



Measuring the Urban Ecosystem Services Based on Residents Perception In Malacca City, Malaysia

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Abstract

The benefits of the urban ecosystem services are that they have the prospective and potential to improve urban resilience, maintain human wellbeing and increase the quality of life. However, urbanization and development activities are increasing rapidly in the country, causing numerous consequences especially to human wellbeing of city residents. Thus, this paper aims to update our current understanding of the concept, analyze the types and the levels of satisfaction on the urban ecosystem in Malacca City, using the survey method to 200 respondents. We can see that many specific studies have been carried out on urban ecosystem services and the overall resident's level of satisfaction on the services is 1.74. However, most of the studies focus on cultural service categories (aesthetic value, educational, tourism, spiritual, social relations and recreation). Thus, by exploring the urban ecosystem interaction, it may add benefits in terms of improving the urban ecosystem services and the urban design to streamline the urban area planning in Malacca City. Finally, we conclude that all parties should play important roles to make sure that the urban ecosystem services and design in Malacca City are sustainable and more livable with the right policies and guidelines such as the Sustainable Development Goals.

Keywords: *Urban, Ecosystem services, Policies, Sustainable Development Goals, Environmental Management*

1. Introduction

The urban design is related to both the aesthetic and functional aspects of the City's built environment. Aesthetics, being a traditional concern of the urban design can only be more meaningful when they are combined with other considerations to generate a comfortable, convenient and visually pleasant environment, which conveys a sense of place, pride and belonging (DBKL, 2019). The Millennium Ecosystem Assessment (MEA) (2005) defines the ecosystem services as the advantages people obtain from the ecosystem and its surroundings. Ecosystem services are the goods given to humans throughout the conversions of environment such as water and vegetation into a flow of necessary services and products such as food and clean air (Constanza et al, 1997). In the other word, ecosystem services are the operations that produce many resources from the environment. Therefore, it is important to understand the roles of nature in maintaining human wellbeing. However, the valuation of urban ecosystem services is usually measured using monetary approaches because they are not directly available for human use especially in the cultural categories of urban ecosystem services.

Based on previous studies by researchers such as Daily 1997; de Groot et al. (2002), the Millennium Ecosystem Assessment (2005) and The Economics of Ecosystems and Biodiversity (TEEB 2011), ecosystem services have been categorized into four main components. The main components are provisioning, regulation, supporting and cultural. In this context, regulation refers to ecosystem services that regulate functions, such as air and soil quality, flood control, storm and disease control (Haase et al. 2014). These benefits are derived from ecosystem service processes such as waste absorption, disease control, climate control, flood control, water purification and extreme weather control. According to Haase et al. (2014), provisioning refers to service benefits including the output of materials from ecosystems such as food, water, medicinal plants and other sources. Additionally, ecosystem services in terms of cultural including socio-ecological benefits (including psychological and cognitive benefits) derive from environmental relations such as recreational, aesthetic, spiritual, and psychological and tourism benefits (TEEB 2011). Furthermore, habitat and support services sustain almost all other services by providing



space and environment for the life of organisms, and also maintain the diversity of plants and animals (Haase et al. 2014).

The ecosystem service concept can be adapted to urban ecosystems due to the importance of various inhabitants services (Tratalos et al, 2007; Ahern, J. 2007). In this case, urban planning and urbanization activities are often associated with the development potential of ecosystem services including in the Malay urban design. Furthermore, urban ecosystem services are also interconnected with the biodiversity aspects of an area. Therefore, its ecosystem services will decrease because an urban ecosystem will be worthless if it is unable to provide any basic benefit and human need. Schewenius et al, (2014) argue that the elements of a sustainable city require a consolidate social-ecological approach in policymaking, city governance, management and planning. They introduced the Urban Ecosystem Services (URBES) and Biodiversity Project and the Scientific Foundation of Biodiversity Outlook (CBO) that contribute as a new social-ecological approach to urban durability and the practice and research of ecosystem services. In order to incorporate ecosystem services and biodiversity in the urban design, development and governance appliance, these projects were functioned as tools in the context of planners and decision-makers who are involved in the urban design and city.

However, the rising requests and demands for space for new uses in the associated residential and industrial areas have generated massive uncontrolled built-up areas occurring in many developing countries and developed cities (Gonzalez & De Lazaro, 2011). Human activities can dominate the changes in land use and unnecessary synergies and trade-offs in the context of the ecosystem service's provision (Zhang et al, 2016). Sometimes, the old buildings carry traditional and unique identities in terms of historical, architectural and heritage value which later reflected towards the urban form aspect (Abdullah et al, 2018). Hence, the contributions of the ecosystem services to the human wellbeing and world's economy have been recognized in policy and also in the basic science and policy (Egoh et al, 2012; Corbera, 2012; Van Oudenhoven et al, 2012; Muller & Burkhard, 2012).

