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PREFACE

Over the past decades, rapid growth of global economic has lifted millions of people out of poverty. In line with rising population, rapid urbanization, and industrialization, it has also led to increased consumption of resources and generated waste almost beyond the limits of the ecological carrying capacity. Some of those problems have a connection with agriculture especially related in agro-industy.

Agro-industry provide a means of converting raw agricultural materials into value added products while generating income and employment and contributing to overall economic development in both developed and developing countries. Food processing converts relatively bulky, perishable and typically inedible raw materials into more useful, shelf-stable and palatable foods or potable beverages processing contributes to food security by minimizing waste and loss in the food chain and by increasing food availability, quality, safety and marketability.

In term of green agro-industry, the use of wastes for production of value added products such as improved feed, bio-processing reagents with selective catalysts, safe green chemicals, bio-fuels, biogas, bio-plastics and biopolymers would serve the agro-processing sector in the region by making it more resource efficient and sustainable. Such links would also support rural livelihoods through increased demand for local crops and bio-resources, enhancing the agribusiness opportunities for farmers and small scale enterprises in the region. Promoting the conversion of of site products and or waste into renewable energy (such as biogas, bio-fuel, etc) will also reduce the need to import costly fossil fuel and serve as a step to mitigate climate change.

Following the successes of the 1st and 2nd International Conference on Green Agro-Industry (ICGAI) were held on 2013 and 2015 at Yogyakarta, Universitas Pembangunan Nasional 'Veteran" Yogyakarta, Indonesia in conjunction with its global partner is proud to announce the 3rd ICGAI. The conference is to be held on October 18-19, 2017, at Yogyakarta, Indonesia. The conference will address problems of primary importance for human security, discussing and proposing a more constructive and progressive approach to ensure future societal sustainability. The meeting will provide a common forum for a wide range of researchers and practitioners specialising in a range of subjects related to the conference themes.

Yogyakarta, July 6, 2018

Dr. M. Nurcholis, M.Agr

ICGAI Chairperson

List of Content

Remote Sensing Application to Support Food Security in Malaysia

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ABSTRACT

Malaysia, a relatively small country with a multiracial population of about 29 million, gained independence from Britain in 1957 after a lengthy colonial rule. After independence the government began an economic re-structuring process to become a developed country Malaysia in 2020 (Vision 2020). Food security is a general concept that goes beyond crop production because achieving it requires accounting for spatial and time variability, as well as physical and economic access. Escalation in population getting more unbalance with the nation food production causing most of the third world country facing food security threat. Malaysia is one of the many countries where food self-sufficiency is declining, year by year. In agricultural production, precision agriculture has been applied in Malaysia. Precision agriculture is one of the agricultural approaches involved on the adoption of technologies for better managing the variability within the field, hence increasing yields. Over the last two decades, traditional ground-based systems have benefited significantly from the addition of satellite remote sensing based inputs. Many national and international systems have developed this technology for monitoring crop conditions and assessing crop production; such monitoring occurs at different scales, which range from the sub-national, to national and global levels. As technology advances, a growing range of remotely sensed data and related technology has become more available and affordable for operational use. Remote sensing is one of the key sources of data for such systems and has the potential to provide in-season information on crops to policy makers, researchers, extension services and ultimately farmers. This paper briefly describes the food security issue in Malaysia, address the role of remote sensing in supporting food security through precision agriculture practice, and present several case studies.

Keywords: remote sensing; food security; precision agriculture

1.0 INTRODUCTION

Malaysia, a relatively small country with a multiracial population of about 29 million, gained independence from Britain in 1957 after a lengthy colonial rule. After independence the government began an economic re-structuring process to become a developed country Malaysia in 2020 (Vision 2020). In the process to be a developed country food security is becoming an important issue. There is close relationship between food security and poverty. In Malaysia Federal Agricultural Marketing Authority (FAMA) is an agency that responsible with their roles in helping securing the food security. FAMA is a marketing agency established under the Ministry of Agriculture and Agro-Based Industry Malaysia. FAMA was founded on 30 September 1965 for the purpose of supervision, coordination, monitoring and promotion of agricultural products, including importation and exportation.

After the economic crisis 1997 until 1998 Malaysia is facing increasing of manufactured goods to support some domestic industries and also value of Malaysia ringgit is also decreasing. This year 2015 the value of Malaysian Ringgit is also decreasing. The concern is whether Malaysia has enough foods if economic crisis is occur again because of too much depending on imports of the agriculture products. As for Malaysia, in order to maintain our food security, the combination of domestic production and imports are be made such as coconut and rice that be imported from Thailand and many others agriculture products. In 2014 Malaysia's population is growing to almost 29 million, thus it will increase the demand for foods. Malaysia can expect to overcome the problem by import from other country but it can give bad impact because rising food import will lead to drawdown of the foreign exchange earnings.

In agricultural production, precision agriculture has been applied in Malaysia. Precision agriculture is one of the agricultural approaches involved on the adoption of technologies for better managing the variability within the field, hence increasing yields. Over the last two decades, traditional ground-based systems have benefited significantly from the addition of satellite remote sensing based inputs. Remote sensing is one of the key sources of data for such systems and has the potential to provide in-season information on crops to policy makers, researchers, extension services and ultimately farmers. This paper briefly describes the food security issue in Malaysia, address the role of remote sensing in supporting food security through precision agriculture practice, and present several case studies. The emphasis is to two main agricultural crops such as oil palm and rice.

2.0 FOOD SECURITY ISSUES IN MALAYSIA

According to the Food and Agriculture Organization of the United Nations (FAO), food insecurity is a major global concern today as 1 billion are suffering from starvation, under nutrition and malnutrition, and still far from the Millennium Development Goals (MDGs) to half risky poverty and hunger by 2015. The cost of food has increased worldwide since June 2011 and is today at an all-time high. This problem is much greater than the levels of the last great food crisis which is in 2007 until 2008. The result is that many people, in their millions, are being dragged below the poverty line and several developing nations are facing the risk of a massive food shortage (Pankaj, 2012).

Food security for agriculture is important to make sure that Malaysia have enough foods if there is any unpredicted things is happening to this country. Malaysia will face a dangerous situation where the supply from domestic is not enough. This food crisis needs an immediate and precautionary action and decision to ensure that food is available for Malaysia citizen. In 2010 Malaysia's population is reached almost 27 million (Basir, 2006) and during that time the gross domestic product for agriculture sector contribute to 7.6 percent while employment rate in agriculture sector contribute to 14.8 percent. This will clearly increase domestic food demand. The Agriculture sector contributed 22.9 percent of the GDP in 1980 but it declined to 14.9 percent in 1994, however the food import increased to 185 billion tones. The increase was also due to low self-sufficiency levels. Malaysia is dependent on imports of food, especially vegetables such as tomatoes, chilies, onions, ginger and potatoes.

Due to bitter experience Malaysian government has realized and identified agricultural sector as one of economic growth development. Agricultural R&D agencies for public sectors are expected to play an important role in achieving this sector (Stads Gert-Jan, 2005). Other than that, government institution can help government in enhancing their effort in securing food production in Malaysia. As stated by Zaharah A Rahaman (2012) currently there are more than 40 agencies that involved in agricultural Malaysia, including Research Universities and private

sector laboratories. In the Malaysian context, food security includes 3 key pillars, namely:

• Food availability in terms of consistency of food supply and adequacy,
• Accessibility of adequate and nutritious food
• Nutrient food that is capable of providing sufficient nutrition

Based on the definition, principally the concept of food security at the national level is to stress to the ability of countries to provide adequate food in the context of domestic production. While at the household and individual level, emphasis is on the ability of each household to obtain enough nutritious food and sustained without any obstacle (Chamhuri et al, 2014**).** In Malaysia food insecurity is a common problem among the low-income households. More of the food insecure households are living below the poverty line, have a larger household size, low education level, more children and school going children and mothers as housewives. From the national perspective, Malaysia has achieved a significant increase in the production of several basic food items such as rice, fruits, vegetables, fisheries, and poultry. However, the country is highly dependent on importation of many agricultural products such as wheat, beef, mutton and dairy items due to their rising demand as well as relatively limited local production (Ferdaushi and Chamhuri, 2013).

Therefore, the key challenge for food security in the country is to achieve self-sufficiency level in most of the food requirements as well as to reduce dependency on food importation. So, further research is urgently needed to set more effective policies and strategies for achieving the self- sufficiency in producing food commodities in the country.

2.1 National Food Security: Oil Palm.

The Malaysian oil palm industry is recognised as one of the most highly organised national agriculture systems in the world. The competitive advantage of palm oil in the world vegetable oil market implies that oil palm will remain an important crop as a source for food, oleochemicals, and biofuel. Yusof (2007) stated that Malaysian oil palm has evolved into a dynamic plantation industry; the management of plantation is highly developed as an art as well as science and technology through active research and development programmes. The Federal Land Development Authority (Felda), set up just over 50 years ago, was tasked with carrying out land development and resettling the landless in the country, and now has developed 853,313 ha of land and resettled 112,635 families (Ahmad Tarmizi, 2008). More interestingly, Felda's efforts have very successfully helped eradicate poverty amongst settlers, as illustrated by the data in Table 1. The success of the Felda scheme has helped ensure that the income levels of the scheme's settlers has remained well above the national poverty line, with the gap between settlers' mean income and the national poverty line widening consistently and indirectly contributing to food security program.

The oil palm industry is a major source of employment, and as the planted area grew from 1.2 million hectares in 1980 to 4.69 million hectares in 2009 (a 3.9-fold increase) , the industry generated a 4.9-fold increase in employment. Based on an estimated 5-person per household, the total number of people in Malaysia dependent on the oil palm industry could well be around 2.26 million. Therefore, over the years, the oil palm industry has consistently contributed towards poverty eradication and narrowing of the income gap between rural and town-folk, created rural townships where workers reside and enjoy good quality of life with adequate social infrastructure (e.g. housing, health, religious facilities), contributed to social security and peace and reduced migration of labour force from the rural to urban areas.

Table 1: Palm oil as a source of higher income and poverty eradication

Year	Felda Settler[1]	Independent Smallholder[2]	National Poverty Line (PGK)[3]
2006	RM 1,338 (US$ 429)	RM 476 (US$ 153)	RM 526 (US$ 169)
2007	RM 2,221 (US$ 712)	RM 1,209 (US$ 388)	RM 740 (US$ 237)
2008	RM 3,278 (US$ 1,051)	RM 1,094 (US$ 351)	RM 691 (US$ 221)
2009	RM 2,457 (US$ 788)	RM 944 (US$ 303)	RM 666 (US$ 213)
2010	RM 3,000 (US$ 962)	RM1,259 (US$ 404)	RM 720 (US$ 231)

Source:
1 Maklumat Asas Felda 2009 (published)
2 MPOB Data
3 Economic Planning Unit (EPU), Tenth Malaysia Plan and Mid-Term Review of the Ninth Malaysia Plan
Note: *PGK for Peninsular Malaysia

The oil palm cultivation in Malaysia is on legally designated agricultural land. The oil palm industry accounts for 5-6 percent of Malaysia's GDP, and the importance of the industry to the country's export earnings is very significant. The main product such as palm oil is very important to this country. Palm oil is the cheaper vegetable oils available in the market and has been a constant supply of cooking oil. In this respects, palm oil industry plays an important role in enhancing food security and has long been an acceptable and affordable food source to the nation. Ensuring adequate supply of edible oils for the nation market at affordable prices is very important to low income peoples.

2.2 National Food Security: Rice

Rice has been selected as the target crop given its importance as a staple food in Asia, where 90 percent of the world's rice is produced and consumed. Some 70 percent of the world's poor live in Asia. Malaysia has more than 100,000 farmers depending on rice production for their livelihoods and many more working in rice-related industry. Furthermore, the sustainable production of rice is critical for ensuring food security and addressing poverty. Increasing food safety is also a growing concern either locally and globally. In Malaysia, National Agro-food Policy (NAP) is intending to replace the Third National Agricultural Policy (NAP-3). NAP aims to increase food production in the country to meet the growing demand and high value agricultural development which is an increase in the contribution of the rice production to national income and agriculture entrepreneurship development. The main focus of this policy is to increase the production and productivity to ensure food supply, exploration of high-value agriculture, strengthening supply chain, the implementation of sustainable agricultural practices and human capital development and more participation by the private sector and effective government support (MOA, 2011). The local rice production should be increasing to ensure sufficiency rice supply as only 7 percent of total world rice production is traded. The stability of supply, growing demand and the small quantity of rice being traded in the international market tend to cause volatility in prices of rice. To ensure the stability of the food security, the government interprets the achievement in the form of self-sufficiency level (SSL) of rice production. The level of SSL is derived from the total production in the country compared to the total domestic demand of rice. It has been used as a proxy to indicate the level of food security of rice, which is the staple diet of the majority of the population in the country (Fatimah and Abdel-Hameed, 2010). SSL target and achievement of this commodity is shows in Table 2.

