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REWETTING OF DEGRADED TROPICAL PEATLAND BY CANAL BLOCKING TECHNIQUE IN SEBANGAU NATIONAL PARK, CENTRAL KALIMANTAN, INDONESIA

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SUMMARY

Sebangau National Park is a tropical peat swamp forest previously used for logging activities (illegal and legal) between the 1970s until 2006. Logging activities created the canal networks used for transportation of logs and led to over-drainage in peatland. Two-hundred and seventy three canals were recorded over a total length of 673.486 km in nine locations at the Sebangau National Park. Restoration of degraded peatland area started by rewetting peatland using canal blocking technique in which the dam increases the water table level. This technique was implemented in the Bulan River, Katingan Catchment, southwest of Sebangau National Park. The location of canal blocking were determined using canal elevation, estimated every 25 cm by combining field survey and imagery data from digital terrain model. Final decision on canal blocking was reached through compromised discussions with the villagers in order for them to understand the aims of canal blocking and to come to an agreement with the beneficiaries of non-timber forest products and fisheries around the affected area. The canal blocking have resulted in 645 dams being built along the 92 canals with total length measuring 226 km. Measurement impacts of canal blocking were monitored by monthly data of surface water level (swl) in 16 locations and groundwater level (gwl) in 112 pipes for the period from June 2013 to July 2015. The analysis shows that canal blocking effect is significantly positively correlated with water level controlled by rainfall ($p < 0.05$). The positive impact after the canal blocking is on the increase of swl (mean of swl: before = -33.966 cm, after = -26.099 cm; rainfall = 191.0398 mm) and gwl (mean of gwl: before = -19.442 cm, after = -11.925 cm; rainfall = 191.0398 mm). Other efforts that should be done to promote restoration include peat fire prevention, reforestation and community involvement.

Keywords: *tropical peatland, canal blocking, rewetting*

INTRODUCTION

The Sebangau National Park area was designated by Ministry of Forestry decree number 423/Menhut-II/2004 on October 19, 2004 with an area 568.700 ha. Of tropical peatland in Sebangau National Park located between Katingan and Sebangau River in Central Kalimantan-Indonesia. Peat accumulation in Central Kalimantan began more than 10,000 years ago (Rieley *et al.,* 1992; Page *et al.,* 2009). The peat swamp is important for biodiversity preservation and water regulatory (Wösten *et al.,* 2008). The peat swamps of Sebangau National Park are also an important habitat for endangered Borneo orang-utan: it is estimated that about 5,400 orangutans are still found in Sebangau National Park (Panda *et al.,* 2010). The peat thickness varies from 1 m – 10.5 m with seven forest type (riverine forest, riverine-mixed swamp forest, mixed swamp forest, mixed swamp – low pole forest, low pole forest, tall interior forest, very low canopy forest) in Sebangau area (Page *et al.,* 1999).

Before Sebangau area become a National Park, it was production forest managed under 13 logging concession from 1970 – 1995. After the logging concession era, an era of rampant and uncontrolled illegal logging activities followed between until 2006. In this era, canals network created in to the peat surface that were used for floating the logs out of the peatland area into the two large rivers. After it was designated to be a national park, two years (2006) were needed to completely eliminate ilegal logging activities in the Park (WWF, 2014). Based on Land Cover Map of Ministry of Forestry (2013), land cover of Sebangau National Park dominated by secondary swamp forest (82%) and other land use and land cover (18%) of total area (Figure 1).

