The Impact of Waterscape Transformation Toward Traditional People Subsistence in Muarajambi Temple Compound

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Abstract. Muara Jambi temple compound is one of the Budhist archaeological site in Southeast Asia which is date from around the 7th century to the 13th century AD. Hundreds of temple ruins were found here, including ancient interconnected hydrological networks which form a unique waterscape. This waterscape is then used by traditional people as their subsistence land to this day. Most of the traditional people carry on their lives as fishermen and farmers. Unfortunately, the transformation in the waterscape and land use in the Muarajambi temple compound since the late 90s have had a significant impact on the sustainability of this subsistence. This paper aims to reveal changes in the waterscape and land use in the Muarajambi temple compound and surroundings and show their impact on the subsistence and food security of the traditional communities living in the vicinity. This paper applies two methods, the first is to show changes in the waterscape and land use using satellite imagery data and aerial photos from the 80s to 2020. The second method is to describe the community's perspective from collective memory aspect regarding the subsistence changes they experienced during the process of changing the waterscape and land use. The results of this research indicate that waterscape and land use changing have an impact on reducing access to food resources. Rice production has been drastically reduced because rice fields cannot be planted optimally. Fish type and their population in rivers and puddles are not as many as the period before the change occurred. The final result of this paper is expected to provide an alternative for determining the conservation strategy of the Muarajambi temple compound in the future, so that traditional communities still have access to their original subsistence.r.

Keywords: waterscape · muarajambi · transformation · subsistence · traditional people

1 Introduction

The Muarajambi Temple Compound is located in Muaro Jambi Regency, Jambi Province, Indonesia. This compound has more than 110 traces of archaeological remains from the period of Buddhist influence in Sumatra. The remains are bricks structures, remnants of

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buildings, and some features of waterworks that are often called ancient canals [1–4]. This compound is situated in fluvial landform, so it is very common to find hydrological features such as rivers and back swamps that cannot be separated contextually. The waterscape consists of the Sungai Batanghari which is the main river, the Sungai Jambi and Sungai Berembang as its tributaries, as well as other channels including the Sungai Terusan, Parit Sekapung, Parit Duku, Parit Buluh, Parit Johor, Buluran Paku, Buluran Keli, Buluran Lembat, and Sungai Kemingking Luar. Some of back swamps are named Payo Terjun Gajah, Payo Rimbo Terbakar, Payo Buluran Keli, Payo Teluk Dekat, Payo Teluk Jauh, Payo Lubuk Gede and Payo Kamal.

The waterscape in the Muarajambi Temple Compound has an important role for the traditional community. The Sungai Batanghari and the waterscape in this area are the main sources of the community's subsistence system. In 1990's, the subsistence of people living in Muarajambi are generally a combination of the agriculture, plantation, and fisheries sectors [5–7]. People grow rice in the back swamp and at the same time look for fish for their daily needs in the rivers and channels that are surrounding their settlements. They also look for fish in some of ancient hidrological feature which are interconnected and belong to the temple compound [1–3, 8]. For now, some people decided to work in tourism services and industries because the agriculture and fisheries sectors are no longer support their daily needs. This shift is likely due to the change of the waterscape and landuse in Muarajambi.

This research aim is to reveal the changes in the waterscape and land use arround Muarajambi temple compound and show their impact on the subsistence and food security of the traditional communities. The changes that occur have an impact on the shift of traditional subsistence. The fulfillment of food needs will also go hand in hand with these changes.

2 Method

To track the changes of the waterscape and its impact to traditional people subsistence, we use three approach. They are geo-history, ethnolinguistic, and landscape archaeology. In geo-history we compare some historical satellite imagery and aerial photograph. Historical aerial photography and satellite imagery can be used to analyse the landscape transformation [9, 10]. The high resolution satellite imagery were derived from Google Earth and the lower resolution satellite imagery were derived from another free-legal sources such Landsat 5, Landsat 7, Sentinel 2A and Sentinel 2B which derived from United States Geological Society (USGS) portal. The comparison between each satellite imagery of Muarajambi can show how the changes occured between 1980s to 2020s.

This changes is then be clarified to the local people in Muarajambi area. People who experienced the process time to time always remember how everything change during their life [11–13]. The transformation of the waterscape are recorded in the traditional people collective memories. This ethnolinguistic approach is used to dig the information from local people deeper from their memories [14–17]. What happened to their livelihood and daily needs before and after the changes and how the manage to fullfill their daily needs during the process. Some of the people memories are left in the linguistic aspect, such toponyms, folklore, and their daily language [18].

