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ASSESSMENT OF TROPICAL PEATLAND MAP IN WEST KALIMANTAN, INDONESIA

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SUMMARY

Tropical peatland preserves huge amount of carbon with rich biodiversity. However, recent anthropogenic disturbance has affected significant impacts to the ecosystem, carbon balance including release of carbon dioxide into atomosphere. In 2009, Government of Indonesia made a commitment to reduce greenhouse gas (GHG) emissions by 26% to Business as Usual (BAU) baseline. As potential GHG reduction from forest and peat sector has been estimated to 88%, assessment of peatland in Indonesia is crucial. Wetlands International prepared a revised peatland distribution maps for Sumatera, Kalimantan and Papua during 2003-2006 and they have been widely used in Indonesia. Experts of Ministry of Agriculture have developed the latest peatland distribution map of Indonesia (Ritung *et al.,* 2011) using all available data collected during 1989-2011. It was authorized by Indonesian government as a national peatland map of Indonesia in 2014. Those two peatland maps by WI (2004) and Ritung et al. (2011) reported different figures of total peatland area in Indonesia, 20.7 million hectares and 14.9 million hectares, respectively. In West Kalimantan, the difference of peatland area is about 50, 000 hectares. As there are large uncertainties in those two peatland maps, it is important to review the maps and recheck with ground truth data. Assessment of those peatland maps was carried out at four districts (Pontianak, Kubu Raya, Kayong Utara and Ketapang) and Pontianak City in West Kalimantan. An improved peatland map was prepared based on by peat thickness measurements at 324 field plots with careful interpretation of various data sets such as satellite images (Landsat, ASTER, PALSAR and DEM), geological maps, land cover maps and others. The result of the assessment showed that the the peatland area derived from WI (2004) was about 52,000 hectares smaller compared to the area determined from the improved peatland map. The peatland map by Ritung et al. (2011) showed a greater peatland area, about 32,000 hectares larger than improved peatland map.

Keyword: *tropical peatland, West Kalimantan, Landsat, ASTER, PALSAR*

INTRODUCTION

Tropical peatland is one of the important carbon pools and it forms unique ecosystem. However, recent intensive developments for industrial plantation and agricultural land have caused significant carbon loss. As a result, huge amount of carbon dioxide is released into atomosphere from the dried peat which is formed by constructing canals and decreasing ground water table. Thus peatland development has great impact to the global warming issue. Although amount of carbon dioxide from peatland is estimated based on the area of peatland map, there is an uncertainty of accuracy of peatland map because of the insufficient information and difficulty of the access to the peatland. Since 1970s, Ministry of Agriculture, Ministry of Public Works, Universities and many institues have developed peatland maps at national and local level, but different extents of peatland have been reported ranging from 13.5 to 26.5 million hectares (Fig. 1).

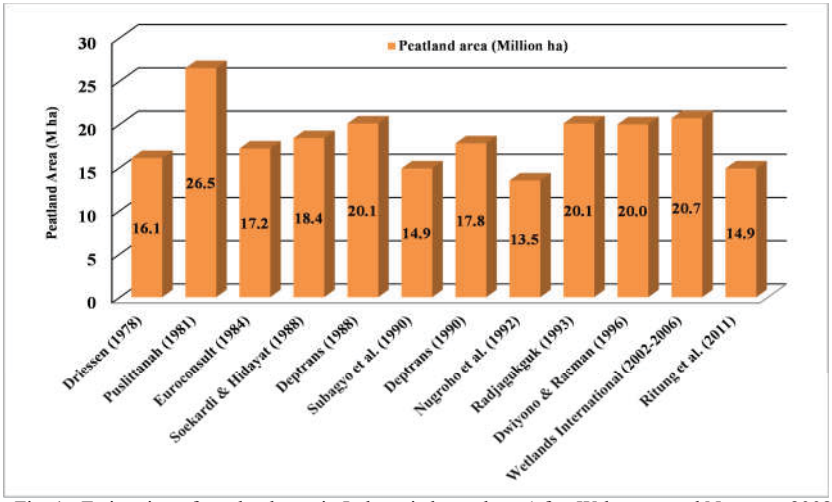

Fig. 1: Estimation of peatland area in Indonesia by authors (after Wahyunto and Nyoman, 2008)

