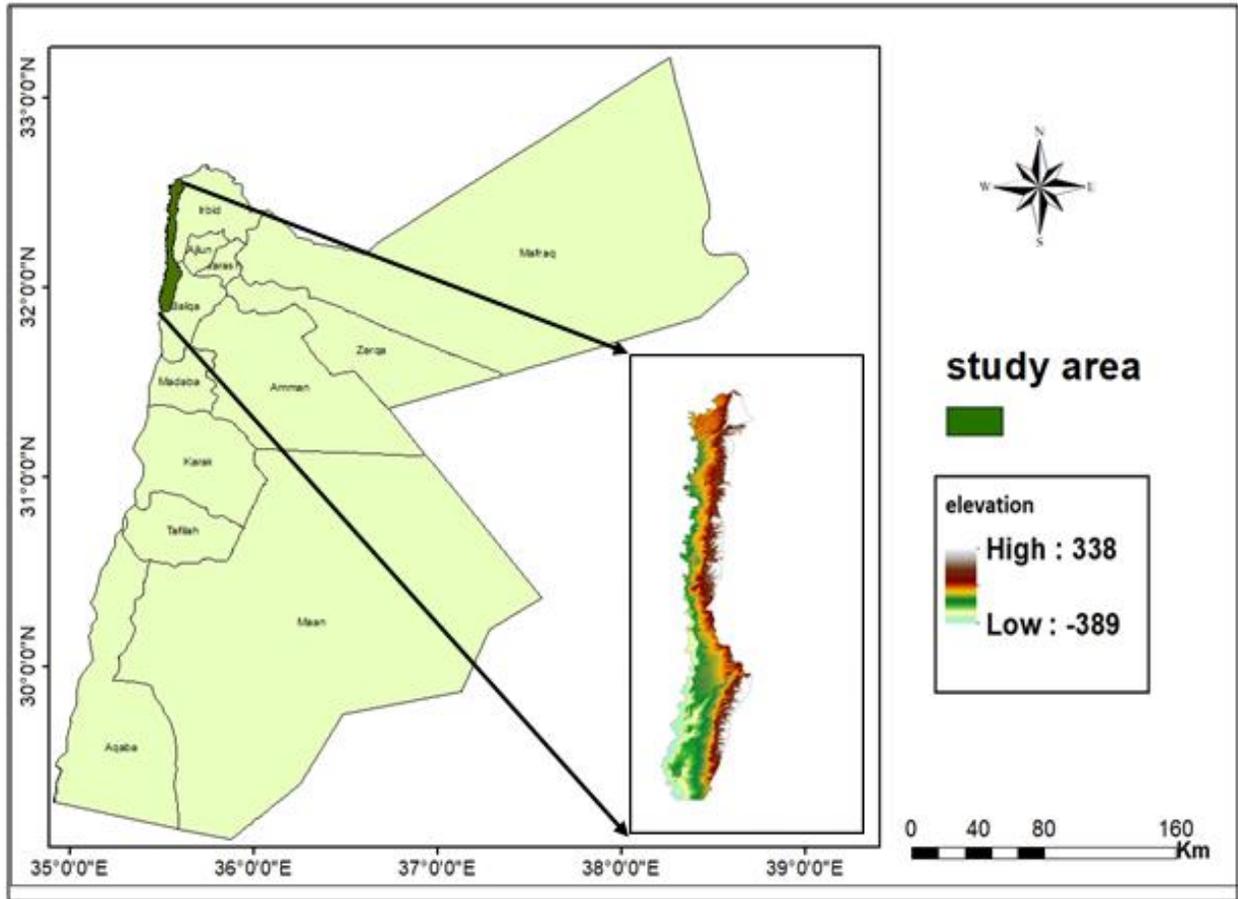
Figure 1: Location of study area

Materials and Methodology

A satellite image was downloaded from the Landsat 8 satellite on 13/4/2018 from the website of the United States Geological Survey (USGS) to estimate evapotranspiration and to match the weather conditions. The visual was clipped to the study area, and the visual was projected using the Jordanian Geographical Projection System (JTM). Hourly data for atmospheric elements were obtained from the Meteorological Department on 13/4/2018. The data used represented the following elements: temperature, wind speed, relative humidity, and solar brightness. Then spatial analysis models are prepared for calculating the reflectance, surface albedo, emissivity, surface temperature, and elements of solar radiations balance, including net radiations, soil heat flux, sensible heat flux, latent heat flux, and finally calculating the instantaneous and daily evapotranspiration values. The following points summarize the steps for calculating evaporation using the SEBAL model.

Calculation of Spectral Radiance.

The first step in the SEBAL procedure was to convert the numerical numbers in the satellite visuals to the spectral radiation values by calculating the spectral radiation of the moon (landsat 8) according to the main equation that depends on the addition and multiplication value of the spectral radiation value (radiance add & multi-band). (Abdul-Radi, 2013)

$$L\lambda = ML*Qcal + AL \qquad (1)$$

Where Lλ = TOA spectral radiance (Watts/(m2*srad*μm)); ML= Band-specific multiplicative rescaling factor from the metadata (RADIANCE_MULT_BAND_x, where x is the band number); AL= Band-specific additive rescaling factor from the metadata (RADIANCE_ADD_BAND_x; x is the band number); Qcal = Quantized and calibrated standard product pixel values (DN).

Correction of error in spectral radiation values is important to avoid atmospheric effects and the previously calculated spectral radiation values are converted into Surface Reflectance (Al-Jashami, 2018) according to the following equations

$$\rho_\lambda = \frac{\pi L(\lambda)}{E_{sun}(\lambda) \times \cos(\theta) dr} \tag{2}$$

Where ρ_λ= TOA planetary reflectance, θ= Is in decimal degree need to be converted into radians as follows:

$$\theta = \text{solar zenith} = 90\text{- solar elevation} \tag{3}$$

dr= It is the relative distance between the Earth and the sun according to the day of the year, and it is calculated through the following equation:

$$d_r = 1 + 0.033 \, \text{COS}(\text{DOY} \frac{2\pi}{365}) \tag{4}$$

where DOY = It is the sequence of the day of the year.

E_{sun}= Exoatmospheric spectral solar irradiance on a surface perpendicular to the sun's ray

(Wxm⁻²xμm⁻¹) as given by Table 1.

Table 1: Exoatmospheric spectral solar irradiance (ESUN) of Landsat-8 OLI bands

Band	2	3	4	5	6	7
TOA _Esun	2067	1893	1603	972.6	245	79.72

Calculation of Surface Albedo

Albedo is the ability of a surface to reflect light falling on it from a light source within a specific wavelength range of the visible and near-infrared spectrum, and the value of the albedo varies according to the characteristics of the Earth's surface. (Al-Jashami, 2018) he values of albedo for the top of atmosphere are calculated as:

$$\alpha_{toa} = \sum(\omega_\lambda \, x \, P_\lambda) \tag{5}$$

$$\omega_\lambda = \frac{Esun_\lambda}{\sum Esun_\lambda} \tag{6}$$

Where $\omega\lambda$ = constant value of weighting coefficient. The value of the total surface reflectivity rate is calculated through the satellite (landsat 8) according to the following equation:

$$\alpha_{TOA} = 0.356 \, X ref_2 + 0.326 \text{ x } ref_3 + 0.138 \text{ x} ref_4 + 0.084 \text{ x } ref_5$$

$$+ 0.056 \text{ x } ref_6 + 0.041 \text{ x } ref_7 \qquad (7)$$

Where α_{TOA} is the weighted albedo and ref 2,3,...7 are the planetary reflectance values for each band. The weighted albedo is converted to surface albedo based on the following equation

$$\alpha = \frac{(\alpha_{TOA} - \alpha_{Path-radiance})}{T^2 sw} \qquad (8)$$

Where α is surface albedo $a_{Path-radiance}$ is the incoming shortwave radiation flux reflected back to the sensor (ranged from 0.025 to 0.04), in SEBAL the value of 0.03 is used. $T^2 sw$ is the atmospheric transmissivity, it is calculated as:

$$T_{sw} = 0.75 + 2 \text{ x} 10^{-5} \text{ x Z} \qquad (9)$$

Where z is an elevation of the weather station above sea level.

Calculation of Land Surface Temperature

-Calculation of the Normalized Difference Vegetation Index (NDVI)

The vegetation difference index is important in the process of calculating the vegetative land cover; Its value ranges between (-1 to 1), and positive values indicate the presence of vegetation cover, and negative values mean that they are bare waste lands. In the process of calculating the values of the vegetative difference index (Allen, 2002), this is done according to the following equation:

$$\text{NDVI} = (\text{NIR-RED})/(\text{NIR+RED}) \qquad (10)$$

Where NIR is reflectivity in the near-infrared band , RED is reflectivity in the visible red band .

- Calculation of the Soil Adjusted Vegetation Index (SAVI)

Soil properties differ in terms of mineral and chemical composition, texture, moisture content, and the percentage of organic matter (Al-Jashami, 2018), Therefore, the modified vegetation cover index of the soil is calculated according to the following equation

$$\text{SAVI} = \frac{(1+L) \times (\text{TIR}-\text{RED})}{(L+\text{TIR}+\text{RED})} \qquad (11)$$

Where L= is a constant, which depends on the area properties, L ~ 0.5 is used , TIR =is Infrared reflectivity.

-Leaf Area Index (LAI) Calculation

It represents the total area of all leaves in the plant to the land area, and is an indicator of biomass, and it is calculated according to the following equation:

$$LAI = - \ln(0.69\text{-}savi/0.59)/0.91 \qquad (12)$$

Land Surface Emissivity is the ratio of the radiant emission of an object to the radiant emission of a black body at the same temperature and wavelength. In the SEBAL model, land surface emissivity is derived from the empirical formula associated with NDVI

$$\varepsilon = 1.009 + 0.047 \ x \ln(NDVI) \qquad (13)$$

Where $\varepsilon \ is$ emissivity, NDVI is Normalized Difference Vegetation Index .

The surface temperature of the Earth is calculated through the use of vegetative and emissive indicators, and accordingly, calculating the Earth's surface from the heat packages of the satellite series sensors (Landsat) in Table (2) requires calculating the brightness temperature first (Tb), or the so-called black body temperature at the satellite, It is calculated according to the following equation (Weng, et al 2004)

$$T_b = \frac{K2}{\ln\left(\frac{K_1}{L_\lambda}+1\right)} \qquad (14)$$

Where Tb is black body temperature at satellite in Kelvins, K1 and K2 are calibration constants for Landsat-8 OLI/TIRS thermal band-10, their values are K1 =774.89 $Wm^{-2} \ .ster^{-1}.\mu m^{-1}$ and K2 = 1321.08 in Kelvin , l_λ is spectral radiance in $W.m^{-2}. \ ster^{-1}.\mu m^{-1}$ and is calculated by the following equation

$$l_\lambda = 0.0370588 \ x \ DN + 3.2 \qquad (15)$$

Table 2 .K1 and K2 Values

	K1	K2
LANDSAT_8	774.89 b10	1321.08b10

then the corrected land surface temperature (Ts) is calculated

$$TS = \frac{Tb}{1+\left(\frac{\lambda \ x \ Tb}{\gamma}\right)x \ln \varepsilon} \qquad (16)$$

Where λ is the average of limiting wavelengths of band 10 of Landsat8-TIRS λ =10.895μm),$\gamma \ is \ the \ constant \ value$ (0.01438 m/K) It is calculated based on a = Boltsmann constant (1.38 x 10^{-23} j.k) , h= plank constant (6. 626 x 10^{-34} j.s), c = velocity of light (2.998 x 10^8 m/s)

$$\gamma = h \ x \ c \ /a \qquad (17)$$

Calculation of Solar Radiations Elements

The flux of net solar radiation (Rn) represents the radiant energy available at the surface

(2002, Allen), and it is calculated according to the following equation

$$RN = (1- a) \ x \ RS\downarrow + RL\downarrow - RL\uparrow - (1- \varepsilon) \ x \ RL \downarrow \qquad (18)$$

Where RS↓ incoming shortwave radiation (Watt/m2), α is the broadband surface albedo (dimensionless), RL↓ is the incoming longwave radiation (Watt/m2), RL↑ is the outgoing longwave radiation (Watt/m2) and ε is the surface emissivity (dimensionless) (Figure 2).
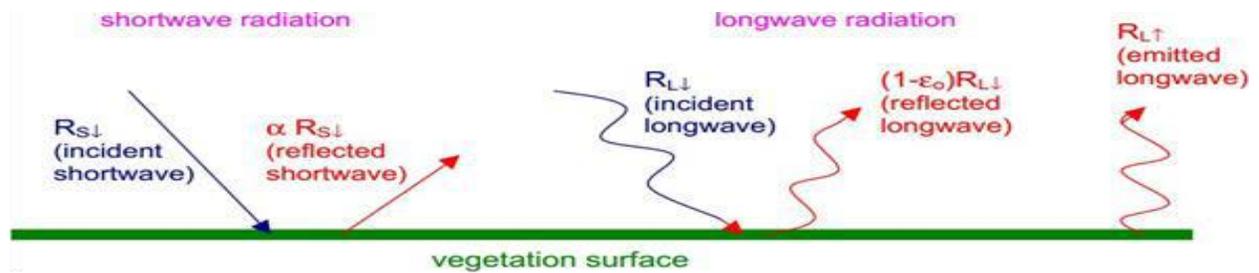
Figure 2: Surface Radiation Balance

The incoming shortwave radiation (Rs↓) is computed from the available climatic parameters such as sunshine hours, relative humidity, maximum and minimum temperature cloud cover and geographic location (Chiemeka,. 2008 ; Waters et al ,2002)

$$RS\downarrow = G_{SC} \ x \ COS\theta \ x \ d_r \ x \ T_{sw} \qquad (19)$$

Where G_{SC} is solar constant (1,367 W/m2), θ is the solar incidence angle $\theta = 90 - \emptyset$, where $\emptyset$ = sun elevation angle, given in the header data file of the LANDSAT_8 imagery, dr = Earth-Sun distance in astronomical, and T_{sw} is the atmospheric transmissivity

The outgoing longwave radiation (RL ↑), is computed at each pixel using Stefan-Boltzmann

equation

$$RL\uparrow = \varepsilon \ x \ \sigma \ x \ T_S^4 \qquad (20)$$

Where ε is the surface emissivity, σ is Stefan-Boltzmann constant (5.67 x10^{-8} W/m^2 /k^4)

and Ts is surface temperature in K.

To compute the incoming longwave radiation (RL ↓), the hot and cold pixels must be selected as anchor pixels, The "cold" pixel is selected as a wet, well-irrigated crop surface having a full ground cover by vegetation. The surface temperature and near-surface air temperature are assumed to be the similar at this pixel. The hot pixel is selected as a dry, bare agricultural field where ET is assumed to be zero. Both "anchor" pixels should be in large and homogeneous areas that contain more than one thermal band pixel. The surface temperature of cold pixel is used as near surface air temperature (Ta) to calculate the incoming longwave radiation (RL ↓) using the following equation (Emara et al ,2018):

$$\text{RL} \downarrow = \varepsilon_a \text{ x} \sigma \text{ x } T_a^4 \qquad (21)$$

Where Ta =Ts for selected cold pixel in K, ε_α is air emissivity computed from the following empirical equation

$$\varepsilon_\alpha = 0.85 \text{ x } (- \ln T_{sw})^{0.09} \qquad (22)$$

Calculation of Soil Heat Flux (G)

The first step in calculating G is to compute the ratio G/Rn using the following equation developed by (Bastiaanssen 2000):

$$\frac{G}{RN} = \frac{Ts}{a} \text{x } (0.0038 \text{ x a} + 0.0074 \text{ x } a^2) \text{x } (1 - 0.98 \text{ x } NDVI^4) \qquad (23)$$

Where, Ts The surface temperature (C°) ,α The surface albedo(dimensionless) ,$NDVI$ The Normalized Difference Vegetation Index.

G is then readily calculated by multiplying G/Rn by the value for Rn computed in equation (19)

Calculation of Sensible Heat Flux (H)

The sensible heat flux (H) is defined as the rate of heat loss to the air by convection and conduction due to a temperature difference (Oberg & Melesss, 2006; Morse et al ,2001) it is computed using the equation for heat transport.

$$H = \frac{P_{air} \text{ x } C_p \text{ x} dT}{r_{ah}} \qquad (24)$$

Where; H is sensible heat flux, P_{air} The density of air (kg/m^3), C_P The air specific heat (1004 J/kg/K), dT The difference (dT = T1 – T2) between two heights (z1 and z2) ,r_{ah} The aerodynamic resistance to heat transport (s/m) (Waters, et al ,2002 ;Tasumi, et al, 2003)

The aerodynamic resistance to heat transport (rah) is computed for neutral stability as follows:

$$r_{ah} = \frac{\ln(\frac{Z_2}{Z_1})}{U_* \text{ x } K} \qquad (25)$$

Where, z1 and z2 The heights in meters above the zero-plane displacement of the vegetation The used values
are 2.0 m, 0.1 m respectively, $u*$ The friction velocity (m/s) , k Von Karman's constant (0.41).

The friction velocity $(u*)$ is computed during the first iteration using the logarithmic wind law for neutral
atmospheric conditions using the following equation:

$$U_* = \frac{K\,U_X}{(\frac{Z_X}{Z_{om}})} \tag{26}$$

Where, k Von Karman's constant (0.41) , U_X Wind speed m/s at height $,zx$ (weather station) Z_{om} The
momentum roughness length (m).

The momentum roughness length for each pixel is calculated as a function of LAI(Waters, et al ,2002)

$$Z_{om} = 0.018\;x\;LAI \tag{27}$$

To complete H calculation, a temperature difference (dT) must be defined. SEBAL computes dT for each pixel
by assuming a linear relationship between dT and Ts

$$dT = b + a\;Ts \tag{28}$$

a and b are coefficients derived by utilizing the anchor pixel concept. To do this, some parameters should be
collected for the two anchor pixels which are:

- Rn and G, and surface temperature for the hot pixel. Rn and G, and surface temperature for the cold pixel. ETr
at overpass time of the satellite.
- Compute H for the two anchor pixels as follows:

$$Hcold = Rn - G - 1.05\;\lambda ETr \tag{29}$$

$$Hhot = Rn - G \tag{30}$$

Calculate dT for the two anchor pixels as follows:

$$dTcold = \frac{Hcold * rah-cold}{\rho air * cp} \tag{31}$$

$$dThot = \frac{Hhot * rah-hot}{\rho air * cp} \tag{32}$$

$$a = \frac{dThot - dTcold}{Ts\;hot - Ts\;cold} \tag{33}$$

$$b = dTcold - a * Ts\;cold \tag{34}$$

Calculation of Latent Heat Flux (λET), Instantaneous ET (ETinst), 24-Hour Evapotranspiration (ET24) and Reference ET Fraction (ETrF).