Table 2: Self-sufficient level of rice in Malaysia. MOA 2012 (Fatimah et al., 2010)

Master Plan/NAP	Period	Self sufficiency level (SSL) target	SSL achieved (%)
First Malaya plan	1956-1960	-	54.0
Second Malaya plan	19611965	-	60.0
First Malaysia plan	1966-1970	-	80.0
Second Malaysia plan	1971-1975	-	87.0
Third Malaysia plan	1976-1980	90	92.0
National agricultural plan I	1984-1991	65	75.9
Fourth Malaysia Plan	1981-1985	65	76.5
Fifth Malaysia plan	1986-1990	65	75.0
Sixth Malaysia plan	1991-1995	65	76.3
National agricultural plan II	1992-2010	65	65.0
Seventh Malaysia plan	1996-2000	65	71.0
National agricultural plan III	1998-2010	65	71.0
Eighth Malaysia plan	2001-2005	65	71.0
Ninth Malaysia plan	2006-2010	65	72.0
National food security policy	2008	80 by 2010	72.0
New economic model	2010	85 by 2020	-
National agro-food policy	2011-2020	70 by 2012	-

Agriculture plays an important role in providing food security in developing countries. Therefore, it is important that governments and development organizations have maximum transparency on expected and actual crop yields, so that they can make better decisions with regard to food security policy. NAP-3 will help governments to mitigate risks to food security and protect farmers from the financial losses that they endure as a consequence of natural catastrophes and economic crisis. Technology is an important part of the food security program; however at the end of the day, it is how technology is being used which decides its value. Setting up the relevant public-private partnerships for that purpose requires substantial management capacity and sufficient fund.

3.0. ROLE/NEED FOR REMOTE SENSING FOR FOOD SECURITY IN MALAYSIA

Malaysia is still insufficient in many major food items especially in the term of agriculture. Securing the food security is not an action that should be responsible by Government only but should not be neglected especially from industry player in agriculture sector. The challenge is clear. The country must produce 30-40 percent more food, with limited land and water, using less energy, fertilizer and pesticide by 2030. At the same time as bringing down the level of greenhouse gases emitted globally, while coping with the impact of climate changes recently. Therefore Malaysia is striving to make best use of technologies already developed and generate and exploit new scientific discoveries. History exhibits science and technology can provide huge increases in yield growth. In Malaysia the application of remote sensing and related technology in food security and productivity is focusing mainly for rice and oil palm production. The main focus is to observe and map crop growth and crop losses, where remote sensing data can also be calibrated to make yield predictions. This can eventually help governments to make informed policy decisions to improve the equitable supply of rice and palm oil, thereby reducing poverty through improved and diversified systems

Food security through remote sensing technology is carried out under precision agriculture (PA) technique. PA is an improved farming system where technologies such as Geographic Information System (GIS), Global Positioning System (GPS) and Remote Sensing (RS) are used to improve agricultural practices. Precision agriculture system provides better management of crops aimed to increase yields and economic returns in agricultural production. Precision farming techniques and technologies introduces many facilities, enable farm managers to collect, store, restore and analyze field data faster, more accurate and consistent than conventional methods. Using data from space or remotely to analyze matters on Earth has become more common lately. Satellites

can produce very valuable information for better crop management if the capacity exists to decode and digest such information. In Malaysia now uses satellite data to observe and forecast rice growth and productivity to improve food security. The advantage of remote sensing is the ability to monitor large areas on regular intervals.

Malaysian Agricultural Research and Development Institute (MARDI) is an agency that responsible to develop and do research on the rice precision farming. Satellite-based data and modeled derivatives are used in combination with ground-based information to better assess potential impacts to the food supply system. The biggest pilot projects for Precision Farming studies were undertaken by Malaysian remote sensing agency (MRSA) together with agriculture-related agencies and Universiti Putra Malaysia (UPM). The project named Malaysian National Paddy Precision Farming Project was started in 2001 and ended in 2007. This research has shown how the principles of precision farming can be translated into practical use by the farmers. The ability to produce and use fertilizer recommendation maps will certainly optimize on the fertilizer inputs and maximize the yield of the precision farming.

Some of the issue that Malaysia look forward is to use remotely sensed products for agricultural monitoring are precipitation, crop water requirements, and vegetation indices. The product such as water requirement satisfaction index (WRSI) is very useful to estimates the water supply and demand for crop especially during a growing season. It is a ratio of seasonal evapotranspiration to the seasonal crop water requirement. Output from this model is potential for crop monitoring and to assess potential food security impacts. Therefore the solution from science and technology for this area is requires. Highlighted below are some major areas.

(a) Crop improvement: Crop improvement through breeding has been key to the past successes of agriculture. Evenson and Gollin (2003) reported that much of the growth in major crop yields in developing countries (21% between 1961 and 1980 and 50% between 1981 and 2000) has been attributed to the use of improved crop varieties. New varieties can present a win –win for crop growth, yields and environmental impact, especially if the focus is on improving the efficiency of crops. For instance, the introduction of improved crop varieties has been most successful for the major crops in favorable agro-ecological areas. Therefore the successful of the PA would be better if started with the crop improvement.

(b) Crop protection: Crop **protection** may be defined as all measures taken to protect cultivated plants against diseases, pests as well as competing weed and grasses. The goal of crop disease management is to reduce the economic and aesthetic damage caused by plant diseases. A key challenge to the protection of current production is the emergence of new pests and diseases. Crop protection through pesticides has made a major impact to growth in productivity since the 1950s. However, losses due to pests globally are still high. The figures vary between countries and crops, but one estimate suggests an overall loss of around 40 percent (Yudelman et al. 1998). Malaysia are very concern on the important of integrated plant protection. The concept will keeping agricultural crops safe from pests, diseases and weed in an eco-friendly way. In 2005, the Malaysian Government recognized biotechnology as one of the key strategic drivers that will propel the nation's social and economic development to greater heights. To propel this new domain, the Government created the National Biotechnology Policy (NBP) and BiotechCorp, a dedicated biotechnology agency. From **Nine Thrusts of the National Biotechnology Policy** one of the trust is to enhance the value creation of the agricultural sector.

(*e) Agricultural Engineering and Mechanization:* Agricultural engineering is necessary to prove technologies for farm mechanization, irrigation, structures and processing. It has contributed significantly to the industrialization of the Malaysian agriculture and it has brought Malaysian

agriculture into the current information ages. Malaysian agriculture has changed from the current traditional method such as the cottage type agro-industry to commercial farm and factories. In line with the NAP3 policy it has emphasized on the modernization of the agricultural sector to lower cost and increase land productivity (Rezuwan et al., 2007). According to Robinson (2008) the effectiveness of the product dependent to the precision of delivery. It encompasses a range of technologies, including for information and communication, monitoring (e.g. remote sensing and global positioning systems (GPS), and automated process control. For example, GPS systems allow accurate control of tractor position and movements, enabling the precise delivery of seed and other inputs. Tractor-based and remote (aerial or satellite) sensors can be used to determine soil and plant characteristics to enable early detection of disease and water stress (Mondal & Tewair 2007).

In order to implement PA practices to support food security there are some other key effective factors may also be taken into consideration, such as;

(a) Political will: Malaysian agricultural sector received strong government support during last three decades. The government of Malaysia, set up strategic directions to use information and communication technologies in third National Agricultural Policy (NAP3). In NAP3, training activities focused on new methods and technologies like PA and providing basic infrastructures (i.e. GIS and remote sensing) in national scale. Government also allocates some fund for enhancing the research for food security purpose.

(b) Human development index (HDI): Any new sophisticated technologies introduces, it need to be educated people to use them. The Human Development Index (HDI) is a summary measure of three dimensions of human development; living a long and healthy life (Health), being educated (Education) and having a decent standard of living (Income)-(UNDP, 2014). Human Development Reports shown that most people in most countries have been doing steadily better in human development. Advances in technology, education and incomes hold ever-greater promise for longer, healthier, more secure lives (Abdel-Latif, 2012). Since 1980 through 2014 Malaysia's HDI rose from 0.541 to 0.773 today, which classify Malaysia as the 62th member out of 187 of the high human development countries with comparable data (Figure 1). Higher HDI, higher adoption rate and success of using new technologies, like those involving in precision agriculture systems. More educated, healthy and wealthy people are mostly choosing better jobs rather than risky, dangerous and tough agricultural jobs.

Figure 1. HDI trend in Malaysia, East Asia and the Pacific and the World (*Source: http://www.undp.org/, 2014)*

(c) Suitable crops for doing PA in Malaysia: In Malaysia, the shortage of labor in the market, especially in agriculture sector is increasing as the HDI increases year to year. In developing and developed countries, labor deficiency with moderate salaries is a challenge and the area of agricultural land that each person should manage will increase, consequently. As a general scientific rule and practical experiences, the soil and environmental variability, increases in bigger areas. The agricultural areas that manage by each person are a good and simple spatial index, to assess the profitability of precision agriculture. The larger the area, the greater the spatial potential for PA. Figure 2 illustrates an areas allocated to each worker/year for specific crops in Malaysia. According to the given data, rubber trees, forestry and oil palm plantations have higher potentials for adoption of precision agriculture in Malaysia. However rice also becoming the important crop to be concern. The PA is hoping would improve the productivity, profitability and job satisfaction plus reducing the risk of facing the nation with the crisis of food security in the future.

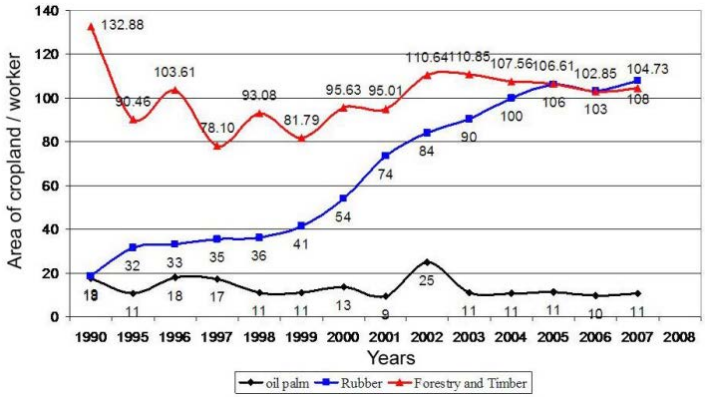

Figure 2: Areas allocated to each worker/year for specific crops in Malaysia (ha).

(d) Decision support systems (DSS): There are not many official Decision Support Systems (DSS)

for agricultural practices to fulfil PA concepts, either internationally and thus for Malaysian specialty crops. The lack of suitable DSSs is one of the main barriers for implementation of commercial PA (McBractney et al., 2005), and developing DSS for oil palm, rice, rubber plantation management and forestry and timber management is one of the main research areas in Malaysia.

4.0. REMOTE SENSING FOR FOOD PRODUCTIVITY IN MALAYSIA: A CASE STUDIES

Cabbage is a short-term cash crop that can be harvested within three months. The harvesting exercise is done by stages. As soon as the harvesting is done on the matured cabbage areas, the farmer started planting new cabbages on the same area. Remote sensing data was tested for estimating cabbage production in Cameron Highlands, Malaysia. Kamaruzaman (2008) had performed the first trial study by using IKONOS. This objective of this paper is therefore to assess the capability of IKONOS data in detecting, quantifying and mapping of young cabbages grown under a mixed cropping system. Once the individual cabbages counted, it is expected that the total cabbage production for the whole of the study area may easily be estimated. Results found that by using supervised classification three main crops, namely cabbage that was grown at 1.5 months and above, cabbage that was grown less than 1.5 months and other vegetation was shown in Figure 3. The cabbage grown areas were verified and found reliable based on FAMA's record. The signatures from IKONOS imagery showed the area of cabbage was not uniform due to the continuous and simultaneous cabbage plantation and harvesting activities. Despite IKONOS 4 m spatial resolution's capability of an individual cabbage counting which lead to about 25,000 cabbage/ha production estimate for the study area. However he recommend the use of an airborne hyperspectral sensor should be capable to produce high accuracy of the estimates.