In 2004, Wetlands International compiled a peatland distribution map for Kalimantan (hereinafter referred as "WI (2004)"), and it has been widely used in Indonesia. In 2011, Ministry of Agriculture has released the latest peatland distribution map of Indonesia (herein after reffered as "Ritung *et al.,* 2011") and it was authorized by Indonesian government as a national peatland map of Indonesia in 2014. However, those two peatland maps showed different figures of peatland area as 20.7 million hectares by WI (2004) and as 14.9 million hectares by Ritung *et al.* (2011). In West Kalimantan Province, the difference of peatland area is about 85,000 hectares for four districts (Pontianak, Kubu Raya, Kayong Utara and Ketapang) and Pontianak City. Thus there are large uncertainties in those two peatland maps and it is necessary for reviewing and rechecking.

The purpose of this study is to improve the accuracy of two peatland maps (WI, 2004 and Ritung *et al.,* 2011) which are often used in Indonesia. Improved peatland map is expected to contribute to local spatial plan, REDD+ project, environmental management plan, and national/provincial greenhouse gas reduction plans (RAN/RAD-GRK) in Indonesia.

METHODS

Definition of peat was appleied based on the definitions of US Soil Taxsonomy (Soil Survey Staff, 1990) and Purunomo *et al.,* (2014) as follows;

[Peat Definition]

- Thickness of peat : more than 50 cm thickness of organic matter
- Carbon content: more than 12% organic carbon (Soil Survey Staff, 1990)

The peatland boundary was determined by using two peatland maps produced by WI (2004) and Ritung et al. (2011) shown as Fig. 2. Landsat-MSS/TM images from before 1990 were used to identify potential peatland area. As intensive peatland development and canal construction were made from 1990s, the characteristics of peatland forests could only be recognized on the satellite images from before the 1990s. ASTER, PALSAR, Digital Elevation Model (DEM) of Shuttle Radar Topographic Mission (SRTM), geological map, tipographic map and land cover map were also used to determine the peatland area. The following procedure was used for improving peatland area (Fig. 3)

1. Comparison between peataland boundary on WI(2004) and Ritung *et al.* (2011)
2. Comparison of geologic map, LANDSAT images (1970~1980s) and SRTM/DEM
3. Distribution of oil palm, industrial plantation with drainage => high possibility of peat forest
4. Distribution of large-scale drainage => high possibility of peat forest
5. Distribution of large-scale agricultural land=> high possibility of peat forest development by immigrants
6. Interpretation for land use type and land cover type using Landsat-7/8, ASTER and PALSAR.

