Restoration of Peat Dome in Ex-Mega Rice Project Area in Central Kalimantan

by

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Abstract. Restoration has been carried out on several tropical peatland water systems in Indonesia. One of them held at ex-Mega Rice Project Area (EMRP) of a million hectare of peatland in block A, Sei Ahas Village, Mentangai, Kapuas District, Central Kalimantan. The method was used to create a canal blocking in several locations which was expected to increase water table level and to repair degraded peatland ecosystems. In this recent research, two cases of blocking in canal D and E had been compared to canal C condition without blocking of water table in upstream blocking and peatland ecosystems. Based on 3 years field observations in restoration process and secondary data in peatland water system by canal blocking constructing, there was finding obtained by the presence of the block on canal E, water table in upstream canal can be maintained at time of rainy season and dry season/ Therefore, the peatland might be inundated. In canal C with no blocking, the level was 0.2 m above the bottom of the canal at the end of long dry season at 2015 and at level 0.6 m at the dry season in 2017. On the other hand, the observation on canal blocking D gave unsatisfactory result because of new redesign on canal blocking. After wildfires hazard in 2015 with direct observation and peat water absorb capacity testing. It is found that canal E that had a longer through restoration process provides better results in absorbing water. Ecosystems in upstream canal E also show better results from the restoration process.

INTRODUCTION

Characteristic and Peatland Degradation

Forest and peatland have been degraded with 2.2 million hectares rate of total degradation over the past 10 years. Degradation of forests and tropical peatland, especially in Kalimantan and Sumatra, mainly due to agricultural activities, construction of plantation drainage networks, illegal logging, and land fires [1]. Tropical peatland in Central Kalimantan have been exploited and have caused extensive and intensive degradation. It is as a result of unsustainable land management that has led to wide fire hazards in the last 3 decades [2]. One of the activities that greatly affects the rate of degradation and loss of forests and tropical peatland in Indonesia is canal construction, both legally and illegally. Those canals usually are built from one or more rivers and are used to facilitate the movement of forest products to villages. It allows water from peatland run to canal into river. It causes peatland being dry peat. Water management is needed in this case to maintain the condition of the peatland in water-saturated conditions. This water management is the basis of restoration on peatland [3].

Peatland ecosystem is characterized by a peat dome in the middle and flat land on the edge and flooded with blackish brown water [4]. The edges of the dome are dominated by many types of wood plants and generally have large diameter that still get the nutrients from soil and river water. It is called mixed swamp forests [5]. The declining part of the land between the river embankment and the peat dome is called sublandform (backswamp) [6]. Natural dome is able to flow water slowly throughout the year, either through subsurface streams, as well as the open flow of natural drainage canals. When the area around the dome is filled with artificial drainage canals, in the

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dry season the water will be quickly drained and the dome can become dry, easy to fire that eventually becomes damaged [7].

This study aims to review restoration process of the peat domes in Block A, Sei Ahas Village, Mentangai sub District, Kapuas District on the Ex-Mega Rice Project (EMRP) of a million hectares in Central Kalimantan water system on peatland between the canal that have been block compared to the unblocked canal. This present research focuses on water table level in upstream canal blocking before and after canal blocking construction as one of the alternative of peatland restoration.

Peatland Water System

Water system management is a success key to peatland development for agriculture and is also the most important aspect of peatland conservation. Water management is an important aspect for peatland development and must fill two main functions: (1) to discard the excess of rainfall efficiently, and (2) to maintain water table level for optimum plant growth [8]. The water system in peatland is divided into two systems: (1) a macro water system that can control water in one area, (2) a micro-water system to control water system in the land unit. One of the important components in water system development in peatland is building controller to maintain water table level not to be too shallow and not too deep. In designing of peatland water systems, the principles to be considered are conservation of peatland and optimum water demand for plants [9].

Water system arrangement through drainage system needs to be done wisely in peatlands. This is to prevent the destruction of peatlands. Drainage not only serves to remove excess water, but also serves to remove toxic substances, especially on sulphide land [10].

Water system for agricultural purpose, where the water table should be lowered contradict with conservation purpose. Water table level decrease should be overcome in the dry season for natural peat conditions [11]. Land management on peatland requires shallow drainage than deep drainage systems. Water system improvements in peatland are needed to rise a water table level, for example by canal blocking [12]. Ten to fifty cm deep drainage system is required for the growth of various types of food crops on peatlands. In addition, one important component in peatland water system is water gate or blocking to maintain water table level not too shallow and not too deep [13].