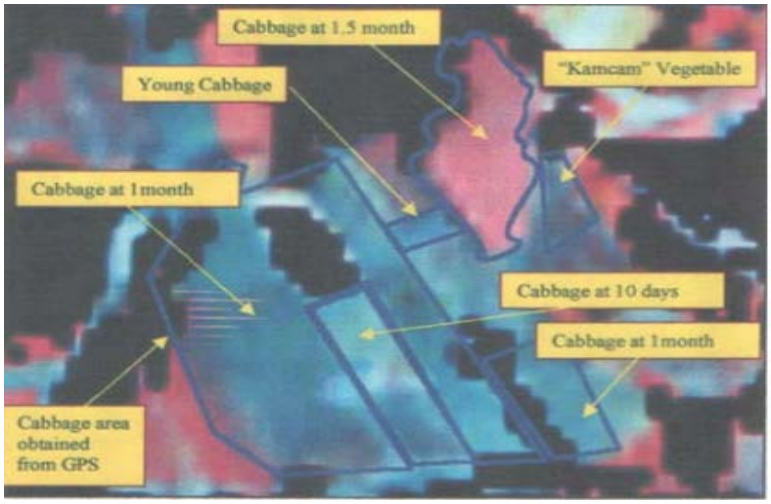

Figure 3: IKONOS imagery of cabbages using band 4-3-2 (RGB) overlaid with ground data

Remote sensing information is capable to identify the soil organic matter content where it can differentiate higher and low organic matter from the soil spectral response of the imagery (Yang and Anderson, 1996).Information on soil properties in crop field is very useful for not only for fertilizer requisite but specific management of the crop and soil. The availability of nitrogen, phosphorus and potassium (N,P,K), whether in soils or plants is among of the most of the nutrient work in remote sensing study. In fact, soil nutrient are essential for crop growth. Spatial variability of nutrient can be occurred in various scales, between region, field or within field especially in variation in soil properties. Studies for mapping soil nutrient in Malaysia were

conducted on orchard and paddy field (Malek et al, 2007; Mohd Hasmadi and Riduan, 2009). Prediction of NPK using Landsat TM image analysis and soil properties were found significant in infra-red channel for N and P, even though the r2 for N and P estimates in the study area is only within the range of 0.12 and 0.14.The spatial distribution of total N, availability of P, and exchangeable K in the soil after kriging process are shown in Figure 4. The study revealed the potential and ability of geospatial technology; furthermore the NPK map can be used to apply fertilizer management efficiently.

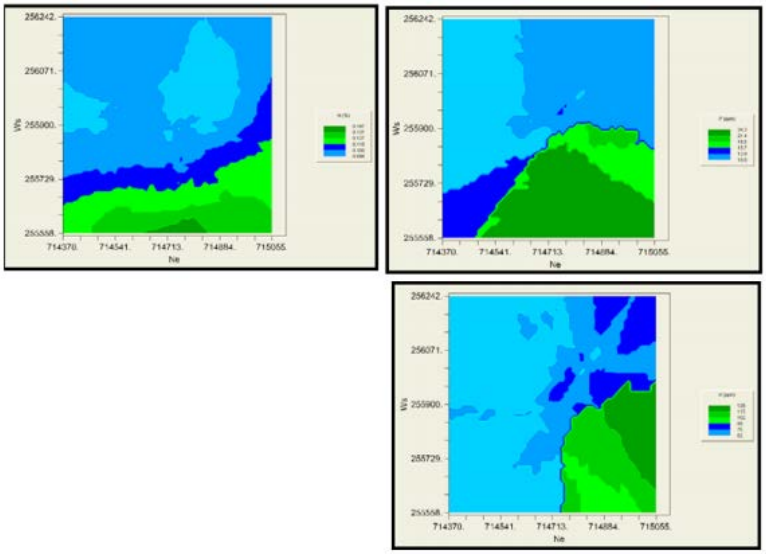

Figure 4: Spatial distribution of total N (%)-Top left, available P (ppm)-Top right and exchangeable K (ppm) in soil-Bottom right.

The index of environmental for fertilizer use (kg per ha of cropland) in Malaysia is 187.8 kg (McBractney et al, 2005). Generally on average, the environmental variation increases with area, the larger the area, the greater the spatial potential for PA. The principal agronomic constraint to high productivity is usually inadequate soil nutrient supply (Chew and Pushparajah, 1998), which is corrected by large amount of fertilizers. Accordingly, fertilizer is the largest cost item in the production of oil palm in Malaysia. It creates about 60 – 70% of the field upkeep cost of oil palm. Wrong fertilization techniques may result in high financial losses through loss of crop or excessive fertilization and risks of high nutrient losses in run-off, leaching and other nutrient loss mechanisms. AA Resources (2015) reported the applicability of PA from a trial study. The classical fertilizer response trials on different soil types showed highly variable FFB yield responses to N, P and K fertilizers, ranging from 0 to over 100 %. These variations could be partially reduced with management zoning of the fields and correct fertilization (Goh *et al.*, 1999). However, the real opportunity to enhance fertilizer inputs lies in the understanding of the large variation in fertilizer responses within the same soil series and similar terrain. A plots with and without nitrogen applications were established (about 25 ha) for generation of yield maps by kriging. Results showed that the yield response to nitrogen varied spatially across the trial site (Figure 5). They ranged from good FFB yield response of more than 50 kg/palm/yr in the central portion of the field to poor or negative response in the eastern and western parts.

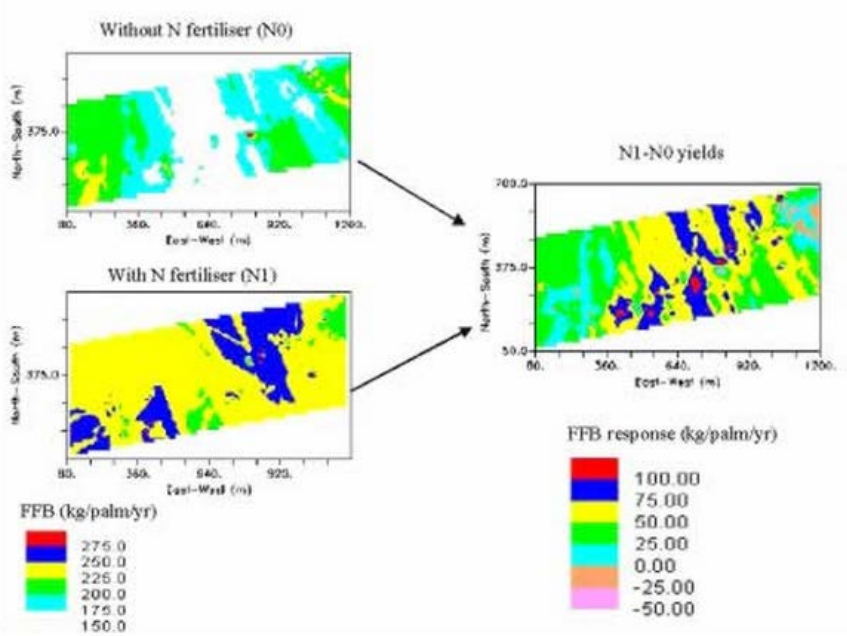

Figure 5: Spatial FFB yield response of oil palm on Kumansi Family soil to N fertilizers

Recently, Malaysian government and industry has move towards the development of the agriculture sector using modern technology by using LiDAR and high spatial resolution airphoto imagery to attain the optimisation of oil palm plantation management practice. There is a growing need for accurate information on shapes of the terrains, particularly those of rugged and vegetated areas. Until recently, large inaccuracies in the estimation of vegetated areas have been observed in the digital terrain model (DTM) and digital elevation model (DEM). The traditional techniques of surveying vast plantation areas are time consuming and costly; they may soon become obsolete. The first ever airborne LiDAR and multispectral survey for oil palm plantation in Malaysia was carried out in early 2012 to test its feasibility (Helmi et al., 2012).

The conventional practice of operation management of oil palm replanting work in Malaysia is expensive and labour intensive. The slow and inefficient conventional practice has wasted a lot of valuable time and hindered the growth of the oil palm industry; the yield of oil palm plantation can be increased with faster and more accurate replanting work. The replanting of old and uneconomic oil palm trees is one of the practical strategies to improve oil palm productivity. High productivity of oil palm plantations will ensure the competitiveness of the oil palm industry in the vegetable oil market (Azman and Mohd Noor, 2002). In fact much advancement has been made since 25 years ago, such as land preparation (including infrastructure and soil conservation), optimisation of planting density and the use of replanting techniques (Idris et al., 2001).

A study was undertaken by Mohamad Khairil (2015) to develop replanting procedures using LiDAR and airphoto imageries. This study proposes a systematic procedure to implement remote sensing for the management of oil palm replanting work. Results of these surveying operations are illustrated in Figure 6. The total area of Block 38 is 49.12 ha. The terrace length created in Block 38 is 27,231.68 m and terrace density is 730.66 m per ha. However, judging from the analysis, only 37.27 ha of this area is suitable for planting oil palms. The proposed planting density for this area is 148 trees per ha, and this means a total of 7,269 trees can be planted in Block 38.

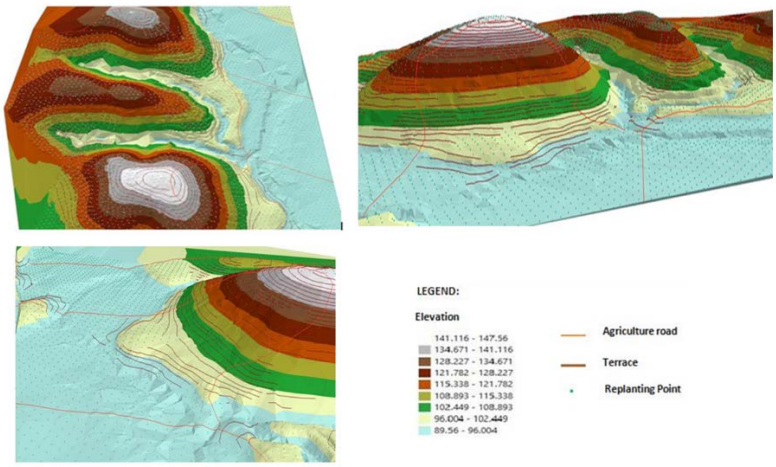

Figure 6: DEM-LiDAR images showing the terrace lines and planting points.

Planting points along terraces were designed according to standard guidelines by FELDA. The palm planting points were determined depending on the width between terraces. The lining of planting points was carried out carefully by using AutoCAD to make sure tree stands will occupy 136 to 148 trees per ha (Figure 7).

Figure 7: Designing planting points on terraces using AutoCAD for FELDA Lurah Bilut

The Malaysian oil palm companies have to improve their productivity in order to remain competitive in the global market. Replanting of oil palm trees for large and remote areas by using the existing technologies is cost-ineffective: it entails expensive ground survey; it is labour intensive and time consuming. Therefore, the industry has to adopt more advanced technologies in planning to accelerate the replanting operations.

While in rice investigation Tan et al (2006) has conducted a study to describe the development of a theoretical model for interpretation of remote sensing data and rice growth. In the early study not much is known about how electromagnetic waves interact with rice fields and how rice crops scatter these waves back to the satellite. Even though rice fields can be classified using the backscattering values and the rice growth can be monitored, a comprehensive study of the theoretical scattering model is crucial to ensure correct application of remote sensing data. By applying image rationing technique, it is possible to classify the rice fields according to the different time of planting (Figure 8). It is noticed that the majority of the rice fields are classified as ‘Late Rice Planting’ (61.4%), followed by the ‘On Schedule Planting (33.5%) and

Very Late Rice Planting (5.1%). Different planting stages are able to be separated using the change detection method. Hence, it is possible to assist in the monitoring of rice field. Results using multi-temporal RADARSAT imagery have confirmed that the backscatter can create a good separation for rice planting stages.

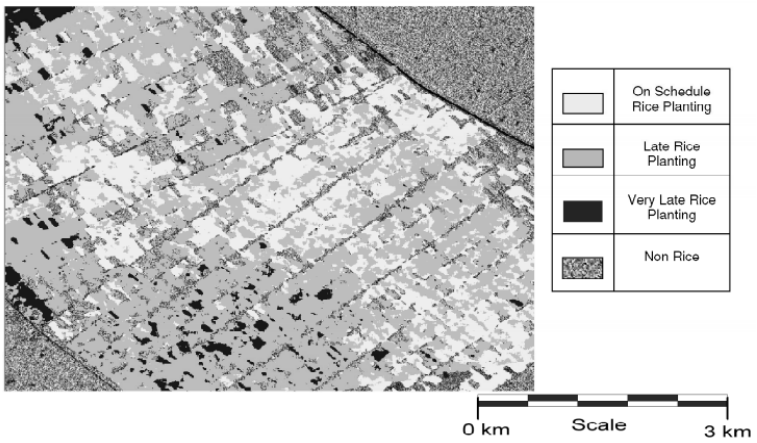

Figure 8: Rice fields classified into three different categories of planting

Management of the crop related spatial and temporal information and variable rate technologies have enhanced the overall cost effectiveness of PA approach in crop productions. MARDI (2012) has reported several R&D works in the development of various PA technologies. These technologies cover areas involving machineries, sensors, information and communication technologies (ICT), services and management related activities, which can provide new opportunities for the SMEs. The studies are field plot boundary extraction and fertilizer treatment maps using remote sensing technique, variable rate seeding technology for rice farming, precision farming technology for variable rate fertilizer application, and the development of vision-based variable rate applicator.

