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Research Article

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Forest Fire Prevention through Agricultural Innovation in the Ex-Mega Rice Project Area in Central Kalimantan

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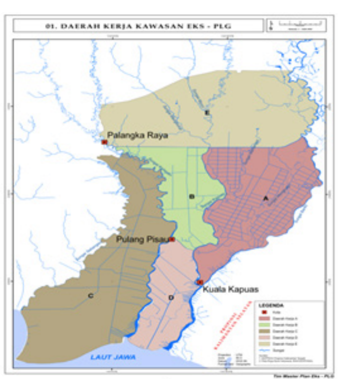
Abstract

In 1995, the Government of Indonesia initiated the Central Kalimantan Peatland Development Project – commonly known as the Mega Rice Project - to convert up to one million hectares of peat and lowland swamp to rice cultivation. In order to prepare the land for cultivation the peatland was drained through the construction of thousands of kilometers of canals and forest was cut. The effects were very damaging for the environment as the soils dried and the forests degraded. Agricultural developments were largely unsuccessful in the difficult peat land conditions. Agriculture is traditionally being practiced on the mineral soils along the river. A diversity of food crops, estate crops and livestock is grown and reared in the area. The limited suitability of the peat lands for agriculture often has to do with the acidity of the soils. Much land is only suitable for a limited number of crops. This leads to low agricultural production resulting in poverty among local communities. Fire has traditionally been used for land clearing and is still a common tool for agricultural preparations and land clearing for other purposes. Farmers traditionally monitor fires as they burn to avoid spreading. However, when peat soils are dry and forests are degraded they easily catch on fire. This paper aims to reduce the incidence of forest fires through the introduction of innovative techniques that limit the use of fire in land clearing. These techniques taken from the Climate Smart Agriculture approach will be able to support the local communities to diversify their farming methods and make use of the environmental circumstances in which they live to increase their agricultural production and improve their livelihoods. The result show that land clearing with limited use of fire have positive effects on agricultural production and can reduce the incidence of forest fires.

Keywords: Forest Fire, Peatland, Innovation, Agriculture

Introduction

In 1995 the Government of Indonesia initiated the Central Kalimantan Peatland Development Project, commonly known as the Mega Rice Project - to convert up to one million hectares of peat and lowland swamps into rice cultivation. To prepare land for planting rice. Peatlands are drained through the construction of thousands of kilometers of canals and cut down forests. The effect is very damaging to the environment when the soil dries and the forest is degraded. Agricultural development is largely unsuccessful under difficult peatland conditions [1].



The province of Central Kalimantan is home to about 2.2 million people, the majority of whom depend upon agriculture and agro-forestry for their livelihoods. The Dayak communities, indigenous to Central Kalimantan, have long sustained their livelihoods in the peat forests through agro-forestry practices for growing rice and food crops interspersed with rubber, rattan and other forestry products [2]. Traditionally, Dayak households use fire to clear land, as it involves the least cost while at the same time helps to eradicate pests, especially rats, and improves soil fertility [3].

Agriculture is traditionally carried out on mineral soils along the river. The diversity of food crops, plantation crops and livestock is planted and maintained in the area [4]. The limited mismatch of peat land for agriculture is often related to soil acidity. Many fields are only suitable for plants in limited quantities. This leads to low agricultural production which results in poverty among local communities. Fire has traditionally been used for land clearing and is still a common tool for agricultural preparation and land clearing for other purposes. Burning or land clearing activities take place during the dry season or from May to September, which is when the vegetation of the land is drier. Farmers traditionally monitor fires as they burn to avoid spreading. However, when the peat soil is dry and the forest is degraded, it is highly flammable.

Climate smart agriculture is agriculture that continuously increases productivity, resilience adaptation to climate change, reduces / eliminates greenhouse gases (mitigation), and increases achievement of national food security and development goals [5]. This innovation includes approaches such as conservation agriculture, agro forestry, sustainable rice production, aquaculture, and integrated approaches that can include livestock and energy production, waste management, composting, and others. The purpose of this activity is to reduce the incidence of forest fires through the introduction of innovative techniques that limit the use of fire in land clearing. These techniques derived from the Climate Smart Farming approach will be able to support local communities to diversify their farming methods and utilize the environmental conditions in which they live to increase their agricultural production and improve their livelihoods. The results of the activities show that land clearing with limited use of fire will have a positive effect on agricultural production and will reduce the incidence of forest fires.

The Ex-Mega Rice Project and Problems In Central Kalimantan

The area of world peatland reaches 400 million ha or about 3% of the earth's surface area [6]. Of that area, a large amount of carbon is stored, which is around 550 G tons, equivalent to 75% of all carbon in the atmosphere. Indonesia has the third largest peat land in the world, which is around 265,500 km2, or more than half the area of peat in the tropics. Based on data from the condition in 2008, Indonesia's peat stores the third largest carbon stock in the world (after Canada and Russia), which is around 54,016 M tons [7]. Given that carbon stocks are large on peatlands, while the ecosystem is very fragile, then if peatlands are not managed well, it will cause a lot of carbon loss, especially in the form of methane gas (CH_4) and carbon dioxide (CO_2) into the atmosphere, which can increase emissions green house gas (GHG).