Latent heat flux is the rate of latent heat loss from the‹ surface due to evapotranspiration (Beg et al.,2016))All the components of the energy balance equation are now computed. λET, ETinst and ETrF can be calculated to get an ET map for the target area. Compute λET using the equation

$$\lambda ET = Rn - G - H \qquad (35)$$

Where, **λ**ET Is an instantaneous value for the time of the satellite overpass (W/m2) (Figure 3)
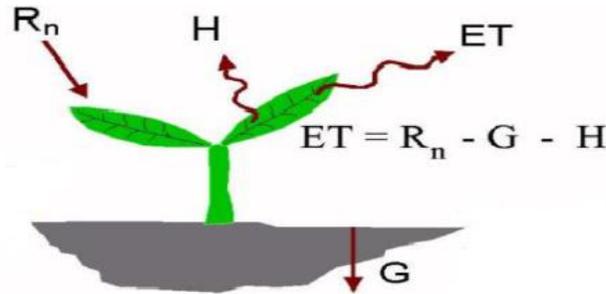
Figure 3: Surface Energy Balance (Wu et al ,2010).

An instantaneous value of ET in equivalent evaporation depth is computed as follows:

$$ETINST = 3600 * 1000 * \frac{\lambda ET}{\lambda * \rho w} \qquad (36)$$

Where, $ETINST$ The instantaneous ET (mm/hr) ,3600 The time conversion from seconds to hours, 1000 The conversion from meters to millimeters, ρw The density of water (~1000 kg/m3), λ The latent heat of vaporization or the heat absorbed when a kilogram of water evaporates (~2257000 J/kg).(Woodward et al. 2011)alternatively, can be calculated as

$$\lambda = (2.501 - 0.00236(Ts - 273.15)) * 10^6 \qquad (37)$$

Then the reference ET fraction (ETrF) computed as follows

$$ETrF = \frac{ETINST}{ET_r} \qquad (38)$$

Where, ETr The reference ET at the time of the image.

Daily values of ET24 are computed by assuming that, the computed instantaneous ETrF is the same as the 24-hour average. Therefore, the ET24 (mm/day) can be computed as:

$$ET24 = ETrF * ETh\_24 \qquad (39)$$

$$ET_{r-24} = \sum_{h}^{24} ET_{r-h} \qquad (40)$$

Where, ETr_24 The cumulative 24-hour ETr for the day of the image.

Using remote sensing data, the components of energy balance were derived.in 40 computational steps to calculate the actual (ETa).Figure 4 depicts the structural chart of the SEBAL model.
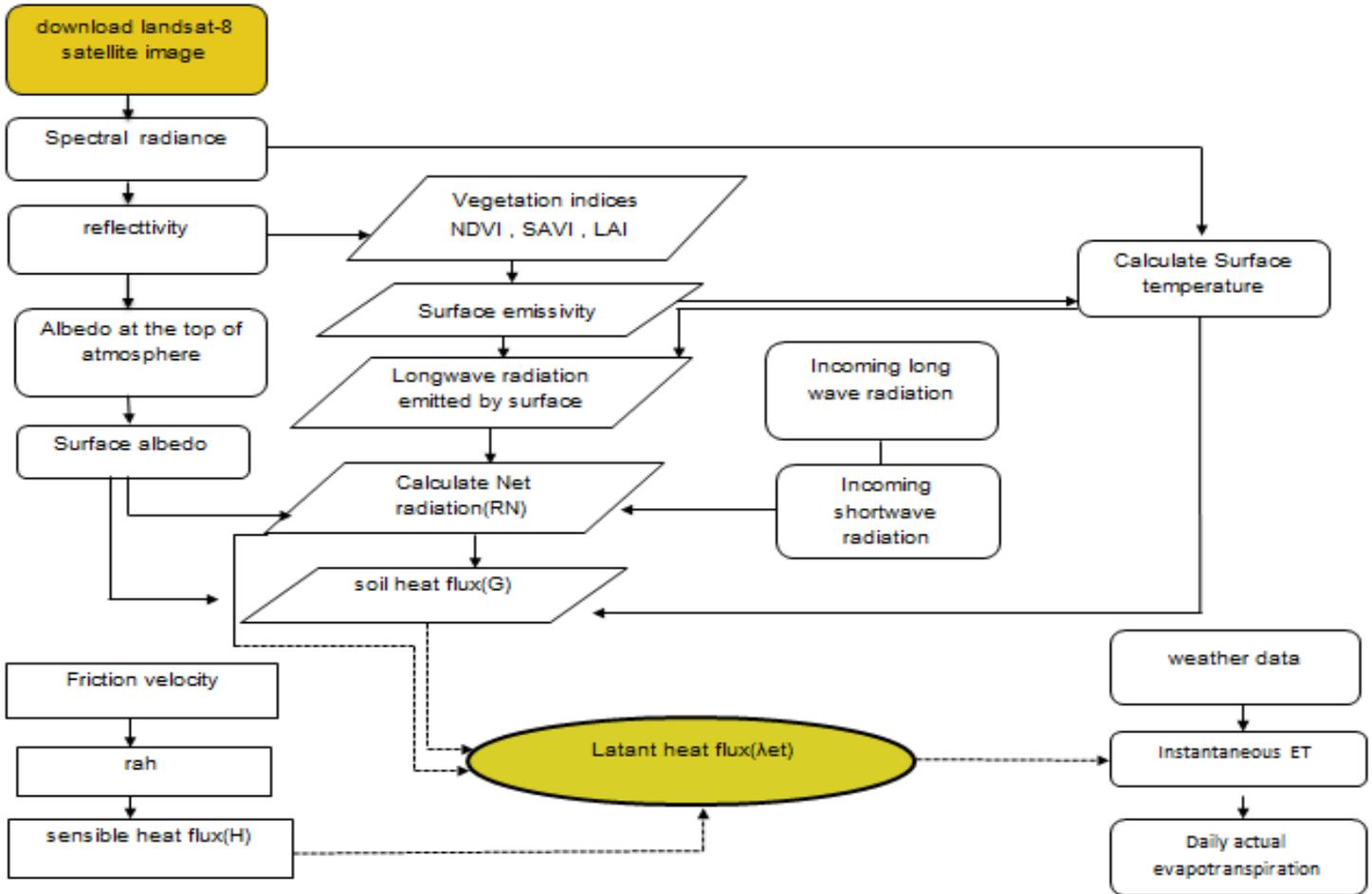
Figure 4: Flowchart of computational steps used to obtain the daily evapotranspiration

Results and Discussion

Land classification was used in the northern and central Jordan Valley region. The region shows 6 categories (Figure 5). The majority of the land cover in the region is agricultural lands, followed by bare rocky lands, then inhabited lands and water bodies. The results of map analysis show the spatial variation of the elements of solar radiation (Figure 6) and evaporation (Figure 7). The results from the albedo show that the bare lands and rocks have a higher value than the albedo (0.33) due to the low absorption and scattering of solar rays, while agricultural lands, vegetation fields and water bodies reached the lowest value (0.09) due to the absorption of a greater amount of solar rays. The values of the vegetation cover indicators NDVI, SAVI, and LAI are higher in agricultural areas and vegetation fields. This is due to the presence of green areas, while rocks, bare lands and water bodies give low to negative values. The surface temperature shows differences, the temperature values ranged from $21C^°$ in agricultural lands, vegetation fields and water bodies due to the green spaces in the region, which have a key role in reducing the temperature through the evaporation process, which works to reduce the thermal range, while the values of the maximum temperature in the lands Bare and rocky $37.1C^°$ due to the lack of vegetation cover, which contributed to the increase in temperature.

The upper limit of the values of solar net radiation (RN) in agricultural lands, vegetation fields and water bodies is (556.9) W/m^2, which means that the surface reflectivity is low, but the lowest value in bare lands and rocks is (389.9) W /m^2, which means that the surface reflectivity ratio in this cover is large. Soil heat flux (G) values in bare lands and rocks (103.8) W/m^2 due to the large amount of heat supplied by direct heating to this surface by sunlight, while the lowest value in agricultural lands, vegetation fields and water bodies (70.1) W/m^2 is due to the fact that the vegetation cover It has a role as a protective cover for heat exchanges between the soil and the atmosphere. Max comes from ET-inst in agricultural lands, vegetation fields, and water bodies (0.44) mm per hour. As for the lowest value of ET from bare lands and rocks (0.09) mm per hour. The daily ET pattern comes with higher values in agricultural lands, vegetation fields, and water bodies (6.11) mm per day. Bare lands and rocks show the lowest value of ET (1.33) mm per day .
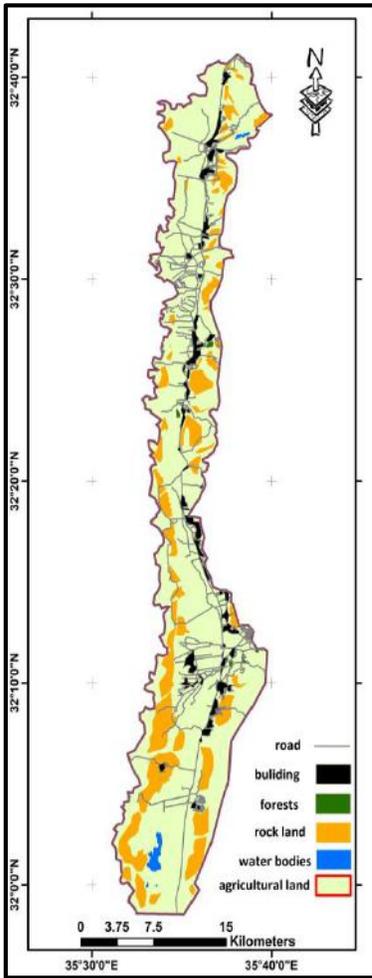
Figure 5: Land use/land cover in North and Central Ghour region.
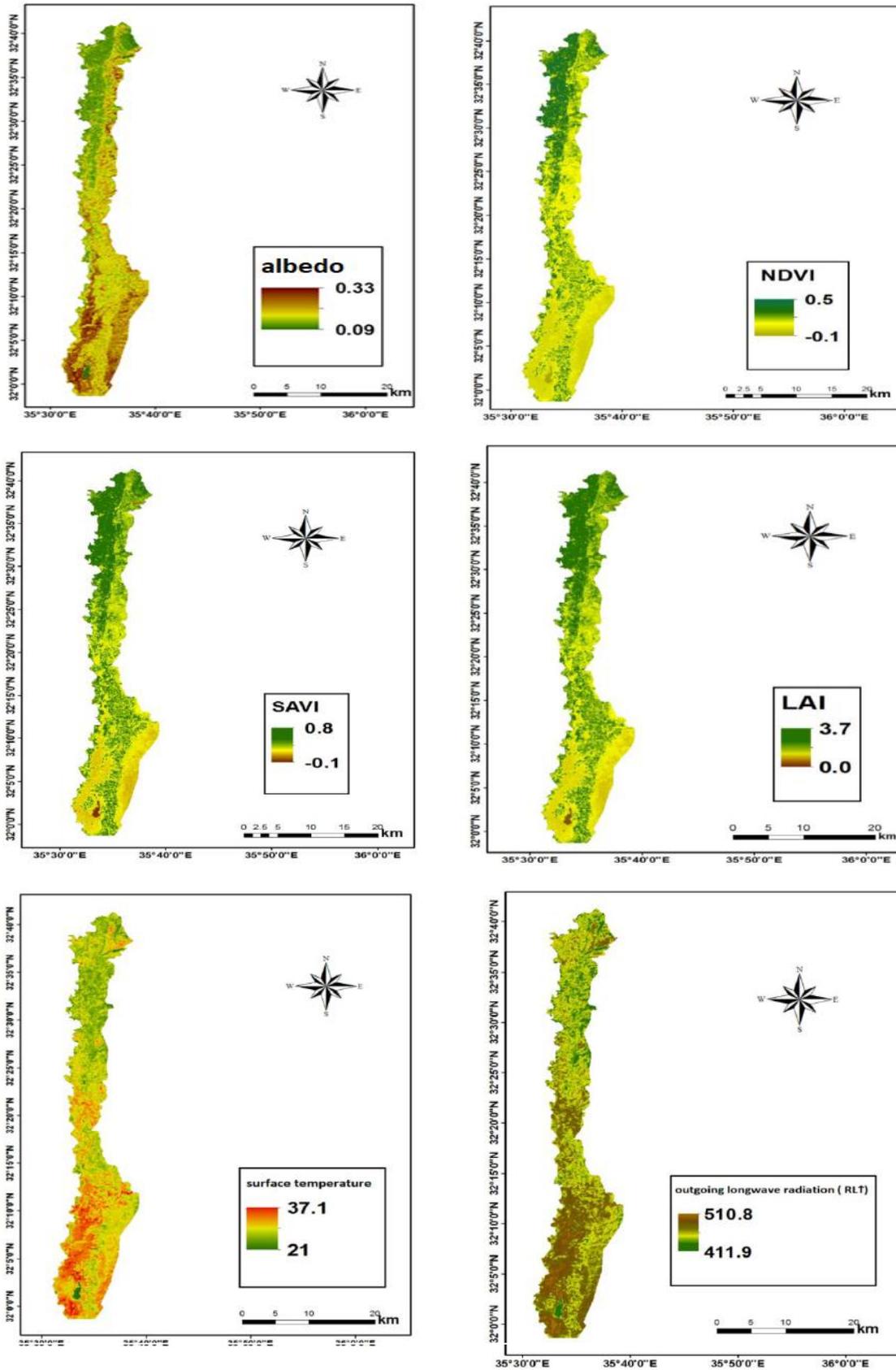
Figure 6: Spatial variation of solar radiation parameters in North and Central Ghour region.
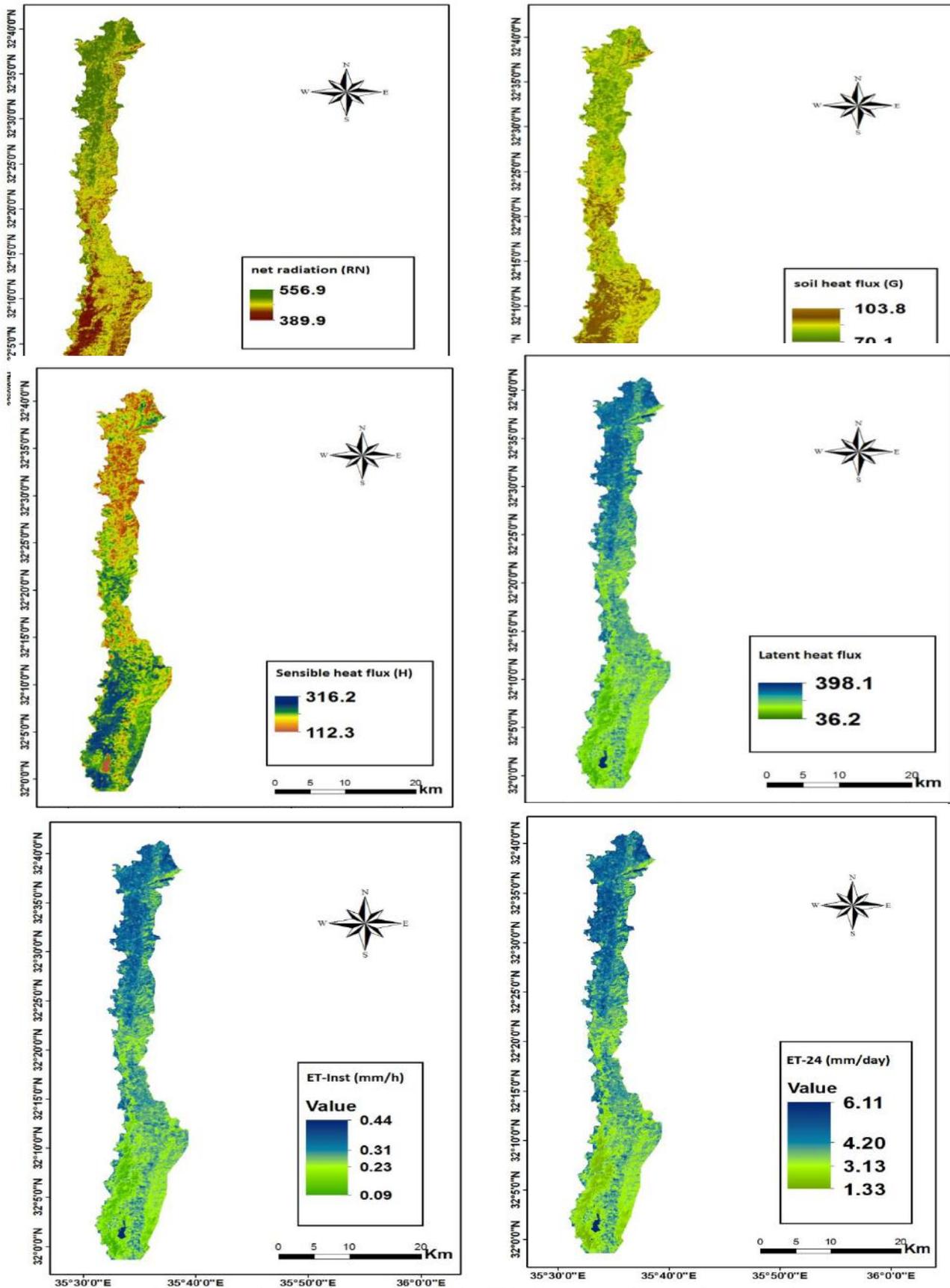
Figure :7 Spatial variation of hourly and daily ET in North and Central Ghour region.

Conclusions

After applying this study to the Jordan Valley region, with the aim of estimating evaporation in the North and Central Ghour region, by performing the necessary calculations using the Surface Energy Balancing Equation (SEBAL), where the Landsat 8 satellite data was used based on visible and infrared radiation. . It was noted that it was very effective in estimating evaporation using a satellite image (Landsat 8) and meteorological measurements of wind speed, humidity, air temperature and solar radiation, by comparing the evaporation calculated from the energy balance equation on the surface from the measured pan evaporation results. Where the study showed that the measured evaporation results equal (7.24) mm / day, and the evaporation value calculated using the surface energy balance equation (SEBAL) equals (6.11) mm / day.

The estimated hourly and daily results based on the SEBAL method show a variance for the different land cover patterns. The lowest range of variation in ET values appeared in bare lands and rocks characterized by the absence of vegetation cover and the highest in agricultural lands. The results show a clear relationship between land use, radiation parameters and the effect of vegetation cover on ET values.

Acknowledgement

Conflicts of Interest

No potential conflict of interest was reported by the authors.