Restoration Method – Canal Blocking

Restoration and management practices have been tested and applied to improve peatlands ecosystems management and increase the capacity of local communities to adapt to climate change. Restoration activities in peatlands are: (1) canal blocking using dams and weirs made with different materials to increase water table level; (2) grazing rotation; (3) replanting; and (4) supplying water to overcome excessive dryness and maintain peat formation [14]. Canal blocking is one of the most widely methods to maintain water table level and to prevent drought in peatlands.

METHODOLOGY

Study Area

The study area is in Block A, Sei Ahas Village, Mentangai sub District, Kapuas District on the Ex-Mega Rice Project (EMRP) of a million hectares in Central Kalimantan on the which is one part of the peat dome damage effected by over drainage according to the KFCP (Kalimantan Forests and Climate Partnership) research through the activities of PTGLD (*Pola Tata Guna Lahan Desa*) or Village Landuse Pattern which can be seen in Figure 1 (a).

In peatland water system network in Sei Ahas which is taken as research area, it consists of 3 canals with name label such as canal C (D01), D (E02) and E (M05). Canal D and E with canal blocking and canal C without blocking. All canals are united into drain canal (E01) to Kapuas River. Peat depth measurements were carried out at 32 points scattered within the study area, conducted on March 15 to March 22, 2012 by Balai Rawa Banjarmasin can be seen in Figure 1 (b) [15].

Based on peat depth points, an area with a peat depth of > 3 meters is a peat dome. This area cut by canal C and D in the middle and upstream of canal.

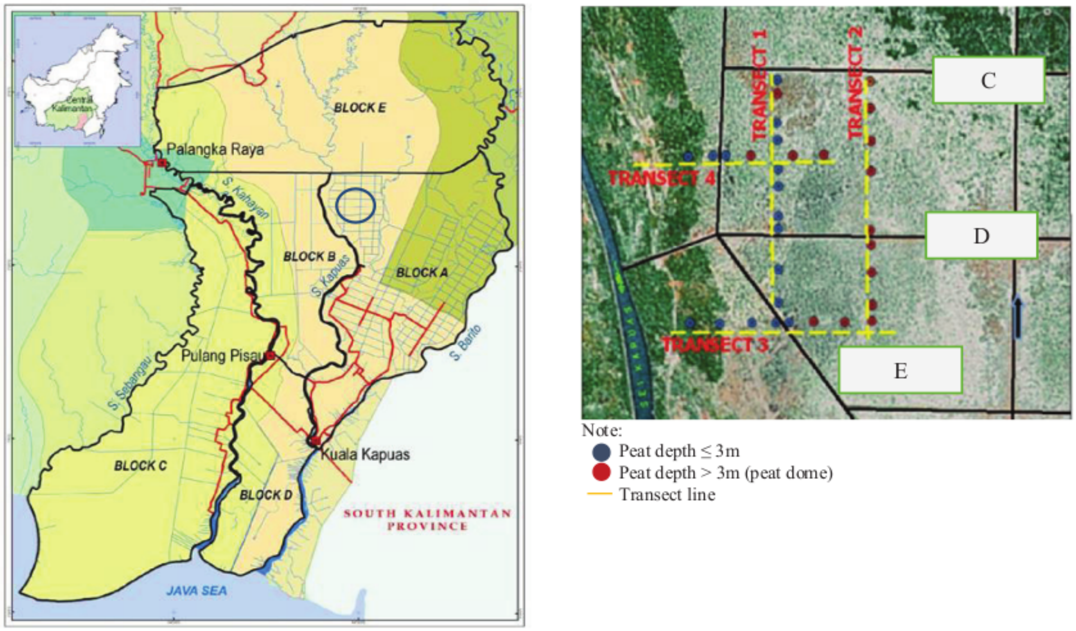

FIGURE 1. (a) Canal layout in block A EMRP (Source: Kalimantan Forests and Climate Partnership, 2009), and (b) Peat depth measurement location points in Sei Ahas Peatlands by Balai Rawa Banjarmasin [15]

Existing Water System in Block A, Sei Ahas Peatlands

Block A, EMRP is dominated by 300 km of canal built in 1996 and 1997 [16]. The project is initiated legally on a Presidential decree 82/1995 about *"Pengembangan Lahan Gambut untuk Pertanian Tanaman Pangan di Wilayah Propinsi Daerah Tingkat I Kalimantan Tengah Seluas Satu Juta Hektar"*. This project is supported with canal system which is originally intended for the benefit of drainage and irrigation in peatlands. However, from the beginning of the design, it does not consider peat dome existence that lies in the middle of the system.