Development and urbanization activities are increasing rapidly in the country, causing the conversion from the original land uses to other uses such as agricultural, residential or industrial area planning. According to Hall (2001), one of the lands uses that changes along with the modernization process is the rapid urbanization process, industrial, agricultural (plantation and livestock) activities, facilities housing, and transportation facilities. According to the research, forest and agricultural areas, such as rubber, oil palm and the likes, are explored for development, which involves construction of new cities, settlements, business centers, etc. Generally, this causes the changes in physical environment consisting of atmosphere, biosphere, lithosphere and even hydrosphere (Md Jahi, 1993). Changes that occur as a result of human activities can affect the human environment, especially in the local area, such as the impact on the wellbeing of people. In addition, measuring the quality and wellbeing of the population who receive the impact of rapid development is too difficult for a community or an individual. In this context, although there are no indicators or effective methods for measuring urban ecosystem service satisfaction and the wellbeing of the population, the rapid development activities in one area will certainly have a social impact on the population in particular. In general, this research aims to measure the level of satisfaction of the population concerning urban ecosystem services in the study area.

Besides, the contributions to the study of ecosystem services such as in the regulation category can also be seen in the area of disease control. For example, Mohd Yaakob and Yunus (2017) conducted a study related to the prevention and control mechanisms of Tuberculosis (TB) disease in Malaysia. The disease is the oldest infectious disease in the world and has spread through airspace which can occur in major cities, including in Malaysia. Furthermore, it is also important to achieve the Sustainable Development Goals by 2030 for a better and more sustainable future for all, including environmental degradation, peace and justice to leave no one behind. In order to determine the urban ecosystem services in Malacca City, this study aims to measure the value of the urban ecosystem services that have been provided based on the perception of the communities there. Besides, we hope that this study will complement the existing policy and help to design a better conservation plan for the urban ecosystem services in the area. Then, we also discuss the methodology and approach that we used and also the results based on the study, as well as the discussion and conclusions. Hence, we conclude this study by a brief



overview role to make sure that the urban, especially in Malacca and other cities in Malaysia and outside Malaysia to be sustainable and more livable with the right guideline in the present and future.

2. Objectives

1. To measure the perception of urban ecosystem services among the residents in Malacca City.
2. To analyze the types and values of the urban ecosystem in Malacca City.
3. To analyze the residents' levels of satisfaction on the urban ecosystem in Malacca City.

3. Methods

The study was conducted around the city of Malacca, Malaysia with an area of 114.7 square miles (303 km²). Malacca is bordered by Negeri Sembilan in the north and west and Johor in the south as shown in Figure 1. Malacca City is a famous tourist city and it is administered by the Malacca City Council (Majlis Bandaraya Melaka Bersejarah, MBMB). Therefore, the study was conducted in residential areas around the city such as Taman Pahlawan, Taman Merdeka, Taman Malin Jaya, Taman Peruna, Taman Sungai Udang, Kampung Kubu and Taman Bukit Katil. The data of this study were obtained from various primary and secondary sources, with the primary data collected by quantitative research through a survey form as its instrument supported by field observations of the researchers. This survey is also used as a purposive sampling method where the form was distributed only to 200 respondents who live in and around Malacca City via door-to-door surveys. 200 respondents were sampled in an experimental group that focuses on the characteristics of the respondents. Furthermore, the survey forms were distributed to the respondents to measure their perceptions of the urban ecosystem services that are provided around them and in their community's life. In this context, observation methods were used to obtain information on the urban design and urban ecosystem services that exist in the city of Malacca. Besides, the secondary data are obtained from various sources including through the ministry's website and the Local Authority such as Majlis Bandaraya Melaka Bersejarah (MBMB).