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GEO-SPATIAL PLANNING FOR SUSTAINABLE ECOTOURISM MANAGEMENT IN THE HANTHANA PROTECTION AREA OF SRI LANKA

Weeraman,PWHT.[1], and Hemakumara, GPTS. 1[*]
[1] Department of Geography, University of Ruhuna, Matara, 81000.
*Correspondence: sam@geo.ruh.ac.lk

Abstract

Ecotourism has received much attention in recent years especially within 21st century. Ecotourism can also be termed as management of tourism and conservation of nature. In this context Hanthana mountain range is identified as a lesser tourist attraction destination in Kandy district. Therefore, the primary objective of this study is to analyze the challenges facing the ecotourism industry in the Hanthana area using remote sensing and GIS as a tool. The study is based on land use data integrated with other GIS datasets to evaluate the land use and natural resources at a grass root level. In addition, this study examined the changes in land use related to tourism decline in Hantana mountain range from 2000 to 2021. The final step of this study was identifying the potential ecotourism places and prioritization of the area that is best suited for ecotourism in assessing ecotourism sustainability. Land use changes resulted in a decrease in tourism attraction surrounding the area otherwise primarily caused by outward and the inward expansion of build-up lands. Therefore, sustainable management policies should be targeted to address the impact of the loss of natural lands due to intense urbanization. The result is useful for tourism facilities development, ecotourism resource utilization and also sustainable ecosystem management. It is envisaged that ecotourism could be more developed in the area in the future. Additionally, the research findings in ecotourism can be used by managers and planners working in governments and other non-governmental organizations.

Keywords: Ecotourism, GIS, Land use/land cover, Protected areas, Sustainability

Introduction

There are several mountain ranges in the central highlands of Sri Lanka and you can identify the ecologically valuable mountain ranges as well as the mountain ranges that are attracted by their unique scenic beauty. Among them, the Hanthana mountain range in the Kandy district is a uniquely attractive mountain range. This mountain range around the city limits of Kandy is located at an altitude of over 600 meters with a cool climate. This ecosystem is home to a number of endemic species of flora and fauna that have a unique biodiversity as well as other mountain ranges in Sri Lanka. Due to this, the area has become a tourist destination for both local and foreign tourists. There are some issues related to tourism industry in this area and there is a need to manage these issues and develop it as a sustainable ecotourism destination. Developed and developing countries have identified ecotourism as a major sector. Therefore, both these countries are paying special attention to the ecotourism industry. It has been identified as especial industry in developing countries, based on its potential for income generation and production growth, its impact on the balance of payments, and its ability to create employment opportunities. But the potential impact on tourism promotion, which is aimed solely at economic development is varied. Infrastructure development as well as the increase in the number of tourists can have a different impact on various sectors. In many countries,

ecotourism is not properly defined and many people find it misused, especially in developing countries. Therefore, it can be identified that there are factors such as lack of understanding of the principles of environmental tourism and misuse of commercial motives. Accordingly, it is important to identify the potential for the development of the ecotourism industry. (Wisumperuma, 2011) Sustainable ecotourism concepts can be applied on the basis of developing potential and protecting that potential. Accordingly, the development of this area as a sustainable land can increase the tourist attraction.

The environment of today's world is at great risk as a direct result of human activity. The tourism industry is environmentally friendly by adopting the eco-friendly methodology that underpins the industry to protect it. The ecological beauty of Sri Lanka gives a tangible value to the tourist attraction. Therefore, measures are being taken to increase the number of tourists visiting the country through various tourism promotion programs by identifying the potential of the ecotourism industry in the country. This research is important to bring the study of ecotourism to the practical level of sustainable use, as it is a new approach that provides an opportunity to experience the spatial diversity of nature and to conserve biodiversity. However, this research aims to focus on the issues that affect the development of a sustainable environmental industry due to the problems that exist in the Hanthana area. Accordingly, identifying the challenges and managing those challenges as well as how to develop ecotourism with minimal impact on the ecosystem under environmental protection.

Ecotourism & Sustainability

Ecotourism concept development in 1980s within new manner to control tourism and its disadvantage to natural environment (WTO, 2002). In the 1970s, the tourism industry was identified as a "golden activity" without pollution. Also, during this period, there was a focus on the economic benefits that come with it. (Choi, 2003) Then in the 1990s the concept of sustainable development became associated with the tourism industry. Accordingly, ecotourism should be carried out with the inclusion of eco-friendly social dimensions. (Azmaiparashvili, 2017) It has already been pointed out that tourism should be used more sustainably. The focus is on the fact that the area in question should benefit the community and not the environment. (Wisumperuma, 2011)

Various formats related to ecotourism

The standard model of the ecotourism presented by Damania and Hutch. It represents tourist who are visiting the surrounding natural areas that generate a high income for private ecotourism lodges, thereby improving welfare at the provincial and national levels. And also Incentives for economic beneficiary's change, which in turn changes governance and land use practices and related to that protects biodiversity. Further, Butler's Tourist area life cycle is a model illustrate the stages of organizing a tourist destination. In this model 06 stages can be identified. That is, Exploration (Having a small number of tourists. Based on primary tourist attractions), Involvement (Involvement of the locals in the tourism industry, Establishment of secondary tourism facilities), Development (Large scale tourist arrivals, growth of tourist attractions), Consolidation (The economy of the area is linked to the tourism industry), Decline (Environmental, social and economic problems in the tourism industry), Rejuvenation (Utilization of new tourist resources and changing tourist attractions) (A tourist area life cycle, 1980)

Ecotourism activities in Sri Lanka

The Sri Lanka Tourist Board has categorized ecotourism activities into five categories. Namely, nature and cultural activities, aquatic ecotourism activities, wildlife-based ecotourism activities,

community-based ecotourism activities, classified as ecotourism activities (Sri Lanka Tourism Board, 2003)

GIS Model for Ecotourism

Spatial location to generate a geographic and ecological inventory using GIS to increase planning and management studies. (Cetin, 2016) As Cetin mention progresses of using GIS may increasing due to advantages of the GIS technology. It integrates many types of data such as Spatial data and Attribute data and also can represent them in one layer according to the digital model. Calculation of NDVI and NDBI using satellite images can identify the vegetation decline areas and built-up areas of the space. (Bandara, R.M.S. et al, 2021) These indicators analysis pure the eco system degradation and also it directly affects to the decline of tourism attraction of the area. In addition, identifying potential areas in the ecotourism, landscapes such as land use and land cover, topography such as elevation and slope, and distance from road to tourist destination can be considered. (Baykedan et al, 2019) In addition, the time taken for destination and also accommodation is also indirectly affected. These factors are important in planning and directing of the ecotourism potentially.

Study Area

Absolute location Hanthana protected area between 7° 18' North Latitude and 80° 35' East Longitude. Hantana Protected Area is situated in Kandy District in Central Province. The whole area of Hanthana mountain range is spread-out in GangawataKorale, Doluwa, Pathahewaheta, Delthota Divisional Secretariat Division (DSD) of 38.56 km² and includes 36 Grama Niladhari Divisions. (CEA, 2021) Hanthana mountain area divided in to two parts as lower Hanthana and upper Hanthana. Lower Hanthana area low to 600m and upper Hanthana area up to 600m. (Chathranga et al, 2017)

In 2010.02.17 the area gazetted under Gazette Notification No 1641/28 as a Protection area due to the above important specifications. (CEA, 2021) Accordingly, under Gazette Notification No 1641/28 in 17.02.2010 represent limits of the Hanthana protection area, of land comprising as follow.

- North: from Galaha Junction at Peradeniya along the Colombo - Kandy Road till it meets the junction at the Hanthana, Uragala, Uduwela Road;
- East: from the last-mentioned point along the Hanthana, Uduwela, Uragala Road up to Uragala;
- South: from the last-mentioned point along Hanthana Uduwela, Uragala Road up to Galaha junction;
- West: from the last-mentioned point along Hindagala up to Galaha junction at the University of Peradeniya. (The Gazette of the DSR SL, 2010)

Materials and Methodology

Primary Sample of Study

Adequate samples should be selected from the study population based on an appropriate methodology to achieve the research objectives. The sample relevant to this study was randomly sampled using Convenience sampling as a non-probability sampling method for the travel information sampling. The first step in selecting the sample is to select the required sample of local and foreign tourists for the survey. Among the tourists visit to Hanthana, 15 were local tourists and 15 were foreign tourists. Accordingly, classification introduced by the Sri Lanka Tourism Development Authority, 30 accommodations were randomly selected for the sample as mention in Figure 1.
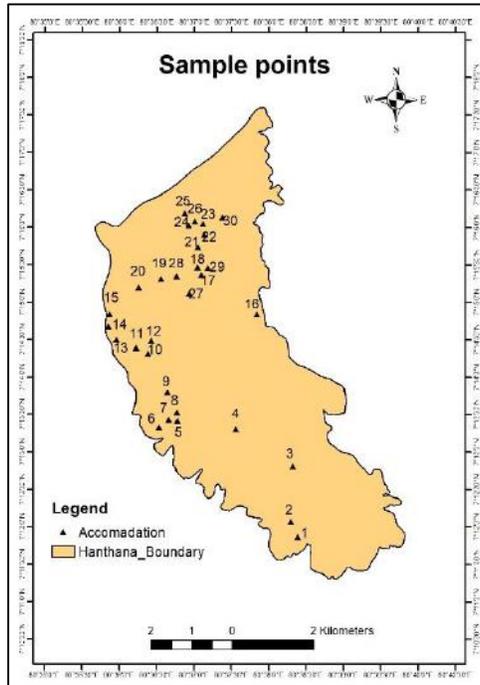
Figure 1: Sample points of the study area

Secondary Data

Maps based on digital data are used to analyse the GIS model in the study of ecotourism in the Hanthana Protection Area. Therefore 1:50000 Metric Map parts 51 and 64 used to digitize geographical features of the land and create a topographic map. Otherwise, 2000, 2009 and 2021 years are chosen to acquire Landsat images. LANDSAT7 & LANDSAT8 images are free download from USGS Earth Explorer website for analysis of land use pattern and land cover to analysis spatial challenges on ecotourism industry of the study area.

Data Analysis

The study caring out mix methodology because of both quantitative and qualitative methods are used for data analysis. Accordingly, multiple regression analysis use as quantitative analysis, considering the number of tourists who visited to the Hanthana area as dependent variable and identified the predictors as the long-distance (1) and cost of transport from Kandy to the Hanthana (2), and the amount of charged per day for accommodation (3).

According to the GIS analysis the creation of maps using Arc GIS 10.8 and QGIS software is the basis of the data analysis. Data analysis methods such as maps and graphs are also used here. Accordingly, satellite images are calculated the area of land use land cover changes using NDVI & NDBI calculations. It uses the equation as below,

NDVI Equations

Landsat7 (2000, 2009)

$$NDVI = \frac{NIR - RED}{NIR + RED}$$
$$= \frac{Band\ 4 - Band\ 3}{Band\ 4 + Band\ 3}$$

Landsat8 (2021)

$$NDVI = \frac{NIR - RED}{NIR + RED}$$
$$= \frac{Band\ 5 - Band\ 4}{Band\ 5 + Band\ 4}$$

NDBI Equations

Landsat7 (2000,2009)

$$NDBI = \frac{SWIR - NIR}{SWIR + NIR}$$
$$= \frac{Band\ 5 - Band\ 4}{Band\ 5 + Band\ 4}$$

Landsat8 (2021)

$$NDBI = \frac{SWIR - NIR}{SWIR + NIR}$$
$$= \frac{Band\ 6 - Band\ 5}{Band\ 6 + Band\ 5}$$

TIN & DEM model use to identify the slope and elevation of the area. And also, accessibility index calculated for the tourism accessibility to the accommodations. In order to develop a sustainable ecotourism industry in the area, analysis spatial challenges and carried out under the five (5) main opportunities presented by the Sri Lanka Tourist Board for identify potential places to development of ecotourism. In addition, SWOT Analysis will be able to analyse the Strength, Weakness, Opportunities and Threats of the ecotourism industry in the Hanthana protection area

Results

The natural forest cover which was 229.34 hectares in the year 2000 has been reduced to 197.74 hectares in the year 2009. It can be identified that the extent of that forest has been reduced to 120.63 hectares by the year 2021(Figure 2). Damage to natural forests can lead to biodiversity degradation as well as declining attractiveness of the area. Accordingly, it also has the effect of reducing the tourist attraction in the area.
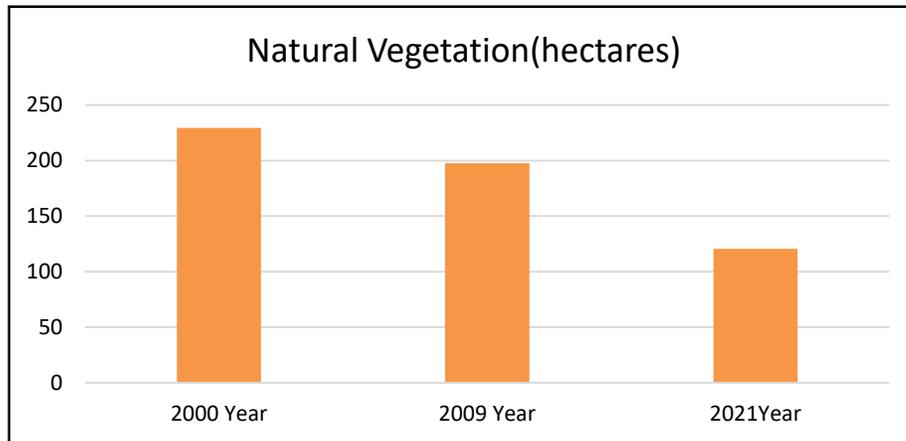
Figure 2: Natural Vegetation density in HPA

Source: Created by Authors

The area non vegetation in the year 2000 was 234.13 hectares and by the year 2009 it has become 343.0 hectares. It is expected to reach 330.87 by 2021, which is a clear indication of deforestation in the region. Further, low and dense vegetation cover can identify the existing grassland growth as well as plantation growth in the area (Figure 2).

Informal agricultural pattern

Tea cultivation can be identified as an ongoing agricultural pattern in the Hanthana area. In addition, rubber, pepper and cinnamon plantations also can be identified. Tea plantation area is 1800 hectares which is 47% of the total land area. The challenge here is to degrade the forest cover in the area and expand agricultural land. Accordingly, rapid expansion of tea estates such as Haloya Colony and Galaha Colony can be identified in according to the time range. According to NDVI calculations, shrub vegetation can be identified as tea plantations. It can be expressed as follows in the Figure 3.
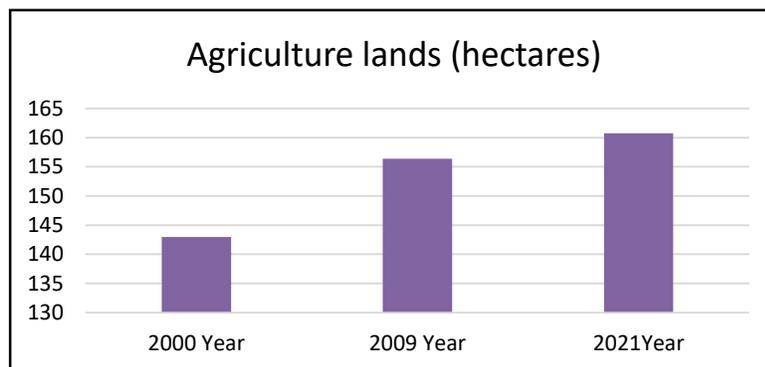
Figure 3: Agriculture lands in HPA

The area under cultivation which was 142.97 hectares in the year 2000 , 156.39 hectares in 2009 and 160.76 hectares by 2021 (Figure 3). The expansion of these plantations poses a challenge to the reduction of natural vegetation cover and the degradation of ecosystem.

Also, most of the tea lands in the area are lands that do not have proper soil conservation practices. Tamil population living in tea plantation areas engage in agriculture around water sources for their own consumption as well as trade. Soil and water pollution is caused by agrochemicals used in forests and water sources. This becomes a threat to the ecotourism activities related to the natural environment, aquatic ecotourism activities, wildlife watching ecotourism activities as well as agro-ecotourism activities in the area (Figure 4).

Constructions carried out in the Protection Area
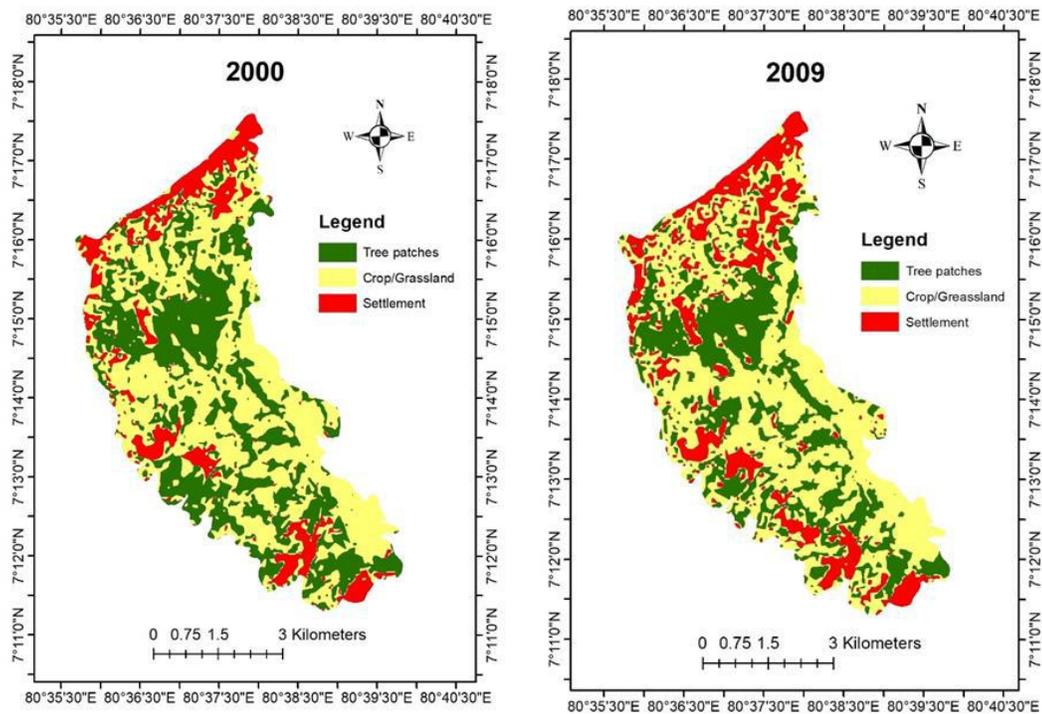
Figure 4: Normalized Different Built-up Index.
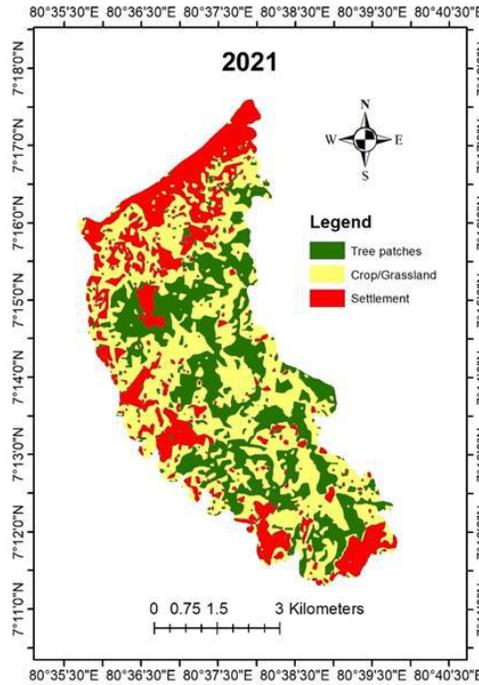
Figure 4 (continue): Normalized Different Built-up Index
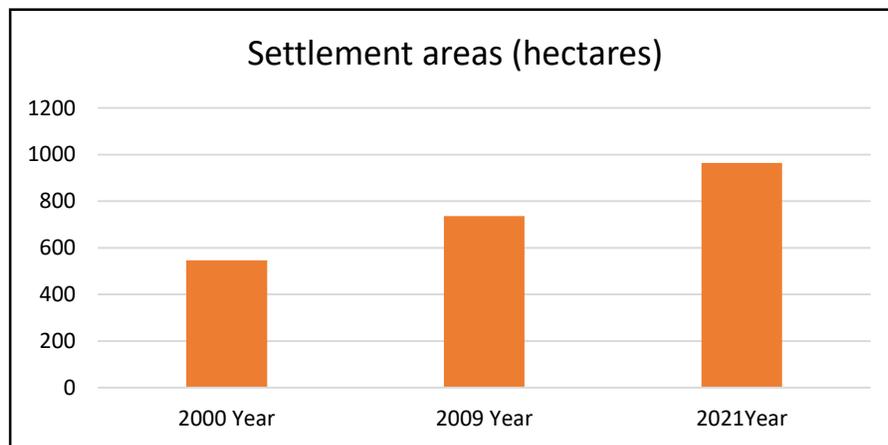
Figure 5: Settlement area density

The area of construction land was 546 hectares in the year 2000 and it has increased to 736 hectares by the year 2009.This area of land is expected to grow rapidly to 964 hectares by 2021 (Figure 5). These maps show the rapid urbanization of the northern part of the Hanthana Protection Area. This settlement has also reduced the amount of forest cover and the amount of grassland. Habitat in the Hanthana Protection Area poses a challenge to ecosystem as well as depletion of water resources in the area. Accordingly, there is a threat to the tourist attraction of this biologically valuable area.