Those canal design is in contrast with peatland water systems management according to Agus [13] and Mukhlis [12]. Plants on peatland require only shallow canals, ranging from 10 to 50 cm. Shallow canals are also useful for maintaining peatland conditions that are always inundated. The current canal with more than 3 meters depth and cuts the peat dome causes the water in the field to drain out and the land becomes dry. This causes the degradation process.

RESULTS AND DISCUSSION

Canal Blocking Design

As part of the strategy for peatland restoration, the drainage and resulting subsidence and oxidation of the peat lands needs to be reduced as much as possible [17]. Canal blocking is one water system management solution in peatland in order to reduce water loss from the system and to raise the groundwater level in the wet season to near the surface, as was the case in the original peatland ecosystem. Canal blocking should be part of an integrated approach to peatland restoration, and should be accompanied by program for fire control management, reforestation and community development. The latter should aim at gaining support of the local population for the restoration efforts and at reducing their dependency on exploitation of the forest resources.

The design and construction of canal blocking made by *Balai Wilayah Sungai* (BWS) Kalimantan II, Banjarmasin in collaboration with *Balai Rawa-Puslitbang SDA*. In canal D, blocking design by compacted peat dam was built in 2014. At 2015, it was redesigned with concrete block. Observation for this present study took 3 years since November 2015 – August 2017. It is showed in Figure 2. In canal E, canal blocking made by concrete material was built in 2014 showed in Figure 3. Figure 4 shows condition in canal C without blocking.

FIGURE 2. (a) Compacted canal blocking in canal D, [15], (b) redesign canal blocking in 2015, (c) canal blocking in 2016 and (d) canal blocking in 2017

FIGURE 3. (a) Concrete canal blocking in canal E in 2014 [15], (b), (c), (d) canal blocking condition in 2015 to 2017

Canal blocking is equipped by flow of boats in the middle that is adjusted to the conditions in the area. This plot is provided so that small boats (local people called *ces*) can pass through the canal blocking so as not to interfere with their daily activities. Boat streamline is made high enough, equal to the block streamline to prevent water from passing as shown in Figure 2 and 3.

The observation was conducted for three years from November 2015 after the end of a long drought and the occurrence of El Nino phenomenon that caused wildfires in tropical peatland in Indonesia. For 3 years, there was a considerable change in peatland ecosystems around and upstream E canal blocking. Ecological condition gradually returns to its original condition of peatland that inundated in rainy season 2017. Upstream canal begins to be covered by fallen trees into the canal. The restoration process in canal E gives good results.

In canal blocking D, the restoration process on peatland ecosystem condition is not seen clearly like in canal E. It is caused by the redesigning of new block material. Ecological condition in upstream canal D gradually returns to its original condition of peatland that inundated in rainy season 2017.

Ecosystem conditions in canal C from observation year 2015 to 2017 do not show any difference without restoration process. It is shown in Figure 4.

FIGURE 4. Canal C condition without blocking in 2015 – 2017

Water Table Level Observation in Upstream Canal Blocking

Water table level observations in canal C, D and E upstream and downstream of the block shows that canal blocking could restrain water from run out to the drainage canal in downstream.

Based on the data obtained from *Puslitbang SDA* before the canal blocking construction in the rainy season for 2 years from 2012 to 2013, water table in upstream canal D up to the range of 1.52 - 2.03 m and in the canal E is 1.89 - 2.16 m.

In this research, the observation of upstream canal water table was conducted for 3 years since 2015 to 2017. In the rainy season, it was found that the increase of water table in the upstream canal. Observations were made until the rainy season of 2017 with the water table upstream up to 2.7 m both on the D and E canal. This water table on the graphic remains rising near to land elevation in upstream canal. It is shown in Figure 5.