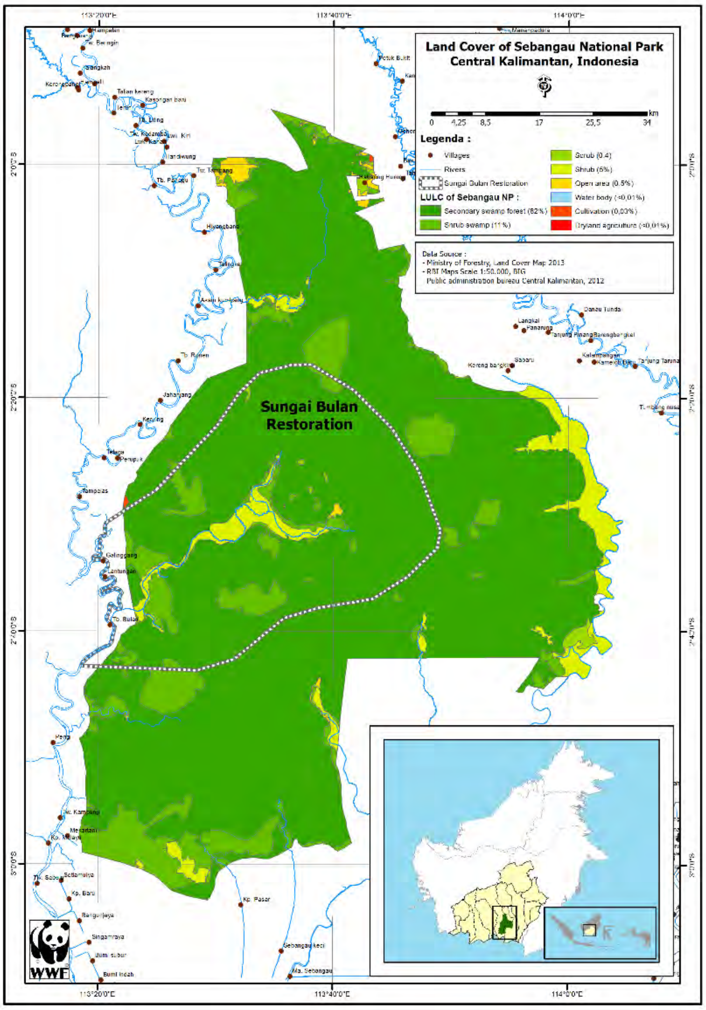

Figure 1: Land cover Map of Sebangau National Park, Central Kalimantan, Indonesia

Based on teresterial survey, 273 canals were recorded, amounting to 673.486 km in 9 locations at the Sebangau National Park. The canals network is having impact on the hydrology of the peat swamp forest, peatland drainage results in peat oxidation and subsidence of the peat surface (Page *et al.,* 2009; Wösten *et al.,* 2008) and also increase the risk of fire. Rewetting the peat is an important key to vegetation restoration and protection of remaining peat carbon stocks (Page *et al.,* 2009). Rewetting in Sebangau National Park is done using canal blocking technique whereby dams are established in drainage canals. The goal of rewetting is to reducing drainage and maintain the groundwater level in degraded peatland in order to restore hydrological and ecological functions. As a result, significant emissions of CO_2 from peatland in that area will be prevented.

The objective of this study is to assess the impact of canal blocking on water table level. Impacts of rewetting was directly measured from ground water and surface water levels data by comparing conditions before and after canal blocking at the project area of Bulan River, Sebangau National Park.

MATERIALS AND METHODS

Site Location

The specific hydrological restoration project sites were chosen in Bulan River, Katingan Catchment, Sebangau National Park. Methods to determine the location of canal blocking were based on canal elevation in each 25 cm by combining field survey and imagery data from digital terrain model. Final decision on canal blocking was reached through compromised discussions with the villagers in order for them to understand the aims of canal blocking and to come to an agreement with the beneficiaries of non-timber forest products and fisheries around the affected area who utilize the canals. In the canals that are used by community members for fishing or to access NTFPs, the dams were built with a spilway that allow access for the types of boats used in his area. In total, 645 dams were built along the 92 canals (226 km) at Bulan River area, Sebangau National Park. The locations of dams are shown in Figure 2.

Hydrological Monitoring

Ground water level (gwl) and surface water level (swl) were monitored to evaluate the effect of canal blocking on rewetting of degraded peatlands. Measurement of surface water level was done using permanent measuring stick which were installed on canals. Measurement of ground water level were carried out using simple tubewells constructed from PVC tubes covered with nylon mesh and with the bottom fitted with a wood block. Sampling points were then established at regular intervals perpendicular to the canal. Transect of tubewell determined by analysis of gradient of slope conditions each canals sample. Two transects were installed in 4 canals sample, each side of canals consisting 7 tubewell with regular interval 50 m for tubewells. Water level are monitored by monthly data of surface water level (swl) in 16 locations and groundwater level (gwl) in 112 pipes. Water level are monitored at the end of the month. Period of monitoring before canal blocking from June to August 2014, and after canal blocking from December 2014 to July 2015. Monthly rainfall data for Sebangau area collected by SSI and Punggu Alas Field Station. Locations of tubewell are shown in figure 2.