In addition, the construction of tourist hotels has grown rapidly due to the environmental attraction. Accordingly, the construction of buildings is also a problem in the 45° slope zone (Figure 6). The expansion of most of the tourist hotels in the 30° - 45° slope region in this area can be identified according to the distribution of tourist accommodation selected for the sample. These lodges can also be found on slopes above 45°.

Figure 6: Construction of tourist hotels
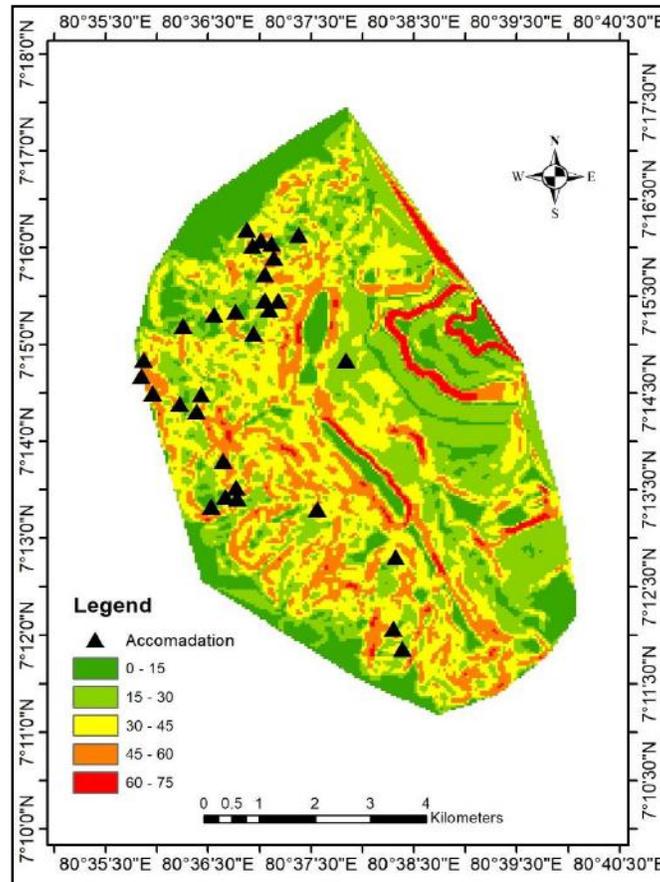
Figure 7: Expansion of Accommodations in steep slope

This can be identified as a major reason for land issues to arise. Most of these tourist lodges are located in the northern part of the Hanthana Protection Area (Figure 7). These tourist lodges cause natural forest degradation as well as biodiversity degradation of the Hanthana area. And also, animals are at risk due to improper disposal of household waste. Slope cutting and loosens soil layers and deforestation and urbanization pose a challenge to the ecotourism industry of the area.

This is well illustrated by the construction of 19 acres of tourist hotels in the Hanthana area in the Spring Heel area. Further, according to the U.D.A development plan identified the northern boundary of the Hanthana area as a contraction area with a slope of more than 45°.

Inadequate infrastructure (Problems with accessibility)

When considering the road network in Hanthana Protection Area, it can be identified by type B roads and other roads expansion. Often the footpaths also extend across the area. Access to tourist accommodation in the area is often minimum. This can be identified by analyzing the road network with the tourist accommodation used for the sample

.
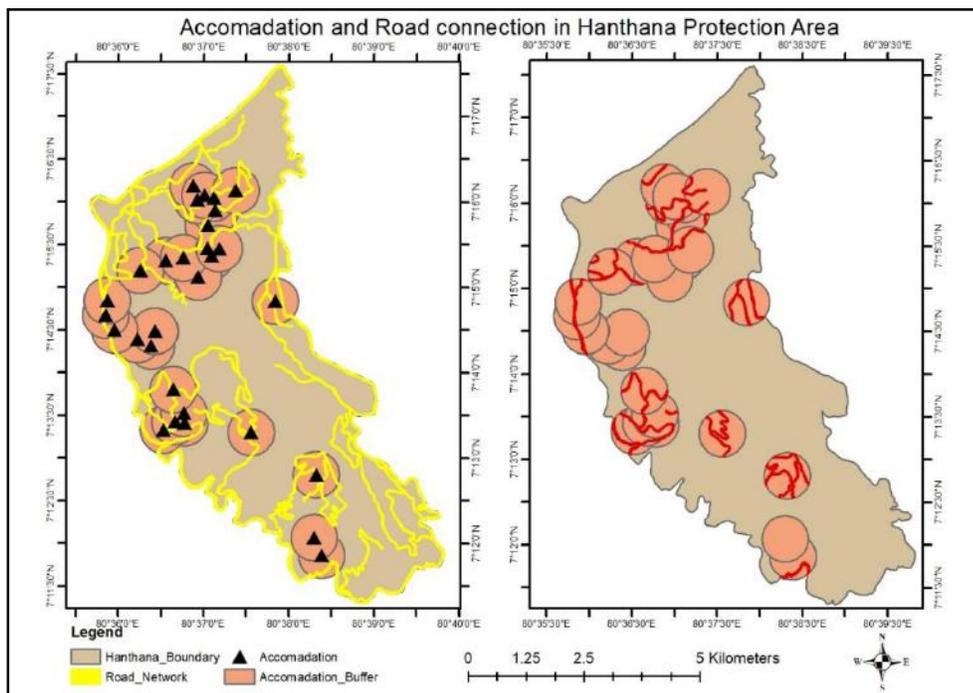
Figure 8: Expansion of Accommodations and Road network

The road density of the lodge was calculated within an area of 500 square meters (Figure 8). According to this calculation the road network to reach some of the lodges is not significant. Because of some lodges have footpaths to reach. So, 25/30 of the tourists based on the information obtained from the questionnaire stated that the road network should be improved (Figure 9). This was recognized by the number of tourist arrivals for most of the tourist accommodations.
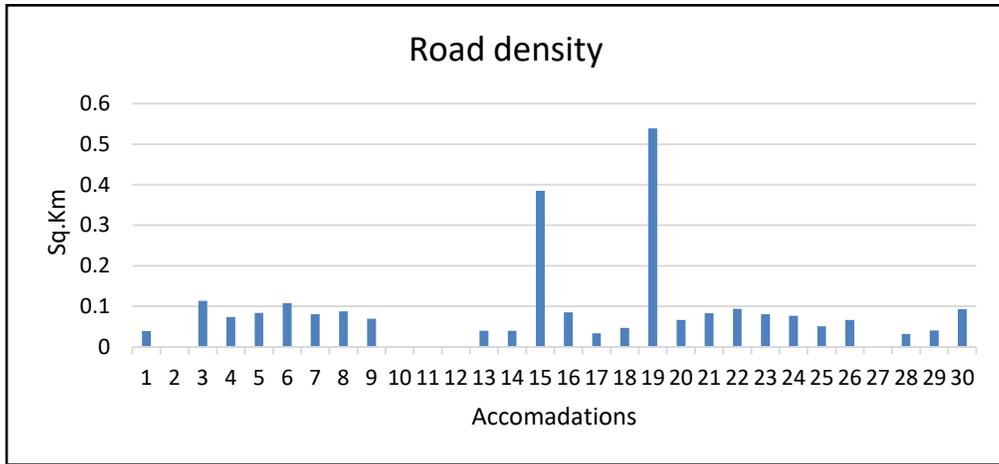
Road density

Figure 9: Road density of Accommodations

Accordingly, access to samples 10, 11, 12 and 27 is at a minimum. There are footpaths for these places and those roads cannot be calculated as square footage. Also, the road densities for samples 15 and 19 are 0.3sqkm-0.6sqkm, which is higher than other accommodations (Figure 10). It can be seen that the high road density in these places is increased due to the, road density in northern part of the Hanthana Protection Area and the expansion of the main road network to the northern and western areas.
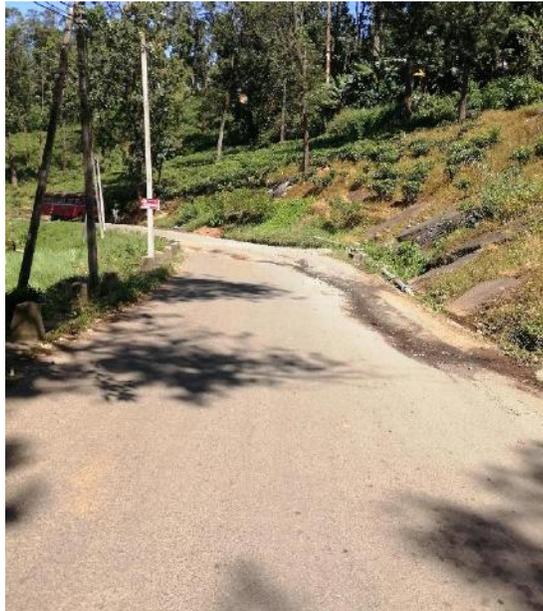
Figure 10: Undeveloped road in Hanthana Uragala

Discussion

The natural beauty and geographical location of the Hanthana region make it a popular tourist attraction in the area. The tourist attraction in the Hanthana area has also decreased compared to the existing tourist attraction in the Kandy District. Accordingly, in the secondary data analysis, 8.8% of the tourist awareness about Hanthana area. The tourism industry has not yet been built on any theme or purpose in this area. There is an unorganized tourism industry in this area. Therefore, the tourism industry should be developed in this area based on a specific objective. That is why, the tourism industry should grow and develop in the area as an interconnected system. Then the existing tourist attraction will continue to grow. The theme is that the ecotourism industry is best suited for the Hanthana area with its high natural beauty. Thus, the potential to develop the Hanthana area as an ecotourist attraction is being identified.

According to the definitions, principles and components associated with ecotourism, Hanthana Protection Area situated in a mountain range is an ideal paradise for ecotourism. The biodiversity, geographical diversity and climatic diversity seen in this area can be recognized as a potential for developing an endemic tourism industry in the area. Accordingly, five ecotourism activities presented by the Sri Lanka Tourist Board were based on the study of the potential for the development of the Hanthana area as an ecotourist attraction. The results are used to identify the potential to develop the Hanthana area as an ecotourist attraction
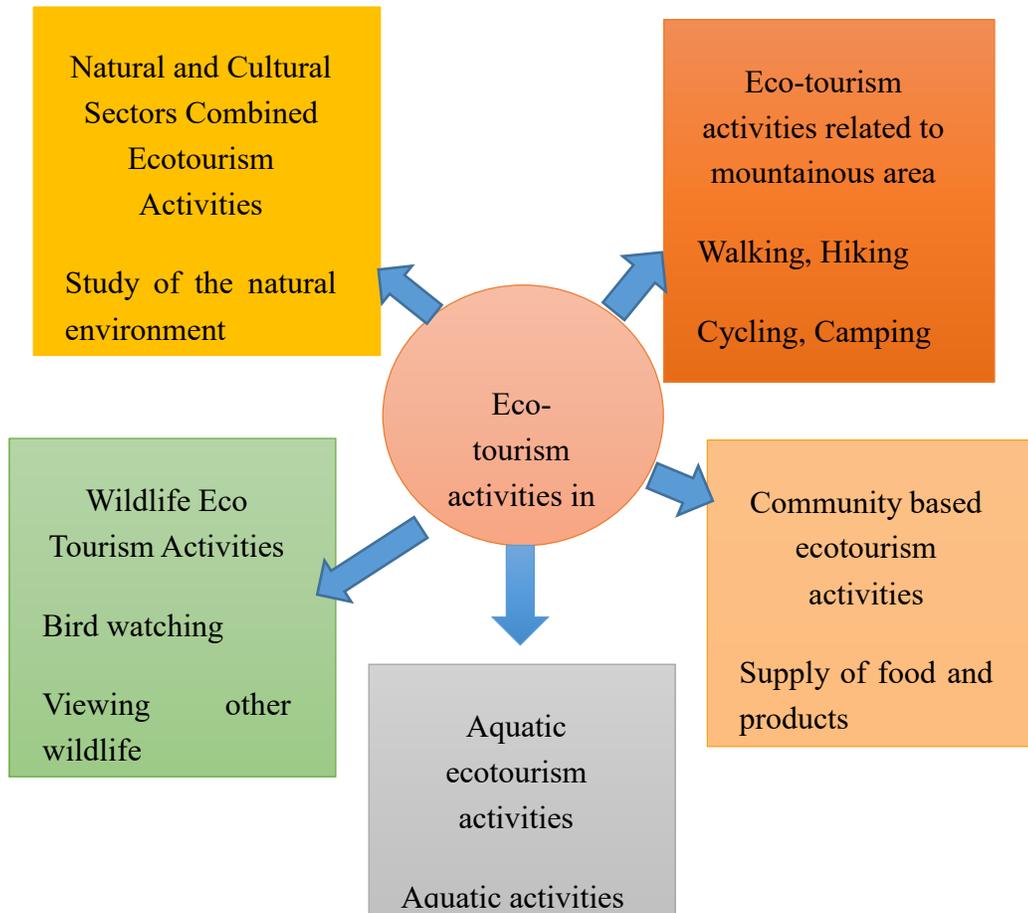
Figure 11: Potential places for ecotourism activities

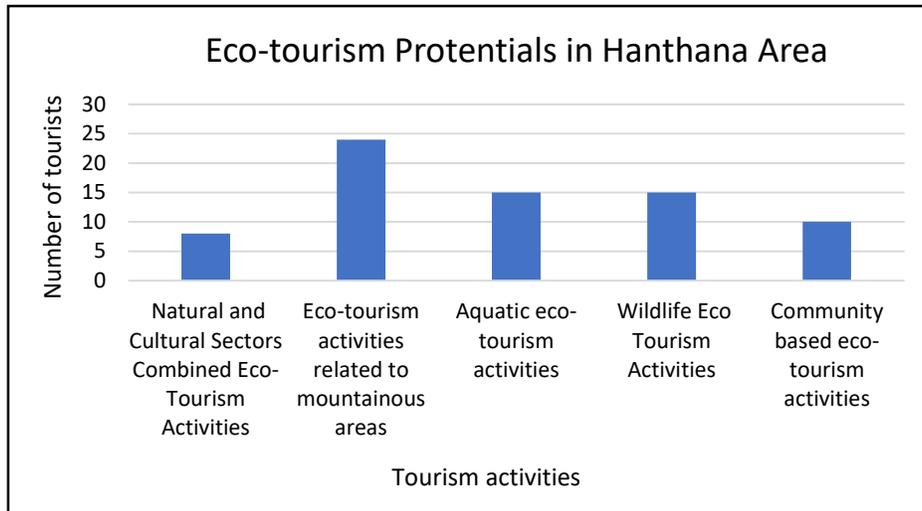## Eco-tourism Protentials in Hanthana Area

Figure 12: Number of tourists for ecotourism activities

Source: Created by Author

Based on questionnaire survey and interviews of tourist recognize potential places for many ecotourism activities in Hanthana mountain area. The area is most suitable for mountain tourism activities that identify by the interviews.24/30 (Figure 11) tourist represent the mountain tourism activities in the area and tourism travel to area for natural and community based ecotourism activities such as tea tourism in Hanthana estate. Tourist from various countries travel to Hanthana area for wildlife experience. The study population represent 15/30 (Figure 12) travel to visit endemic flora and fauna species guiding under local community.

Accordingly, potential locations for these ecotourism activities can be identified in relation to the area. Many tourists come here for mountain ecotourism activities and the Hulankanda site is used by many for camping. In addition, the camping area maintained by the individuals for camping can be identified.

Thus, the camp areas can be identified in the upper hills as well as in the lower Hanthana area. The Hanthana area is accessible from 4 lanes for walking as well as cycling. Many tourists use the Peradeniya entrance. Field observation also revealed that tourists staying in tourist lodges also visit the highest point of the Hanthana Range like Uragala for activities such as walking and mountaineering.

In addition, tourist accommodations as well as tour guides facilitate aquatic activities in the area. Accordingly, activities are organized by each institution for swimming as well as aquatic sports activities. Tourist lodges in the area also offer visitors a chance to watch the birds. Accordingly, they are working to increase the tourist attraction by creating high places in the lodges and showing the different bird watching areas as well as the times to the tourists. Wildlife viewing as well as the

opportunity to explore the area on horseback are available through the lodges. Here they work to give tourists a high level of enjoyment of the natural environment.

The Tea Museum in the area is also a popular tourist destination. Accordingly, tourists are encouraged to experience tea-related activities, visit tea plantations and view the tea production process. Local communities also benefit greatly from this. The tourism industry in the area can also be identified as a tourism potential that strengthens the community.