A healthy paddy crops canopy state of growth would guarantee a good yield and quality produce. It is already acknowledged that crops canopy growth status can be managed toward an optimum canopy health through managing canopy color and size (Green Area Index) by manipulating the inputs. Too big a canopy size and dark green color indicate that the crop is over fertilized and can lead to low yield and susceptibility to pest and disease attack. Therefore, growing a bigger and greener canopy leads to overuse of fertilizer and consequently, might eventually require more pesticides input to protect and control the canopy from potential damage from pest and disease infestations. A good canopy management protocol will reduce excessive use of fertilizer through applying fertilizer according to crop demands. Hence, this will lead to reducing wastage and production cost. The effectively practice this management technique has been adopted by MARDI. MARDI has developed system consists of field data collection, processing and analyzing unit, treatment map processing and production unit and the Variable Rate (VR) application unit at FELCRA Seberang Perak, Stesen MARDI Seberang Perai and Sungai Limau Yan districts (Figure 9). The studies have indicated that the fertilizer saving for each plot is about 10 to 15 per cent. The saving is mostly due to the farmer's field having less shoot population as compared to reference crop data.

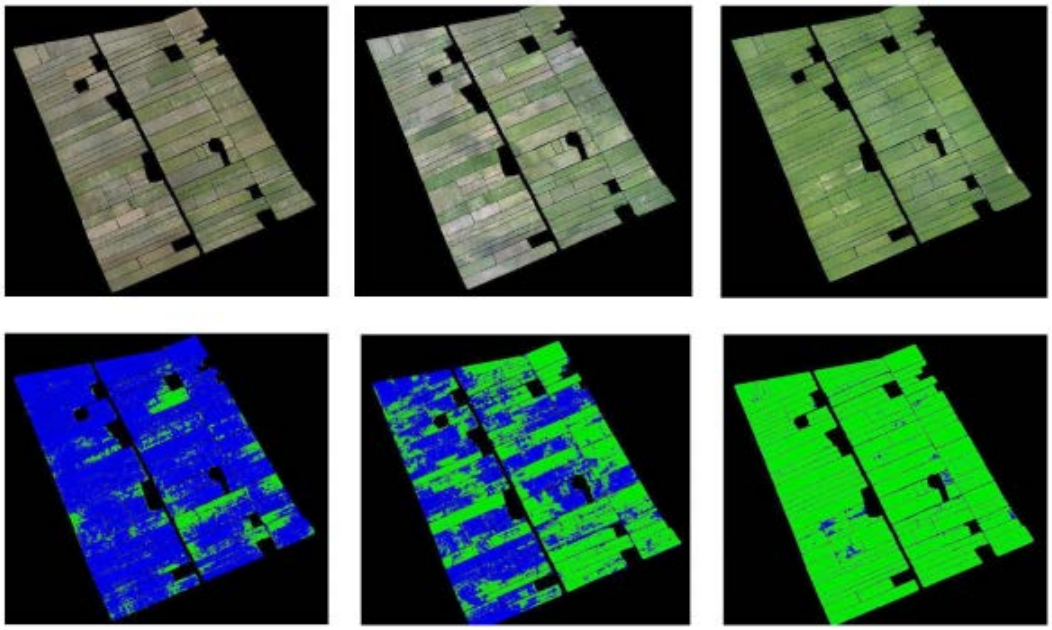

Figure 9: Rice crop growth monitoring using unmanned aerial vehicle (UAV) system and image processing techniques

Other studies for detecting rice disease was carried out by Ghobadifar et al.,(2014). They used SPOT-5 for detecting Brown Plant Hopper (BPH). Infestation of rice plant-hopper such as Brown Plant Hopper (BPH) is one of the most notable risk in rice yield in tropical areas especially in Asia. Initial recognition of pest infestation by means of remote sensing was performed. Specific image indices such as Normalized decrease food production costs, limit environmental hazards, and enhance natural pest control before the problem Normalized Difference Vegetation Index (NDVI), Standard difference indices (SDI) and Ratio Vegetation Index (RVI) were used for analyses. Results showed that all the indices to recognize infected plants are significant at $\alpha = 0.01$. Examination of the association between the disease indices indicated that band 3 (near infrared) and band 4 (mid infrared) have a relatively high correlation. This study showed that SPOT images could be used to demonstrate the coarse scattering of infected plants in the field by recognizing chlorophyll content and the degree of green colour in the leaves. Using the indices as an indicator can clarify the threshold for identifying healthy plants from unhealthy ones. However, a better spectral resolution imagery system is needed (narrower bandwidth and more bands particularly in the infrared range) and in particular, higher spatial resolution.

5. CONCLUSION

As the Malaysian population increase, more food, energy and goods are required. The natural resources and land are limited and while it is necessary to produce more food by using modern technology. Definitely it pushes the need to improve management of the world's agricultural resources to support food security agenda. Satellite-or aerial-based RS technologies and related technologies are become important tools in improving the present system of acquiring and generating agricultural and natural resource data. Remote sensing technology has the potential of revolutionizing the detection and characterization of agricultural productivity based on biophysical attributes of crops and/or soils. Essentially, like other PA components, the information gained from RS data is more meaningful when used in combination with ground data. Although RS cannot capture all types of agricultural information, it can reliably provide accurate and timely information to guide agronomic and economic decision-making. Remote

Sensing can play a role by providing a comprehensive knowledge base in use of satellite sensor-based maps and statistics that can be used to develop strategies for croplands management for food security. Much work is ongoing to turn this potential into operational and reliable decision support systems that can estimate cultivated area, planting dates, yields, and damage from extreme events, and do so over large areas season after season. Last but not least, remote sensing and related technology has done more to enhance food security for the nation especially in agricultural production.

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Industry of zeolites and its nanocomposites and their application in soils and environment

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ABSTRACT

Zeolites are aluminosilicates widely used in industry, agriculture and environment, and have high capacity for adsorbing cations. However, the removal of zeolites from water after adsorbing cations is difficult because zeolites are usually powdery materials. We developed corporealized zeolites, zeolite-embedded sheets, by using Linde type A (LTA-sheet) and mordenite (MOR-sheet) zeolites for easy removal from water. Analyses by SEM and XRD indicated that zeolite structures were maintained in the LTA-sheet and MOR-sheet. Cu2+ adsorption generally increased by increasing (LTA negative charges)/(Cu positive charges) ratio. Cu2+ adsorption of the LTA-sheet was slightly lower as compare to that of the LTA-powder, and a longer contact time was needed. However at lower Cu2+ initial concentrations, the adsorption was very fast, and the concentration of Cu2+ decreased to below 16 μM after 20 min, and the concentrations were lower than the maximum Cu2+ concentration permitted in drinking water recommended by WHO. The MOR-sheet had Cs+ adsorption capacity almost the same with that of the MOR-powder. Radio-cesium decontamination test of the MOR-sheet on 4 soils from Fukushima prefecture proved that MOR-sheet decreased the radioactive dose of 15-36%.

Keywords: Zeolite; zeolite-sheet; copper; cesium; adsorption

INTRODUCTION

Zeolites are aluminosilicates mainly consist of Si, Al, and O atoms with three dimensional frameworks, and have pore or channel with certain sizes (Sun and Seff, 1994). Zeolites possess negative charges originated from isomorphic substitution of Si to Al, and the negative charges are neutralized by exchangeable cations. More than 200 types of zeolites are known, and they are widely used in industry as adsorbent, cation exchanger, deodorant and catalyst. For example, ZSM-5 is a well-known catalyst for oil refinement in petroleum industry, and Linde type A (LTA) is mixed in detergents as a water softener.

Zeolites can be synthesized from industrial byproducts such as coal fly ash (Wang *et al*., 2015), rice husk ash (Johan, *et al.*, 2016, Ogami *et al.*, 2015), and natural resources such as diatomite (Johan and Matsue, 2014; Yamada *et al*., 2015). For the synthesis of high-silica zeolites, structural directing agents (SDA) or organic templates are added. The functions of zeolites can be improved by a variety of treatments: acid or alkaline treatments; Fe-treatments to provide anion adsorption sites for phosphate (Johan *et al*., 2013) and arsenate (Shukla *et al*., 2013); zeolite-magnetite nanocomposition for decontaminating radioactive ^{137}Cs (Aono et al., 2013, Aono et al., 2014, Yamada *et a.l*, 2015); zeolite-TiO_2 nanocomposition for VOCs photocatalysis (Fukugaichi and Matsue, 2015).

In the decontamination of environmental pollutants such as toxic metals from water, zeolites are useful materials because they selectively adsorb metals such as Cu (Kabwadza-Corner *et al*., 2014), Pb (Kabwadza-Corner *et al*., 2015), and Cs (Johan *et al*., 2014. Johan et al., 2015, Munthali *et al*., 2015). However, the removal of zeolites after decontaminating water is difficult because zeolites are usually powdery materials, and therefore the water decontamination procedures have been commonly carried out by apparatuses having column systems containing zeolites.

Here we introduce corporealized zeolites, zeolite-embedded sheet, as easy-to-use materials for decontaminating water. "Corporealization" engenders the provision of a physical form to powdery zeolites that facilitates the addition of the zeolites to water, as well as their removal. This study described the preparation of zeolite-embedded sheets and their application to remove toxic metals in water media. We aimed to find a cheap adsorbent for the removal of heavy metals from water, to establish a simple method to purify contaminated drinking water, to remove toxic metals from wastewater, and also to decontaminate Cs-polluted soils.

MATERIALS AND METHODS

Preparation of zeolite-embedded Sheet

A Synthetic Linde type A zeolite (LTA) was purchased from Wako Co. Ltd., and natural mordenite (MOR) was obtained from Nitto Funka Trading Co., Ltd. The zeolites were used without any pretreatment or purification. Commercially available non-woven fabric composed of polypropylene and polyethylene (Platec Co. LTD) was used to make zeolite-embedded sheets. The LTA and the MOR samples were separately sprinkled on the sheet, then the sprinkled sheets were heated at 160-180C for 6-8 min. After cooling, the sheets were washed with water with vigorously shaking for 2 h to remove any unattached LTA or MOR, then was dried in air. The obtained sheet was referred as MOR-sheet for the mordenite-embedded sheet and LTA-sheet for the LTA zeolite-embedded sheet. The MOR-sheet and the LTA-sheets were characterized by using SEM (JEOL JFC-1200) and XRD ((Rigaku Ultima IV X-ray Diffractometer) at 40kV and 40 mA with scanning speed at $2\theta = 2$ °/min.

The LTA-sheet and powder LTA were used for Cu^{2+} adsorption, and the MOR-sheet and powder MOR were used for Cs^{+} adsorption. This choice was based on our previous results in which LTA had the highest Cu^{2+} absorptivity (Kabwadza-Corner *et al*., 2014) and MOR had the highest Cs^{+} adsorption selectivity (Johan et al., 2014, Munthali et al.,) as compare to other zeolites.

Copper adsorption experiment

A batch adsorption experiments were carried out in a 250 mL polypropylene centrifuge bottle by adding 0.01–0.2 g of LTA, either as the LTA powder or LTA-sheet, to a 100 mL of 0.3 mM $Cu(NO_3)_2$ solution containing 2.5 mM $Ca(NO_3)_2$. The $Cu(NO_3)_2$ solution was adjusted to pH 5.0 before adding the LTA. The ratio of (LTA negative charges)/(Cu^{2+} positive charges), LTA/Pb ratio, ranged from 1 to 20. The CEC of the LTA was 600 cmol (+)/kg. Addition of $Ca(NO_3)_2$ in the solution was purposed to give a uniform ionic strength, and to simulate a hard water. The mixtures were shaken at various times up to 6 h. Centrifugation was done for the LTA powder to separate the powder and supernatant. For the LTA-sheet, the sheet was simply removed without centrifugation. The Cu^{2+} concentration of the supernatant was measured by an atomic absorption spectrophotometer (AAS, Hitachi Z-5000).

Cesium Adsorption experiment

Non-radioactive Cs^+ adsorption experiments were carried out for the MOR-sheet in order to investigate its capacity to remove radiocesium from water. Each 0.6 g of the sheet was mixed with 6.0 mL of $CsNO_3$ solution of various initial concentrations (0-113 μmol/L) in 0.5 M NaCl background solution. The mixtures were shaken with a reciprocal shaker for 1 h, then centrifuged at 3000 rpm. Cs concentration in the supernatant was measured by AAS (Hitachi Z 5000). The amount of Cs adsorption was calculated from the initial concentration subtracted by the final concentration. For comparison, same adsorption experiments were also carried out for MOR powder, Prussian blue, and a commercial Prussian blue sheet.

Decontamination of radio-cesium contaminated soils

Decontamination experiments of soils were conducted to four radioactive Cs contaminated soils from Fukushima Prefecture (1589-5030 Bq/kg, collected in 2015). 4.0 g of each soil was put in a 250 mL bottle, and topped with 200 mL distilled water, then 2.0 g (20 cm^2) of the MOR-sheet was added. The bottle was shaken for 16 h, and centrifuged. Supernatant was discarded, and the soil and the sheet were separated. Radio-cesium content of the soils was measured before and after the decontamination experiments. A control experiment was done for each soil without adding mordenite sheet, only mixing of soil with distilled water.