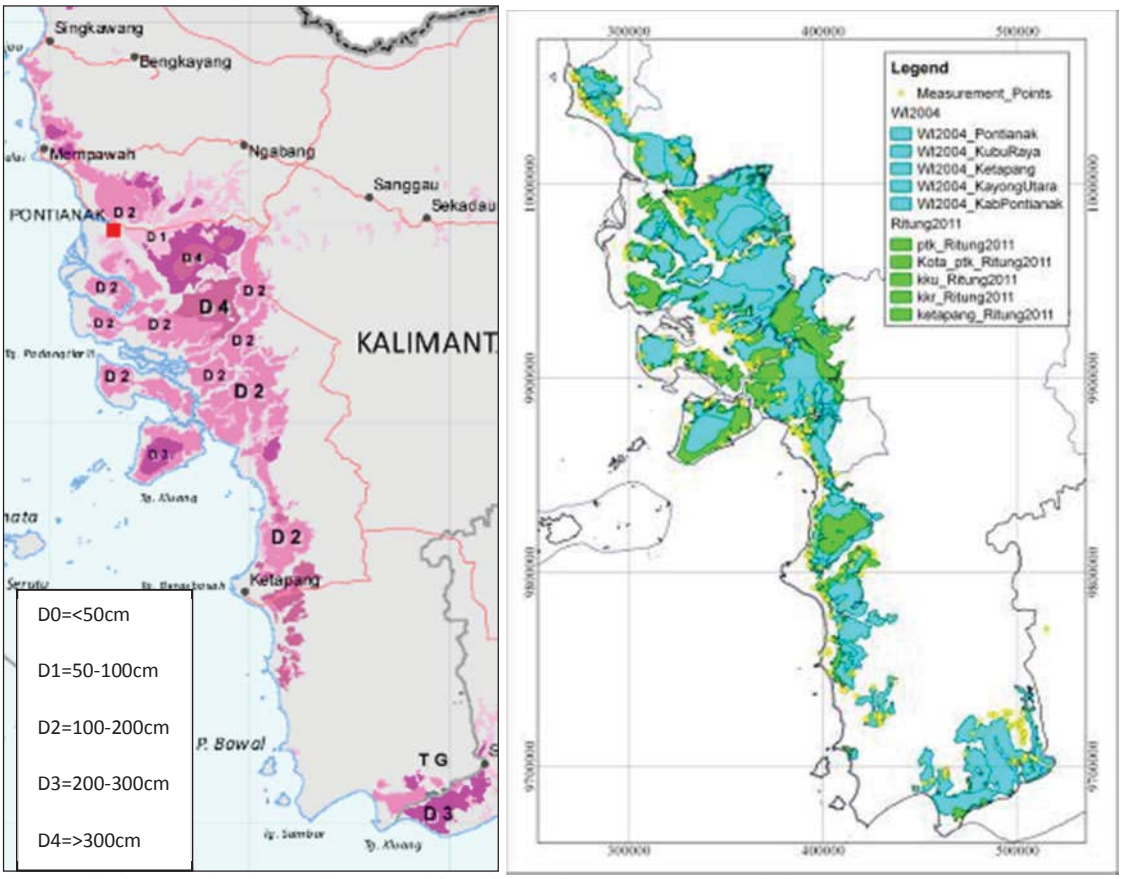

Fig. 2 Peatland Map, Left: Ritung et al. (2011), Right: Difference between WI (2004) and Ritung *et al.* (2011)

After determining the peatland boundary by using various of the above mentioned data sets, field measurements of the peat thickness was carried out at 324 sampling points by using a peat sampler auger (Eijkelkamp) from August to November 2014. The purpose of the field survey was to confirm the existance of the peat soil type, its thickness and thus determine the peat boundaries. The physical and chemical properties of 265 peat samples were analysed. The analyses included Bulk density, Loss of Ignition (LOI), Total Organic Carbon (TOC), and Total Nitrogen Content.