Another factor that can be identified here is the provision of vegetables and other necessities for the tourist accommodation by the community and the organization of the tourist transport services. Accordingly, tourist accommodation as well as travel service providers make a significant contribution to the development of the tourism industry in the area. Accordingly, the following Figure 13 show the areas identified as potential areas for the development of the tourism industry in field observation.
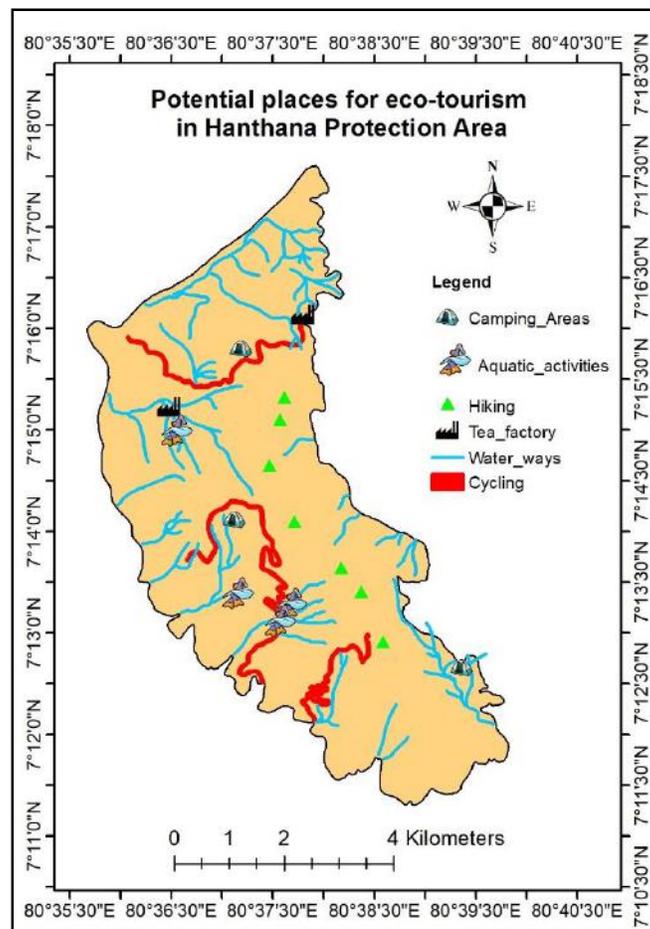

Figure 13: Potential places for ecotourism in Hanthana

Conclusion

Accommodation as well as infrastructure facilities were taken into consideration while examining the factors affecting the tourist attraction. The distance from the city of Kandy to the tourist accommodation, the transport charges for it and the charges for the tourist accommodation were considered. Accordingly, it was found that these factors have no effect on tourist arrivals. This is because of the fact that Hanthana is one of the popular tourist destinations in Kandy for those who prefer mountaineering and the cost of transportation is high although the choice of places with a good view of the natural environment for accommodation. In addition, it was found that the facilities available at tourist resorts attract tourists regardless of the distance or the cost of transportation. The conclusion that can be examine from, the cost of tourism does not affect the tourist attraction of the area.

Investigating whether the existing land use pattern in the area is affecting the tourism industry identified by the changes in the land use pattern. Accordingly, deforestation, informal agricultural practices as well as urbanization are a threat for tourism industry in Hanthana area. The natural forest cover is more degradation than the previous years. In addition, the urban area extends from the Kandy city limits to the Hanthana area can be identified. Irregular construction on slopes has led to ecosystem degradation. Therefore, rapid expansion of plantations, deforestation and environmental degradation were also identified. In addition, the road network in the Hanthana area is underdeveloped. It was concluded that the lack of infrastructure development in the area has also affected the tourist attraction. Accordingly, it can be concluded that the tourist attraction of the Hanthana area is declining due to environmental degradation issues as well as the lack of facilities for tourists.

However, it is important to identify the potential for the tourism industry to grow in the region. Accordingly, it can be concluded that there is potential to carry out the ecotourism activities proposed by the Sri Lanka Tourist Board as ecotourism activities in the area. Thus, there is a high potential for tourism activities in mountainous areas. Therefore concluded that, there is potential for develop in the mountain ecotourism industry due to the short duration of mountaineering, the presence of a temperate climate for camping and the presence of four main entrances to the area. In addition, this research recognize that there is potential in the area for the development of aquatic ecotourism activities as well as the development of eco-activities such as wildlife viewing and natural environment viewing.

Thus, research can show that land use pattern in the Hanthana area is declining tourism attraction due to environmental degradation and there is potential in the area for the develop of the existing tourism industry and sustainable management manner should be include of the ecotourism industry.

Conflicts of Interest

"There are no conflicts of interest in this study".

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MAPPING MALARIA RISK AREAS: A SUSTAINABLE CONTROL STRATEGY IN JIGAWA STATE, NIGERIA

Yakudima, I.I. [1,2,*] and Samat, N.[2]
[1]Department of Geography, Kano University of Science and Technology, Wudil, Kano, Nigeria
[2]Geoinformtics Unit, School of Humanities, Universiti Sains Malaysia
Correspondence: yakudima@student.usm.my & ismailayakudima@kustwudil.edu.ng

Abstract

Malaria continues to pose a severe health burden, with high rates of morbidity and mortality in many regions of the world, particularly in sub-Saharan Africa, despite increased worldwide concern and efforts to control the disease. Due to a multitude of risk factors, Jigawa is one of the Nigerian States where malaria is endemic. Nevertheless, a number of intervention strategies were put in place in the state with sustainability in mind. Therefore, risk mapping, which identifies high-risk communities and places where intervention facilities are less needed, is an efficient strategy to assure sustainable malaria management. Multi-Criteria Evaluation (MCE) approach was used to map the risk of malaria. The model included eleven risk variables. Every risk factor was reclassified, and weights were given to them based on how well they fit the malaria risk. By combining all risk indicators with the weighted overlay tools in ArcGIS, the final malaria risk map was created. The results show that 46.07%, 33.71%, 9.94%, and 10.28% of the study area fell under low, moderate, high, and very high malaria risk categories. This finding indicates that malaria was present at high and very high risk levels in one-fifth of the research area. The risk map created can act as a decision-making tool for allocating resources by focusing on high-risk locations, particularly in the event that domestic and foreign funding is reduced. Interventions will become more scientifically supported as a result, improving the sustainability of malaria control.

Keywords: Risk mapping, Sustainability, Jigawa State, Malaria, *Multi-Criteria Evaluation*

1.0 INTRODUCTION

Malaria continues to pose a serious health risk, with high rates of morbidity and mortality (Rumisha, Shayo & Mboera, 2019; Romero *et al.* 2021), particularly in African nations south of the Sahara where it is endemic. The World Health Organization (WHO) recently released official statistics estimating that there were 241 million cases of malaria worldwide in 2020 and 627,000 deaths from malaria-related causes in 85 malaria-endemic countries. Sub-Saharan Africa accounted for a very high percentage of cases (95%) and deaths (96%) from malaria, with children under five accounting for about 80% of these deaths (WHO, 2021).

Since 2000, the number of malaria cases per 1,000 people at risk in the WHO's African region has decreased from 368 to 222 in 2019, before rising to 233 in 2020 as a result of COVID-19 pandemic-related disruptions. Malaria mortality decreased by 36% between 2000 and 2019, from 840 000 in 2000 to 534 000 in 2019, and then rose to 602 000 in 2020. The malaria fatality rate decreased by 63% between 2000 and 2019, from 150 to 56 per 100 000 people at risk, before increasing to 62 in 2020. Nigeria has the greatest disease burden among the nations in the WHO's African region. In 2020, it is responsible for 26.8% and 31.9% of all cases and fatalities worldwide partly because as much as 76 percent of the population resides in high transmission zones (WHO, 2021; Babalola, Omeono, Osuntade, Julius & Kalu, 2021). This makes the nation the most endemic in the entire planet.

The significant financial contributions made to malaria research and control by foreign donors and governments of endemic countries have resulted in the achievements seen so far in the reduction of malaria incidence and deaths from 2000 to 2020. For instance, the overall spending on malaria related programmes in 2020 was estimated at US$ 3.3 billion, an increase from US$ 3.0 billion in 2019 and US$ 2.7 billion in 2018, representing a consistent increase (WHO, 2021). Even though the amount invested in 2020 appears to be substantial, it only accounts for 48.5% of what was required globally to maintain the momentum in the fight against malaria. The report also indicated that the financial disparity between the resources committed and those needed has widened substantially over time, and that if it widens as predicted, it will be harder to sustain the gains obtained.

According to information made available by the WHO for the past 10 years, more than two thirds of the financing for malaria control came from international donors, with the remaining one third coming from governments of countries where the disease is endemic. The WHO African Region received more than three quarters (79%) of the US$ 3.3 billion funded in 2020 (WHO, 2021). This highlights how reliant on foreign help African countries were, and how they probably wouldn't be able to sustain their malaria-control initiatives in the event of a shock to the world economy.

The endemic countries therefore need to devise more effective ways to utilise the scarce resources by focusing on areas that require more attention as the global fund, which currently provides more than three-quarters of malaria interventions, becomes increasingly constrained in its ability to fund malaria programmes. This has resulted in the establishment of a pan-African collaboration, the Mapping Malaria Risk in Africa collaboration (MARA/ARMA), in 1996. The essence of the collaboration was to produce a more detailed evidence-based malaria maps to effectively target new vector methods in Africa (Omumbo, Noor, Fall & Snow, 2013). Numerous malaria risk maps were created as a result of this partnership.

Following this initiative, risk maps have been created in sub-Saharan Africa at various geographic scales with the goal of identifying locations where the most control effort should be concentrated (Le Sueur *et al.* 1997; Snow *et al.* 1998; Kleinschmidt *et al.* 2001; Omumbo, Hay, Snow, Tatem, & Rogers, 2005; Gemperli, Vounatsou, Sogoba, & Smith, 2006; Kumi-Boateng, Stemn & Mireku-Gyimah, 2015; Ferrao, Niquisse, Mendes & Painho, 2018; Mohammed, 2018; Mihiretie, 2022; Gouzile *et al.* 2022). Similar maps for additional areas in Nigeria were created (Cross Rivers by Njar, Akpama, Iwara, Ita, & Lasisi, 2013; Lokoja by Ifatimehi and Ujoh 2014; Akure by Abdulkareem, Adegboyega, Balogun, Eteng & Adebayo, 2017; Osogbo by Oladejo, Ojumu & Ogunbiyi, 2018; Kano Metropolis by Madobi, 2019; Abuja by Ndace, 2020).

A malaria risk map for the Jigawa State, however, has not been attempted by any of the studies that have been reviewed. As a result, the goal of this study is to develop a malaria risk map for Jigawa State utilising a variety of risk indicators to identify areas that are more susceptible to malaria transmission in order to control the disease in a sustainable and effective manner.

Study Area

The study was conducted in Jigawa, one of the 36 States that make up the Federal Republic of Nigeria. Five Emirate councils and 27 local government areas (LGAs) make up the state. The area is located approximately between latitudes 11° N and 13° N and longitudes 8° E and 10.15° E, in Nigeria's northwest geopolitical zone. It shares boundaries with Yobe State to the northeast, Kano and Katsina States to the west, and Bauchi State to the east. Jigawa State shares an international border with the Niger Republic to the north. It has a total land area of approximately 24, 515 km^2 (Figure 1). Jigawa State is classified by the Koppen system as having a "Aw" tropical wet and dry climate. Low temperatures as low as 10° C are typically reported in the colder months (December to

February), while maximum temperatures (over 42°C) are common during the hottest months of March and April and may stretch to mid-May. The average monthly temperature varies between 21°C and 23°C in the coolest months and over 30°C in the hotter months, with the mean yearly temperature around 26°C (Olofin, 2008).
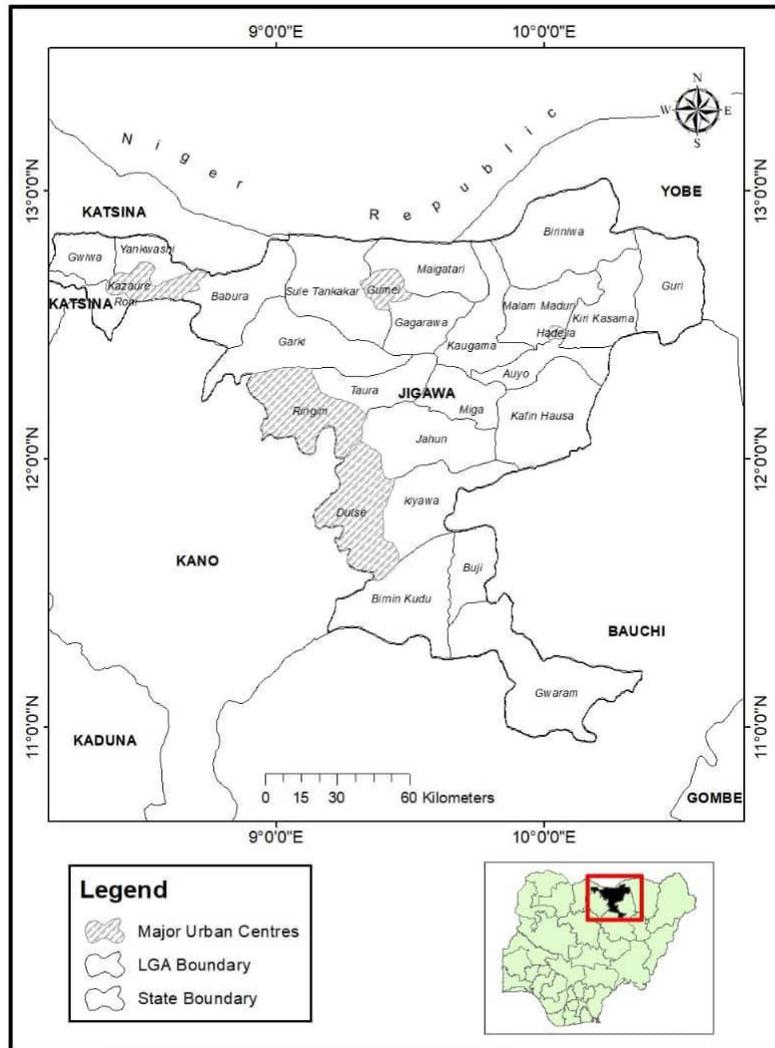

Figure 1: Map of the study area (Jigawa State)

In the southern portions of the state, the average annual rainfall is often between 1000 and 1100 mm, but in the north and north-eastern parts, it drops to 500 to 550 mm (Olofin, 2008). The state belongs to the Savanna vegetation type, and all three types (Guinea, Sudan, and Sahel) are visible there. The area has a variety of land use patterns, including agricultural land, wet lands, water bodies, built-up areas, and bare ground. Seventy percent of the state's workforce works in agriculture (Jigawa State Ministry of Health, 2010). Both irrigation and rain-fed agricultural farming systems are practice in the state. Jigawa State had a population of 4,348,649 in 2006 (Federal Republic of Nigeria, 2007), with an average density of roughly 177 people per km2. According to the 2019 projections (NPC, 2009), the state's population was 6, 526, 432, with a density of 266 people per km². As of 2010, there were 614 healthcare facilities, both public and private.

Materials and Method

Materials

This study was conducted using four main datasets. These datasets came from several sources, as shown in table 1.

Table 1: Data used and their sources

Data	Factor	Source
Climatic:		
Temperature	Temperature ^oC	JARDA
Rainfall	Rainfall (mm)	JARDA
Earth observational:		
Slope	Slope (degree)	Aster DEM (30M), BUK (GEOG, DEPT)
Elevation	Elevation (meter)	Aster DEM (30M), BUK (GEOG, DEPT)
Land use/Land cover	Land use/Land cover	BUK (GEOG, DEPT)
Proximity related:		
Rivers/streams	Distance (km)	BUK (GEOG, DEPT)
Stagnant water bodies	Distance (km)	BUK (GEOG, DEPT)
Wet lands	Distance (km)	BUK (GEOG, DEPT)
Roads	Distance (km)	BUK (GEOG, DEPT)
Healthcare facilities	Distance (km)	NPC (Coordinates)
Population	Population density	NPC

JARDA: Jigawa State Agricultural and Rural Development Authority, BUK: Bayero University, Kano, GEOG: Geography, DEPT: Department, NPC: National Population Commission

Method

The technique used in this study was a spatial Multi-Criteria Decision Analysis (MCDA) approach in conjunction with GIS. GIS-MCDA is capable of translating and fusing geographic feat (criteria maps) and value judgments (decisionmakers' preferences) to produce pertinent data for decision making (Boroushaki and Malczewski, 2010). The primary justification for combining MCDA and GIS is the way in which these two research instruments can enhance one another. While MCDA offers a wealth of procedures and algorithms for structuring decision problems, designing, evaluating, and prioritising alternate decisions, GIS is widely acknowledged as a powerful and integrated tool with unique capabilities for storing, manipulating, analysing, and visualising spatial data for decision making (Boroushaki and Malczewski, 2010; Kumi-Boateng *et al.* 2015). Three steps were taken in adopting the approach: identifying and standardising malaria risk variables, determining and weighing risk factors, and finally integrating weighted risk factors to identify danger zones.

Identification of risk variables

Malaria transmission is influenced by a variety of variables that vary by location. A reliable malaria risk mapping requires a thorough understanding of local transmission factors. In light of this, interviews were conducted with four malaria experts who were familiar with the circumstances in the study area. Eleven risk variables were identified based on conversations with local malaria experts in the study location. They are the following: temperature, precipitation, slope, elevation, proximity to rivers and streams, proximity to still water, proximity to wet land areas, proximity to healthcare facilities, proximity to roads, land use and land cover, and population density. Following that, for each factor suggested ratings and classes were ordered as follows: very low = 1, low = 2, moderate = 3, high = 4 and very high = 5 (Table 2).

Table 2: Malaria risk factors used for the study

Factor	Weight	Class	Rank	Level of Risk
Temperature	0.12	29-31	5	Very high
		25-29	4	High
		21-25	3	Moderate
		> 31	2	Low
Rainfall	0.08	> 1000	4	High
		700-1000	3	Moderate
		500-700	2	Low
		< 500	1	Very Low
Elevation	0.113	> 400	5	Very high
		> 400	4	High
Slope	0.037	< 5º	5	Very high
		> 5º	4	High
Distance to wet lands	0.21	0-500 m	5	Very high
		500-1000 m	4	High
		1000-1500 m	3	Moderate
		1500-2000 m	2	Low
		> 2000 m	1	Very Low
Distance to water bodies	0.087	0-500 m	5	Very high
		500-1000 m	4	High
		1000-1500 m	3	Moderate
		1500-2000 m	2	Low
		> 2000 m	1	Very Low
Distance to rivers/streams	0.053	0-500 m	5	Very high
		500-1000 m	4	High
		1000-1500 m	3	Moderate
		1500-2000 m	2	Low
		> 2000 m	1	Very Low
Distance to health facilities	0.05	> 5 km	5	Very high
		4-5 km	4	High
		3-4 km	3	Moderate
		< 3 km	2	Low
Distance to road	0.05	> 5 km	5	Very high
		4-5 km	4	High
		3-4 km	3	Moderate
		1.5-3 km	2	Low
		0-1.5 km	1	Very Low
Land use/Land cover	0.10	Wetland/water bodies	5	Very high
		Built-up areas	4	High
		bushes/ forest	3	Moderate
		Agricultural land	2	Low
		Bare land	1	Very Low
Population density	0.10	> 1000	5	Very high
		700-1000	4	High
		400-700	3	Moderate
		200-400	2	Low
		< 200	1	Very Low

Temperature and rainfall were taken into account as climatic variables for their impact on malaria transmission. While extremely high temperatures produce substantial mosquito death and so reduce malaria transmission, low temperatures have a limiting influence on mosquito and parasite development (Chikodzi, 2013). On the other side, rain increases the number of mosquitoes by creating more hatching grounds. The Kriging interpolation method was used to create maps for these variables using data on total monthly precipitation and mean monthly temperature for the state's 27 LGAs from August 2017 to October 2019. Based on the 2 km flying range of mosquitoes from their breeding locations, Euclidean distance was estimated and classified into groups for proximity-related malaria factors, such as distance to water bodies, rivers/streams, and wet lands (Van Der Hoek *et al.* 2003; Zhang *et al.* 2016). These classifications were then assigned values of 5, 4, 3, 2, and 1 and designated as having very high, high, moderate, or low risk of contracting malaria. The same process was applied for the distance to medical facilities and the distance to the road, although in this case, the risk classifications for the closer regions are lower.