RESULTS AND DISCUSSION

Characterization of zeolite-embedded sheets

Fig. 1 shows the photograph and SEM images of the blank fabric sheet, LTA-sheet, and MOR-sheet. The SEM image shows that single and aggregated LTA particles embedded on the fibers (Fig. 1d), and aggregated MOR particles embedding on the fibers seem to be more dominant (Fig. 1e).

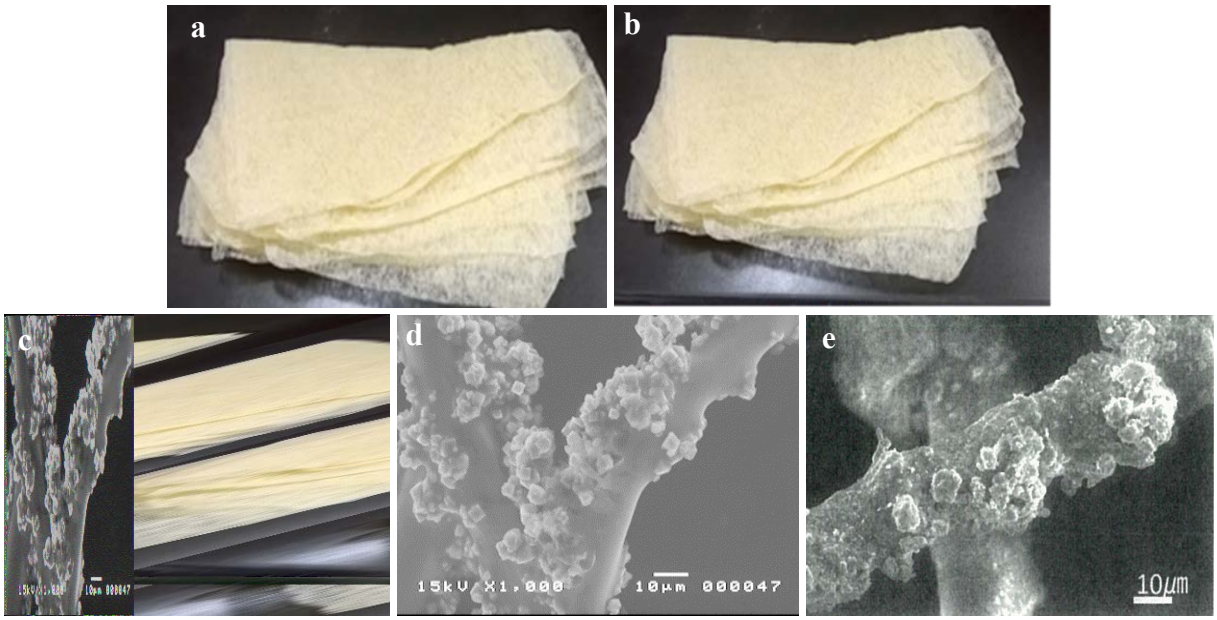

Fig. 1 Photographs (a and b) and SEM images (c, d, and e). a: LTA-sheet; b: MOR-sheet; c: blank fabric sheet; d: LTA-sheet; e: MOR-sheet

Fig. 2 shows XRD patterns of the LTA-sheet and MOR-sheet, together with those of the LTA, MOR, and blank fabric sheet. The XRD patterns of both LTA-sheet and MOR-sheet showed the peaks of the fiber and the LTA or MOR, indicating that the LTA and MOR were embedded in the sheets. Much decrease in peak intensities were observed for the LTA-sheet, nevertheless the LTA structure was still maintained as shown in the SEM image (Figure 1). Furthermore, when the sheets are touched, no powder attached to our hand indicating that the zeolite particles were attached strongly or embedded to the fabric.

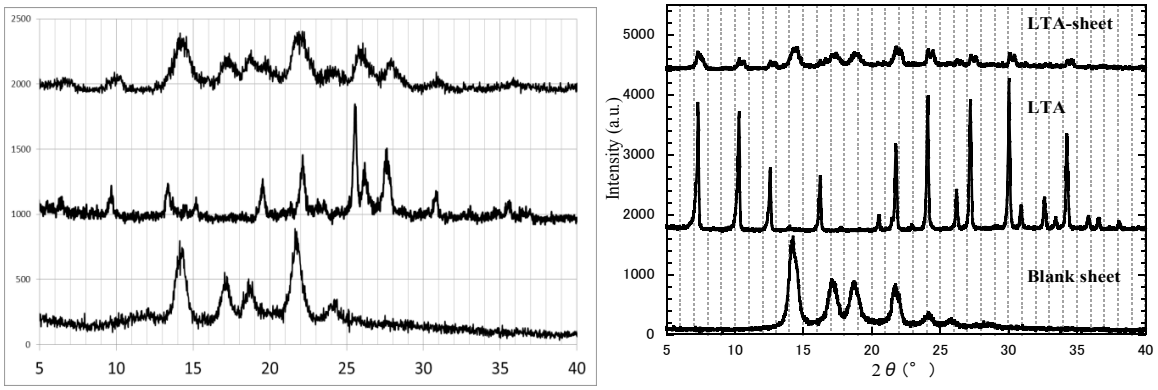

Fig. 2 XRD patterns of LTA-sheet, LTA, and blank fabric sheet (left), and MOR-sheet, MOR, and blank fabric sheet (right)

Copper adsorption

Fig. 3 shows the effect of shaking time on the concentration of Cu^{2+} for LTA powder at various LTA/Cu ratios, and Fig. 4 shows the effect of shaking time on the concentration of Cu^{2+} for LTA-sheet at various LTA/Cu ratios. For both LTA and LTA-sheet, the Cu^{2+} adsorption increased with increasing the LTA/Cu ratios. For the LTA powder, more than 90% of Cu^{2+} was removed from the solution at LTA/Cu ratio of 5 and higher, at contact time of 60 min and more. In case of LTA-sheet the same Cu^{2+} removal was achieved at the LTA/Cu ratio of 10 and higher, and at the longer contact time of 180 min and more.

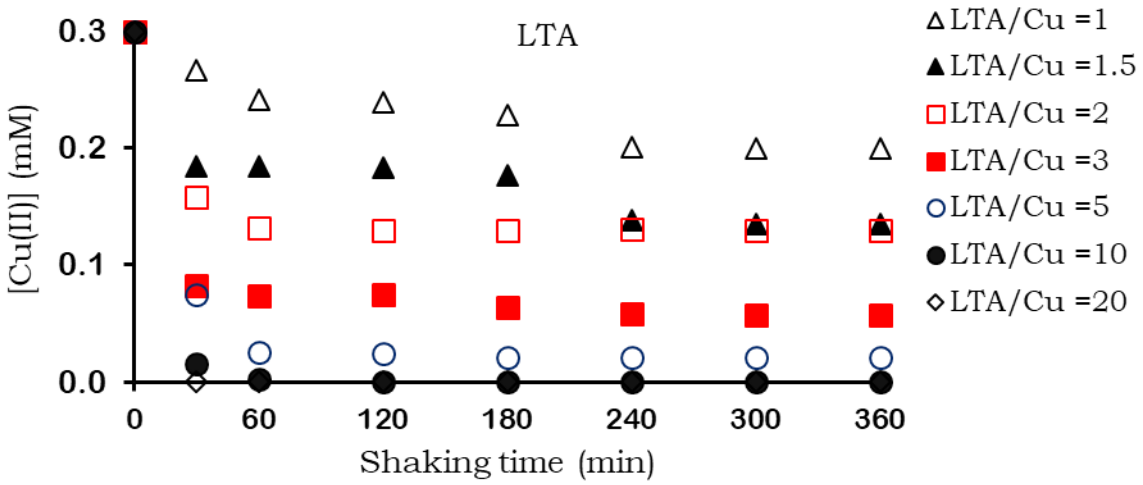

Fig. 3 Effect of shaking time on the concentration of Cu^{2+} for LTA at various LTA/Cu ratios

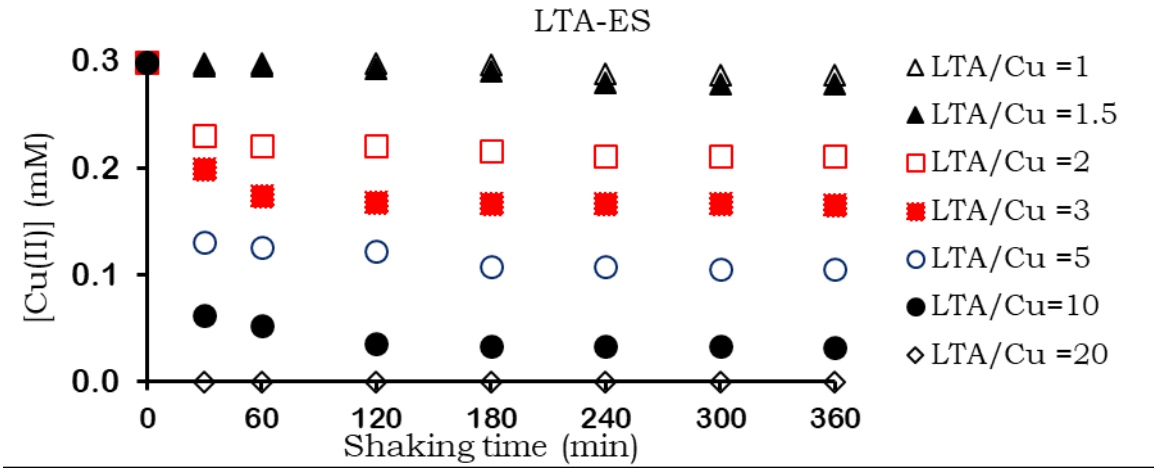

Fig. 4 Effect of shaking time on the concentration of Cu^{2+} for LTA-sheet at various LTA/Cu ratios

An experiments at lower initial Cu^{2+}concentrations (16 μM~160 μM) were also carried out with solid/solution ratio of 0.03 g/30 mL. The resuts are shown in Fig. 5. The adsorption rate for both LTA powder and LTA-sheet was very fast. For the sheet, the concentration of Cu^{2+} decreased to below 16 μM after 20 min, and these concentrations were lower than the maximum Cu^{2+} concentration permitted in drinking water recommended by WHO (Rao et al., 2006). This finding indicates that LTA-sheet can be applied for heavy metal removal from drinking water. The easy recovery of the sheet after removing Cu may make the LTA-sheet a convenient tool for decontaminating water of the populations in the rural area.

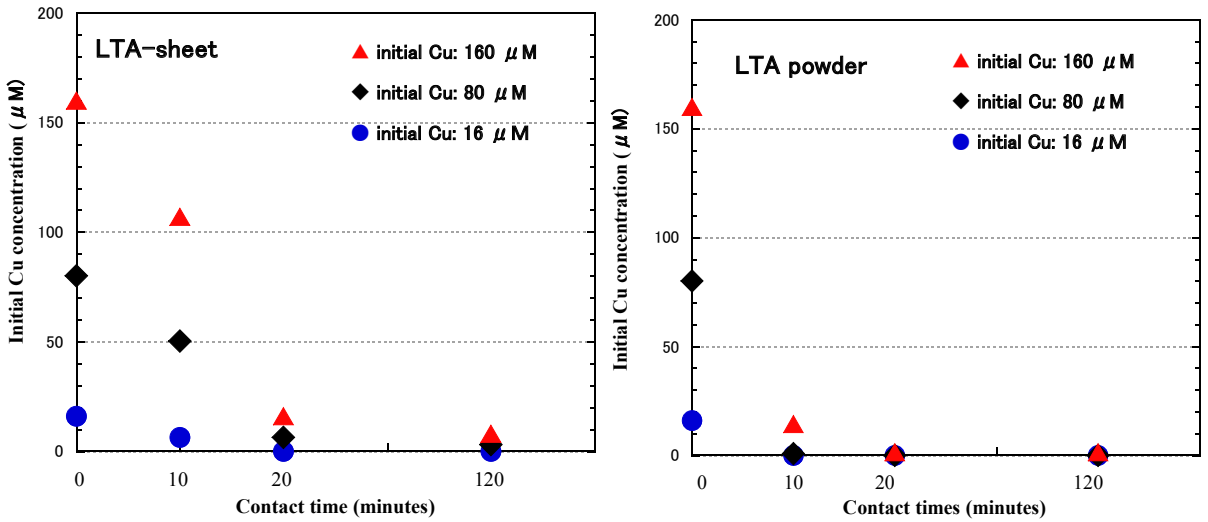

Fig. 5 Effect of contact time on the concentration of Cu^{2+} of the LTA-powder (left) and LTA-sheet at various initial Cu concentration; experiment conditions: 0.03 g sample in 30 mL Cu(NO3)2 solution at 16μM~160μM in the presence of 2.5 mM $Ca(NO_3)_2$ and initial pH of 5

Cesium adsorption

Fig. 6 shows adsorption isotherms of non-radioactive Cs^+ on MOR-sheet, MOR powder, Prussian blue sheet and Prussian blue powder. The figure indicated that mordenite strongly adsorbed Cs^+ ion. Furthermore, the Cs^+ adsorption on the MOR-sheet was almost the same to that of MOR powder, indicating that the Cs^+ adsorptivity capacity did not decrease due to the corporealization. However, in case of Prussian blue, the Cs^+ adsorption on Prussian blue powder was very high and higher than MOR powder, but for the commercial Prussian blue sheet was very low. In this experiment, no any adhesive was added during the corporealization process of MOR, consequently the adsorptivity was maintained. Furthermore, the Cs^+ adsorption was done under 0.5 M NaCl background solution, in which the Na^+ concentration is about 5000 times higher than Cs^+ concentration. This indicates that the MOR-sheet can be used for decontaminating sea water polluted by radioactive Cs.