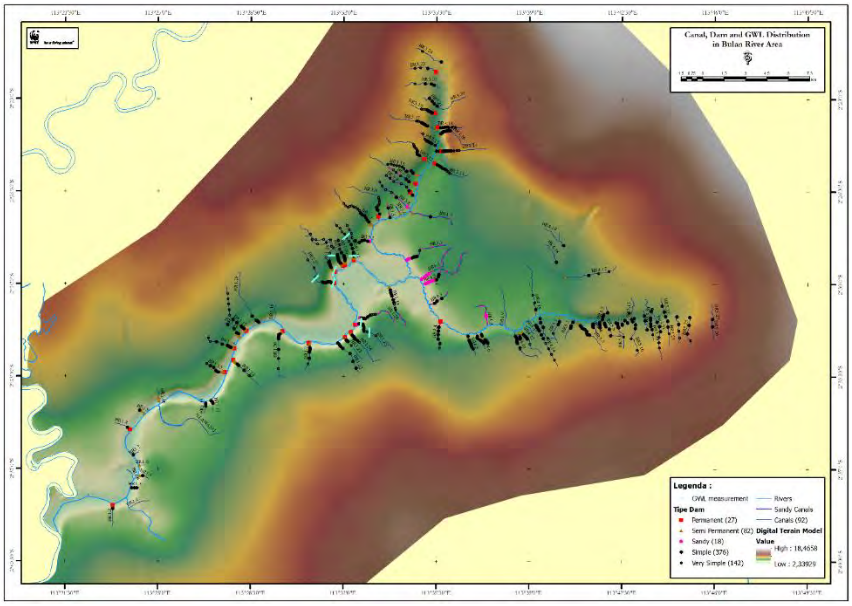

Figure 2: Canals, dams, and tubewells distribution on Bulan River Project area

RESULTS AND DISCUSSION

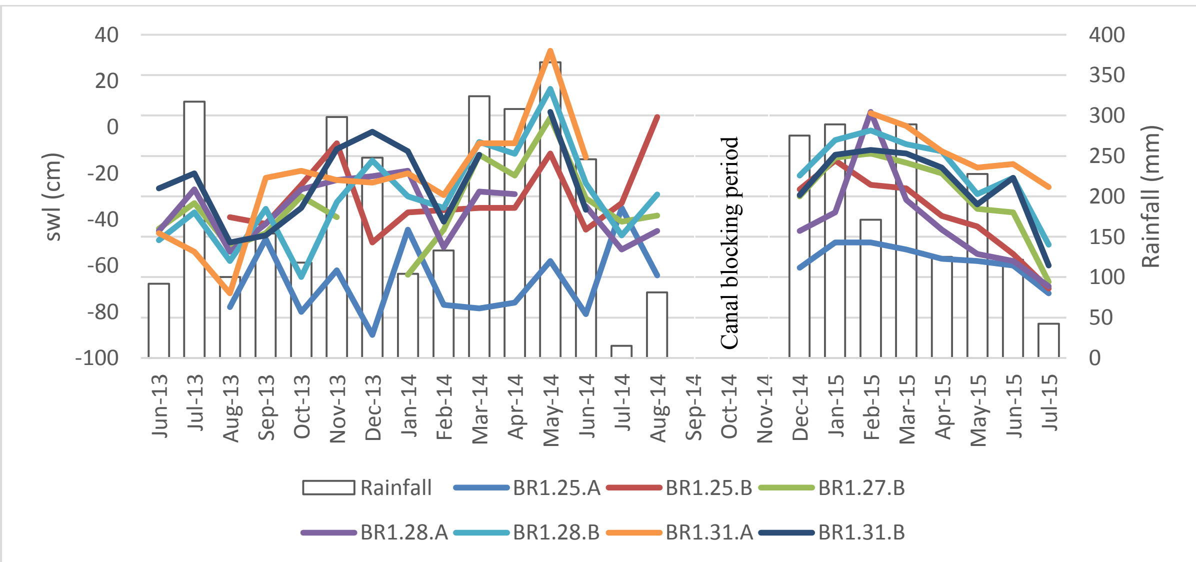

Figure 3: Chart of rainfall and surface water level

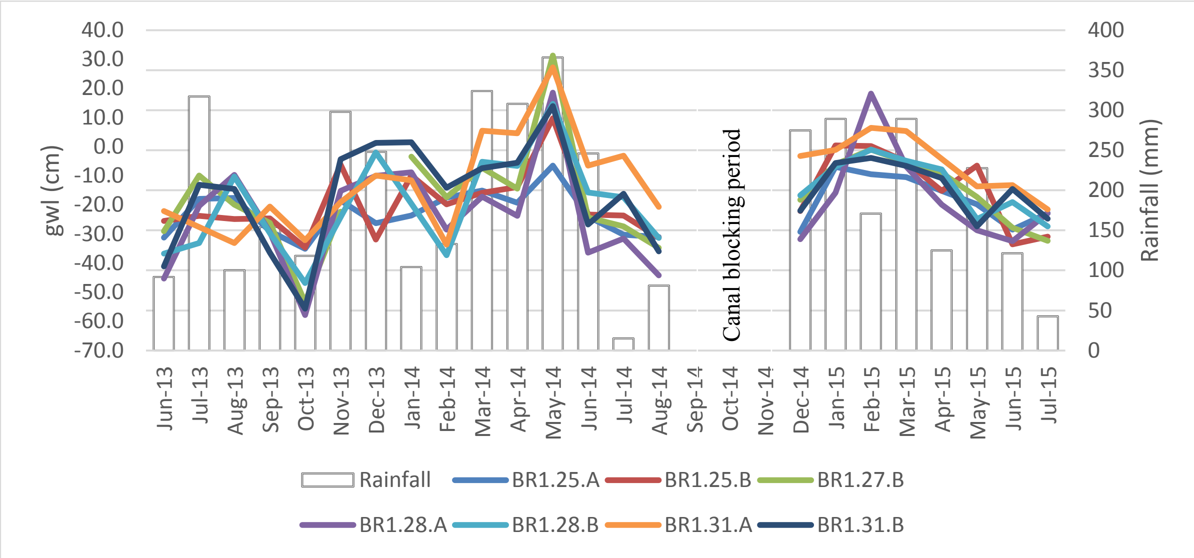

Figure 4: Chart of rainfall and ground water level

The effect of dam constructions on raising water levels in the peatland area measured in the field and compared the situation before and after canals blocking. Before canals blocking period when dry seasons, conditions of surface water level in canals almost -60 cm to -70 cm and ground water level almost -50 cm to -60 cm below soil surface. Rainfall is not distributed evenly over the year, range of rainfall between 10 mm to 300 mm per month in Sebangau area (Fig 4). The existing of the canals cause drainage besides limited rainfall source on dry seasons. Degraded peatland conditions is a major factor to reducing the capacity of peatland to store water during the dry season. Based on water balance condition on tropical peatland (Ritzema, 2008), rainfall is the main factor that determines other hydrologycal factors such as water levels dynamics.

Results of univariate analysis of variance shows the water level is significanly positively correlated with canal blocking treatment controlled by rainfall ($p < 0.05$). The positive impact after the canal blocking is on the increase of surface water level and ground water level. Generally water levels are closer to soil surface after canals blocking. Average water level conditions before and after constructions canal blocking are shown in Table 1.