Topographical features like elevation and slope can affect malaria directly or indirectly. Two classes were designed for each of these factors and reclassified maps map were created based on the condition of the study area. Different patterns of land use and cover create distinct conditions that are favourable for certain vectors, such as mosquitoes (Zeng, Cui, Lui, Cui, & Wang, 2006). The land use and land cover map of the area was divided into five risk classifications based on how well they bred mosquitoes. In order to assess the malaria risk in the area based on population density, a population density map was created using the projected population data for local government areas for the year 2019. There are now five different risk classes.

Determination and weighing of risk factors

Analytical Hierarchical Process (AHP) was used to establish the relative importance of each risk factor. The technique involved designing a pair-wise comparison matrix for the eleven factors, after which malaria experts were tasked with assigning a weight to each factor by evaluating its significance in relation to the significance of the other element in pair using. The value of each factor in a pair in relation to the other would be given a score between 1 (very less important) and 9 (extremely more important) (Saaty, 1994). As a result, ArcGIS 9.2 /AHP extension software calculated the Eigen vector of the weight of the factors. The final weight of each element was then determined using the computed principal eigenvector of a square reciprocal matrix of pair-wise comparisons between the criteria. The pair-wise matrix's consistency is then assessed using a threshold of 0.1; if the ratio is higher than that, the pair-wise matrix should be changed; if it is lower, the consistency is considered to be acceptable (Saaty, 1994). The pair-wise weights provided are accepted, as evidenced by the derived Eigen Vector's consistency ratio of 0.078.

Risk factor integration

After assigning a weight to each risk factor, the various weighted were combined to produce malaria risk zones for the study area. The Weighted Linear Combination (WLC) approach was used for this. Given that all component weights sum up to 1, the WLC is a linear function that combines fuzzy layers based on their importance weights (Fuller, Troyo, Alimi & Beier, 2014; Alimi *et al.* 2016). It has the equation shown below:

$$S = \sum_{i=1}^{n} w_i\, x_i c_j$$

Where wi = the weight of factor i, xi = the criterion score of factor i (value corresponding to the raster cell in the criterion raster map), n = the number of factor, and ci = the criterion score (1 or 0) of constraint.

The final malaria risk map of the study area was produced after combining all the weighted risk factor layers by using the Raster Calculator in an ArcGIS (Figure 2).
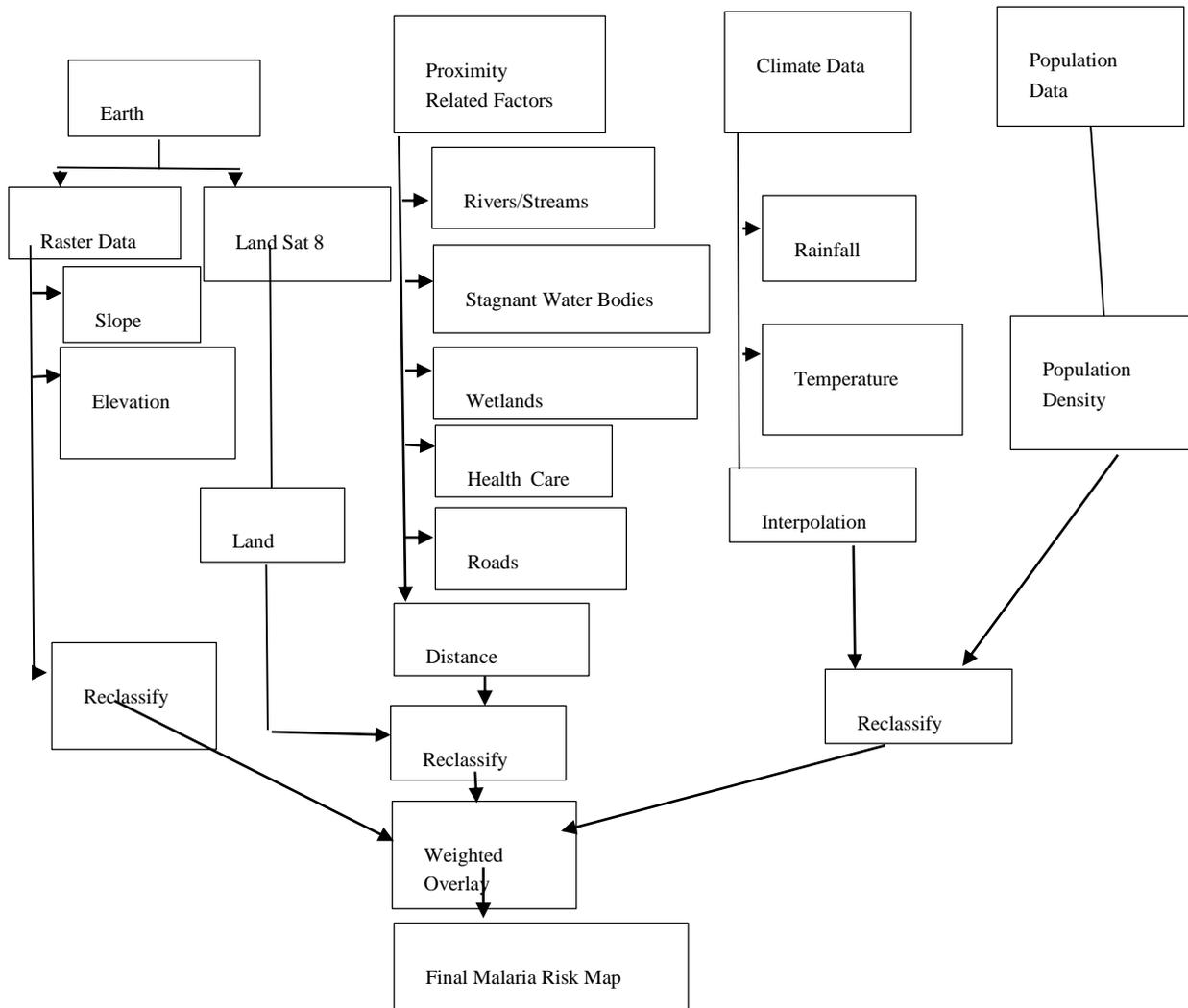

Figure 2: Work flow chart

Results

Analysis of malaria risk factors investigated

Figure 3 depicts the classes of malaria risk levels associated with each of the eleven malaria risk factors investigated in this study**.**

The reclassified temperature map of the area is displayed in Figure 3a. According to the map, 9956.43 km^2 (40.61%) and 7882 km^2 (32.15%) of the area were classified as having high and very high malaria risk levels, respectively, while 2377.22 km^2, or 9.7 percent of the state's total land area, was classified

as having low malaria risk levels. For rainfall the reclassified map (Figure 3b) indicates that the areas with low, very low, and high-risk levels of malaria are 7566.78 km^2, 6990.3 km^2, and 3649.06 km^2, representing 30.87%, 28.51% and14.8% respectively.

Figure 3c's reclassified elevation map shows areas with high and very high malaria risk levels, with sizes of 6619 km2 (27%) and 17,896 km2 (73%) respectively. According to the slope analysis's findings (figure 3d), 99% of the area had a very high malaria risk, while the remaining 1% had a high malaria risk level.

Due to their proximity to rivers, 18,071 km^2 (73.72%), 1906 km^2 (7.78%), and 4536.58 km^2 (18.5%) were categorised as low, moderate, and high levels of malaria risk, respectively (Figure 3e). The analysis of the distance to water bodies is shown in Figure 3f. According to the figure, there is a low risk of malaria in 21,728.07 km^2, a moderate risk in 623.71 km^2, a high risk in 691.19 km^2 and a very high risk in 1472.03 km^2, respectively. According to the reclassified malaria wetland map (Figure 3g), the bulk (75.72%) of the study area is at moderate risk for malaria, covering an area of 18562 km^2. Very high-risk level accounts for 18.19% of the area, or roughly 4460.11 km^2, while high malaria risk area makes up about 6.09%. As a result, three-quarters of the research area had a moderate risk of malaria due to wetlands.
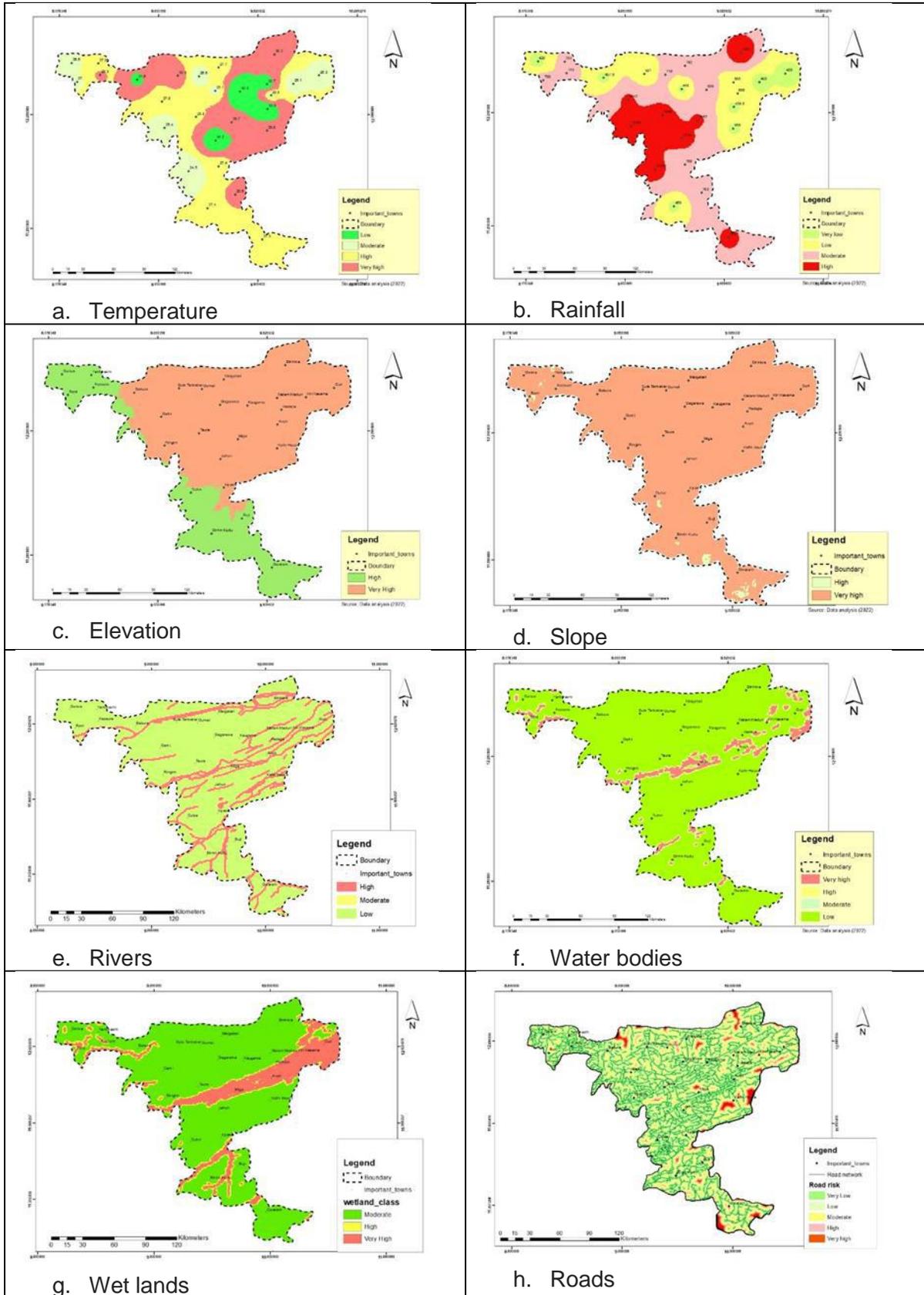
According to the reclassified road networks map, an estimated 12,988 km^2, or almost 53% of the state's total land area, was shown as having very low malaria risk, followed by 5,343.45 km^2 with moderate risk (figure 3h). Approximately 12,149.1 km^2 of the study region, or 49.56%, is in very high malaria risk, according to the reclassified distance to healthcare facilities map, while 6285 km^2 of it is in moderate risk (25.64%). 17.36% and 7.44%, or around 4254.9 km^2 and 1825.92 km^2, respectively, are locations with high and low malaria risk levels (Figure 3i).

As seen in the reclassified land cover land use map (Figure 3j), the very low, low, and moderately malaria risk classes occupied 987.9, 19,629, and 1152.75 km^2 respectively, which translates to 4.03 percent, 80.07 percent, and 4.7 percent of the total land area. On the other hand, areas with high and very high-risk levels made up 39.18 and 2706.04 km^2, respectively, which is equal to 0.16% and 11.04%. The reclassified population map (Figure 3k) reveals that 2002.23 km^2 of the map have a very low risk of malaria, as do 12624.2 km^2 of low risk, 7385.06 km^2 of moderate risk, 1467.21 km^2 of high risk, and 1036.3 km^2 of very high risk. Accordingly, these amounts translate to 8.17%, 51.5%, 30.12%, 5.98%, and 4.23%.

Malaria Risk Levels Identification

Weighted overlay methods were used to create and assess the final map of the study area's malaria risk. So, using weights provided to each risk factor by malaria specialists in the area, the eleven malaria risk variables were overlaid. In light of this, the risk map in figure 3l showed that, of the total area, 11,294.88 km^2, 8263.41 km^2, 2437.84 km^2, and 2518.87 km^2 were each susceptible to low, moderate, high, and very high risks of malaria, respectively. The corresponding percentages are 46.07%, 33.71%, 9.94%, and 10.28%.

The risk map produced by this study identifies 4956.71 km^2, or 20.22% of the area as malarious zone. The area stretched from north east to the western part of the state. It affects Guri, Kiri Kasamma, Hadejia, Auyo, Miga, Jahun and Ringim local government areas. Other areas affected in the south are Birnin Kudu, Buji and Gwaram local government areas. Other affected local government area was Roni on the north western part of the state.
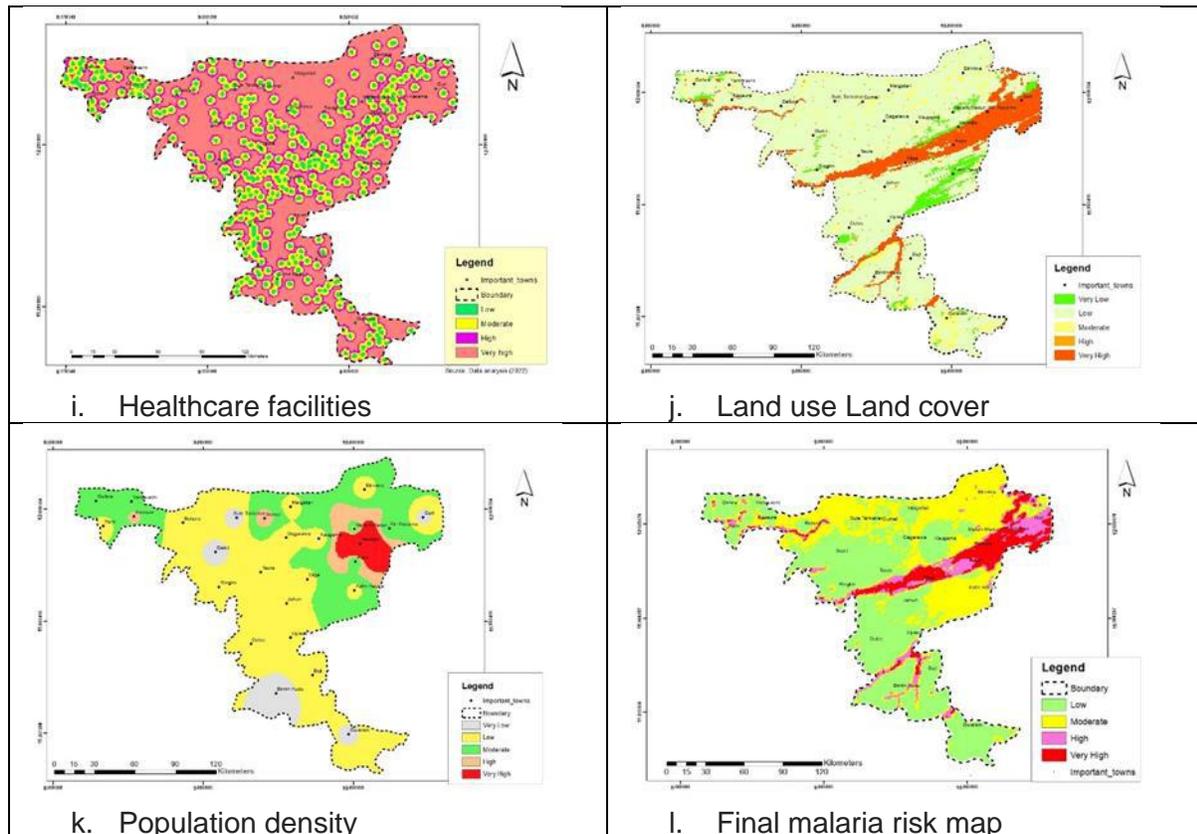
a. Temperature

b. Rainfall

c. Elevation

d. Slope

e. Rivers

f. Water bodies

g. Wet lands

h. Roads

| i. Healthcare facilities | j. Land use Land cover |
| k. Population density | l. Final malaria risk map |

Figure 3 a-l: Malaria risk map for different risk factors and final risk map

Discussion

This study creates a malaria risk map for Jigawa State using environmental, social, and economic data. In order to control malaria effectively and sustainably, itis necessary to identify high transmission areas that could be used to conduct surveillance-response methods, allocate resources, and provide health facilities based on each area's needs.

One of the factors influencing the transmission of malaria is known to be temperature. It has an immediate impact on mosquito growth, survival, reproduction, activity, and extrinsic incubation rate (Haque *et al.* 2010). According to this data, 73 percent of the study area falls between the 21° to 31°C temperature range, which is considered as ideal for mosquito development and breeding (Mulefu, Mutua & Boitt, 2016). This demonstrates that the temperature in most part of the study area is within the range that is acceptable for both mosquito and plasmodium parasite growth and development. The result (73%) obtained in this study for high and very high risk of malaria, is greater than the 54% reported by Gebre *et al.* (2020) and lower than the 93.8% found by Simeon, (2014). The topographical settings at the study sites could be the possible explanation of this variation.