Figure 1 Malacca City

4. Results

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Respondents' background

Figure 2 shows the respondents' background in the sampling area around Malacca City. Then, based on the survey that is distributed to 200 respondents, 63.0% are Malay, 18.5% are Chinese, 17.5% are Indian and 1.0% are other races. 57.5% of the respondents are female and 42.5% are male. In terms of age, it was divided into 6 age categories. The first category was under 19 years old, which has no respondents, then 20-29 (21.0%), 30-39 (39.5%), 40-49 (25.0%), 50-59 (5.5%) and over 60 years old (9.0%). Besides, in terms of marital status, some of them (48.5%) were married, 40.5% were single and 11.0% were in another marital status such as widowed and divorced. In addition, most of the respondents have a bachelor's degree (36.0%), followed by SPM (29.5%), diploma or equivalent (15.0%), master's degree (7.7%), PMR (7.5%), PhD (3.0%) and UPSR (1.5%). For occupation background, most of the respondents work in the private sectors (29.5%), followed by self-employed sectors (22.0%), the government sectors (18.5%), others (17.5%) and the remaining were retirees (12.5%). In term of income, most of the respondents earned RM4,001-RM5,000 per month (28.0%), followed by RM1,001-RM2,000 per month (24.5%), then the income group RM3,001-RM4,000 per month (21.0%), next is the income group more than RM5,001 per month (14.5%) and 12.0% for income RM2,001-RM3,000 per month. Most of the respondents have stayed in Melaka for more than 20 years (35.0%), followed by 6 to 10 years (22.5%), then 20.5% for duration of 11 to 15 years, 11.5% for duration of 16 to 20 years and 10.5% less than 5 years.

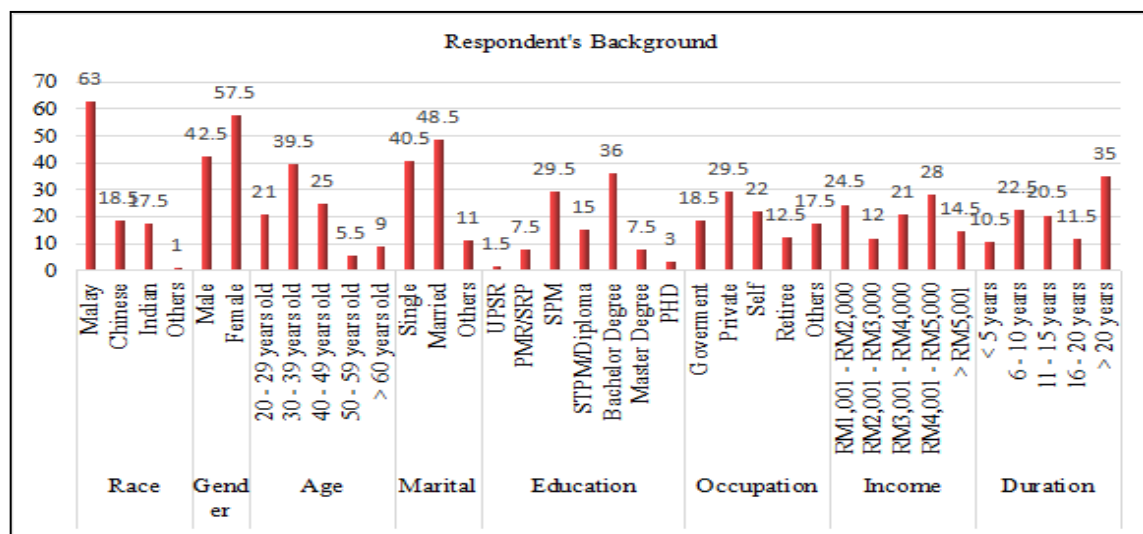


Figure 2 Respondent's Background

Urban Ecosystem Services Assessment

Table 1 shows the respondents' perceptions of the urban ecosystem services that are offered around them from the survey data in Malacca City. All the urban ecosystem services were measured based on a Likert scale with 3 scores: offered, neutral and none-offered. The classification of urban ecosystem services was referred to as Millennium of Ecosystem Assessment (2005) and The Economics of Ecosystems and Biodiversity (2011); five services belong to regulating services, single service from supporting services and six services from cultural services. However, there is no service from provisioning services because the services were rare and none was offered directly in the urban ecosystem services as shown in Table 1.

**Table 1** Urban ecosystem services assessment in Malacca City

	Categories	Offered (%)	Neutral (%)	None-offered (%)
Regulating	Climate regulation	80	10	10
	Flood regulation	33	50	17
	Disease control	50	34	16
	Carbon sequestration	45	45	10
	Noise pollution reduction	23	43	34
Supporting	Hydrology Cycle	60	40	0
Cultural	aesthetic value	92	8	0
	spiritual	92	7	1
	education	60	40	0
	recreation	75	24	1
	tourism	100	0	0
	social relations	75	25	0