Last but not least, the landscape archaeology approach is used to sharpened the interpretation [10, 13, 19]. Watescape transformation are left in the relict of the landscape. What is used in the past and then abandoned can be observed significantly. They are the evidence of the transformations and the trails of cultural change [20–22].

3 Result

3.1 Traditional People Subsistence in Muarajambi Temple Compound

The people who live around the Muarajambi Temple are a community that has existed for generations. In the Dutch East Indies period, they were part of the Maro Sebo clan [7, 23]. The oldest data of settlements existence in the Muarajambi can be observed from 18th century maps (Fig. 1). This map is one of the oldest map of Jambi which is part of nationaalarchief.nl maps collection. On this map, Muarajambi is named *Jambilamme* (old Jambi). Old settlement locations near Muarajambi whose names can still be traced are *moori Compe* (Muara Kumpeh Hulu), *Tallamdouckoi* (Talang Duku), and *Combon* (Sekumbung). These old settlements are still traditional settlements like the settlements around Muarajambi Temple.

The traditional people in Muarajambi and its surroundings is generally an agrarian community. They depend on agriculture and fishing for their livelihoods. People grow rice, secondary crops, vegetables, fruits, and look for fish for their food needs. This tradition is a continuation of the Austronesian-speaking community like in the other Southeast Asian region [24, 25].

In Muarajambi, there are two types of rice plants that are cultivated, namely *padi payo* (plant in wet rice field) and *padi sematang* (plant in dry rice field) *Padi payo* cultivation in Muarajambi is carried out by the community on land which is a back swamp. This land is formed naturally due to fluvial processes which are always submerged during the flood season. Water enters through tributaries and is held in the basin for several months. The community has never carried out topographical manipulations such as making terracing as is commonly done in highland areas. They don't even plow and fertilize the land

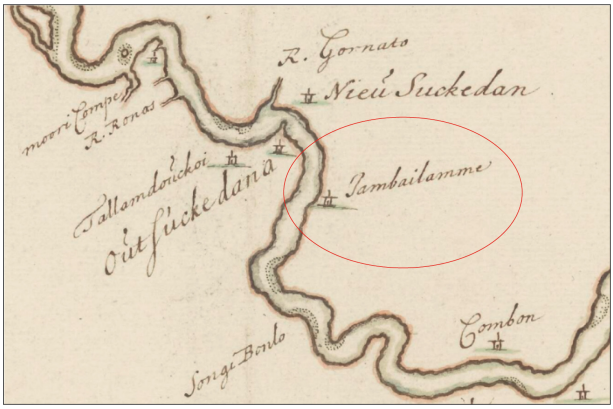

Fig. 1. Part of the 18's century map of Muarajambi and surround settlement

before planting. People generally only do manipulation to make short embankments that limit rice ownership and make water channels to manipulate the flow towards the river. These channels are often called *sakean* and named after the channel maker.

Padi sematang were planted on land that is not flooded, except during the big flood season. In local terms, the land is given the name *sematang*. The process of planting *padi sematang* is different from *padi payo*. The community must first clear the land by burning them. They then make a ceremony before carrying out the planting procession. The way of planting *padi sematang* is called *nugal*, or making small holes in the ground with a wooden stick named tugal. The process of making this hole is done by men. After the holes were made, the women insert about 7 grains rice seeds into the holes.

People in Muarajambi also grow vegetables for their daily food needs. Some types of vegetables are planted near rice fields, but some are grown on separate lands. The community grows vegetables such as long beans, eggplants, and pumpkins. Fruits are also a separate commodity and several types of fruit are often used for annual income such as duku and durian. The fruits found around Muarajambi today include jackfruit, *cempedak*, coconut, types of oranges, types of mango such as *pauh*, *mempelam*, *kemang*, and *manggo*, *rambutan*, banana, sapodilla and mangosteen. The community also consumes several types of forest fruits such as *rukam*, *menteng*, *tampui*, and *barangan*.

In Muarajambi, agricultural land is not privately owned. Agricultural land is owned by the clan, so anyone can plant in these locations as long as they are part of the clan. Ownership is not for the land, but for the plants. Land ownership is rather new concept, and only known when there is a policy to certify land by the government.

