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Review of Ecosystem Typology of the Musi River Flow is Affected by Several Ecological Functions of Peat, Mangrove, and Estuarine Ecosystems

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ABSTRACT

The Musi Watershed as a priority watershed is also contained in the Decree of the Minister of Forestry No. SK.328/Menhut-II/2009. The Musi watershed with an area of about a million ha is one of the 108 watersheds in Indonesia that was designated by the Minister of Forestry Decree No. SK.328/MenhutII/2009 as a priority watershed because of its critical condition. This condition is indicated by the area of critical land with a moderately critical to very critical category which reaches 1.7 million ha. Another indication is that the remaining forest cover in South Sumatra is 1,346.8 ha (± 15.6% of the total area of South Sumatra). Musi watershed is simply an area unit that drains water to the same point which is influenced by various ecosystems in it, such as Peatland is a unique ecosystem that has economic value, ecological value, and environmental function, and downstream there is a Mangrove ecosystem and Estuaries, this ecosystem from ecological and environmental functions, among others, has a high biodiversity value, a hydrological function in the management of storage and release of water, as well as a carbon storage function. South Sumatra has a peat area of 14 million ha or 16.3% of the total area, and this condition is one of the potential natural resources to be managed and utilized for the benefit and welfare of the entire community.

Keywords: Watershed, Ecological Function, Peat Ecosystem, Mangrove, Estuary.

INTRODUCTION

A Watershed is a land area that is an integral part of a river and its tributaries that functions to accommodate, store and drain water originating from rainfall to lakes or the sea naturally, the boundaries of which on land are topographical and geographical separators boundaries in the sea up to water areas that are still influenced by land activities (Susanti et al., 2019). A watershed is simply an area unit that drains water to the same point. Watershed management, as stated above, involves many stakeholders with different perspectives. Damage to watersheds is caused by the strong background of sectoral thinking, various interests, and obstacles in coordinating. Coordination is key in bridging differences.

The determination of the Musi watershed as a priority watershed is also contained in the Decree of the Minister of Forestry No. SK.328/Menhut-II/2009. The Musi watershed with an area of about 8.6 million ha is one of the 108 watersheds in Indonesia that was designated by the Minister of Forestry Decree No. SK.328/MenhutII/2009 as a priority watershed because of its critical condition. This condition is indicated by the area of critical land with a moderately critical to the very critical category which reaches 1.7 million ha. Another indication is that the remaining forest cover in South Sumatra is 1,346.8 ha (± 15.6% of the total area of South Sumatra) (Pramono & Putra, 2017).

The expanse of territory is bounded by topographic barriers that receive, and collect rainwater, sediment, and nutrients and drain them through tributaries and out in the main river into the sea or a lake. Musi watershed is simply an area unit that drains water to the same point which is influenced by various ecosystems in it, such as Peatland is a unique ecosystem that has economic value, ecological value, and environmental function. Ecological and environmental functions include having high biodiversity values, hydrological functions in water storage and release management, and carbon storage functions (Saragi-Sasmito et al., 2018), South Sumatra has a peat area of 1.4 million ha or 16 million ha 3% of the total area, and this condition is one of the potential natural resources to be managed and utilized for the benefit and welfare of the entire community.

Estuary and Mangrove Forest Ecosystem which is also known as brackish forest, tidal forest, coastal forest, or mangrove forest is one of the potential natural resources and has a unique ecosystem (Wibowo & Handayani, 2006). Mangrove forests protect coastal areas from various disturbances, provide habitat for more than 1300 animal species, and are one of the most productive ecosystems (Fatoyinbo et al., 2008).

The need for land for cultivation and infrastructure in the context of economic development puts pressure on forest resources through forest conversion activities that threaten land cover in the Musi watershed area. The industrialization has contributed to the decline in water quality and environmental quality in general in the Musi river basin. The different perspectives of stakeholders related to the Musi river basin have also contributed to the deterioration of the environmental quality of the Musi river basin. The Musi river basin provides various benefits in its management of many stakeholders. Stakeholders related to the management of the Musi watershed come from various sectors with different perspectives on the watershed. This condition has the potential to worsen the condition of the watershed if efforts are not followed to bridge the various stakeholders in the management of the Musi watershed.

