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Canal Blocking to Maintain Groundwater Level at Peatland Central Kalimantan

Ulfa Fitriati, Rusliansyah, Muhammad Afief Ma'ruf

Civil Engineering Department, Faculty of Engineering, Lambung Mangkurat University, Banjarbaru, Indonesia

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ABSTRACT

Canal Blocking (Tabat banjar language) is one of the buildings of water in the channel that aims to keep the water table soils. The hope is to keep the soil remains moist peat can prevent the peatland fire. In this study measured levels of groundwater on the land with canal canal blocking and no blocking. The result peatland Sungai Ahas Wetlands of Central Kalimantan, which channel by blocking the canal has a moisture content of nearly 250% compared with the soil in which that channel does not have a canal blocking only about 60%. This is one proof that the canal blocking can maintain groundwater levels around the channel, which in turn can prevent peat fires. Although it can not restore the ability of peatlands as it was before the burning which the moisture content can reach up to 1500%
KEYWORDS: canal blocking, water table, peatland.

INTRODUCTION

Forest fires [1] and haze [2] during the dry season that occurs in a peatland area [3, 4, 5, 6, 7, 8] Kalimantan, which not only disturb people in the region, but also disturb the area another nearby. The thick smoke coming from peat fires in the ex project area Pembukaan Lahan gambut (PLG) million hectares for agriculture in Kapuas. The opening of PLG in 1996 until the year 2009 to the beginning of the destruction of peatlands in Central Kalimantan and cause to serious environmental problems, flood [9] during the rainy season and flammable during the dry season. Mismanagement of water in peatlands in the past led to peat loses its ability to store water during the rainy season.

Peatlands in the Wetlands of Sungai Ahas is one of the areas of the Peatland Project (PLG) 1 million hectares that has left 400 thousand ha tropical rain forest (tropical moist forests) into open land. The ex-PLG peat land can not be used (bongkor) and always burning during the dry season. In addition, the construction of 187 km of primary channels are built to cut the peat dome is very dangerous, because the network of the water system is required to break the peat dome, which should serve as a reservoir field would lose its function resulting decline in the water table. Thus the peat becomes dry and irreversible (irreversible drying) to trigger the occurrence of fire.

Exploitation of peatlands few years through deforestation [10], drained [11] and dried by making canals for oil palm development [2, 12, 13] in peatlands, forest plantation and agriculture [10], even felling timber illegally increased the peatland degradation. As a result of excessive drainage decline in ground water level [14], and the thickness of the peat thinning through the process of subsidence [15]. Drainage changing soil conditions from anaerobic to aerobic [16], resulting in decomposition of organic materials by a process of oxidation. Decomposition of organic materials [17] generates CO2 emissions. If drainage is continued by deepening the channel resulted in subsidence process [15], drought [9, 11, 18] and fire hazards, as well as carbon emissions [19] will increase. Likewise peatland as water retention will be reduced which will increase the danger of flooding [9] on the river mouth. Within a few decades the whole peat dome will be lost, and the rest of peatland carbon emitted into the atmosphere. The issue is one important factor in the management of water in the peat.

Corresponding Author: Ulfa Fitriati, Civil Engineering Department, Faculty of Engineering, Lambung Mangkurat University. Jl. A. Yani Km. 35 Banjarbaru, Indonesia (70714). Tel. (+62) 511-477-3868
Email: ufitriati @unlam.ac.id

Based on Landsat satellite images in 1990, 1997, 2001, 2002, 2004, 2005, 2006, and 2009, many fires occurred in Block A former PLG, especially those around the canal. In Block E, fires occur around the trans street (the street of Mantangai Hulu to Tanjung Kalanis).