Table 1: Water level before and after canal blocking period 2013-2015 (WWF Indonesia)

Water Level	Mean	95% Confidence Interval	
		Lower Bound	Upper Bound
gwl before canal blocking	-19.4 ± 1.26	-21.9	-16.9
gwl after canal blocking	-11.9 ± 1.69	-15.3	-8.6
swl before canal blocking	-33.9 ± 2.30	-38.5	-29.4
swl before canal blocking	-26.1 ± 3.08	-32.2	-20.0

a. Covariates are evaluated at the following values: rainfall = 191.

Canals blocking with multiple dams can hold water and decrease rapid drainage during the dry season. Dams can act as barriers restricting water outflow during the dry season and thus decrease depth and duration of the lowest water level conditions (Jauhiainen, 2008). The ultimate goal of rewetting is to restore the hydrological functions of the peat swamp forest. Increase of water levels as the effects after canals blocking is the first and primary way to restore degraded peatland. Deceleration of water discharge after canals blocking also decrease water drainage in canals. Naturally this conditions will be followed by the accumulation of litter and organic materials on several canals that will accelerate process of canals closing.

CONCLUSIONS

This study shows the implementation of management on degraded tropical peatlands through hydrological restoration. Rewetting with canals blocking technique positively correlated to increase the surface and ground water level in peatland. Rewetting degraded peatland as main way to restore the nature ecosystem of tropical peatland. Other efforts such as peat fire prevention, reforestation and community involvement can also contribute to promoting peatland restoration.

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