FINDING (LITERATURE REVIEWS)

The Musi River area is administratively located in four provinces, namely South Sumatra, Bengkulu, Jambi, and Lampung provinces. Most of the Musi watershed area is in the province of South Sumatra, which is the area that has the largest watershed area compared to the other three provinces (Jambi, Lampung, and Bengkulu) (Bompard & Guizol, 1999). The Musi watershed area is divided into 22 sub-watersheds. The sub-watersheds are the Banyuasin sub-watershed, Batang Pelidang sub-watershed, Batanghari Leko sub-watershed, Baung sub-watershed, Bungin sub-watershed, Calik sub-watershed, Deras sub-watershed, Kelingi sub-watershed, Kikim sub-watershed, Komering sub-watershed, Lakitan watershed, Lalan sub-watershed, Lematang sub-watershed, Macan sub-watershed, Medak sub-watershed, Musi downstream sub-watershed, Musi Hulu sub-watershed, Ogan sub-watershed, Rawas sub-watershed, Soleh sub-watershed, Semangus sub-watershed and Sugihan sub-watershed (Putranto et al., 2015).

3.1 Topography

The topography of the Musi watershed covers an area of 59,942 km² in the province of South Sumatra which is located between 2°17' to 4°58' south latitude and between 102°4' to 105°20' east longitude. Most of these areas are in the Province of South Sumatra, and only a small part is included in the Provinces of Bengkulu, Jambi, and Lampung as shown on the map. The topography of the Musi watershed is divided into 5 zones; namely, from the west, are the Mountain Zone, Piedmont Zone, Central Plains, Inland Swamps, and Coastal Plains. The Mountain Zone which includes the northwest and southeast of the study area consists of valleys, plateau plates, and volcanoes. The Piedmont Zone is almost 40 km wide which is the transition between the Mountain Zone and the Central Plains. The area is hilly to wavy and plain. The central plain consists of three parts, namely highlands, flood plains, and river embankments. The Inland Swamp consists of natural river embankments and lebak swamps. The swampy swamp is slightly lower than the river level and floods during the rainy season. The coastal plain consists of a lowland along the coast and a lowland delta to the north, which is covered with peat swamp forests (Kulkarni et al., 2022).

3.2 Geology

Geology By the progress of interpretation, the Indonesian Ocean is experiencing surface subsidence of about 6 cm per year under the island of Sumatra. The decline began in the middle of the third period (Miocene). Like the intertwined curvature of the Bukit Barisan, which leads downwards to form a lie to the west of Sumatra. Until the fourth period, the Southwest and Southeast Regions were separated by Lake Ranau and were a continuation of the peak of the line. The displacement occurred laterally, dividing Sumatra in two. Volcanic activity with interrelated momentum and its peak is the eruption of the Ranau crater and the form of breccias, the release of lava and tuff ash. The regional geology is as follows: the geology consists of the oldest and non-derivative forms of Pre-Tertiary intrusive and metamorphic rocks from the *Eocene* to the *Pliocene* and volcanic rock forms from the Pleistocene and Holocene, as well as marsh pools and *Alluvial* deposits. Geological surface layers are classified for land and soil classification such as peat, *Alluvial*, deposition of debris, deposition of volcanic eruptions, acidification of igneous rock, the bedrock of igneous rock, marble, and limestone, as well as other types of metamorphic rocks (Kulkarni et al., 2022).

3.3 Morphology

The morphological conditions in the Musi watershed are influenced by the tropical season, which causes a hot and humid climate throughout the year in this area. Meteorological conditions Average annual rainfall varies by less than 2,000 mm in the Coastal Plain and 3,500 mm in Lahat, which is located to the east of the Bukit Barisan foothills; this place is higher than any other area in terms of evapotranspiration capacity which ranges from 1,200 mm to 1,500 mm. Rainfall has an impact on evapotranspiration throughout the year. Relative humidity throughout the year ranges between 60% and 90%. The daily temperature shows a slight variation, which is around 28°C with an average minimum temperature of around 20°C and an average maximum temperature of about 35°C at an altitude of less than 150 m above sea level. The length of the day varies under 12 hours throughout the year concerning below latitude. The southeast wind will blow during the dry season, usually from May to October, and the southwest wind will blow during the rainy season, usually from November to April (Kulkarni et al., 2022).