Apart from agriculture, fisheries are the main subsistence of the people of Muarajambi. The flood season is always awaited by people because in that season the fish are very abundant. However, when there is no flood, fish can still be easily found. The community searches for fish in both large rivers and small rivers and swamps. Even in rice fields that are still submerged, people are also looking for fish and other aquatic animal like shrimps and shells.

Up until 2000's, there was a fish exploitation system called *lelang sungai* (river auction). The village government provides opportunities for some groups of people to exploit fish in the creeks by paying the village a fee. If the group win the auction, they have full right to gather the fish on the river and built a wooden dam called *tebat*. Other communities are not allowed to fish in the area. Several tributaries that have been auctioned by Muarajambi include the Sungai Kandis, Sungai Bungur, and Sungai Bayur.

Many types of fish can be obtained before the 2000's and only large ones are taken. Small fish are released in order to breed. The community has its own rules in catching fish, such as not being allowed to *nubo* or using *tubo* (poison). Even in fishing, there are restrictions that must be avoided such as *nyarang*. *Nyarang* is a local term refer to the fishing activity of brooders who are taking care of their young.

3.2 Waterscape Transformation

The waterscape in Muarajambi Temple Compound appears to have undergone a significant change. This assumption is based on observations of a series of satellite images and aerial photography from 1989 to 2021. Changes that occurred from 1989 to 2000 are seen in the land cover and land use pattern, from forests to plantations and industrial

areas. Changes are then increasingly seen in contrast, especially from the period 2002 to 2019.

One of the most fundamental changes that can be demonstrated is the loss of natural hidrological feature around Danau Kelari (Fig. 2). The 2002 and 2008 satellite images show that the water lodge (red arrow) is to the northeast of today's Danau Kelari (blue arrow). In 2012 satellite image, the normalization and deepening project has been carried out, but the water lodge is still visible (red arrow). Danau Kelari (blue arrows) appears to be deeper and are connected with unnatural form of natural water flow (yellow arrows). In 2016 satellite image, the lodge on the northeast side (red arrow) has disappeared, while the inundated feature is only Danau Kelari (blue arrow) and the normalized channel (yellow arrow).

The second example of the waterscape transformation in the Muarajambi is found to the west of Gumpung Temple, or to be precise in the Sungai Melayu (Fig. 3). In the 2002 satellite image, it can be seen that no normalization has been carried out, while in 2008 it appears that there has been normalization, but only in part of the Sungai Jambi and the Sungai Melayu (red arrow) which flows up to Payo Rimbo Tebakar (yellow arrow). Payo Rimbo Tebakar is a back swamp that becomes a natural inundation area aproximately 25 ha during the flood season. The water flows in and out through three channels, in the southeast to the Sungai Melayu through Lubuk Guci, on the northeast side through the Empang Pecing, while on the west side it goes through Buluran Lembat and Buluran Leper to the Sungai Putih. In 1989 Landsat 5 image, the water lodge in Payo Rimbo Tebakar is clearly visible at the peak of the flood season. In 2012 satellite image, an excavation of new channel can be seen connecting the Sungai Melayu on the west side of Gumpung Temple with the flow leading to the Sungai Keliling (blue arrow). The channel is also made to cross Payo Rimbo Tebakar which is supposed to be a natural swamp. This swamp inundated during the flood season, but later became inundated less often. Therefore, in the November 2019 aerial photo, it can be seen that plots of plantation land have been cleared (yellow arrows) in the area that was supposed

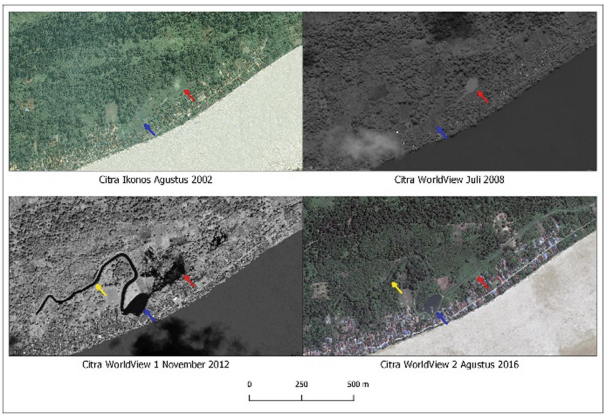

Fig. 2. The transformation of waterscape around Danau Kelari

to be a swamp. The canals was then become green perhaps because it was not flow like normal river. So that the water plant grew significantly and rapidly there.