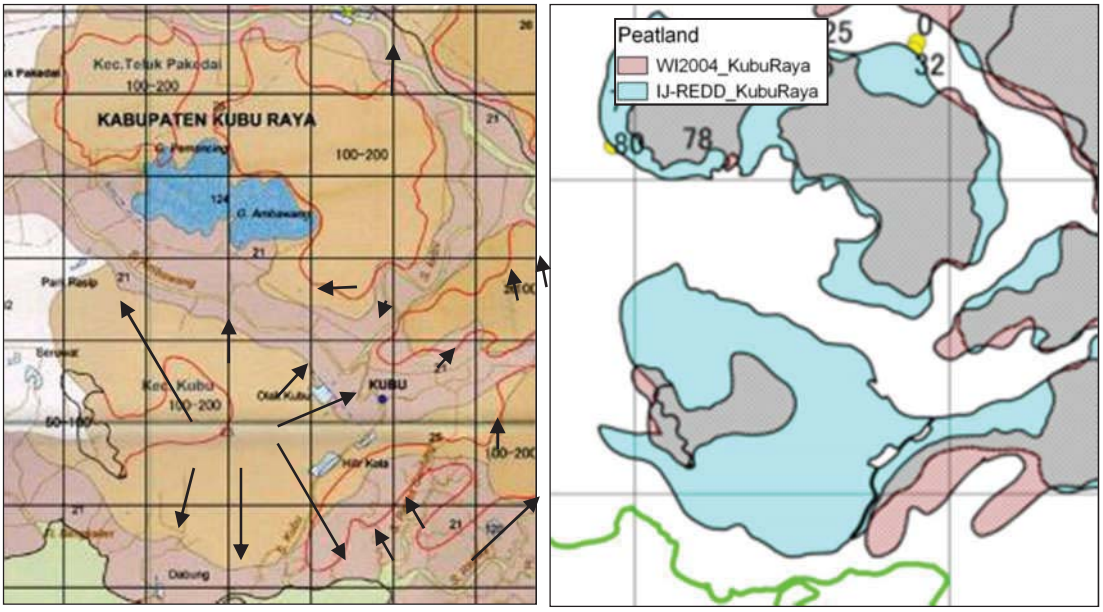

Fig.3 Red line shows the area of peatland with 100-200cm peat depth suggested by WI (2004). Ocher color is peatland area suggested by Hidayat *et al.* (2010)

RESULTS AND DISCUSSIONS

The peatland map for four districts and Pontianak City was improved by using the results of 324 peat thickness measurements, interpretation of satellite images and various geospatial data. Comparisons with the earlier work by WI (2004),and Ritung *et al.* (2011) were made (Table 3, Fig. 4).

Fig.4-(1) shows that peatland area by WI (2004) is about 52,000 hectares smaller than the area resulting from the peatland map of our work, from here referred to as "IJ-REDD+ (2015)". Areas where WI (2004) are larger compared to the IJ-REDD+(2015) figure are recognized with blue color at the southern part of Ketapang District. The Ritung *et al.* (2011) peatland area is 32,000 hectares greater than the IJ-REDD+ (2015) area. This is shown at central parts of Kubu Raya District, Kayong Utara District and Ketapang District with green color (Fig. 4-(2)).

Table 1 Comparison of peatland area for four distrcts (Pontianak, Kubu Raya, Kayong Utara and Ketapang) and Pontianak City among WI (2004), Ritung et al., (2011) and IJ-REDD+ (2015)

Peatland Area (ha)	(1) WI (2004)	(2) Ritung (2011)	(3) IJ-REDD+ (2015)
KayongUtara	163,303	214,054	193,930
Ketapang	337,552	255,873	259,283
KubuRaya	410,241	519,885	503,990
Pontianak	70,889	74,755	74,441
KotaPontianak	398	2,280	2,801
Total	982,383	1,066,847	1,034,445