3.4 Hydrology

Hydrology The lower part of the Musi River is where it meets the Komering River with a river flow of between 2,500 m3/second which changes during the dry season and the rainy season between 1,400 to 4,200 m3/second. Usually, the flow from the Musi River and its tributaries reaches a maximum between February and March, and a minimum between July and September. The water level of the Musi River is +1.2 m above sea level and the highest is around +0.0 m in the dry season. In the rainy season, the water level of the Musi River is +1.8 m above sea level as the maximum height and the average height is +1.0 m. The maximum height at high tide can reach up to +3.3 m at Talang Buyut Station at the mouth of the Musi River. In general, the maximum tide occurs from December to June and the minimum tide occurs from March to September (Kulkarni et al., 2022).

3.5 Groundwater

Groundwater In Bukit Barisan, there is a place that is not yet known but is suspected as a potential place of groundwater as a source of springs and shallow wells that can be utilized. In the Piedmont Zone, potential groundwater sources appear to be less significant. Deep wells are not prioritized as a potential source of groundwater utilization. The Pre-Pleistocene Penelains, including those around Palembang, are generally not suitable for deep-good groundwater exploitation (Kulkarni et al., 2022).

3.6 Soil

There are 6 (six) soil classifications in the Musi river basin, namely: *Organosol*, *Regosol*, *Alluvial*, *Rendzinas*, *Podzolic*, and *Andosol*. *Organosol* are formed from heaps of peat soil which are distinguished by the depth and degree of decomposition of the peat. Furthermore, it is further divided into sub-classifications based on peat soil deposits such as Fabric *Organosol*, Hemic *Organosol*, and Sapric *Organosol*. *Regosol* is a type of soil that has no horizons except for the top layer which is pale and contains little organic matter. The largest part of the *Regosol* soil is in the Belitung area, which is the southeastern part of the study site. This soil type is formed from volcanic eruption sedimentation, new heap, and is mostly a mixture of *Alluvial* from heap shift. *Alluvial* soil is formed from new *Alluvial* piles and this pile is influenced by river currents and coastal areas. Rendzina is a small part that covers the Musi watershed. *Podzolic* soils are the largest part of the catchment area because these soils result from the formation process on dry soils with low elevation leachings, such as from clay and displacement to lower parts of the soil to form an argillic horizon layer. *Andosol* are soils from volcanic eruptions that slowly form into the subsoil and cambial soil layers, each consisting of more than 60% volcanic material.

The suitability of the soil to be used for agricultural land depends on its texture, structure, permeability, acidity, and nutrient content. For wetland rice, the type of land is not so important, because what the plant needs is a little acidity and nutrient content. The only soil problem faced is the soil with sulfuric acid content in the tidal area which affects the toxin composition of rice plants. Fertility for barren soils, such as *Alluvial*, *Andosol*, and *Rendzinas* will be slightly affected. Soil types that are at moderate to marginal fertility levels are *Regosol*, *Latosol*, and *Oxisol*. As for the infertile soils, namely *Podzolic*, Gleysol, and *Organosol* soils, this type of soil cannot be used for crops without soil fertilization. This soil type, however, is suitable, for the types of plants that allow life on dry land. There is a wide variety of soil types found in the Musi river basin suitable for crops recommended for dry soils. Coffee plants can grow in various types of soil, ranging from *Latosol* soil types with tropical climates to loamy beach sand. Rubber is also suitable for a wide range of soil types from shallow loam to clay, gravel, and lateritic soils. Oil *Palm* plantations are suitable for deep soil, loose soil, and well-irrigated soil.

3.7 Landform and land cover of the Musi watershed

Forms and land systems of the Musi Watershed Landform parameters are spatial variables that can describe the appearance of the natural conditions of the earth's surface (soil) and can show the natural characteristics of the basin areas of a landscape in the watershed system based on the types of terrain that compose it. Landform parameters are the basis for compiling land system maps (Trisakti et al., 2009). Landform units embodied in land system units conceptualized by Christian and Stewart in 1968 and developed in the preparation of land resource mapping by RePPProT in 1990 (Poniman et al ., 2004) are very precise and useful in supporting the availability of secondary data sources for the development of the concept of a watershed typology developed by (Paimin et al., 2012). Landform parameters are very flexible to be used at any map scale and map-making purpose due to the availability of a landform catalog in Indonesia from Desaunettes in 1977 and the availability of detailed and simple classifications of landform parameters (review scale) from Kucera in 1988. In addition, by only using landform information, it turns out that other land characteristics/information can be obtained, for example, *Alluvial* landforms have a characteristic picture in the form of flat conditions, poor drainage, fine texture, and deep soil solum (Wahyuningrum et al., 2003).