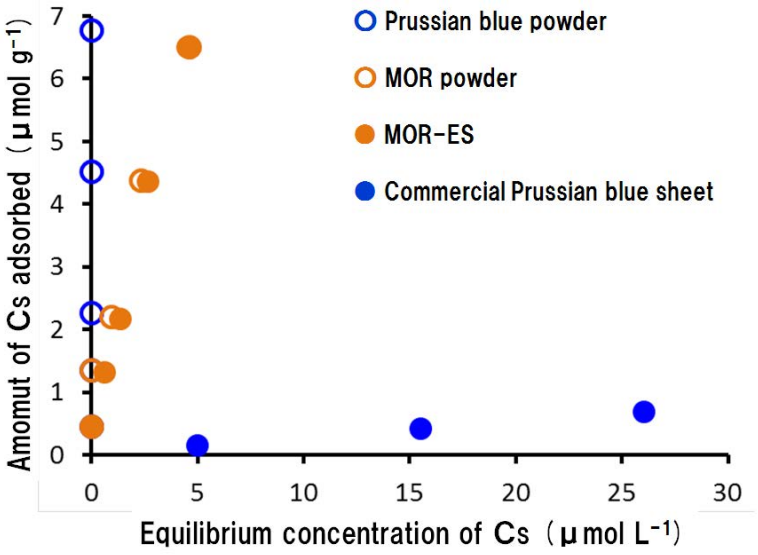

Fig. 6 Adsorption isotherms of non-radioactive Cs^+ on MOR-sheet, MOR powder, Prussian blue sheet and Prussian blue powder

Decontamination of radioactive Cs-polluted soils

Table 1 shows decontamination results of the Cs-polluted soils. The results indicated that the radioactive dose decreased after the decontamination using MOR sheet for all the soils. The decontamination ratio was varied from 15% to 36%, probably it was affected by soil texture. For controls (the soils were mixed with water without

Table 1 Decontamination results of the soils from Fukushima Prefecture

Sample	Radioactive dose (Bq/kg)		Decontamination rate (%)
	Initial	final	
Soil 1	1589	1352	15
Soil 2*	2146	1469	32
Soil 3	3639	2321	36
Soil 4	5030	3961	21

* Another experiment was done for this sample, using 4g MOR-sheet and shaking time was prolonged to 72 h, the decontamination ratio increased up to 49%

adding MOR-sheet), decontamination ratios were only around 1%. This is because in case of control, ^{137}Cs released from the soil will be adsorbed again by soil. Conversely for the MOR-sheet treatment, the released ^{137}Cs will be adsorbed by the MOR-sheet located nearby the soil. The presence of adsorbent together in the system is important to "catch" the released Cs, and the high Cs adsorptivity of the mordenite, lead the reaction equilibration turn to the mordenite. The same trend was found in in the decontamination simulation using Cs adsorbing vermiculite as a Cs-radioactive contaminated soil and mordenite as an adsorbent (Munthali *et al*., 2015).

CONCUSSIONS

1. Zeolite-embedded sheets were developed with a simple heating method and characterized. The key points of sheet making is a low heating temperature, short heating treatment, and no any adhesive was used. These points lead the zeolite structures maintained, so the metals adsorptivity was maintained.
2. The zeolite-embedded sheets were effective to remove heavy metals from water media: LTA-sheet for Cu^{2+} removal; MOR-sheet for Cs^{+} removal. The adsorptivity of the sheets were almost the same with that of the zeolite powders, but longer contact time was needed for the sheets.
3. The advantage of using the sheets is easy recovery after the adsorption, so it can be easily applied for the people in rural area to provide safe drinking water.
4. The sheet making technology is simple, convenient, and useful; applicable for various adsorbents depending on the purpose. The important is to select and use appropriate

adsorbents for their purpose.

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Enhancing Lake Resources in Mindanao, Philippines to Support Green Agro-Industry

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ABSTRACT

Enhancing productivity of Lakes in Mindanao specifically in Lake Buluan is a joint undertakings of the Department of Science and Technology, Sultan Kudarat State University and the Local Government Units with the goal of providing technical and institutional support in establishing measures for controlling and utilizing the aquatic vegetation of the Lakes towards enhancing its productivity. Since then, it was able to generate employment, mostly composed of head of the families and out-of-school youths in the locality. Various families (140) are directly benefiting from the Project through income augmentation derived directly in the form of salaries and wages received by head of the families, income from the livelihood program and access to livelihood opportunities for both the heads of the families, the housewives and the children. The project has initially placed Lake Resources to a minimal level of control of the proliferation of water hyacinth which endangers the existence of fresh water resources thriving in the lakes. Left unattended, the continued increased in the production of water hyacinth is definitely detrimental to the lake which is the source of living not only for the people living within the Lake but also for those nearby municipalities, barangays relying on the productivity of the Lake for their livelihood.

Keywords: Water hyacinth; proliferation; detrimental; productivity; and livelihood

BACKGROUND/RATIONALE:

Green technology evokes images of pristine waters, clean air, productive soils, and lush vegetation. Green technology is a dynamic process that aims to achieve all these, by generating technologies that are least impactful and most regenerative to natural resources, organisms and environment in general. It encompasses sustainability, source reduction, innovation, and viability (Burgos, 2013).

Lake Buluan is the third largest lake in Mindanao, with a surface area of 6,500 ha. It lies southeast of Buluan town and east of Municipality of Tacurong, Sultan Kudarat within the territorial jurisdiction of Buluan, Maguindanao and Lutayan, Sultan Kudarat. A large portion of the lake (nearly 90%) lies in Buluan while the rest lies in Lutayan and is bordered by thirteen lakeshore barangays (Fig 1).

Lake Buluan is a shallow, eutrophic lake (depth of 3-6meters) characterized by high primary productivity which favor the growth of abundant littoral vegetation and dense plankton population. Although Baluyot (1982) reported an estimated first yield of 1,600 kg/ha, the fish catch has been declining due to heavy siltation and sedimentation caused by denudation of the watershed area.

The shallowing of the lake is aggravated by the over growth and dominance of littoral vegetation such as *Eichornia crassipes* (water hyacinth), *Ipomea reptans, Ipomea acquatica*_(swamp cabbage) *Nymphaea nouchalii* (water lily) and *Pistia striates*.

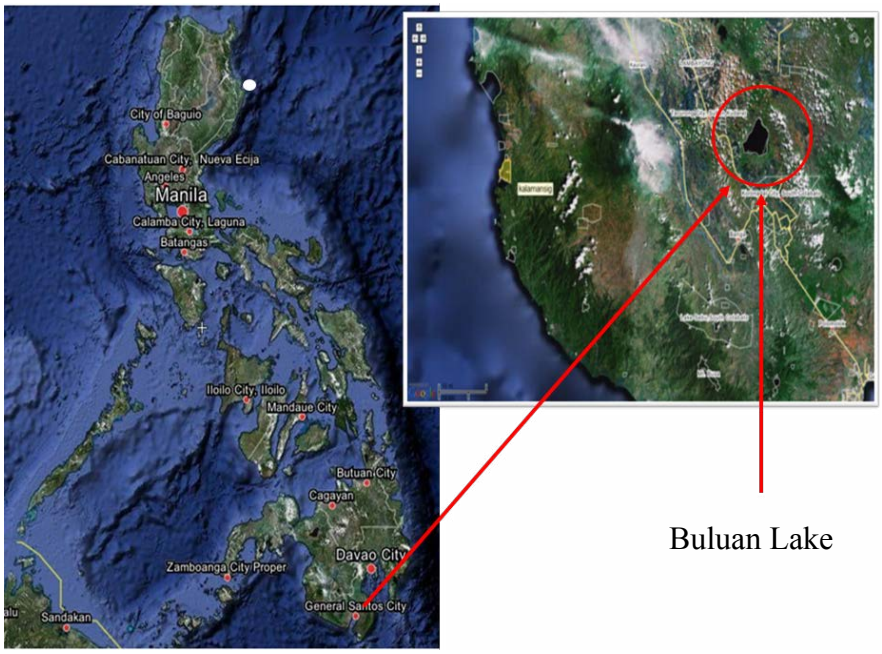


Fig. 1. Location Map of the project

Among its aquatic vegetation, water hyacinth is the most abundantly thriving and seriously affecting on the lake's productivity. When not controlled, water hyacinth will cover large areas for fishing, block navigations, smother aquatic life by deoxygenating the water, and reduces nutrients and sunlight penetration for algal production. They also serve as habitats for vectors of diseases.

The removal of water hyacinth by chemical and biological control pose risks to the environment and have met limited success. Currently, the most effective control method remains the control of excessive nutrients and prevention of the spread of this species. A water hyacinth infestation is seldom totally eradicated but it can be continually manage by finding ways to benefit from this resource.

In some areas, uses have been found for this invasive species for cattle's food and biogas production. Waste water treatment and recently, for handicraft production.

Restoring the productivity of Lake Buluan must begin in dealing with the control and judicious utilization of its aquatic vegetation.

Project Components:

Organization and orientation of Environment Brigade and Lake Cleaners

The project implementation was done through rigorous coordination with the Local Government Unit of the municipalities. Major activities undertaken included the following:

- MOA signing, orientation and tasking of all stakeholders including the LGU counterpart, workers and the project staff.
- Hiring of the workers. The hiring of workers was facilitated by the Local Government Unit. The workers are identified based on their employment status. Head of the families

with no regular source of income, unemployed graduates and out of school youths were given priority.

- Organizing the Environment Brigade and Lake Cleaners. Through series of orientation meetings and programs the workers were organized and given briefings based on the expected output.

Mapping of water hyacinth pathways and distribution.

- Actual mapping was conducted with the local key persons. A theoretical map was produced and the project team with the local key informants identified the areas where water hyacinths are critically proliferating. The cleanup activities concentrated in these areas has somehow controlled the overgrowth of water hyacinth. There are times of the year usually in the onset of the rainy season when the lake expanse is extensively covered by water hyacinth that block the cages and prevent the water from flowing freely.
- Mapping activities were conducted and the local people were involved in the actual mapping of the water hyacinth pathways and distribution pattern within the lake and its tributaries. The mapping covers areas of Buluan Municipality which occupies the larger part of the Lake and the Buluan River that serves as the outlet of the lake overflow.

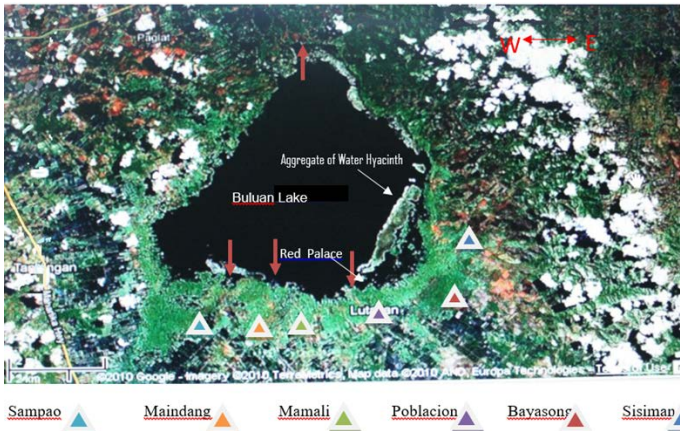


Fig. 2 .Map showing the various sites covered by the project. The three (3) red arrows in the southern portion of the lake indicate the major creeks' opening that branched out from Buayan River from Mt. Matutum traversing Tampakan, South Cotabato. These creeks are the inlets of Buluan Lake while the single red arrow at the northern portion points to the opening into Buluan River the only outlet of the Lake going to Ligawasan Marsh and into Rio Grande de Mindanao flowing out of Cotabato City.

It is very apparent that the lake is already saturated with fish cages with only little space left for navigation. Only two pump boats can pass through these waterways and navigation is difficult maneuvering through edges of these fish cages. Lutayan, occupies only about a quarter or less of the total area of the lake the rest is within the territorial jurisdiction of the Municipality of Buluan. The territorial jurisdiction is debatable because of the boundary conflict between two municipalities.