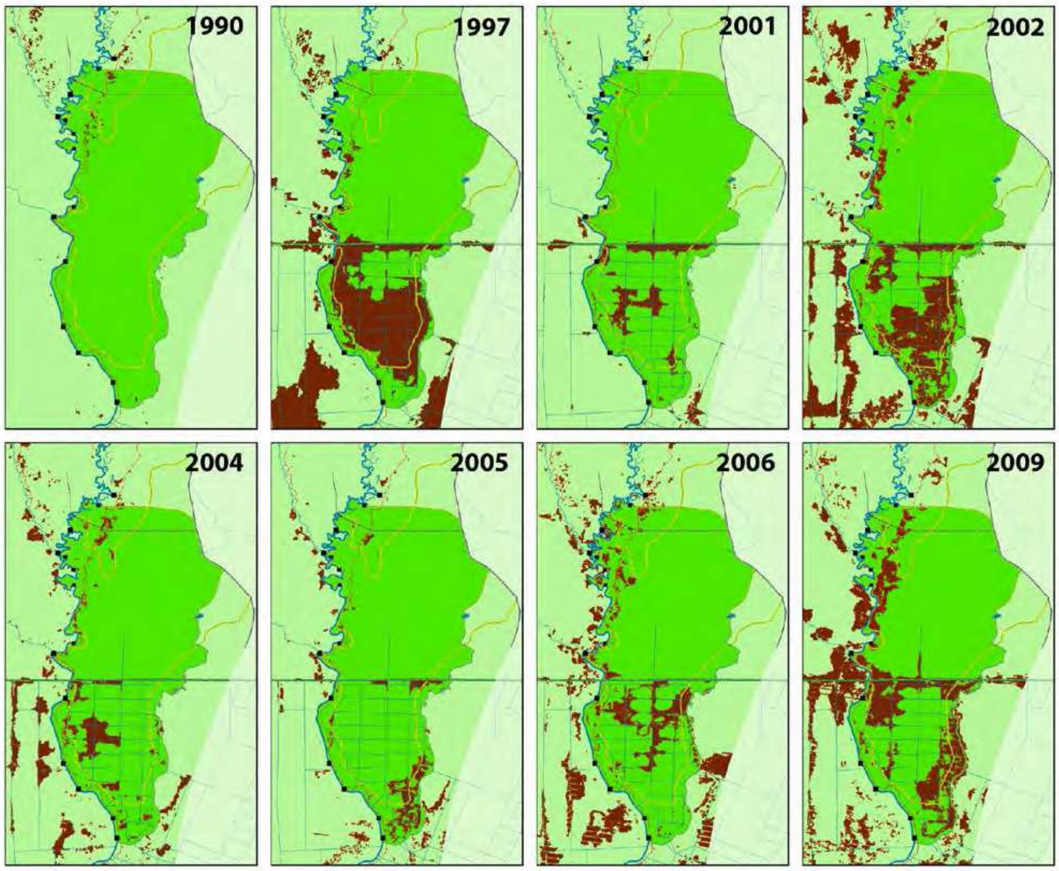

Figure 1. Map of Forest Fires (Source KFCP, 2014)

Figure 2. Forest Fire Condition (Source KFCP, 2014)

MATERIAL AND METHODS

According to the great dictionary Indonesian, said peat (Gambut) derived from Banjar Language (colloquially - the population of South Kalimantan), which means the ground is soft and wet, consisting of moss and other plant material rotting (usually formed in the swamp or lake asinine). Peat is formed from the decomposition of materials - organic materials [17] such as leaves, twigs and shrubs that took place in a slow pace in an anaerobic or saturated with water [20]. In general, peat brown to black and with a characteristic odor due to weathering and decomposition of organic material constituent. The organic content of the soil is high because the peat is derived from the weathering process fragments - fragments of organic material derived from various types of plants decompose due to the effects of weather and fossils. Areas that contain a lot of peat soil can be found in the mountains, plateaus and plains are submerged in a long time. Peat in Southeast Asia began to form about - about the 18,000 years ago [21]. Peat in Indonesia is estimated to form between 6,800 to 4,200 years ago [22].

It is estimated that at that time in the area along the coast of the island of Sumatra, Kalimantan, and Papua formed alluvial soil (alluvial) wide due to falling sea levels several meters and increasing clay particles. This resulted in changes in growing conditions for some species that grow mangrove forests in the area are slowly being replaced by other plant species as a result of the accumulation of materials - organic materials. At the end of the mangrove swamp forest turned into a peat swamp forest in the water conditions had changed into fresh water.