Based on the table, majority of the respondents have agreed that Malacca City offered most of the cultural classifications; there is a 100% score on tourism, 92% score respectively on aesthetic value and spiritual, 75% score on recreation and social relations and 60% score on education service. There are only a small number of respondents who disagree that Malacca City provides good urban ecosystem services to its residents. Then, the supporting classifications show a 60% score on the hydrology cycle and 40% of respondents who became neutral about those services. Then, in term of regulating classifications, most of the respondents (80%) agreed that Malacca City offered climate regulation, while 10% were neutral and the remaining 10% of respondents disagreed, flood regulation category shows that 33% of the respondents agreed, 50% were neutral and also 17% disagreed that they are offered the flood regulation there. Then, the disease control classification show 50% of respondents agreed on the urban ecosystem services offered, 34% neutral and the remaining 16% disagreed. Besides, based on the table, it also shows that most of the respondents (45%) are neutral about the carbon sequestration that is offered in their areas, 45% of respondents agreed that the service is offered and 10% is in the non-offered category. In terms of noise pollution reduction, 23% of respondents are neutral that Bandaraya Melaka has offered the services of noise pollution reduction, while the remaining 43% of them agreed and 34% disagreed.

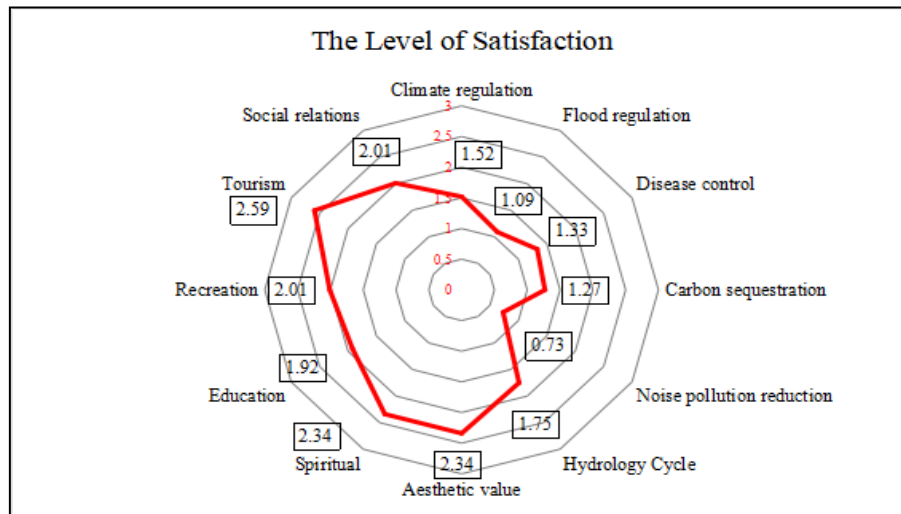


Figure 3 The residents' levels of satisfaction

Figure 3 shows the residents' levels of satisfaction on the urban ecosystem services in Malacca City. The highest level of satisfaction is 2.59 in tourism services with 2.59, followed by 2.01 and 2.34 in recreation services and spiritual services respectively, then 2.01 with both recreation services and social relations services. Education services is at 1.92, hydrology cycle services follows at 1.75, climate regulation services with 1.52 and disease control services with 1.33. Carbon sequestration services is at 1.27, flood regulation services is 1.09 and the lowest resident's level of satisfaction is noise pollution reduction services with the score of 0.73. Overall, the average of the residents' level satisfaction in Malacca City is 1.74.

5. Discussion

Overall, there are several problems and challenges that need to be faced while carrying out this study. In the area of data collection in the field, namely the distribution of questionnaires, the main challenges are the difficulty to get the respondents to complete the questionnaire. Besides, many respondents did not understand the terms and key variables in this study of the urban ecosystem services. Therefore, the researcher should take a considerable amount of time to inform the respondents before they complete the questionnaire form. Based on the findings, Malacca City provides good urban ecosystem services which are the regulating services i.e. climate regulation, flood regulation, disease control, carbon sequestration, noise pollution reduction, then supporting services i.e. hydrology cycle, and cultural services i.e. spiritual, recreational, tourism, aesthetical value, educational and social relations. However, none of the provisioning services seems important because the services are rare, and none is offered directly in the urban ecosystem services. Based on this, the attempt to generate a livable and sustainable city, including urban design that is complete with all the good infrastructures, social activities and interests, green landscapes, human security, social safety and protection, residents, public health, education and social work; shows the sustain process and usually needs enhancement (Khalid, 2016).