During dry season however, the water recedes and the water hyacinth are deposited in the bank and left to decompose. Mass die off of the vegetation add up to the bulk of organic matter deposited in the shoreline and this contributes to the shallowing of the lake. According to the residents the area that dried up during summer is becoming wider offshore of the lake

while the water flooding the inshore during rainy days is encroaching inland almost the whole municipality. This indicates the deterioration of the water holding capacity of the lake and therefore changes in the biological ecosystem and composition of the area in the years to come. The problem on the over growth of water hyacinth will be recurrent and difficult to control in the sense that the seeds of these vegetation remain dormant until the next rainy season and when fully grown its suckers multiplies rapidly within a week. Harvesting these plants for other productive purposes is the best way to benefit from the nuisance it can cause to economic activities and other environmental impact.

What Are Some of the Solutions Undertaken By The Project?

Conducted the training on "community volunteerism & resource mobilization".

This seminar workshop for the workers of the lake aimed at inculcating to the minds and heart of the local workers the importance of their responsibilities and their jobs to the future of their community. This is to genuinely encompass the spirit of volunteerism that should sustain their willingness to participate in managing and taking care of their valuable resources in the lake. This seminar-workshop also aid in making the people understand the basic principles and knowledge about the lake ecology and environment and the ways they can harm or protect their Lake resources.

Fig 3. Training on Community Volunteerism and Resource Management

Conducted on-site visit in other lakes/Meetings

Regular on site visits were conducted to monitor the status of the project implementation.

On-site Visits and Launching of the Project

The project staff of the Lake Buluan project visited the water hyacinth-based handicraft producers in National Capital Region including meeting with the project implementers of successful lake management system in Laguna de Bay under the Laguna Lake Development Authority (LLDA) and to visit the project sites in the area.

Fig.4 Visit at the Provincial Tourism Office

Fig. 5 The team from PCAMRD with Executive Director Cesario P. Pagdilao visit in Lutayan to evaluate the local products and the project area.

During the launching of the program, Secretary Alabastro of the DOST challenged the local women to engage themselves in productive activities especially in producing village level products from the locally available materials like the water hyacinth. She appreciated the display of local made products from water hyacinth and encouraged the local processors to develop the quality of their products for bigger market.

*Fig.6 Secretary **Estrella F. Alabastro** giving her message during the Launching of CLEEP Project (left)*

*Fig.7 Secretary Alabastro with SKSU President **Dr.Teresita L. Cambel** and Project Staff evaluating the handicrafts made from water hyacinth produced by the employed processors of the project (above).*

Cross Visits to Other Similar Projects

Sharing of experiences on the management of water hyacinth in the other water bodies (e.g. Environmental Army in Laguna de Bay; Water hyacinth control in the Riconanda Lakes) was undertaken. Selected project staff learned the technologies, and known the experiences of successful projects on the utilization of water hyacinth and effective lake management schemes for the control of lake overgrowth of vegetation. The project staff visited the City of Taguig where the utilization of water hyacinths is implemented as livelihood program specifically for women's organization. The project implementers were able to see the various products and the video presentation of how people were organized and worked as groups to produce saleable products sold in their local market. Their effort is continuous in developing export quality products to expand their market area.

Fig. 8 Finished Products from water Hyacinth

The visit in Forest Products Research and Development Institute (FPRDI) was also very enriching in giving insight on technologies that can be appropriately considered in the production of various products from water hyacinth. Technology prospecting was made possible through the presentations delivered by the experts from UPLB on the preparation of materials for handicraft making and the technology on paper making using materials from water hyacinth. From this visit the possible request for training of the processors was tentatively arranged and finalized through the assistance of DOST Region XII. The training has enhanced the skills and improved the quality of the products produced by the processors. The FPRDI was very supportive of the project and were very accommodating in proving the necessary training needed by the processors.

Lake Clean –up.

The cleanup activities are the major component of the project which involved the provision of emergency employment for the workers. Mostly benefited by the project are the people of the local community hired for the work. The lake clean-up is done by removing as much water hyacinth as they can. Others are assigned to cut the stalks to be used by the processors for handicraft making and then they spread the stalks for drying. Once dried, the bulk are hauled to the processing area for the processors to weave into various items. So far it has provided employment to many residents along the Lake communities that only depend on the unstable income from lake fishing.

Employment Profile of Workers:

- No. of employment generated is 209
- No. of families benefited 140

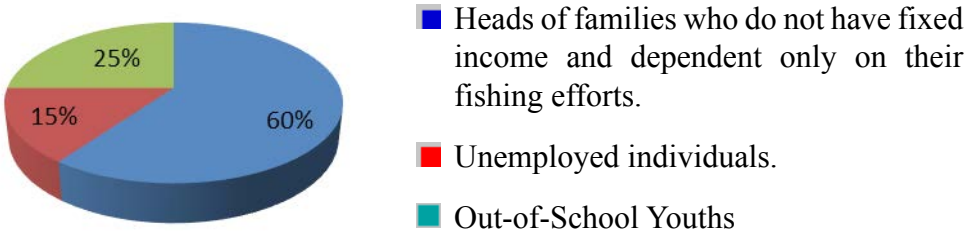
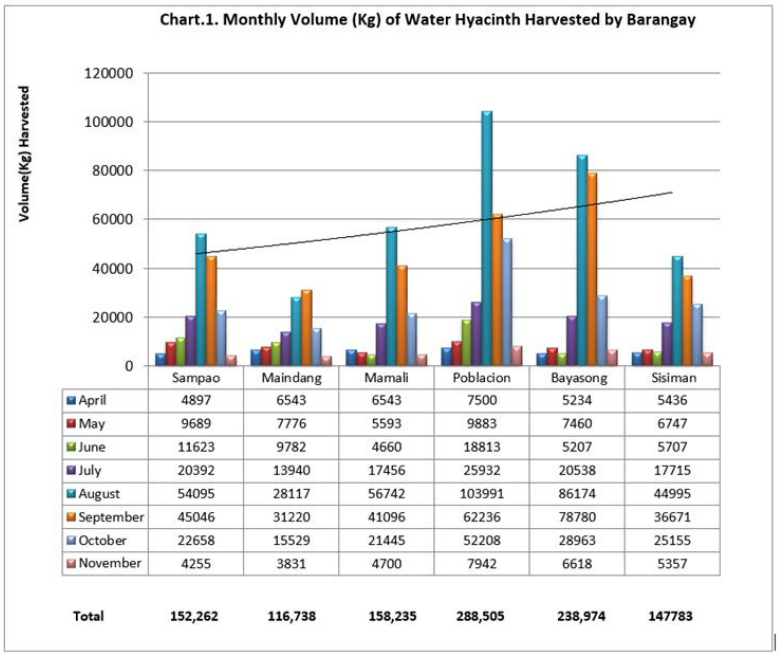


Fig. 9.The lake workers are lost in the densely covered expanse of water hyacinth growth.

- The total harvested volume of water hyacinth is 1553.81 tons (Chart 2) from the months of April to November, 2009 with months of August and September having abundant volume collected (Chart 1) from the six barangays of Lutayan, Sultan Kudarat.
- Average volume harvested per month is 194.22 tons (Chart 2) of all barangays in Lutayan, Sultan Kudarat.

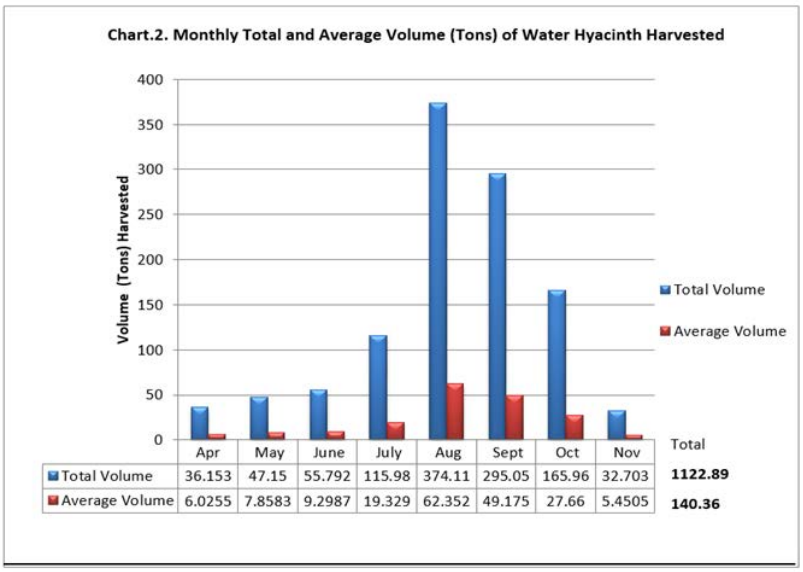
The figures on the graphical presentation of the data on volume collected (Fig.10) will be converted into viable products through the processing component of this project. This will provide a stable source of income for the many poor families of the locality.

The Chart 1 below shows that the most volume of collected water hyacinth was in Barangay Poblacion and Bayasong that reached over 200,000 Kg. These areas are at the opposite side from the outlet and located where most of the established fish cages block the pathways and trap the vegetation from flowing out into Buluan River (see Map of Buluan Lake page 4). The exponential trend line of the vegetation growth falls on the month of August and declined in September and following months because of the intervention of the project. The growth pattern may still have increased considerably in September, October and November considering that these months are typhoon laden months and flood usually occurs as results of heavy downpour of rain that brings along loads of nutrients from the uplands. Eutrophic condition can occur during these months.



	Sampao	Maindang	Mamali	Poblacion	Bayasong	Sisiman
April	4897	6543	6543	7500	5234	5436
May	9689	7776	5593	9883	7460	6747
June	11623	9782	4660	18813	5207	5707
July	20392	13940	17456	25932	20538	17715
August	54095	28117	56742	103991	86174	44995
September	45046	31220	41096	62236	78780	36671
October	22658	15529	21445	52208	28963	25155
November	4255	3831	4700	7942	6618	5357
Total	**152,262**	**116,738**	**158,235**	**288,505**	**238,974**	**147783**

Fig. 10. Shows the total volume 1,122.89 tons of water hyacinth harvested for the 8 months period from April to November, 2009. With the increasing volume up to the month of August and gradually decreased in the succeeding months. The decline can be attributed to the harvesting activities in the lake. This indicates that harvesting can temporarily control the fast proliferation of the water hyacinth vegetation.



	Apr	May	June	July	Aug	Sept	Oct	Nov	Total
Total Volume	36.153	47.15	55.792	115.98	374.11	295.05	165.96	32.703	**1122.89**
Average Volume	6.0255	7.8583	9.2987	19.329	62.352	49.175	27.66	5.4505	**140.36**

Fig. 11. Shows the total volume 1,122.89 tons of water hyacinth harvested for the 8 months period from April to November, 2009. With the increasing volume up to the month of August and gradually decreased in the succeeding months. The decline can be attributed to the harvesting activities in the lake. This indicates that harvesting can temporarily control the fast proliferation of the water hyacinth vegetation.

Training on converting water hyacinth into useful products.

- The training for the processors was a counterpart of the Local Government Unit of Lutayan.
- Skills training on water hyacinth stalk processing (drying, bleaching, pre-treatment and dyeing) and weaving techniques for handicrafts were undertaken by processors.

Based on the evaluation of the products made by the existing women processors, there was still a need for enhancement training to improve the skills and quality of their products. Technology updates particularly on the processing of water hyacinth were provided to the processors.

Trainers from Forest Products Research and Development Institute (FPRDI) of UPLB were invited to conduct a three-day training-seminar on technologies from pre-treatment of materials, bleaching and dyeing to the making of raw materials into finished products. Hands on activities were provided to the participants including the theory and techniques especially on how to determine early signs of fungal attacks and the treatment of the materials to avoid its occurrence. Thirty (30) processors participated and completed the training and learn from the trainers the basic techniques in the preparation of raw materials from pre-treatment to prevent fungal and insect attacks to dyeing techniques.

Fig. 12. Part of the hands-on activities of the participants on the different steps in the preparation of raw materials before making it into handicraft products.

Processing water hyacinth into useful products.

Handicrafts

Water hyacinth stalks are utilized for handicraft making that can be produced for commercial purposes. Processors are already starting to produce but the quality of the products still requires improvement and equipment to produce with quality and more efficiently are still to be provided. Pre-treatment techniques and procedure needed to improve the products and the techniques to prevent fungal infections (darkening) which had been observed were already provided in the trainings conducted to the project processors. Refinement of the product texture and use of hand tools for speedy work was also introduced by the trainers. For the processing purposes the College identified an area where the operation of handicraft production can be undertaken by the processors. This is to ensure that the processing operation is properly undertaken and the production can be properly supervised by the project staff.

The processing component has provided a potential livelihood for the women especially the mothers who are engage in the production to help increase their family income by utilizing their skills in handicraft making. They utilized water hyacinth stalks for handicraft making that can be produced for commercial purposes. Some of the trained processors continue to produce inspite of the issues on the quality of the products that still requires improvement and equipment to produce with quality and more efficiently. Pre treatment techniques and procedure needed to improve the products and the techniques to prevent fungal infections (darkening) which had been observed . Refinement of the product texture and use of hand tools for speedy work was has been done but still the problem on longevity of the finished products still needs assistance from concerned agencies specifically the Department of Trade and Industry. These activity has been individually performed by some households only. Problems had been encountered on the financial assistance for commercial production especially on the equipment and materials needed for the sustainable production of quality products

The processing venture will also sustain the clean-up of water hyacinth, wherein, the harvesters will now be able to sell the stalks of their harvested water hyacinth to the processors while the other parts can be utilized as materials for composting to produce organic fertilizer.

