



Sustainable Development in Water Resources. Case Study: A Review of Malacca River

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Abstract

Sustainable development refers to development that meets the needs of current generations without compromising the ability of future generations to meet their needs and aspiration. Meanwhile, water resources are the total range of natural waters which are potentially useful to human beings, and can exist in liquid, vapor, or solid forms. This review study evaluates the success of sustainable development of water resources in the Malacca River. The selected sample area is along and adjacent to the Malacca River. Results have shown that several factors have become obstacles to sustainable development, namely natural environmental activities and human activities. Natural environmental activities have short-term, minor effects on river water, but human activities have a long-time, major effect on water in the river. Human activities involve agriculture and livestock, industrial activities, residential and commercial activities, municipal and open spaces, and other factors. These activities lead to point source and nonpoint source pollution. When these factors are constrained and controlled, then sustainable development of water resources in Malacca River can be achieved.

INTRODUCTION

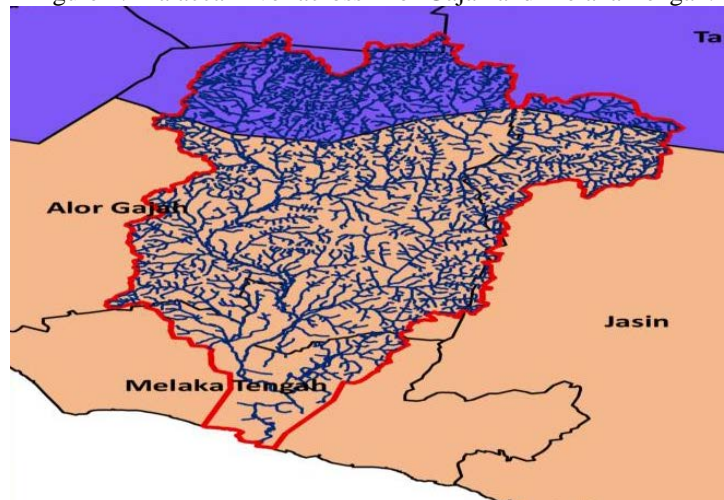
Sustainable can be described as having the ability to maintain, to keep going, to support life for bodily needs, to withstand, to comfort, to carry on, and to nourish (Little, 1972). *Sustainability* has the same definition with *sustainable* and concentrates on a large field perspective, which can be defined as maximizing the net benefits of economic development, subject to maintaining the services and quality of natural resources over time (Peace and Turner, 1990), or the dynamic equilibrium between natural inputs and outputs, modified by external events such as climatic change and natural disasters (Fresco and Kroonenberg, 1992). Meanwhile, *development* can be explained as the process of growing or causing something to grow or become larger or more advanced (Merriam-Webster Official Portal, 2015), or improving or bringing to a more advanced state (Flint, 2010). *Sustainable development* brings a definition to development that meets the needs of current generations without compromising the ability of future generations to meet their needs and aspiration (WCED, 1987), or development that improves the quality of human life while living within the carrying capacity of supporting ecosystems (IUCN *et al*, 1991). Usually, sustainable development will be used from an environmental perspective, especially towards water resources. Therefore, water resources can refer to the total range of natural waters which are potentially useful to human beings, whether in liquid, vapor or solid form (TutorVista Official Portal, 2015).

This review study has been carried out to evaluate sustainable development of water resources in Malacca River. Basically, the main purposes to apply sustainable development in water resources are to maintain the assessment and planning of water resources, increase efficiency in water use, water quality control, legislation relative to water resources, education and training, research and development, and etc. (Da Cunha, 1989). However, there are certain issues and problems that become factors in the success of sustainable development in water resources, such as water scarcity, inefficient water use, water pollution, floods and droughts, disturbance of aquatic ecosystems, waterborne disease, and erosion and sedimentation (Da Cunha, 1989). This situation also occurred in Malacca State, especially water pollution that happen in Malacca River (Nasbah, 2010; Jabar, 2010; Hua and Kusin, 2015) leading to a negative impact to other matters such as the river water gaining a black color and bad odor, affecting human quality life through smell, bringing disease to human and aquatic animals, poisoning aquatic animals and bring death, and causing extinction of aquatic animals and the loss of soil nutrients while affecting plant species (Hua, 2015a). Hence, to achieve sustainable development, the problems of water pollution should be settled, which can be involved with land use development through human activities and natural environmental activities (Hua, 2015b).