The spread of peat land in Indonesia are mostly located on the island of Sumatra, Kalimantan, and Papua, which is largely a lowland peat. There is also the peat in the highlands as in the area of Mount Kinabalu although the percentage is quite small. Peatlands Indonesia is the largest tropical peat lands, which is about 21 million hectares.

The basic theory of the formation process of the peat deposits are weathering the original material, accumulation, and the last is the preservation or storage. So the weathering process plants as original material has an important role in the formation of peat. At first, the plant life, then die and decompose or weathering. Results of decomposition or weathering that if left to accumulate, then over time will form layers of peat soil[23].

Parameter physical properties of peat soil which important role is the water content, the specific gravity, organic content, void ratio, acidity, seepage, and heavy volume. Is known to three phases soil, namely: solid phase, liquid phase and gas phase, as well as on peat soil. Differences between peat and other land lies in the solid phase on peat soil where the solid phase is not always a solid part because peat fiber typically contains water and gas. Pori on fibrous peat soil is divided into macro pores (pores between the fibers is great) and micro-pores (pores inside the fiber) [24].

The physical properties of peat soils are fibrous (amorphous granular peat) has some similarities with clay soils (clay), but differ greatly with fibrous peat (fibrous peat). An important parameter for determining the physical properties of peat soil is the moisture content (Wc), volume weight (γ), void ratio (e), the specific gravity (Gs), organic content, fiber content, ash content, acidity, and the ability to absorb water. To limit - Atterberg limits which are important parameters of clay was not required on peat [25].

At the beginning of the development of swamp areas, functions governance more channels emphasized padap embuangan excess water that pooled on the land that comes from rain or flood water from rivers, flood protection, transportation advocates water, soil quality improvement by reclaiming or ameliorisasi, washing materials toxic (pyrite), dilution water channel washery toxic materials, and the provision of irrigation water. At this stage, the channel system are not usually equipped with a water flow control structures, because the main goal of making the channel system is the removal of excess water and reclamation, so the water can exit or enter the land freely. The process has resulted in uncontrolled reclamation process, so as if the reclamation process was never completed [26].

The management of the water system can be divided into micro-management of the water system (on-farm water management) and macro management of the water system (water canal management). Management of micro water management aims to maintain the availability of water for crops, discard the excess water in the fields, hinder the growth of weeds in the soil, improve water quality, acidity and toxicitas wash the soil, improving soil maturation process, and transform organic soil becomes more fertile soil. The management of the water system macros for more supportive management activities micro water management, the aim, among others, the disposal of excess water and flooding, prevent the decline in groundwater levels that endanger, dilute and dispose of acid water out of the ground and channels, providing water for domestic use, and guarantee the continuity of sufficient depth to water system [27].

Most of the land in the area of wetlands maturation during the early stages, although the subsequent development occurs both physical and chemical changes are still ongoing. That change depends on how the management of water in the swamp development is done. At the time of the reclamation process with hidroteknik then ground in a swamp area experienced a maturation process. Development of land result in reduced water content and volume of pore spaces (soil density increases), reduced organic matter content, as well as changes in soil structure and exchangeable cations [28].

High permeability in the immature soil are the factors that lead to control of the water layer on the face of difficult land, soil saturation becomes impossible to do, to do is to maintain the depth of the ground water level from 0.2 to 0.3 m from ground level and utilize the available height difference between the ground water level with the water level in the channel to allow the washing process. With the process of good drainage and long maturation will result in ground slowly along with the waste of soil acidity, and also prevent anaerobic conditions are sustainable and will stimulate oxidation and loss of organic matter [28].

RESEARCH METHODS

Testing of soil water content based SNI 03-6793-2002 Test method for moisture content, ash content and organic matter of peat and other organic soil. Heavy testing soil types based on ISO 1964: 2008 on the test method for heavy soil types. Soil samples were collected on land without blocking the canal and canal lands with blocking. Soil samples were taken at a distance of 1-2 m of the channel with a depth of ± 50 cm.