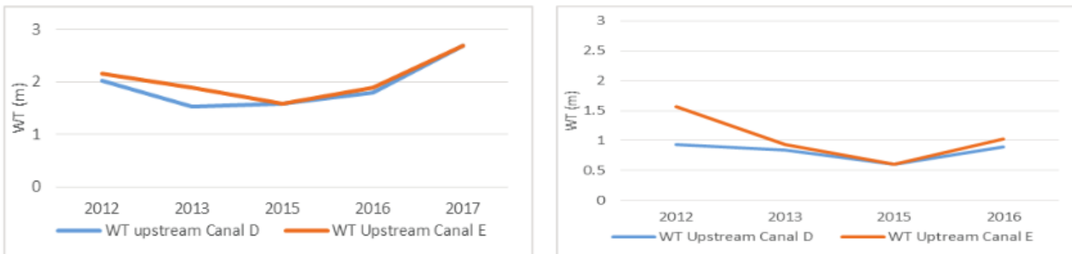

FIGURE 5. (a) Graph of water table in upstream canal blocking in rainy season, and (b) Graph of water table in upstream canal blocking in dry season

Based on the data obtained from *Puslitbang SDA* in 2012 – 2013, the water table level tendency during the dry season which ranges from 0.84 to 0.93 upstream of channel D and 0.93 - 1.56 in upstream channel E before the canal blocking is built. This condition dropped dramatically in 2015 due to a long drought and accompanied by the phenomenon of El Nino so that the water level was at 0.6 m, while the downstream observation of the insulation obtained a water level of 0.4 m. This is still quite good if compared to water level conditions in canal C that range from 0.2 to 0.6 m.

In the field local soil test in 2015, it was found that on the peatland, in the upper part of the E block the depth of soil is at 1.5 m. Observations on canal D cannot be done due to the redesigning of the block. The data taken on the block E is compared to the data obtained from canal C with depth of hard soil at 3 meters depth. This shows that there is land subsidence in upstream canal C.

Peat Ability in Absorb Water in Upstream Canal Blocking

The testing of the ability of peat water absorb water used samples from 3 places in upstream canal E, upstream of canal D and upstream of channel C [18]. The experiment is divided into 3 conditions: 1. peat soil dried in oven until dry perfectly, 2. peat soil that air dried, and 3. peat soil is left as the original condition in the field. The sample is placed inside a hollowed tube and placed in a container containing water. The researcher observed how high the depth of water lost from the container. The results of the experiment can be seen in Figure 6.

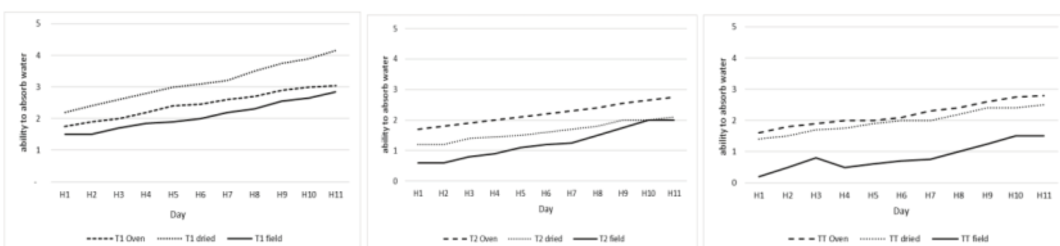

FIGURE 6. (a) Graph of absorb water in upstream canal E soil sample, (b) Graph of absorb water in upstream canal D soil sample and (c) Graph of absorb water in upstream canal C soil sample

The highest peat water absorb capacity is in the soil sample in upstream canal E from air dried sample conditions. Overall sample testing, the highest value is on soil samples from upstream canal E that has already been restored compared with the results from canal D sample and canal C without blocking. This is in line with field observations for restoration of canal D and E. Locations in upstream canal E shown that peat ecosystem conditions gradually return to natural conditions. Canal begins to close with trees and branches that are decaying.

CONCLUSION

The observation of the restoration process has not been maximized by considering the time limit of this research, which was conducted for only 3 years after the canal blocking construction. Although the process has not yet been seen, it has been found that the extinction of the ecosystem in the upper part of the block shows a tendency to return to the initial stagnant condition of peatland.

On the water table observation for the rainy season, a good result is found where the block has been able to maintain the water table in the upper part of the canal blocking and it is not out to the drainage canal into the river. This data has not been supported by data in the dry season which still shows a reduction of the data obtained before the canal blocking construction.

The observation on canal C with no blocking is done at level 0.2 m above the bottom of the canal at the end of long dry season at 2015 and at level 0.6 m at the dry season in 2017. While the observation on canal blocking D gives unsatisfactory result as newly redesign canal blocking.

After wildfires hazard in 2015 with direct observation and peat water absorb capacity testing in 2017. It is found that canal E that has a longer through restoration process provides better results in absorbing water. Ecosystems in upstream canal E also show better results from the restoration process.

The research needs to be improved with the new research on a system to see the condition of the water table of peatland in upstream blocking to adjust to the peatland conditions.

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