Rainfall factor analysis shows that, almost 60% of the state was at low to very low risk of malaria, indicating that rainfall is not a key predictor in malaria transmission in most part of the state. This is due to the area's seasonal pattern of rainfall, which features longer (7-8 months) of dry time than of wet. Most of the pools that functioned as mosquito habitats during the wet season tend to dry up

throughout the lengthy dry months, which lowers the mosquito population. Even though the volume and duration of rain in the region are both limited, the average annual rainfall (800 to 900 mm) received in the region, is sufficient to transmit malaria (Tiruneh, 2010).

Malaria transmission is typically far more common in low-lying areas than in middle- and high-lying areas (Kimbi *et al.*, 2013). Our finding on elevation revealed that about two-third of the area is highly suitable for the transmission of malaria due to low elevation (below 400 meter). A study by Myers *et al.* (2009) established a positive association between low elevations with malaria risk. Similar findings were found by Nicole *et al.* (2010), Dlamini, Sabelo, Franke, & Vounatsu, (2015), Ferrao *et al.* (2018), and Zhao *et al.* (2020). The suitability of a habitat for mosquito breeding is determined by slope conditions. Water can move more quickly down steeper slopes, which deters the build-up of stagnant water bodies. Contrarily, locations with relatively gentle slopes are more likely to gather water, generating water pools that attract mosquitoes to reproduce in and raise the risk of malaria (Eniyew, 2018). Our finding concluded that the area is excellent for the transmission of malaria. The percentage of land area classified as very high risk in this study (99%) is higher than the percentages discovered by Worku (2016), Gebre et al. (2020), Simeon (2014), and Eniyew (2018), who found, 15.34%, 18%, 30.2%, and 51.3% respectively.

River is not a good place for mosquito to lay its eggs since its pressure-driven movement upsets and kills the eggs and larvae. Conversely, river water that has been channelled for a variety of uses and that gets motionless when rivers overflow supports mosquito egg-laying. From our analysis, 18.5% of the study area is at high risk of malaria based on proximity to river/stream. The few rivers in the state as a result of the dominant geological formation (Chad formation) may be the explanation of this result. In contrast to our findings, Worku (2016) and Gebre, Temam & Regassa, (2020) discovered that more than half of their research areas were at high and very high risk of malaria based on distance to rivers. Another significant malaria risk factor is closeness to stagnant water since it can serve as a breeding ground for vectors (Zhao *et al.* 2020), and support higher mosquito densities (Oesterholt et al. 2006; Zhou, Munga, Minakawa, Githeko & Yan, 2007). Our analysis indicates that the great majority (88.63%) of the research area has low malaria risk levels. This was due to the extremely small number of water bodies like lakes, dams, ponds, and pools that served as breeding sites. Our result is substantially higher than the 44% obtained by Ferrao *et al.* (2018). However, moderate and high malaria risk levels were identified by Simeon (2014) and Worku (2016) studies as the classes with the largest proportion of land area, accounting for 48.76 percent and 24.39 percent, respectively. Wetlands and agro-forestry areas are regarded as one of the obvious danger factors since they not only offer good breeding grounds for mosquitoes but also make ideal resting places for adult mosquitoes in addition to providing protection from unfavourable climatic conditions (Minale and Alemu, 2018). This study indicated that because of their proximity to wet lands and other irrigated areas, about 25% of the study area was at risk of malaria.

The distance that patients travelled to get to the closest medical facility affects how quickly and effectively malaria control and treatment are provided (Chikodzi, 2013). According to our analysis, the state has very low to low malaria risk levels for around 72% of its total area. The research indicates that the area is largely connected by roads, making it possible for malaria intervention facilities to quickly reach local residents. Contrary to what we discovered, Ferrao *et al.* (2018) found that, based on the road network element, the majority (54%) of their research area came under the moderate to high malaria risk group.

Settlements located within a 3 km radius of a healthcare centre are less at risk of diseases than those beyond the range, according to WHO, (2003). Based on this judgement, our investigation came to the conclusion that more than 90% of the area is at high risk of malaria due to its remote location from medical services. This result is not unexpected considering the state's total number of health facilities

(614) and its approximate total land area (24,515 km^2), which when compared results in one health facility per 40 km^2. The result for very high and high-risk levels (92.5%) found in this study is higher than the 60.5%, 42.73% and 22.41% observed in the corresponding studies by Gebre *et al.* (2020), Worku, (2016) and Eniyew, (2018) respectively. Because of this, the state needs more health facilities especially in the high and very high-risk areas, in order to address the health issues there.

From the analysis of this study, 84% of the area had very low to low malaria risk levels based on land use factor. The most obvious explanation for this finding is that, of all land uses, agricultural land, which is typically put to cultivation during the brief wet season, covered the biggest area. Long dry spells during which the land was left uncultivated expose it to sunlight, which gradually evaporates the soil moisture, rendering the area unsuitable for malaria habitat. Further analysis of our results revealed that just 11% of the area is thought to be malarious, which is slightly less than the 13.3% stated in Lemessa's (2011) study. However, Gebre *et al.* (2020), Simeon (2014), and Worku (2016) reported high results of 62.1%, 52%, and 51.22% for malarious areas. The presence of more wetlands and water bodies in their research areas may be the reason of this wide variation.

Dense populations encourage the spread of malaria since infected mosquitoes may bite numerous individuals and spread the disease to them (Wondim, Alemayehu & Abebe, 2017). Based on population size factor, the analysis of the study showed that 60% of the area had very low and low risk levels of malaria. This was because agriculture is the state's primary economic activity, and it requires a sizable amount of land, which when compared to the population results in low population density in many parts of the state. Our research supports that of Ferrao *et al.* (2018) and Lemmessa (2011), who found that, based on population density, a very high proportion (92% and 89% respectively) of their study sites fell within low malaria risk. Gebre et al. (2020) discovered a different outcome, with the highest proportion (45 percent) of their study area being at very high and high-risk levels.

The malaria risk map produced by this study identifies 4956.71 km^2, or 20.22% of the area malarious zone. The high-risk level discovered in this study (20.22%) was considerably lower than the 36.88%, 45.5%, 50.94%, 54.45%, and 80% reported by Gebre *et al.* (2020), Mihiretie (2022), Aniyew (2018), Worku (2016), and Minale and Alemu (2018) respectively. Comparatively to our findings, research by Ferrao *et a*l. (2018), Mohammed (2018), Lemessa (2011), Ahmed (2014), and Moha, Maru & Lika, (2019) reported lower results of 4%, 7%, 7%, 15.7%, and 19.6%, respectively. The variations in the presence and extent of wetlands, swampy areas, and small irrigation projects in the study areas might have been the reason of the discrepancies between these researches (Gebre *et al.* 2020).

Conclusion

Risk maps reveals the locations that take the most control effort. Only when the available resources are utilised more judiciously will a sustained malaria control be possible. This is accomplished by focussing on high risk, underserved, and highly inhabited areas where intervention is most needed. In order to support resource allocation and increase the sustainability of control effort, the study recommends integrating risk mapping into the state's vector control programme. To provide data for accurate risk mapping, increased monitoring for temperature, rainfall, population changes and other variables is necessary. More health facilities should be provided especially in high-risk areas to reduced spreading of the disease to other areas.

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Conflicts of Interest

The authors declare that they have no conflicts of interest.

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ASSESSING THE CARRYING CAPACITY OF THE TOURISM LAKES IN SAN PABLO CITY, LAGUNA, PHILIPPINES

Perez, G.[1,3]*, Magcale-Macandog, D.[2], Nacorda, H.[3], Sanchez, P.[3], Settele, J.[4], Pleto, J.[2], Campang, J.[2] , Cabillon, Y.[2], Natuel, F.[3] and Larida, N.[2]

[1] University of the Philippines Rural High School, University of the Philippines Los Baños, College, Laguna, 4031.

[2] Institute of Biological Sciences, University of the Philippines Los Baños, College, Laguna, 4031.

[3] School of Environmental Science and Management, University of the Philippines Los Baños, College, Laguna, 4031.

[4] Department of Conservation Biology and Social-Ecological Systems, Department of Community Ecology, Helmholtz Centre for Environmental Research – UFZ (Umweltforschungszentrum), Halle, Germany.

*Correspondence: mdperez11@up.edu.ph

Abstract

The City of San Pablo is known for its seven crater lakes. Three of which namely Sampaloc, Yambo, and Pandin are considered ecotourism spots offering various tourism-related activities. This study estimates the tourism carrying capacity for various activities using Boullon's Carrying Capacity Mathematical Model. Face-to-face and online interviews with tourists were conducted to elicit perceptions regarding tourism-related activities. The model revealed that for the twin lakes Yambo and Pandin, the real carrying capacity (RCC) for swimming ranged from 214 persons up to potentially 296 at assumed two-hour stays of visitors. The calculated RCCs for rafting, fishing, and sightseeing/Figure taking at Lake Pandin and Yambo were 165 and 167, 106 and 108, and 284 and 168, respectively. Lake Sampaloc's RCC for biking, walking, jogging, viewing and Figure taking was estimated at 1019, while the areas for picnic and exercise were 557. When compared with tourist arrival data since 2005, the arrivals for Lakes Pandin and Yambo have not exceeded the calculated RCCs. However, Lake Sampaloc showed that the RCCs in all the present activities have been exceeded with an estimate of 1183 tourists per day compared to the estimated computed RCCs of 1019, 38, and 557, respectively. The calculations made were also based on the set limiting factors—typhoons, rainy days, tourists' average time of stay, and the rank of activities based on the responses in the questionnaires. Further recommendations in maintaining the lake's biophysical state and enhancing the tourist facilities in consideration of sustainable tourism are strongly recommended.

Keywords: Carrying Capacity, Ecotourism, Limiting Factors, Sustainable Tourism

Introduction

Ecotourism is defined as environmentally responsible travel and visitation to areas for recreation and enjoying the scenic environment that promotes conservation, has a low visitor impact, and allows beneficially active socio-economic involvement of the locals (Joshi, 2011). It promotes the sustainable use of natural resources while also providing economic opportunities for residents (Farrell & Runyan, 1991; Bhattacharya, Chowdhury and Sarkar, 2011; Garcia 2012). Ecotourism is anticipated to become the world's largest industry in the future by the United Nations (UN) and the World Trade Organization (WTO) (Kaur, 2006 as cited in Jaafar & Maideen, 2012).

In the Philippines, it is noted that ecotourism is one of the fasting growing economies. In 2016, 5.97 million tourists visited the country, according to Arnaldo (2017) as cited by the Department of Tourism (DOT), with a 1.11% growth in visitor revenues, driving economic activity across tourism areas in the Philippines.

The Seven Lakes are found in the City of San Pablo of the Province of Laguna, about 70 km away from Manila. The Seven Lakes namely, Sampaloc, Yambo, Pandin, Calibato, Bunot, Palakpakin, and Mohicap, were formed by a unique process called a phreatic eruption, where shallow lava from Mt. San Cristobal intersected groundwater which blew out (steam-heated eruption) the overlying rocks to form circular and crater-like depressions that were eventually filled up with rainwater. The varying depths of these lakes are from ~7 m to 156 m, suggesting a volcanic origin (LLDA-EQMD, 2008). Lakes Sampaloc, Yambo, and Pandin are considered ecotourism sites among the seven. The twin Lakes Pandin and Yambo are considered to have the most pristine water, categorized as oligotrophic with abundant flora and fauna within the area (LLDA-Pandin DMP, 2014), while Lake Sampaloc mainly caters aquaculture is categorized as eutrophic (LLDA-EQMD, 2005). In line with this, the LLDA Board Resolution No. 295, Series of 2006 was authorized to lay out the rules for the use of the Sampaloc Lake shoreline in San Pablo City and its transformation into a recreational park (LLDA-EQMD, 2005).

For Lake Pandin, it was Mr. Mandy Mariño, a civic leader, who, in 2005, started the campaign of establishing the Lake as an ecotourism site, promoting his advocacy for lake preservation (Amit, Bicomong, and Sandalo, 2016). Fundacion Kalikasan, a non-government organization of which Mr. Mariño is a member, took the initiative to be an advisor to the residents living near the Lake. The aim was to make Lake Pandin an ecotourism site and to become beneficial through income-generating activities for the residents, promote the Lake's beauty, and practice sustainable use of the Lake. At present, Lake Pandin is continuously operating as one of the famous tourist sites in San Pablo City. Adjacent to its twin lake - Pandin, Lake Yambo is also mainly used for ecotourism purposes. Recreational activities that the locals and tourists could relish in Lakes Pandin and Yambo are swimming, swinging, outings, photography, picnics, and hiking in its nearby peak – Mount Mabilog. Tourists could rent bamboo rafts or balsa, with or without food, as they explore the lake. Furthermore, both male and female residents acquire their income from these ecotourism activities by touring the visitors who want to get a glimpse of the lake as well as those who would like to go on a hike at Mount Mabilog, cooking and serving food, paddling of bamboo rafts, as well as making and selling souvenir items, among many others, Since Lake Yambo officially operated as an ecotourism site under the management of its lake organization in 2005, tourists were required to pay tourism fees to experience the lake's activities (San Pablo CLUP, 2015-2025). Meanwhile, Lake Sampaloc is an open park with various entrance and exit ways, wherein both locals and tourists can enjoy its beautiful sceneries for free. As the closest lake to the city proper, it is one of the city's most popular tourist attractions and serves as a recreational destination for those locals and tourists who love biking, jogging, and picnics, area for aerobics/Zumba (San Pablo CLUP, 2015-2025).

These sites are known for having majestic sceneries in the city, visited by thousands of tourists both foreign and locals annually. However, the determination of tolerable change for both natural and social science components caused by human intervention has not yet been taken into consideration. Exposed areas for the activities intended for tourists might cause an adverse impact on the lake. For ecotourism lakes (Lake Sampaloc, Lake Yambo, and Lake Pandin), the prescribed capacity of the areas exposed to recreational activities such as biking, jogging, trekking, swimming, rafting, picnic, and the likes, that the lake can support a sustained basis without the deterioration of the resource base have not yet been considered. The concept of carrying capacity refers to a degree of recreational use that can be sustained (Sievänen, 2004). Its major assumptions focus on the amount of impact related to the amount of use, that decreasing the amount of use will decrease the impacts, and that it is possible to estimate the number of users with acceptable impacts (Kaiser and Beadman, 2002). The carrying capacity must be determined through objective factual studies that are specified by subjective value weighing. It comes from the idea that tourism cannot continue to flourish in an area without creating irreversible damage to the local society (Coccossis and Mexa, 2004). The concern is

that recreational impacts differ with the types of use, the timing and duration of use, distribution of use, environmental setting, management actions, and people's expectations and norms.

This research paper focuses on assessing the carrying capacity of the ecotourism lakes in San Pablo City, Laguna to pave the way for its sustainable management by suggesting the number of visitors while preserving the environment and sustaining the growth of tourism. The estimates that the study provided aid the plan to ensure few and tolerable impacts on natural resources. This will ensure the tourism capacity of the lake to make its operation sustainable and lasting.

Study Area

The City of San Pablo is situated at an elevation of about 100 m above sea level, has 80 barangays (Figure 1), and has a total population of 266,068 (PSA, 2015). It is geographically located between 14' 4' north latitude and 121' 19' east longitude which covers 80 barangays that has a total land area of 19,756.04 ha (CLUP, 2016).
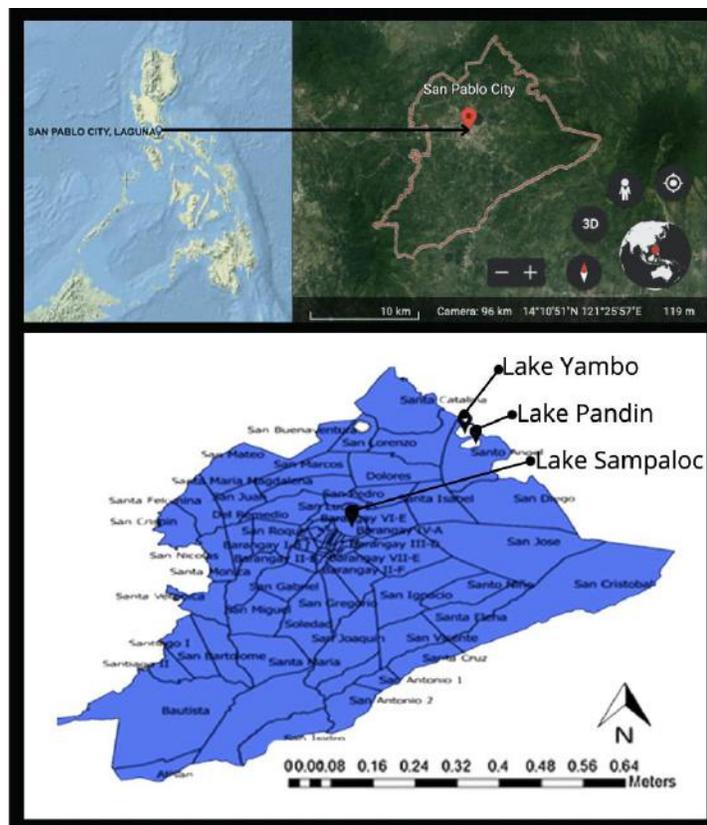
Figure 1: Map of San Pablo City study site (Map Source: PhilGIS, 2020; Google Earth and Google Maps, 2022).

Lake Sampaloc is considered the biggest and premier lake of San Pablo City, located within the city proper. It has an area of about 104 ha and a maximum depth of 27 m (LLDA-EQMD, 2005). The Pandin Lake micro-watershed is located at about 100 m in the southern portion of Lake Yambo. Lake Pandin has a total area and total perimeter of 24.15 ha and 1.91 km, respectively, while Lake Yambo has a total area of 30.5 ha (LLDA-Pandin DMP, 2014; Brillo, 2016).

Materials and Methodology

The threshold limit of tourism activities, as well as the number of individuals who can be supported within the natural resource limits of each lake, were estimated using land-based surveys and management-by-objectives approaches. Parameters that were collected include population data, the number of tourists, and daily reception number/day (Ding et al., 2015). Data on various variables which have a noticeable effect on the ecotourism of the lake, such as the ecotourism awareness and the possibility of ecotourism disturbance on the ecology and education, increase in crowd seasonally or annually, the modes of transportation, and the reason for visiting, were collected and incorporated in the management of carrying capacity.

A comprehensive structured questionnaire with a Likert Scale was formulated to assess tourists' satisfaction regarding their visit to the Lake, e.g., the facilities available, quality of service, the naturalness and size of the lake, as well as the presence of plants and animals. The questionnaire was also developed to account for the number of tourists in the area based on the recreational activities offered and the quality of existing facilities in the area. Other variables considered in the estimation are the following: the size of the lake intended for tourism activities, points of activities, infrastructures and facilities available, and other amenities for tourists.