Figure 3. Canal Blocking

RESULT

Sampling was taken at Wetlands of Sungai Ahas, Mentangai subdistrict, Central Kalimantan conducted on Saturday, March 26, 2016 at the hour 8:00 a.m. to 1:00 p.m. (rainy season). Testing the physical properties of peat soil consists of water content test, the Unit Weight, the specific gravity, void ratio and porosity.

Table1. Peat Soil Physical Properties at Wetlands of Sungai Ahas, Central Kalimantan

No.	Parameter	Unit	Test Result	
			Without Canal	With Canal
1.	Soil Water Content (wc)	%	61,64	243,25
2.	Unit Weigth (γ)	gr/cm³	0,59	1,05
3.	Specific gravity (Gs)		2,93	2,61
4.	Void Ratio (e)		7,13	6,22
5.	Porosity (n)	%	87,70	86,14

DISCUSSION

The water content of peat soil Sungai Ahas Wetlands of Central Kalimantan without blocking the canal amounted to only 61,64% while with the canal blocking by 243,25%. The main characteristic of peat is the ability to absorb and retain water is very high, so the peat acts as a backup storage of water large enough that seen with the high water table soils. The large amount of water absorbed by peat depends on the degree of decomposition of peat. Fibrous peat absorption capacity is much larger than fibrous peat. This is due to fibrous peat has a macro pore inside the fiber itself. The water content of peat soil can reach 500% [29, 30, 31] - 1500% [24], but the water levels can change drastically if contaminated with inorganic substances although relatively minor. This is one proof that the canal blocking can maintain groundwater levels around the channel.

Unit Weight peat Sungai Ahas Wetlands of Central Kalimantan without canal of 0,59 g / cm3 was with canal blocking of 1,05 gr / cm3. On peat soils, unit weight depends on the water content and organic content of peat soil which is submerged and a high organic content have unit weight to unit weight of water approaching. The high unit weight due to their peat soil inorganic content [24], which showed that the price of peat soil unit weight between 0,9 t / m³ up to 1,25 t / m³. Indonesian peat unit weight ranged from 0,96 t / m³ - 1,04 t / m³ [29, 30, 31].

Specific Gravity peat Sungai Ahas Wetlands of Central Kalimantan without blocking the canal was 2,93 while the canal blocking of 2,61. To determine the value of Gs peat used kerosene oil and not with water as the soil in general [32]. For soil containing organic matter such as peat soil is high enough generally has a value of about 1,4 Gs, being inorganic soil generally has a value of about 2,7 Gs [33]. Gs value for peat soils ranged between 1,5-1,6 [24], while the value of Gs for peat in Indonesia ranges from 1,38 to 1,52 [29, 30, 31]..

Void Ratio peat Sungai Ahas Wetlands of Central Kalimantan without blocking the canal was 7,13 while for the soil with a lower blocking canal is at 6,22. Void ratio of peat especially fibrous peat could reach a value of 25 [34], were to no fibrous peat soils have a smaller void ratio of about 2 [35]. Indonesian peat soil has a void ratio between 5-11 [29, 30, 31].

Porosity for peat soils Sungai Ahas Wetlands of Central Kalimantan with no canal blocking of 87,70% while for land with canal blocking is low at 86,14%. It shows the volume of pore spaces of the soil aggregate volume so large that it can be said that peat soil has uneven particle quite a lot and be unrestrained (not solid) [36].

One of the main properties of organic materials is their ability to absorb and store water in large enough quantities (water retention). Peatlands can absorb water up to 850% of the dry weight. Therefore, the peat has the ability to store water during the rainy season and release water during the dry season.

CONCLUSIONS

Peat soil Sungai Ahas Wetlands of Central Kalimantan, which channel by blocking the canal has a very high water content of nearly 250% compared with the soil in which that channel does not have a canal blocking only about 60%, while about the same soil porosity is above 85%. This is one proof that the canal blocking can maintain groundwater levels around the channel, which in turn can prevent peat fires. Although it can not restore the ability of peatlands as it was before the burning which the moisture content can reach up to 1500%

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