The transformation of the waterscape in Muarajambi is getting worse with the emergence of an industrial area. Altough it was already started in 80's for wood processing industry, the planning of Kawasan Industri Kemingking is making the changes very devastating for the waterscape. This development is part of the National Strategic Project (Proyek Strategis Nasional) and projected to be complete in 2024. For now, in the southern part of Sungai Batanghari, there are about five coal stockpile industries which can be seen from satellite imagery, and much more to Tebat Patah, Talang Duku, and Kunangan Village. These industries are built around the back swamp where it was used to be a rice field before. They were build deep channel to make the area drier, and the soils are dump near of the channel to build dams. This land manipulation are effecting in the annual water circulation. In wet season, the water lodge was really high in the swamp, but they were easily to become dry because of the channel. In dry season, there were no water left in the swamp. So it was not suitable for rice field anymore. The rice fields are seem to be abandoned for now if we look at the satellite imagery (Fig. 4).

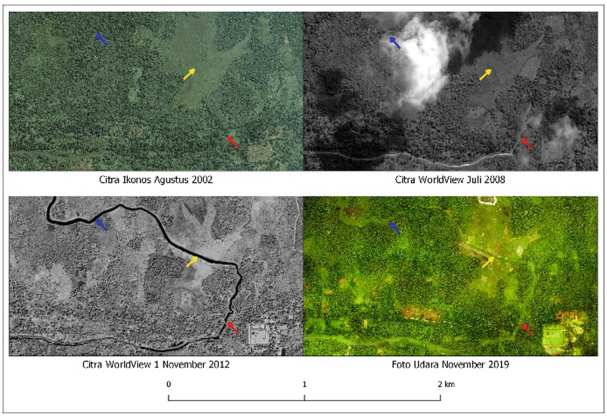

Fig. 3. The transformation of waterscape around Sungai Melayu

Fig. 4. Some abandoned rice field (red circle) which was surounded by coal stockpile (yellow circle) near Payo Lopak Segatal

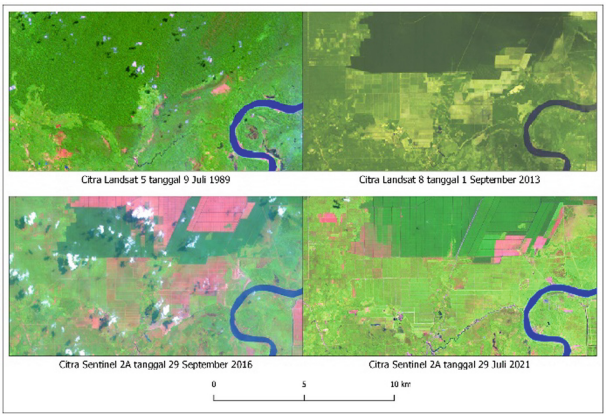

Fig. 5. The transformation of waterscape in the northern part of Muarajambi Temple Compound between 1989 to 2021

Development of the modern road network around Jambi also effecting in the degradation of the waterscape. The fluvial landform around Jambi make the road development is not that easy. The road must be higher than the natural level of the soil so as not to get flooded. So it was a lot of cut and fill works and they change the natural topography, including pile up of some river and channels. Sungai Jambi which was part of Batanghari tributaries are closed in upstream, so it was not active untill this day. Modern road network are began to build around 90's. The first bridge across Batanghari River near Jambi is built in 1982 and functioned in late 80's. Road usage began to increase after that, so that is why modern day people start to leave the water transportation.

In northern part of Muarajambi Temple Compound, the waterscape is changing in different way. This was occured because of deforestation. The seriation of sattelite imagery shows that the deforestation is very massive (Fig. 5). That is why some of the river are missing there, but their estuaries in Sungai Berembang are still can be seen. This deforestation is likely happened due to the purpose of the plantation of *Acacia manguium* which are very common in paper industries.

4 Discussion

The people in Muarajambi Temple Compound confirm that the transformation of the waterscape were happened and impacting their livelihood. Most of the people still clearly remember the condition of the waterscape around their settlement. The life of the people in Muarajambi in the 60's to 90's still clearly flashes in the memory of the informants. This period is when some of the informants on this research are still childrens and teens. Their lives and subsistence cannot be separated from the waterscape.