At present the conversion or conversion, reclamation and drainage of peatland has occurred and still continues today, both to be used as agricultural land and settlements. Even though it is known that peat volume will shrink if peatlands are drained, and subsidence occurs. Apart from the volume shrinkage, subsidence also occurs due to the process of decomposition and erosion. According to Agus and Subiksa, the subsidence rate could reach 50 cm in the first two years after the peatland was drained [8]. Furthermore, the subsidence rate of about 2 - 6 cm in 1 year depends on the maturity of the peat and the depth of the drainage channel. Sedangka Limin et al., reported that the decrease in peatland surface in the Kalampangan area (former UPT Bereng Bengkel) was at least 1-3 cm per year [9]. Although weathering of organic matter produces nutrients for plants, weathering also produces organic acids which have a stronger effect and can cause poisoning to plants [10].

The million-hectare peatland project in Central Kalimantan, which was built by making drainage canals or canals across thick peat layers, has a long-term negative impact. The canals built have cut peat domes and peat beds between four major rivers (Sabangau, Kahayan, Kapuas and Barito). As a result there has been a drastic change in the water balance in the four watersheds, and in a short time the water content has shrunk. Peatlands are dry, and it is known that one of the physical properties of peat soil is the non-reversing nature of the soil. The peat that has dried, with a moisture content of <100% (based on weight), cannot absorb water anymore if it is moistened. The dried peat is the same as dry wood which is easily washed away by water flow and easily burns in dry conditions [11]. The burning peat produces heat energy greater than burning wood or charcoal. Burned peat is also difficult to extinguish and the fire can propagate below the surface so that land fires can expand uncontrollably. At the end of every dry season, land fires occur, followed by smogging in Central Kalimantan. Another problem with the Central Kalimantan peatland project is the loss suffered by local indigenous people due to changes in the ecosystem, because traditional businesses that have been relied upon as sources of income have decreased productivity until they are lost (can no longer be cultivated). This fact is a reflection of the fallacy of wetland management including peatland [9].

Traditional Farming and Peatland Fires

In traditional farming on peat land, limited access and ability to obtain fertilizers and ameliorant materials to increase soil fertility, farmers are usually replaced by burning plant litter and some dry peat layers before planting. This practice is found mostly among farmers who grow vegetables and food crops traditionally in various places in West Kalimantan, Central Kalimantan, South Sumatra and Jambi [8]. In this way farmers get ameliorants in the form of ash which can improve peat productivity. But the combustion ash is easily washed away and its effectiveness in increasing soil fertility does not last long.

The method of combustion of land is certainly also very dangerous, because it can trigger forest and land fires more broadly, accelerate subsidence, increase CO_2 emissions and bring smoke that disrupt health and affect traffic. As it is known that peatland fires are more dangerous than fires on dry land (mineral soils). In addition to the vegetation fires on the surface, the peat layer also burns and lasts long, resulting in thick smoke due to incomplete combustion. Limin et al. Stated that the depth of the peat layer burned on average 22.03 cm (variation between 0 - 42.3 cm) but at a certain point the layer could burn to reach 100 cm [12]. Therefore fire fighting on peatlands is very difficult and requires a lot of water. Limin et al. also reported that to extinguish an area of 1m2 of peatland 200 - 400 liters of water was needed as an effect of the density of peat [12].

To avoid fire, the litter burning activities by local farmers must be carried out in a controlled manner in a special place in the form of holes lined with mineral soils so that the fire does not burn peat. This method is applied well on peat lands in Pontianak, West Kalimantan [8]. If litter burning must be carried out directly in the field, it must be ensured that the bottom peat is saturated with water so that the peat does not burn. In the long term burning of litter and peat needs to be prevented to maintain the sustainability of agriculture on peatlands. For this reason, we need guidance on how to farm without burning and giving assistance to ameliorants and fertilizers for farmers.

There are also reports of nine characteristics of fires on peatland that are fast and easily extinguished, namely: (i) fires of vegetation above the peat layer, (ii) the peat layer is burned depending on the depth of the groundwater, (iii) fires in the peat layer are difficult to extinguish and last long, (iv) fires produce thick smoke because of incomplete combustion, (v) fire can propagate through the bottom layer, even though the vegetation above has not been burned or is still fresh, (vi) many fallen trees and dead trees but still standing tall, (vii) there are types of flammable vegetation (viii) former peat fires covered with charcoal, and (ix) spraying water on peat that is not burning to complete extinguishing, will cause thicker smoke products Limin et al. [13].

Agricultural Innovation in Management and Prevention Peatland Fire

Peatlands have the potential for annual food crops, especially on shallow peat (<100 cm). The basic consideration is that shallow peat has a relatively higher fertility rate and has a lower environmental risk than deep peat. Peatlands with a depth of 1.4 - 2 m are classified as marginal (S3 compatibility class) for various types of food crops. The main limiting factor is the condition of the roots and nutrients that do not support plant growth. Food crops that are able to adapt include rice, corn, soybeans, cassava, long beans and various other types of vegetables.