Based on land system data from the Sumatra Island Report map, it can be seen that the Musi watershed land system has been identified as consisting of 47 types of land systems. The most dominant species is MBI (Muara Beliti) with an area of 2,361,123.72 ha. The MBI land system is characterized by a plain landform in the form of tuffaceous sedimentary plains with a wavy to wavy topography, with a slope of 9-15%. Each land system is then identified as its landform. Land cover in the Musi watershed Land cover classification is one of the key steps in the typology analysis of the watershed which relates the actual land cover types to the land characteristics. The type of land cover is important to know because it affects the hydrological process in the terrestrial ecosystem. This is based on several research results that change in land cover and land use affect river flow, discharge, and flood potential (Olang & Furst, 2011). Classification of land cover in the Musi watershed by the Musi Watershed Management Center (2012) from the analysis of the RBI map and Landsat 5 TM map (Basuki & Putro, 2013) shows that the types of land cover in the Musi watershed vary by 18 types. Land cover in the Musi watershed is dominated by dry land mixed with shrubs, which is 48.4% of the watershed area. The next dominance is land cover in the form of plantations (11.6%) and shrubs (11.3%) consisting of swamps (7.8%) and shrubs on dry land (3.5%). Meanwhile, forest cover in dry land and wetlands is only 14.6% of the Musi watershed (780,444 ha) consisting of 6.5% primary dry forest, 4.8% secondary dry forest 0.3% secondary swamp forest, and plantation forest. The existence of land cover in the form of forest in the Musi watershed is still very far from the minimum conditions as mandated by Law No. 41/1999 concerning "Forestry". Broadly speaking, the distribution of cover types can be grouped into upstream areas dominated by forest, dry land agriculture mixed with shrubs; the middle area is in the form of plantations, dry land agriculture, shrubs, and downstream in the form of dry land agriculture, scrub and swamp scrub. Meanwhile, land cover in the form of rice fields is almost found in all watershed areas in spots and the Komering sub-watershed seems to dominate.

Classification and weighting of dry land mixed with shrubland agricultural land cover (PLK mixed bush) which is the most dominant type of cover in the Musi watershed need caution so as not to cause fatal errors as is the case with the results of the study by Savitri

& Pramono (2017). At a glance, this type of closure can be classified into group number 4 (rice fields, grass, shrubs/shrubs) which has a value of 3; or number 6 (tegal, rocky soil) which has a value of 5. According to the Director General of Forestry Planning (2015), dry land mixed with shrubs is a type of land cover in the form of agricultural cultivation on dry land alternating with shrubs, shrubs, and logged-over areas. usually a shifting cultivation area. This land cover condition is different from the condition of dry land agricultural cover (PLK) which is related to the vegetation coverage, where PLK mixed with shrubs is in the form of semi-natural vegetation coverage while PLK is purely artificial/human intervention which is visually clear in the form of fields/moor. Based on this, the PLK mixed bushland cover type was reclassified (Savitri & Pramono, 2017) to separate the areas indicated as PLK areas and as bush areas. Ecosystems affecting the Musi river basin is a stretch of the area bounded by a topographic barrier that receives, and collects rainwater, sediment, and nutrients and drains it through tributaries and out of the main river into the sea or a lake. Musi watershed is simply an area unit that drains water to the same point which is influenced by various ecosystems in it, such as:

1. **Peatland Ecosystem**: Peatlands are unique ecosystems that have economic value, ecological value, and environmental functions. Ecological and environmental functions, among others, have high biodiversity values, hydrological functions in water storage and release management, and carbon storage functions (Saragi-Sasmito et al., 2018) which are closely related to climate change mitigation. In addition, peatlands can also provide other forest products (*Jelutung sap*, etc.), biodiversity conservation, and the development of ecotourism potential. Peatlands in Indonesia cover about ten percent of Indonesia's land area, making it the country that owns the largest tropical peatland area in the world (Uda et al., 2018). The area of peatlands in Indonesia is currently around 14.9 million ha. Some of the peatlands have been used for agriculture and some are abandoned or degraded and overgrown with shrubs. South Sumatra has a peat area of 1.4 million ha or 16.3% of the total area, and this condition is one of the potential natural resources to be managed and utilized for the benefit and welfare of the entire community. Currently, the condition of the peat swamp land in South Sumatra has been partially damaged, unproductive, and has not been managed properly. The utilization of peat swamp land is currently only limited to agricultural activities, and there are still many obstacles, both physical, chemical, and biological. Agus & Subiksa (2008) define peatland as land that has a layer of soil rich in organic matter (C-organic > 18%) with a thickness of 50 cm or more. Meanwhile, according to the Ministry of Manpower and Transmigration (2008), peatland island has a peat thickness of more than 50 cm. According to (BBP2SLP, 2008), the definition of peat swamp land is swamp land dominated by peat soil. According to (Murdiyarso, 2004) peatland (peat swamp land) is a wetland ecosystem characterized by a high accumulation of organic matter with a very low rate of decomposition. In a natural forest state, peatlands function as carbon sequesters so that they contribute to reducing greenhouse gases in the atmosphere, although the tethering process runs very slowly as high as 0-3 mm of peat per year or equivalent to 0-5 tethering. 4 t CO2 ha-1 year. When peat forests are cut down and drained, the carbon stored in peat is easily oxidized to CO2 (one of the most important greenhouse gases). In addition, peatlands are also prone to subsidence when peat forests are cleared. Peat swamp land has an important role in maintaining and maintaining the balance of the environment, both as water reservoirs, sinks, and carbon storage, climate change, and biodiversity whose existence is currently increasingly threatened (Daryono, 2009). Currently, peatlands in Indonesia cannot be separated from disturbances, one of

which is forest and land fires. (Saharjo, 2000) states that the causes of forest and peatland fires come from several sources, including shifting cultivation, forest concessions, plantation forests, plantations, and logging related to land use and its changes. Fire is one of the causes of the destruction of peat forests. The largest forest fires occurred in 2015 which consumed an area of 261,060.44 Ha with Central Kalimantan Province as the largest fire contributor (122,882.90 Ha) and followed by South Sumatra Province with an area of 30,984.98 Ha.

2. **Mangrove Ecosystem**: Mangrove Forest Ecosystem Mangrove forest ecosystem which is also known as brackish forest, tidal forest, coastal forest, or mangrove forest is one of the potential natural resources and has a unique ecosystem (Wibowo & Handayani, 2006). Mangrove forests protect coastal areas from various disturbances, provide habitat for more than 1300 animal species, and are one of the most productive ecosystems (Fatoyinbo et al., 2008). Mangrove forest vegetation cannot grow in coastal areas with large waves and does not contain mud deposits and steep beaches. Mangrove forests are specific vegetation in tropical and subtropical areas that inhabit relatively protected coastal areas (Driptufany et al., 2003). According to (Fadhilah et al., 2019), beach conditions that are good for mangrove forest vegetation are beaches that have the characteristics; of calm water/low waves, brackish water, containing silt, and sediment slope not more than 0.25-0.50%. The tidal zone as a mangrove habitat is also characterized by variations in environmental factors, such as temperature, sedimentation, and tidal currents (Nagelkerken et al., 2008). Geophysical factors, geography, geology, hydrography, biogeography, climate, edaphic factors, and others also greatly affect the structure and composition of mangrove forest vegetation spatially and temporally. According to (Wibowo & Handayani, 2006), the mangrove forest ecosystem is composed of flora belonging to the *rhizoporaceae*, *combretaceae*, *meliaceae*, *sonneratiaceae*, *euphorbiaceae* and *sterculiaceae* families. Meanwhile, in the landward zone, ferns (*Acrostichum aureum*) are overgrown. One type of zoning of mangrove forests in Indonesia according to (Bengen, 2001) is as follows: 1) The area closest to the sea, with a slightly sandy substrate, is often overgrown by *Avicennia sp*. In this zone, it is usually associated with Sonneratia sp, which predominantly grows in deep mud and is rich in organic matter; 2) More towards the land, the mangrove forest is generally dominated by Rhizophora sp. In this zone also found *Bruguiera sp* and *Xylocarpus sp*; 3) The next zone is dominated by *Bruguiera sp*; and 4) The transition zone between mangrove forests and lowland forests is usually overgrown with *Nipah* (*Nypa fructicans*) and several other *Palm* species. (Laulikitnont, 2014) argues that each mangrove plant species has its tolerance level to salinity, so the zoning will vary from place to place. Mangrove zoning is classified into three zones based on the position of vegetation in the tidal zone, namely the seaward zone, the mid-tide zone (mid zone), and the zone near land (landward zone). By the results of research by (Jamili et al., 2009) that mangrove zoning is controlled by high seawater inundation which also affects salinity. According to (Supriharyono, 2000) that four main factors determine the distribution of mangrove forest plants, namely the frequency of tidal currents, soil salinity, groundwater, and water temperature. Soil salinity is strongly influenced by the height and length of time inundated by tides. Several mangrove forest plants are resistant to salinity above 90‰, such as Avicennia marina and Lumnitzera racemosa. However, some are only able to live at low to normal salinity, such as *Sonneratia caseolaris*, *S. alba*, *S. appleata*, and *S. griffthii*. Temperature is also an important factor for the plant life of mangrove forests. According to Walsh (1974); (Supriharyono,