In people's memories, period between 2000's and 2010's is the starting point of very fundamental change. Waterscape began to transform and their subsistence shift. This change happened during the massive development of industial area in the southern part of the settlement. Muarajambi people once have their wet rice field there, the largest

and most productive rice field they ever remember. But when this area transformed to be industrial area, the rice field were abandoned (Fig. 6). It is because the each of the company build large canals and embankment to protect their land from flood. This waterworks made the water can not be kept by the swamp. So that is why the rice field are no longer can be planted. Rice production in the 90's averaged 300 *kaleng* per each person (3 quintals) and was enough to fulfill food need for 1 year because it was stored in the barn which called *belubur*. However, in 2020's they only get under 100 *kaleng* on average, so they have to buy rice for for the rest.

The things also happened in the northern part of the settlement. What was seen from the satellite imagery in Fig. 3 is probably because of the misinterpretation about ancient canal. This assumption leads a project of normalization of the canal, but it was wrongly goes. Of course, this normalization principle then affects the nature of the swamp itself. Swamps are supposed to hold water during the flood season and store water for several months, so people could plant rice there. However, because of the canal, the water cannot be kept. They just flew into the canal when flood gets lower.

There are several attempts to optimize rice planting that have been carried out, one of which is the manufacture of modern irrigation around 2015's. This project to provide water needs and control flooding is seen in Payo Terjun Gajah, one of the largest natural swamp in Muarajambi. Irrigation canals were built complete with water sluice. However, according to the people found at the location, this channel is not effective because during the flood they are submerged, while during the dry season water cannot enter. Observations in the field show that the irrigation canal is currently not being well maintained and the floodgates are abandoned (Fig. 7).

The only area that were not affected were around Payo Sungai Kamal, Payo Lubuk Gede (Fig. 8), Payo Teluk Jauh and Payo Teluk Dekat. In this area, people can still grow *padi payo* in their traditional way. Unfortunately, it's just that on the south side of Payo Sungai Kamal, at the mid of 2022, an industrial area is being built that makes deep channel and high embankments.

Fig. 6. Abandoned wet rice field near Payo Lopak Segatal

Fig. 7. Abandoned water sluice in Payo Terjun Gajah

Fig. 8. Wet rice field in Payo Lubuk Gede, the deeper part of the submerged land has not been planted

The impact of waterscape transformation also has an effect on the fisheries sector. The chaos of the water system has disrupted the natural habitat of fish. The Batanghari river fish can no longer spawn and breed in swamp areas and creeks. The number and types of fish catches decreased drastically when compared to before 2010's. In late 1990's and early 2000's, pople still easy to get giant fish like *gabus*, *toman*, *serandang*, and *bujuk*. But now, people can only get small fish like *sepat* and *serapil* on their trap (Fig. 9). Although most people still use traditional methods to catch fish, some others have started using electric shocks to get more fish than traditional methods.

Fig. 9. Fish catch in a day using *tembilar*

People in Muarajambi eat fish for daily meal. Therefore they look for fish every day along with their activities in the rice fields or in the farm. They always leave fish traps such as *tembilar* along the waterways and in the wet rice fields that are still flooded. Every morning and evening they take the fish trapped in the tool. One of the people who are still carrying out these traditional activities nowdays only gets a maximum of 10 fish of the *sepat* and *serapil* species for daily meals with his family (Fig. 9).

Fisheries sector is getting worse because of deforestation in northern part of the area. What we have see from satellite imagery in Fig. 5 was confirm by people in Muarajambi. The deforestation made the water level lower. Some of river tributaries are lost, like Sungai Puding, Sungai Bungur, and Sungai Bayur which in 90's fully loaded by fish. Muarajambi Regency is the worst in Jambi for deforestation during 2005 to 2013. The forest are reduced to 9,6% or about 14.218.615 hectares [26]. This deforestation may lead to the plantation of palm and acacia. So there is no natural forest left in Muarajambi.

5 Conclusion

The waterscape transformation are majorly effecting traditional subsistence in Muarajambi. It was ocurred between late 1990's to 2020's and still continued. The main cause of the transformation is the development of industrial area, plantation area, road network development, and misinterpretation of the ancient canal. For now, traditional people still struggle with their old way, although food production are no longer enough for their daily living. The younger people are starting the new way such becoming an industrial labor and so on. Paradoxically, Muarajambi Temple Compound is now claimed to become the

centre of cultural heritage conservations. So the traditional people's subsistence have to be conserved as well as the material culture heritage. Culture conservation is not only about preserving material, but it is about preserving traditional way of living and traditional value of living.

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