Food crop cultivation on peat land must apply water management technology, which is adjusted to the characteristics of peat and plant species. The making of micro drainage channels as deep as 10-50 cm is needed for the growth of various types of food crops on peatlands. Rice paddy plants on peatlands only need 10-30 cm deep trenches. The function of drainage is to remove excess water, create an unsaturated state for plant roots breathing, and wash some organic acids. The shorter the interval / distance between drainage ditches, the higher the yield of the plant. Although drainage is important for plant growth, the deeper the drainage channel the faster the subsidence rate and the decomposition of peat will be.

Peat soil reacts sourly, so amelioration efforts are needed to increase pH and improve plant root media. Lime, mineral soil, manure and residual combustion ash can be given as ameliorants to increase pH and soil bases [14-16]. Unlike mineral soils, the pH of peat soil is sufficiently increased to just pH 5 because peat does not have the potential for toxic Al. Increasing pH to no more than 5 can slow the rate of decomposition of peat. The adverse effects of toxic organic acids can also be reduced by adding ameliorant materials which contain a lot of polyvalent cations such as steel, laterite mineral soil or river mud [16, 17]. Provision of high-grade mineral soils can increase rice growth and production [15, 16, 18].

Fertilization is needed because the nutrient content of peat is very low. The type of fertilizer needed is containing N, P, K, Ca and Mg. Although peat CECs are high, the holding capacity is low for exchangeable cations so fertilization must be split several times with low doses so that nutrients are not washed much. The use of fertilizers that are available slowly such as natural phosphate will be better than SP-36, because it will be more efficient, cheaper and can increase soil pH [19]. Addition of polyvalent cations such as Fe and Al will create a trapping site for phosphate ions so that it can reduce the loss of P at the washing point [20]. Peat soil is also deficient in micronutrients because it is chelated (bonded) by organic matter [20]. Therefore micro-fertilization is needed such as resin, magnesium sulfate and zinc sulphate, each 15 kg ha-1 year-1, manganese sulphate 7 kg ha-1 year-1, sodium molybdate and borax 0.5 kg ha-ha 1 year 1. Micronutrient deficiencies can cause voidness in rice plants, empty cobs on corn or empty pods on peanuts.

The implementation of innovative agricultural cultivation carried out on peatland is significantly able to suppress land fires, such as the preparation of farming land with limited and controlled burning by actors in the Taruna village, Saka Kajang, Tumbang Nusa and Henda, in Jabiren Raya District, Pulang Pisau Kalimantan district. The middle Farmers and communities burn limited, controlled, supervised peatlands and anticipate watering with the availability of water pump machines or boreholes. This combustion is still a reliable method because their experience shows that ash from combustion is the most important fertilizing material for agricultural crops on peat soil. Farmers only burn the litter and the surface layer of peat that is still raw, rough because it is full of rooting bushes around a depth of 5 cm, below that depth the fire cannot burn because the peat is quite wet. Controlled fire only burns areas that are prepared for planting land, and does not expand to cause large-scale fires. In the 2015 land fire and smog disaster, the lands managed thus proved to be safe from land fires and better than uncontrolled burning.

In the method of combustion of controlled land, the stages of opening and preparing peatlands for agricultural farmers generally prioritize bushes to be used as agricultural land, not forests. The ditch around the area to be cultivated is made with the aim that the fire does not spread wildly. Drilling wells made on peatlands are used for water supply when burning land. Land that has been burned, wood or unburnt branches is collected around large trees that are not burned. The goal is to knock down large trees. After the big trees have collapsed, the wood is cut and collected to burn to produce ash. The finished ash is immediately drenched with water so as not to fly in the wind. After the area is open, it is continued by making beds, then being hoeed evenly for the planting area. If there are stumps and roots, pieces of wood are stacked in that place, to burn stumps / roots. Planting began with the use of ash from previous combustion, mixed with manure and agricultural lime. After 1-2 years of planting, we will grow the 1st generation weeds in the form of ferns. The next step is to do the planting, cleaning and making and refining the beds and burning again as before the 1st year planting. After that it is planted again with various seasonal plants such as the previous stages. After 4 - 5 years, the 2nd generation weeds will emerge, namely weeds. This 2nd generation weed is good enough for compost and animal feed. Subsequent combustion is carried out every time the planting starts, but what is burned is only the remaining crop and weeds without burning the peat again. The time period needed to prepare peatland from forest to ready-to-use land for agricultural crops is approximately 5 years.

Conclusion

The adoption of innovative agricultural cultivation carried out on peatlands can significantly reduce land fires. The application of the main technological innovation based on local wisdom in the form of preparing farming land with limited and controlled burning, is able to create peatland into environmentally friendly agricultural land which gradually makes peatland a productive land. This management model with innovation involves making a moat before the land is burned (as a barrier so as not to expand), utilizing boreholes that have been made on peatland as water supplies in the event of a fire, as well as the use of ash from remaining litter as a source of organic material.

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