METHODOLOGY

This review study has been conducted in Malacca State, as the sample area is concentrated adjacent and along the Malacca River. According to the geographical, Malacca State is located at South West Peninsula Malaysia with coordinate of 2°12'0"N, 102°15'0"E (Universal Transverse Mercator Service, 2015), which covers an area of 1,658 km² and is divided into three districts, namely Alor Gajah, Jasin, and Melaka Tengah or Malacca Central (Melaka State Government Official Portal, 2015) (Melaka State Government Official Portal, 2015). The total population of Malacca State is 830,900, which can be categorized into Malay (523,800), Chinese (210,100), India (49,400), Other Bumiputera (9,600), non-Citizen (34,900) and others (4,000) (Melaka State Government Official Portal, 2015). Since the review study is focused on the Malacca River, collecting and gathering data will only be based on two districts, which are Alor Gajah and Malacca Central (figure 1). Therefore, the focus points will be upstream river, middle stream river, and downstream river.

Figure 1: Malacca River across Alor Gajah and Melaka Tengah.

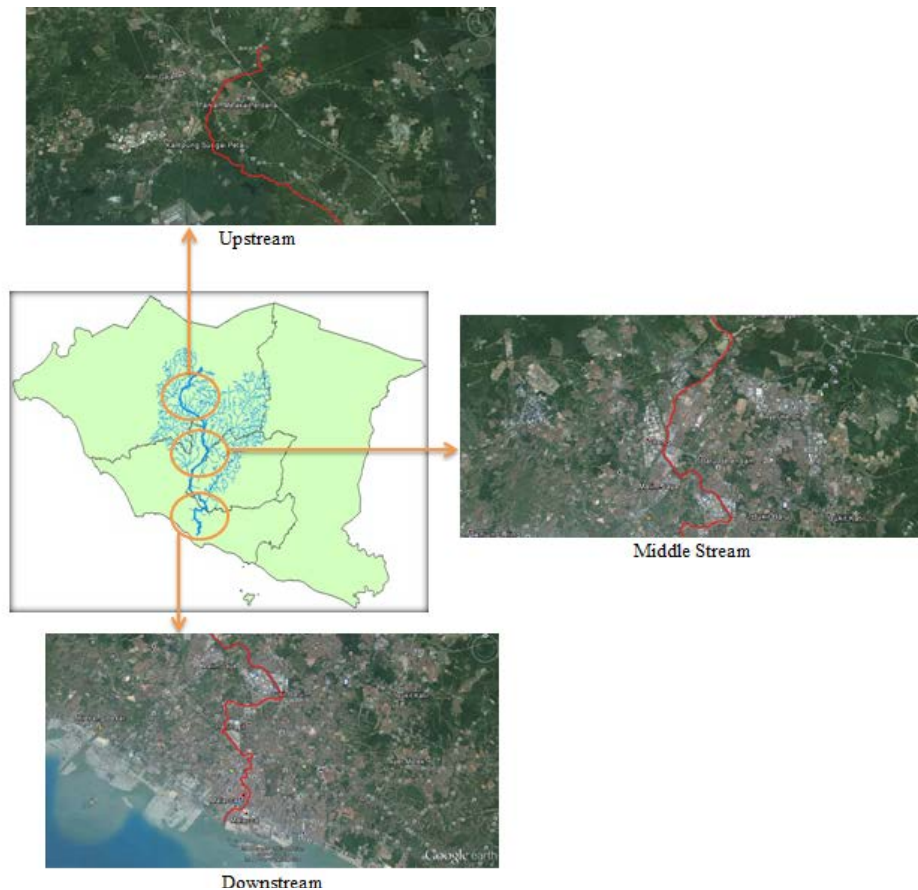


Source: <http://www.slideserve.com/ashby/jabatan-pengairan-dan-saliran-melaka>

DISCUSSION

Since the success of sustainable development in water resource depends on factors that contribute to water pollution in the Malacca River, so these factors should be addressed due to continuously creating issues and problems. The factors can be divided into natural environmental activities and rapid land use development for human activities (figure 2).

Figure 2: Activities along the Malacca River.



Source: Malacca Town and Country Planning Department (2012) and Google Earth.

Natural Environmental Activities

Environmental activities occur naturally which may lead to contamination of water in the river can be divided into several categories, namely heavy rain, landslide incident, riverbank erosion, and flooding. When heavy raining occurs, the water falling on the surface will become water surface runoff and transport all materials together into rivers, which consider as the first point to contribute contamination in river. Next, the rain water droplets produce energy that can 'break' the soil structure, where it can cause an incident such as landslide. The impacts of landslide leads to soil sediments being transported into river and causing contamination occur. Continuously, heavy rain will increase the speed of water flowing in the river. The high water speed will have high repulsion energy to cause riverbank erosion and increase the percentage of polluted water in the river. Lastly, when raining is nonstop, this will increase the quantity of water in the river and cause flooding. Flooding not only brings benefits to soil fertility, but also causing disadvantages through increasing the effects of water pollution in river. This is because excessive water that spill out of river will 'pick up and transport' together all matter back into the river when the water recedes. Therefore, natural environmental activities show that contamination can also occur in the river, but the natural pollution will not take a long period of time and the water quality will back to normal.