2000), a good temperature for mangrove plant life is not less than 20ºC with a range not exceeding 5ºC. Low temperatures and a wide temperature range are limiting factors for mangrove plant life. Mangrove forest vegetation consists of various types of plants that are unique because they can grow even when exposed to waves and seawater salinity in the coastal environment (Agustian et al., 2019). According to (Das Gupta & Shaw, 2013), mangrove plants can adapt morphology and physiology in the face of environmental and natural pressures in tidal habitats. Meanwhile, according to (Chakraborty, 2013) mangrove plants can develop unique adaptations, including adaptation to environments with low oxygen levels and high salinity; adaptation to support other plant life; adaptation to water loss from tissues; adaptation to nutrient uptake; and adaptation in maintaining the survival of propagules. The mangrove arboretum or also known as the mangrove trail was formed in 2014 it is located in a mangrove restoration area which is more precisely located beside the Barong Kecil River, Solok Buntu Resort Section I, Sembilang National Park at the coordinates of the estuary 02°09'52” and 104°54'18”. The types of mangroves in the arboretum are expected to cover all types of mangroves found in the TNS area. Arboretum can be interpreted as an area used to collect types of woody plants or trees that can be useful for science. This area can also be used as a biodiversity conservation area and as a tourist spot. The Arboretum in TNS has many benefits including a place for education, research, and development. Currently, the types of mangroves in the TNS arboretum do not have structure and composition data. Observation of the structure and composition of mangroves is important to determine field conditions, what types of mangroves exist, and how the position of a species in the community. These data can support the benefits of the mangrove arboretum as a research site. Therefore, it is necessary to make observations to examine the structure and composition of mangroves in the TNS arboretum. Most of the mangroves found in the TNS arboretum are included in the major mangrove category with a total of 9 mangrove species, 2 minor mangrove species, and 2 associated mangrove species. Tomlinson categorizes major mangroves as being able to form a pure stand and can secrete salt water so that this type of mangrove can grow even in stagnant water conditions, minor mangroves grow on the edges of mangrove habitats and do not form pure stands. Annisa stated that association mangroves generally consist of various types of land plants that have a high salinity tolerance. Associated mangroves tend to only grow in terrestrial habitats. According to Annisa, from the ecological aspect, mangroves live entirely in coastal ecosystems with high tidal dynamics.

3. **Estuary Ecosystem**: One of the ecosystems included in the coastal wetland ecosystem (coastal lowlands) is the estuary. This ecosystem is influenced by tides. Estuary ecosystems with mangrove vegetation are known to be productive, but sensitive to disturbance and degradation. In some areas, the causes of degradation are sea level rise (global warming effect), sediment depression, and hydrological changes. Indonesia is included in the Asia Pacific region which has wetlands with high mangrove biodiversity, one of which is on the East Coast. Estuary ecosystems are very dynamic, marked by changes in inundation areas from time. The type of vegetation that is highly adaptive to estuarine conditions is mangrove (Sukardjo, 2002). Estuary ecosystems with mangrove vegetation are known to be very productive, but sensitive to disturbance. In general, the type of vegetation in the tidal area of South Sumatra is influenced by the estuarine system. The vegetation is dominated by mangrove forests with mud and sand land and deltas. In the upstream part of the Banyuasin watershed, some of the