Tourist respondents were interviewed face-to-face during the wet season (September to November 2019) and dry season (January and February 2020) for Lake Pandin. A note of consent was provided for the assurance of confidentiality in the shared data and personal information. To augment the sample size, an online survey through Google Forms was used to gather responses from more tourists who visited the sites (Lakes Sampaloc, Yambo, and Pandin) during the same months. They were only reached through social media and given the link to the online survey. This is due to the restrictions in line with the posed threat of the Covid-19 pandemic.

Following the manual of Calanog (2015) of the Department of Environment and Natural Resources – Ecosystem Research and Development Bureau (DENR-ERDB), the determination of the carrying capacity was based on the Boullon's (1985) carrying capacity mathematical model, which determined the standard requirement of the visitor, such as space, time, and other needs, while enjoying an activity, like swimming.

Materials

In Boullon's Carrying Capacity Mathematical Model (BCCMM), the Basic Carrying Capacity (BCC), Potential Carrying Capacity (PCC), and Real Carrying Capacity (RCC) were computed. The RCC was used to determine the total Carrying Capacity (CC) of an area.

- *Basic Carrying Capacity (BCC)*

   The parameters needed to identify BCC are the following: (a) total size of the area used by the tourists; and, (b) standard or average space requirement of visitors.

- *Potential Carrying Capacity (PCC)*

   PCC was calculated by computing the rotation coefficient (RC) of specific tourism activity. RC was determined as the total number of hours the lake area was open for recreational activities (e.g., swimming) divided by the average number of hours the tourists enjoyed swimming. The average number of hours the tourists enjoyed recreational activities was based on responses obtained during the interviews.

- *Real Carrying Capacity (RCC)*

   RCC is the maximum permissible number of uses of an area once limiting (i.e., corrective) factors derived from the characteristics of the site (or standards/needs of the visitors) have been applied. RCC was computed by incorporating the limiting factors identified from the interviews and observations on-site. The following limiting variables were incorporated: (a) Lf_1 (typhoons); (b) Lf_2 (rainy days); (c) Lf_3 (time available for swimming); and, (d) Lf_4 (quality of the Lake as a tourism site, based on tourists' perceptions).

Major Considerations in Computing the Carrying Capacity of Lake Pandin

The major objective of determining the carrying capacity is to assess the optimum number of visitors to a tourism site to preserve the environment as well as sustain the growth of tourism. Using the reference manual of DENR-ERDB (2015), possible limitations not only of visits but of use of the resources were assessed. In this study, the average requirement for space needed by an individual to enjoy a leisure experience was gathered through a survey that used infographics (Figure 2). According to the manual, following the WTO standard for tropical regions, visitors/tourists were asked about their perception of how much space they needed to enjoy a recreational facility fully and safely without disturbing other visitors/tourists.
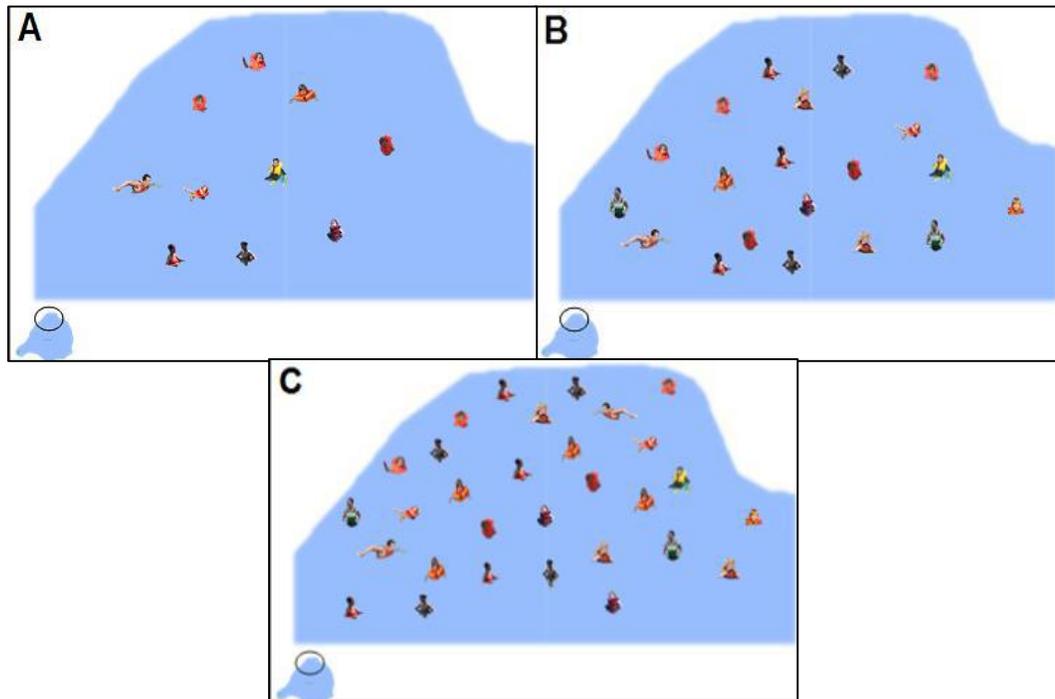
Figure 2: Infographics used for the survey of the preferred size of an area for swimming—A, 30 m^2, with 10 swimmers at a given time; B, 20 m^2, with 20 swimmers at a given time; and, C, 10 m^2, with 30 swimmers at a given time.

Institutional Review Board Statement

This study was conducted according to the guidelines of the Declaration of Helsinki and approved by the National Ethics Committee of the Philippine Council for the Health Research and Development of the Department of Science and Technology (NEC Code: 2019-005-Macandog-Lakes, October 11, 2019).

Methodology

The tourism carrying capacity (TCC) of Lakes Sampaloc, Yambo, and Pandin was evaluated. The variables needed for computing the tourism carrying capacity were the size of the lake intended for tourism activities, points of activities, infrastructures and facilities available, and amenities for tourists. Following the manual of Calanog (2015) of the Department of Environment and Natural Resources – Ecosystem Research and Development Bureau (DENR-ERDB), the determination of the carrying capacity was based on the Boullon's (1985) carrying capacity mathematical model (Figure 3), which determined the standard requirement of the visitor, such as space, time, and other needs, while enjoying an activity, like swimming. The considerations in estimating the probable number for each lake are vital as to how it will sustain its capacity to cater tourism-related activities. The carrying capacity (CC) for tourism-related activities in the Lakes was applied to address present or future challenges in terms of the amount and level of use. The rotation coefficient (RC) is intended to provide the probable potential capacity of the lake in terms of hours used by the tourists. The set limiting factors (Lfs) such as (a) Lf_1 (typhoons); (b) Lf_2 (rainy days); (c) Lf_3 (time available for swimming); and, (d) Lf_4 (quality of the Lake as a tourism site, based on tourists' perceptions) were used to provide the maximum permissible number of uses of an area per day. The RCCs for each activity per lake were compared to estimate the status of each lake in terms of use.
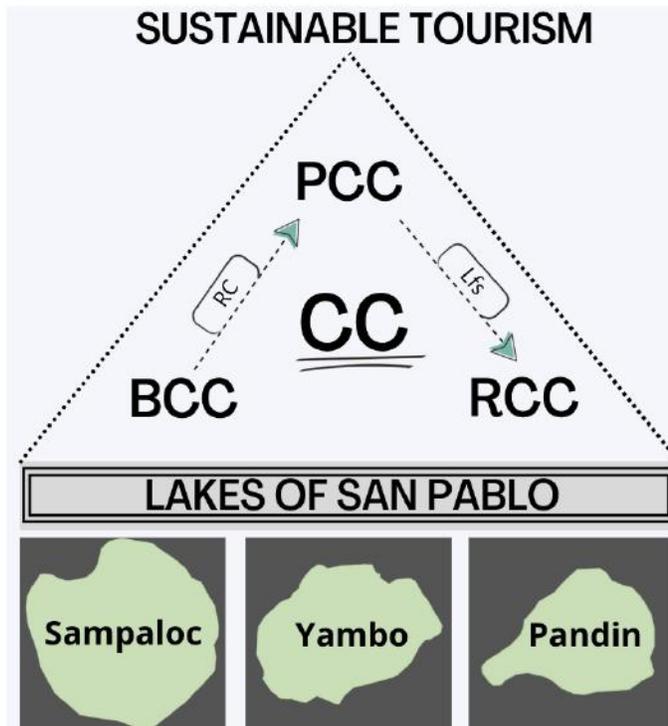

Figure 3. Determination of the tourism carrying capacity of Lake Pandin. Legend: RCC, real carrying capacity; PCC, potential carrying capacity; BCC, basic carrying capacity. Source: Calanog, 2015

Results

Tourists' Arrival Data

Figure 4 showed the data on tourist arrivals during the last five years. It revealed that the most obvious peak of arrivals is at Lake Sampaloc. This is due to the accessibility in the area which is located within

the city proper and has several entrances, while both lakes Yambo and Pandin require an entrance fee and limited time (at most for 2 hours). The year 2019 data was used to evaluate the capacity of the lake based on the number of tourists who visited the area.
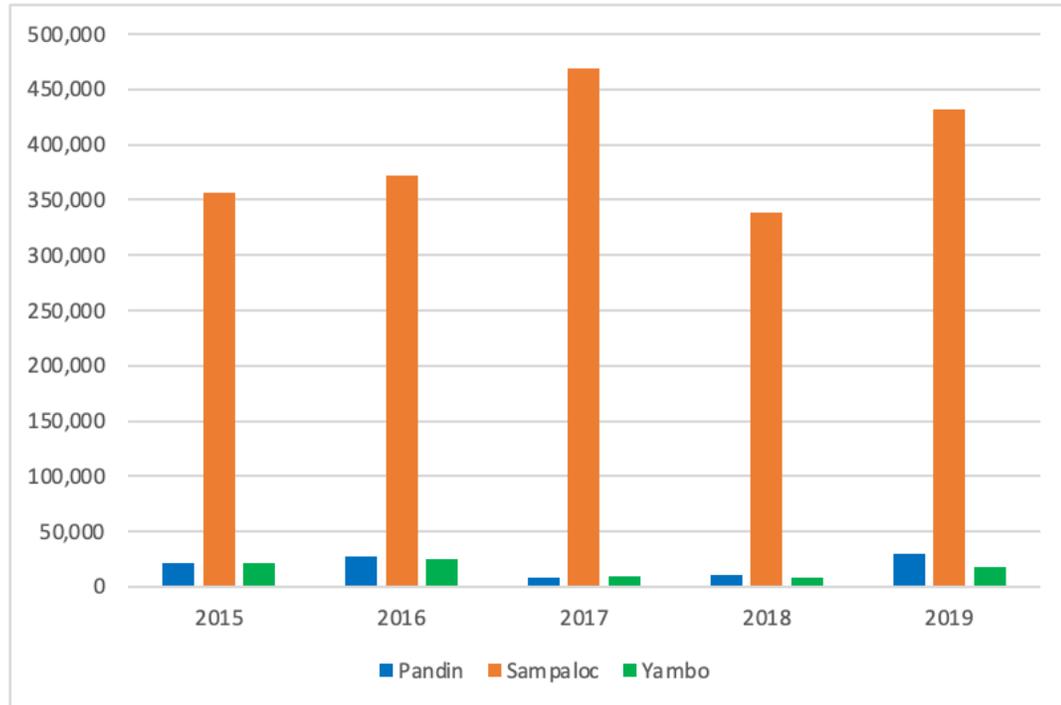

Figure 4: Annual trend in the number of tourists visiting Lake Pandin, Lake Sampaloc, and Lake Yambo from 2015 to 2019. Source: City Tourism Office of San Pablo.

Visitors' Preferred Space Size for Leisure Activities

Table 1 shows that out of the 250 tourist respondents, 132 (53%) preferred a 30 m^2 area with 10 individuals swimming at a time. A 20 m^2 with 20 individuals swimming at a time was chosen by 87 tourists (35%), while 31 tourists (12%) preferred having 30 individuals at a given time. Those who chose the small-sized space stated that it would be more enjoyable if the space were occupied by only a few individuals.

Table 1. Choices for tourists' preference of an area for their leisure activities, e.g., swimming. * denotes the maximum area recommended by the WTO for tropical regions.

Scenario	Description	Approximate area, m^2	Frequency	%
A	The swimming area is occupied by 10 persons	30*	132	52.80
B	The swimming area is occupied by 20 persons	20	87	34.80
C	The swimming area is occupied by 30 persons	10	31	12.40

*Results of the Carrying Capacity for Tourism Activities in Lake Pandin*

Using Boullon's Carrying Capacity Mathematical Model (BCCMM), the BCCs and PCCs were computed to reveal the RCCs per activity of Lakes Pandin, Yambo, and Sampaloc. Figure 5 shows the summary of the computed real carrying capacities for the main tourism activities offered in Lake Pandin, Lake Yambo, and Lake Sampaloc.
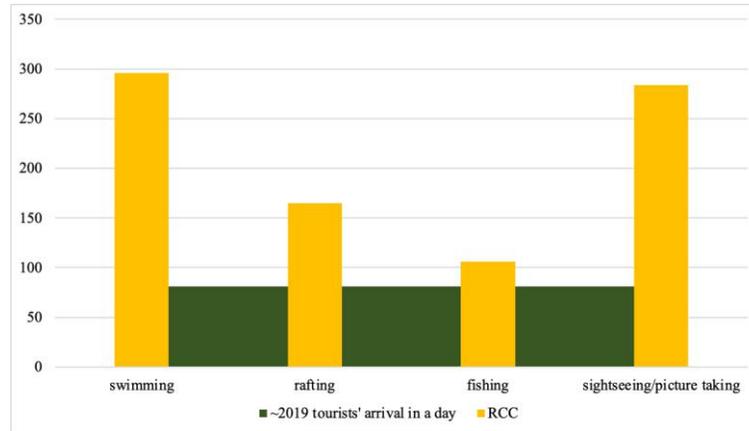
(a)
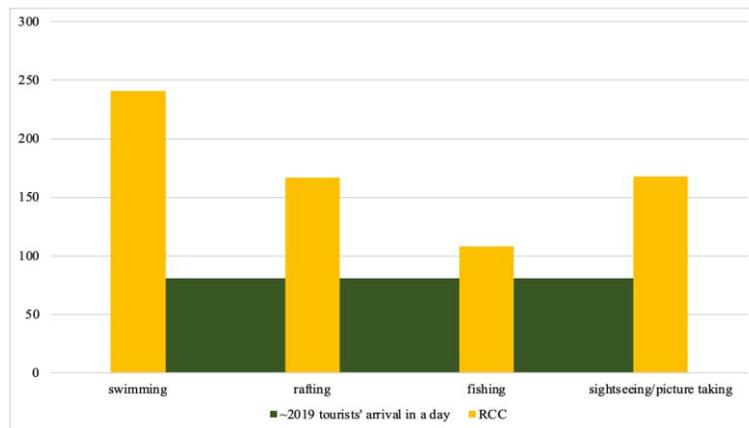
(b)
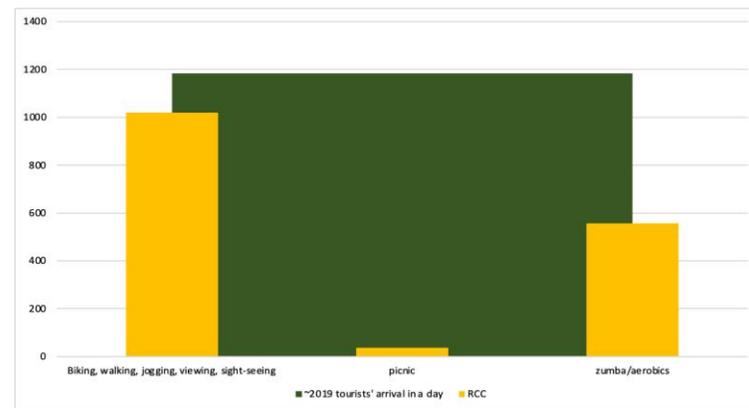
(c)

Figure 5: Calculated RCCs per activities in Lake Pandin (a), Lake Yambo (b), and Lake Sampaloc (c) with respect to the calculated 2019 tourists' arrival in a day. Source: City Tourism Office of San Pablo, 2019.

Discussion

The calculated RCCs for swimming, rafting, fishing, sight-seeing, and photography in Lake Pandin and Yambo were less at 296, 165, 106, and 284 persons per day, and 214, 167, 108, and 168, respectively. When compared with tourist arrivals data per day in 2019, these RCCs have not been exceeded so far. However, Lake Sampaloc showed that the RCCs in all the present recreational activities such as picnicking, biking, jogging, and areas for exercise (Zumba and aerobics) have been exceeded with an estimate of 1183 tourists per day compared to the estimated computed carrying capacity of 1019, 38 and 557, respectively. The calculations made were also based on the set limiting factors—typhoons, rainy days, available time tourists may enjoy sight-seeing and photography, and the rank of the activity based on the responses in the questionnaires.

This was based on the 250 tourists interviewed during the wet and dry season for lake Pandin, and 24 and 75 tourists who visited Lakes Yambo and Sampaloc, respectively, who responded to the Google forms distributed during the pandemic season. The TCC computation done was based also on consideration of the area intended for tourism activities, the recreational activities available for the tourists, as well as the declared limiting factors applicable to the site. Further recommendations in maintaining the lake's biophysical state as the tourists emphasize the preservation of the scenic view of Pandin. However, the tourism association is recommended to enhance the tourist facilities in consideration of sustainable tourism.

Conclusion

Based on the yearly tourists' arrival, the computed real carrying capacity in Lake Pandin and Lake Yambo has not been exceeded yet. However, Lake Sampaloc exceeded the value for its real carrying capacity of "number of tourists" as the number of tourists that visit the lake exceed the maximum number that the lake can sustainably accommodate. The management of tourism, as well as the LGU of San Pablo City, are highly encouraged to implement the limits on the number of tourist arrivals and the rate of use. In addition, for a tourism site to work sustainably, the positive engagement of the residents, as well as proper implementation of protocols and rules, must be taken into consideration, whether for the maintenance of the lake, flora, and fauna, or even the management of local communities. It is recommended for ecotourism management to improve the existing facilities like the receiving and holding areas, to put directional and safety signage as well as information bulletin to make the public become aware and informed of the restrictions and policy while enjoying the area. For Lake Sampaloc, it is highly recommended to have control of the entrance and exit pathways to monitor the use of the area with respect to the number of tourists in a day. Another equally important recommendation is to continue the conduct of training and seminars for the members of the organizations to enhance their skills in communication and hosting of guests. The tour may begin with a brief orientation to ensure the safety of the visitors, solid waste management practices, and other practices that ought to be observed. Informing the public and the visiting tourists of various environmental laws and regulations is also important.

Acknowledgment

various organizations that manage the lakes' ecotourism enterprises, and the tourists' respondents during the face-to-face and online interviews, all willingly spent their time participating in several social surveys.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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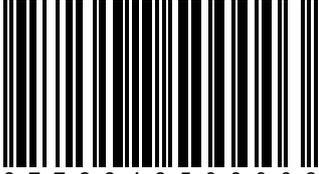
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