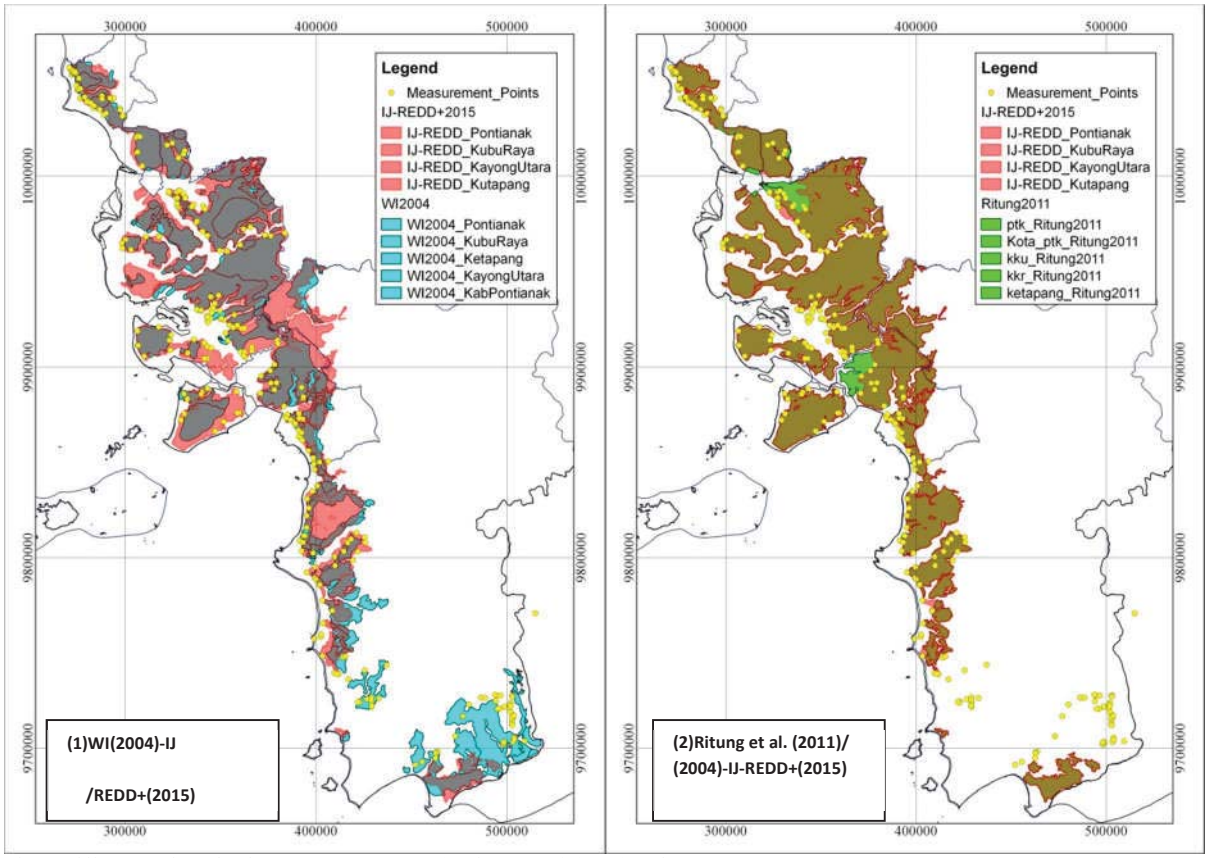

Fig. 4 Difference of peatland area among WI (2004), Ritung *et al.* (2011) and IJ-REDD+ (2015)

As shown in Fig. 4, peatland area produced by WI (2004) shows underestimating than the peatland area by Ritung *et al.* (2011). But Ritung *et al.* (2011) indicates larger peatland area than IJ-REDD+ (2015). The large uncertainty derived from different definitions, field data and different interpretations by experts still exists. Therefore, further field survey and interpretation are necessary for delineating the peatland distribution area more precisely. Intensive artificial drainage has caused degradation of peatland and it accelerates the decrease of peatlands. In 2013 the Ministry of Agriculture published an Indonesian peatland degradation map (Wahyunto *et al.,* 2013) showing the peatland distribution area in seven degradation classes. The most severe degradation class

accounts for 4.3 % (72,330 ha) in West Kalimantan where the most vulnerable peatland area is located. For the future improvement of the peatland map also the degradation of peatlands caused by forest fires should be monitored by using satellite images.

CONCLUSION

An assessment of the two existing peatland maps was carried out for four districts (Pontianak, Kubu Raya, Kayong Utara and Ketapang) in West Kalimantan. An improved peatland map was prepared to check those two peatland maps by 324 ground truth data with careful interpretation with various data sets such as satellite images (Landsat, ASTER, PALSAR and DEM), geological maps, land cover maps and others. The result of assessment showed that peatland map by WI (2004) was an underestimating of about 52,000 hectares than the improved peatland map by IJ-REDD+ (2015). Peatland map by Ritung *et al.* (2011) was about 32,000 hectares larger than IJ-REDD+ (2015).

Although a Presidential Moratorium was issued in 2011 on the conversion of primary and natural forests and peat lands, peatland has been developed and disappeared. Thus further field survey and improvement of peatland map is necessary to contribute to various strategies on climate change issues such as national GHG emissions reduction plan.

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