Based on the questionnaires that have been answered by the respondents, most of them agreed that they get benefits in the tourism services categories in Malacca City. For example, respondents who were directly involved in the development of tourism activities in the vicinity of my home got the highest score (75%) among the respondents. Based on this, Bandaraya Melaka has ventured as an educational urban and tourism. It was supported by a study by Samsir et al, (2016) and stated that tourism products in Malacca have a piece of valuable knowledge and experience to communities and tourists. Next, in the category of



spiritual services, the respondent's soul was very calm when staying in the residential area that their score are the highest (82%) among the respondents. For example, the mosque can be found anywhere in the city or village with the uniqueness of the architecture and attraction design (Abdullah, 2012). Furthermore, based on aesthetic value services in Malacca City, some historical sites and landscapes are valuable in the vicinity of the residents' home (74% scores) and there are a diversity of landscapes such as rivers or lakes or on the spacious panoramic view around them (68% scores). It connects with the studies that Malacca is a popular tourism terminus and destination that is rich with cultural attraction and historical heritage which also offers knowledge and educational opportunities to various communities including Malays and visitors (Sri Winarni et al, 2016).

Furthermore, based on the twelve urban ecosystem services which are based on residents' perceptions from the survey data, the highest score belongs to the tourism services, followed by aesthetic value and spiritual services, climate regulation, recreational and social relations, educational services, hydrological cycle services, disease control, carbon sequestration, flood regulation services and the lowest score is noise pollution reduction services. Overall, the most significant values of the urban ecosystem services are cultural services (aesthetic value, recreational, tourism, social relations, spiritual and educational), regulating services (climate regulation, disease control, flood regulation, carbon sequestration and noise pollution reduction) then followed by supporting services (hydrological service).

As reported by Elmqvist et al. (2015), cities are a key nexus of the relationship between people and nature and a huge center of demand for ecosystem services, and also generate extremely large environmental impacts. Based on the results, it can be concluded that Malacca City is a convenient city and have an advantage in providing the urban ecosystem services, especially towards the communities. While the city can provide many benefits and services to humans through the development and urban expansion activities, however, it remains an adverse impact on the environment. Thus, maintaining and increasing the providing of various ecosystem services, are relevant and significant in both perspectives of human living and the economy such as non-marketed and non-monetary services (Rodríguez-Loínez et al, 2015). This is important for the urban dwellers and communities who are surviving in the urban areas in a long duration, who want to make sure that their quality of life is in good condition including the cultural services. According to Ali et al, (2010), urban dweller's quality of life is very much depending on the livability of the city and people tend to leave the city when it has become less livable.

Based on the assessment of urban ecosystem services in Malacca City, we found that several aspects should be taken to consideration seriously by the authorities such as MBMB. For example, the authorities should play their roles in providing social infrastructures such as maintaining the natural environment in the recreational area that can be used by the communities safely. Furthermore, the other services in Malacca City that should be monitored from time to time is to make sure that all the repairing, conservation and improvements on the facilities aspect are conducted immediately. It can be related to Riechers et al, (2016) who reported that the cultural ecosystem services could be one way to achieve awareness on the socio-ecological aspects, as the results show that there are connections between cultural ecosystem services and urban social sustainability. Therefore, it is necessary to ensure that a city is primarily sustainable, livable and securable, without having to sacrifice various natural resources and its UES. Next, the SDG's goals will be achieved as all the countries comply with the policies such as the Paris Agreements, and hence the standard of urban ecosystem services would be allowed to enhance in the future.

6. Conclusion

The study has given an overview of urban ecosystem services in Malacca City, Malaysia that relates to a variety of benefits provided by the environment especially to the community and economy for maintaining human wellbeing. Overall, based on the results and our studies, the most significant values of the urban ecosystem services include cultural services (aesthetic value, recreational, tourism, social relations, spiritual and educational), regulating services (climate regulation, disease control, flood



regulation, carbon sequestration and noise pollution reduction) then followed by supporting services (hydrological service). Studies on the urban ecosystem services and urban design covering various aspects and benefits of its services, especially to humans and the environment have received increasing attention from researchers. Therefore, there are several researches proposals for future study. In this study, the researchers emphasize the general aspects of the residents in the city of Malacca. In the next study, the researchers intend to broaden the scope of the study area to include a broader range of aspects such as to the tourist's respondents and the deep categories of urban ecosystem services. In the context of data analysis, the researchers only use a simple descriptive analysis, therefore in future research, the researchers intend to diversify the data analysis method so that various data inputs can be presented and discussed in detail. For example, a statistical analysis such as the Correlation Test and the Manova test can be utilized. So, the studies on the aspects of urban ecosystem services and each category are relevant to ensure that urban areas with a variety of ethnic groups will live safely, habitably and sustainably. Finally, we conclude that the level of satisfaction among respondents toward the urban ecosystem services that have been offered in Bandaraya Melaka is moderately good, but a few adjustments and improvements are in need immediately. So, all the parties should take important roles to make sure the cities, especially Malacca City, are kept sustainable and more livable with the right policies and guidelines efficiently.

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