Human Activities

Human have made various changes towards the Earth surface with the purpose for development. Rapid development in land used is carried out to fulfill the daily demand from the society. Human activities can be categorized into several types, namely agricultural and livestock activities, industrial activities, residential and commercial activities, municipal and open spaces activities, and others activities that involve with development of land used. Usually, agricultural and livestock activities will be carried out in rural or remote areas, which need a large scale of land used and water resources. Hence, in Malacca State, especially Malacca River, most of the resident will undertake the agricultural and livestock activities in rural area and upstream river in easily to obtain water resources from river. So, this is the starting point to cause contamination in the river through

pesticides and chemical fertilizer, and excrement from livestock wastes will lead to nonpoint source pollution to happen. Next, industrial activities are most important to be developed because they provide job opportunities, fulfill demand from society, improve the quality of human life, bring economic value to the country, and so on. Basically, these activities will also conduct adjacent to the river with the purpose to obtain water resource and release wastewater into the river (with permissions that meet the standards of Department of Environment, Malaysia). Nevertheless, due to the greedy and irresponsible attitudes of individuals, wastewater is dumped directly into river or released into drains and flows into the river without having any treatment because they want to save cost. This action will cause the water to get polluted in the river and considered as point source pollution. On the other hand, there are certain industrial operators who dump the wastewater on the ground surface and let it flow into river. This action causes nonpoint source pollution. It is more dangerous when the wastewater is absorbed into groundwater and causes contamination, which may poison people who use groundwater for drinking as mineral water.

Meanwhile, residential and commercial activities will be carried out at downstream area in Malacca River (figure 2), where development of land used for human activities that occurred is extremely large and too much. Referring to figure 2 in downstream area, there are many settlements concentrated at the particular area with less vegetation is detected. Thus, concentrated settlement has increased the amount of garbage waste, sewage water, bathing water, and washing water that will be channelled into the drain and enter the river. Hence, the percentage of river pollution is not showing decreasing, but increasing dramatically. This situation worsened when commercial activities are carried out in environmental sensitive areas, especially water resources in Malacca River. In general, commercial activities may involve restaurants, chain stores, shopping malls, gas stations, and others. Commercial activities are absolutely required by the local residents to purchase daily needs. However, rapid development in commercial activities will lead to an increase of water pollution in river, for example restaurants. Most food stores and restaurants use a simple way by removing the oil waste, food waste, garbage waste, and so on, into the drains without thinking twice. This attitude will increase water pollution in the Malacca River.

Continuously, municipal and open spaces activities are seen as a factor that has less of an effect on water pollution in Malacca River, but both activities can be acts as an agent of pollution, whether positive or negative. Municipal activities especially the Department of Environmental Malacca should be developed near or adjacent to the river. This is because the monitoring activity of water quality in the river can be monitored at all times. In addition, if contamination occurs, then a drastic action can be taken against individuals polluting the Malacca River. Not only that, a program of '*gotong-royong*' or 'cooperation in a community' activity around the river can always be carried out in order to maintain the cleanliness and beautification of the river. So, municipal activities play an important role in providing positive impact to the local residents and protect the environment. On the other hand, open spaces activities also have a role in determining the percentage of contamination in the Malacca River. Open space activities can be divided into several types, namely park, zoo, recreation, picnics, and others. Although these activities are seen to contribute minor effects on the environment, it will be the opposite when the quality control and management are very weak in taking care of the environment, such as at zoos. A zoo is a place or a garden where wild animals are kept for exhibition or for public display. However, if the cleaning management for animal's excrement waste and animal's food waste is not correct, this will cause water pollution. Indirectly, contaminated water on the surface will flow into the nearby drains before it gets to the river or it will be absorbed into the soil and pollute the groundwater. Therefore, these activities will be categorized as nonpoint source pollution.

CONCLUSION

This review study of sustainable development of water resources in Malacca River showed that the water quality in the river is polluted due to natural environmental activities and human activities. Basically, natural environmental activities are likely to cause water pollution in the river for a short period of time, and are different from human activities. Intervention of human in land use development for agriculture and livestock, industrial activities, residential and commercial activities, municipal and open spaces, and others factors will cause long-term water pollution and may harm the environment. These activities are involved with point source and nonpoint source pollution, directly and indirectly in the Malacca River. So, if human activities can be constrained and controlled, water pollution in the river will be reduced and sustainable development in water resources can be achieved.

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