ecosystems are brackish and freshwater swamps (Septifitri, 2003) Mangroves as ecosystems are defined as intertidal (tidal) and supra (upper) tidal zones from muddy beaches in bays, lakes, and estuaries, dominated by highly adaptable woody halophytes associated with flowing waterways. The estuary of the aquatic environment is an environment that is very abundant in nutrients, where the nutrients themselves are the most important elements in the growth of phytoplankton. The abundance of nutrients for the growth of phytoplankton is a unique feature of the estuary environment. As a place that is very abundant in nutrients, the estuary is dubbed the name of the nursery ground for various types of important medium-sized fish, invertebrates, and many more. In general, coastal areas including estuary waters have an important role in the environment and an important role in the regional economy. An important ecological role is a place to find food for several types of aquatic biota (Sugiharto, 2005). Estuary waters are inhabited by various types of aquatic biota, both endemic and permanent, including various types of crabs, shellfish, and fish (Nontji, 2005). Fish that live in estuaries are generally eurahaline which means they are resistant to changes in high salinity. The types of fish that are often found in the estuary are Belanak, Dukang, Sembilang, Giant Prawns, Snapper, and others.

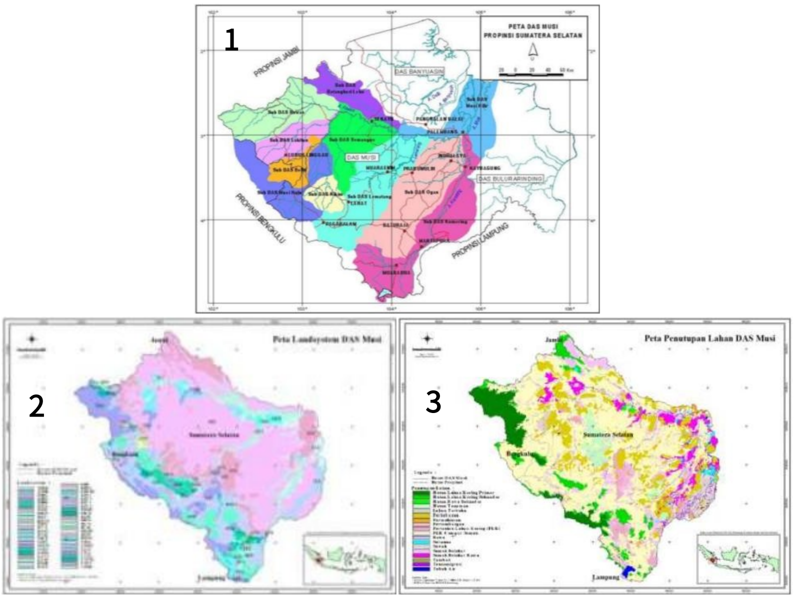

Figure 1. 1) Musi watershed map; 2) Map of the Musi watershed land system; and 3) Map of land cover in the Musi watershed.

CONCLUSION

The environmental ecology of the Musi watershed has undergone many changes due to various human interventions in the environment around the Musi watershed. Changes in land cover in the Musi watershed area which is heavily influenced by the Peat, Mangrove, and Estuary ecosystems have an impact on various changes in the ecosystem system, especially on flora/fauna, the results of observations and research conducted by various parties show this condition is indicated by the area of critical land with a moderate category. critical to very critical which reaches 1.7 million hectares. Utilization of peat swamp land is currently only limited to agricultural activities, and there are still many obstacles, both physical, chemical, and biological. Meanwhile, in the mangrove and estuary ecosystems in the downstream area of the Musi river basin, the mangroves found in the TNS arboretum are mostly included in the major mangrove category with a total of 9 mangrove species, 2 minor mangrove species, and 2 associated mangrove species. Ecological influences give birth to different physiological adaptations of mangrove plants, there are several physiological adaptations of mangrove plants carried out on several things as follows low oxygen levels by forming roots that have pneumatophores, soil stability, and tidal conditions with developing an extensive root structure that functions to strengthen, take nutrients and hold sediment. To maintain the preservation of the condition of the Musi watershed with various ecosystems that affect it, it is necessary to formulate policies in the management of the environmental ecology of the Musi watershed concerning the carrying capacity and capacity of the Musi watershed to realize a sustainable environmental ecology of the Musi watershed.

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