Fig. 13. The stalks of the water hyacinth are removed (Upper left). The fresh stalks are spread in the ground and left to dry (Upper right). When dried after pre-treatment of the raw materials are woven into various handicraft products by trained weavers (Lower left). The weavers employed in the project with their finished products (Lower right).

Organic Fertilizers Production. Vermicomposting using a combination of water hyacinth, manure and other farm wastes.

The College of Agriculture in Lutayan Campus sustained the project operation in the production of vermicompost or organic fertilizer. This is an offshoot of the technology where the project had initiated in utilizing water hyacinth as one of the substrates of the organic fertilizer production. To date, this is one of the income generating project of the campus and they also make use of the technology as one of their extension activities to farmers in the municipality. At present, there are ten (10) farmer adoptors of the technology wherein they are collecting or sometimes buying some water hyacinth in the lake as one of the substrate in their organic fertilizer production for their own farm.

The technology is an ecologically friendly, low cost and effective way of recycling waste and agri-products/kitchen waste.

The area for composting of the water hyacinth by-products is already established and the production of organic fertilizer has already started. Vermicomposting technology was adopted by various stakeholders not only in the locality but also in its neighboring provinces. Stalks, leaves and roots that are leftover of the handicraft making were used as one of the organic materials (Banana leaves, stalks, falling leaves and grasses, etc. are also used as substrate) for vermicomposting.

The constructed plots for trial production used improvised materials of plastic to hold the substrates. The initial six plots are now over sixty plots of sizes ranging from 2x5 meters to 2.5x6 meters placed under banana plantation and under concrete shaded area. The produced organic fertilizer is now for sale at 350Php /bag, 50 Php lower than the prevailing market prize.

Fig. 14. Conducted trial for vermicomposting at Lutayan Campus, College of Agriculture in an improvised structure making use of water hyacinth wastes and other materials like grasses and dried leaves for composting.

Fig. 15. The red arrows are the plots constructed for Vermi-composting under banana plantation.

Fig. 16. After drying the vermicast, it is place in sacks/bags at 40kg and sold at PhP350/bag.

CONCLUSION

Substantially, the project served as eye opener of the community that sometimes what they consider as a "nuisance" can become a good source of livelihood by utilizing available technology. It also impacts on the environment since its removal in the lake will enhanced survival of aquatic species since these plants block sunlight's penetration into the water

Aside from generating or providing jobs for the locals in the community as harvesters/gatherers of water hyacinth, the project also helped women and out of school youth to engage in small cottage industry like making bags, baskets, matting, slippers and sold these to the markets or "pasalubong" centers for the tourist industry. In addition, utilization of water hyacinth into agricultural use is by turning these water hyacinth into green manure or as compost. As a green manure, it can be either ploughed into the ground or used as mulch. The plant is ideal for composting. After removing the plant from the water it can be left to dry for a few days before being mixed with ash, soil and some animal manure. Thus, this project ultimately help the people in the community creating business out of these "nuisance/weeds" and at the same time protecting the environment in support of the green agro-industry.

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Supporting the sustainability of rural areas by agro-touristic programs: transferring Austrian experience to Indonesia

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ABSTRACT

The article informs on the multifaceted relationship of agriculture and tourism in rural areas. It proposes a much stronger involvement of stakeholders in agriculture to contribute to agro-tourism policies for the future wellbeing of rural areas and their residents. We inform in five sections on i) global, ASEAN region and Indonesian tourism development, ii) data with regard to the comparability between Indonesia and Austria including an assessment of sustainability concerning agriculture and tourism, iii) a description of rural tourism in Austria, iv) exemplifying food pleasure region as an important part of rural tourism with close interactions of the agricultural and tourism sector and v) conclusions with recommendations on how to take best use of the Austrian experience in Indonesia considering international trends and the necessity of the agricultural sector to become more active in overtaking the lead in agro-tourism strategies.

Keywords: tourism development, agriculture, rural tourism, food pleasure tourist destinations

1. Introduction

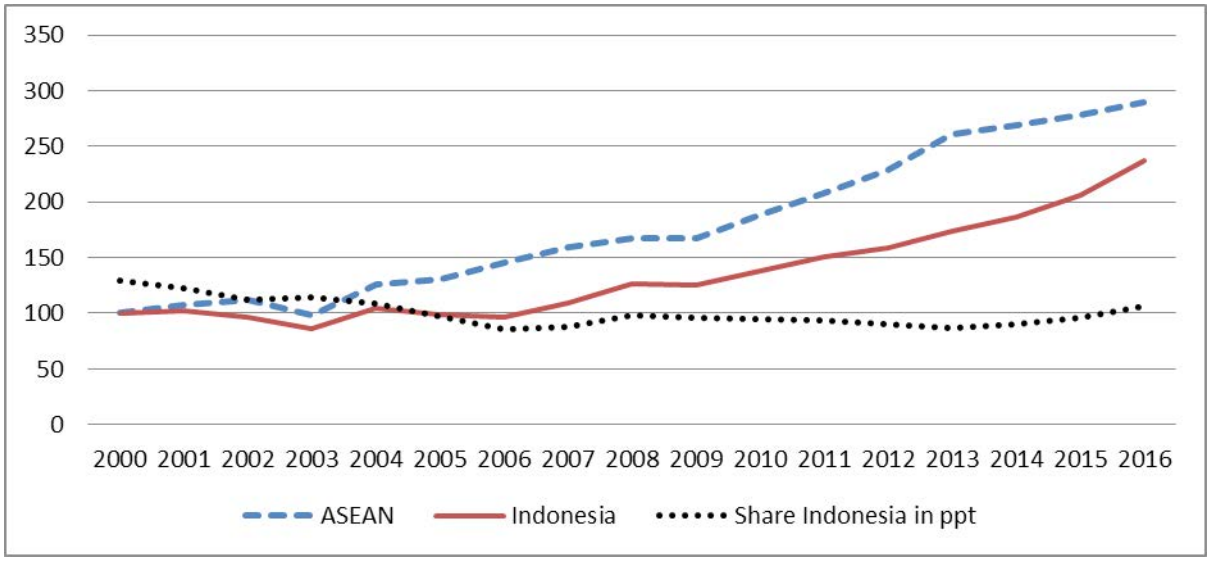
Tourism is a relatively young and dynamic economic sector. Since 1950, global tourism has grown steadily. While this growth was initially observed in Europe and in North America, its future growth is expected primarily in Asia and in countries that have the largest economic growth rates and higher disposable incomes. e. International tourist arrivals have increased from 25 million globally in 1950 to 278 million in 1980, 674 million in 2000, and 1,235 million in 2016 (UNWTO 2017). The contribution of tourism to the global economy in 2016 is US$ 2.3 trillion or 3.1 percent directly and US$ 7.6 trillion or 10.2 percent of global gross domestic product including benefits in other sectors (WTCC 2017). Thereof are US$1.4 trillion in foreign earnings or 6.6 percent of all global exports or almost 30 percent of all global service exports, 7 percent less than the maximum of US$ 1.5 trillion in 2014 (WTO 2017). Some 500 million jobs or 10percent of global jobs are due to tourism (UNWTO 2017). The United Nations has designated 2017 the International Year of Sustainable Tourism for Development in its appreciation that tourism creates jobs, drives exports, and generates prosperity across the world.

So far not sufficiently highlighted is the close relation of tourism and agriculture which go in parallel in many countries, but in quite a different weighting. Agriculture is the senior partner

that opened doors for tourism development at many places particularly of those destinations that experienced primarily an endogenous tourism development. Here local people were the driving force behind tourism activities. In 2016 the share of agriculture in global GDP was 3.7 percent as compared to 7.9 percent in 1996. The share of tourism in 2016 is 3.1 percent in global GDP and within short time tourism will become economically more important than agriculture. In contrary to the endogenous development based on agriculture and rural areas we find many places where tourism development is promoted by external developers boosting primarily the regional economy and not necessarily the local one.

Tourism in Indonesia is an important component of the Indonesian economy as well as a significant source of its foreign exchange revenues. The vast country of sprawling archipelago has much to offer, from natural beauty, cultural heritage to biologic diversity. The direct contribution of travel and tourism to Indonesia's GDP in 2014 was US$ 26 billion constituting 3.2 percent of the total GDP (Indonesia Investments, 2014). The Indonesian government aims to increase this figure to 8 percent of GDP and the number of foreign visitors is targeted to about 20 million in 2020. The number for 2016 was 12 million foreign arrivals (Indonesia Travel, 2017) generating some 15 billion US$ in foreign exports. Foreign tourists stay almost 10 days per visit in the country. Currently the split between foreigners and residents in tourism earnings is 40 percent to 60 percent due to some 270 million trips undertaken domestically. Singapore, Malaysia, China, Australia, and Japan are the top five sources of visitors to Indonesia. Indonesian government want to focus on some top destinations to further develop tourism: Borobudur, Mandalika, East and West Nusa Tenggara, Labuan Bajo, Bromo, Thousand Islands, Toba, Wakatobi, Tanjung Lesung and Morotai and Tanjung Kelayang.

Figure 1: Tourism Development in ASEAN and Indonesia 2000 to 2016 (relative to 2000 = 100)



Source: http://www.aseanstats.org

Indonesia is embedded within the ASEAN region. This region has one of the highest growth in international tourism and almost tripled the amount of foreign visitors during 2000 and 2016. The direct contribution of Travel & Tourism to ASEAN GDP was US$ 0.12 trillion or 4.7percent of ASEAN GDP in 2016. The 113 million foreign ASEAN tourists contribute to 8.6percent of total exports in 2016. The total contribution of Travel & Tourism is 11.8percent of GDP and is expected to be 13.5 percent of GDP in 2027. This is considerable higher than the world average and ASEAN region is one of the top tourist regions in the world. The rank of Indone-

sia is however not in the forefront of ASEAN countries. Other ASEAN countries were more successful in promoting their tourism. Despite the fact that Indonesia hosts 41 percent of the 639 million ASEAN people (2016), its share in international tourism was around 10 percent of international ASEAN tourism with a maximum of 12.9 percent in 2000 and a minimum in 2006 with 8.6 percent. Countries like Malaysia and Thailand had close to three times more tourism than Indonesia with a similar range of touristic products.

2. Country comparison Indonesia - Austria

In this article we first describe Austrian tourism - which is to more than 80percent rural - to an Indonesian audience and then emphasise that local food and agriculture can play a key role in advancing tourism. Particularly in rural areas tourism and agriculture can go hand in hand to further regional economic development like it was the case in Austria. In Indonesia there might come a similar major shift towards tourism in the near or mid-term future. Tourism builds widely on the structure that was built up by agricultural and fishing activities. These activities do no longer provide enough income. Taking a combined tourism-agriculture strategy from Austria and Europe, we can exemplify how tourism and agriculture can jointly create considerable higher incomes. In a second part we propose to use the varied Indonesian food and cuisine to promote tourism at all scales: national, regional and local. Thereby tourism will support the sustainability of agro-industry. In fact we already find many good Indonesian examples on how to promote food specialities and they can be combined in a strategy. Eventually the experience from Austria can help here.

An introductory task is to make the two different countries comparable to allow judgements in how far transfers of approaches are likely to succeed. In Table 1 we give recent data on the structure of the two countries.

Table 1: Country Comparison Indonesia - Austria with selected indicators

	Indonesia	*Austria*
World Bank Classification	Lower middle income country	High income country
Gross National Income	$1,020,000 billion	$387,299 billion
Population in million	261	8.8
Area in km²	1,904,569	83,879
Population density	125	104
Per capita income	$3,895	$44,561
Arable land per person	0.09 ha	0.16 ha
Agricultural land in percent of total	32percent	38percent
Forest Land in percent of total	50percent	47percent
CO2 per capita	1.91 t	7.36 t
Rank in CCPI (Germanwatch 2017)	22 [score 58.86]	41 [score 52.0]
Passengers carried by plane	89 million	14.7 million
Agriculture in percent of GDP	13.5	1.3
Services in percent of GDP	43.3	70.7
Incoming tourism percent exports	5.8	9
Outgoing tourism percent imports	5.1	5

Source: World Bank 2016 (most recent data 2014 to 2016)

While Indonesia is an emerging economy, Austria is a mature economy. The per capita income of 2016 is more than 10 times higher in Austria and annual CO2 emissions are four times higher. Agriculture is on retreat in Austria, the agricultural land is declining while forest land is again going up. This is different in Indonesia where the forest land was shrinking and the agricultural land increased. There is twice the arable land per inhabitant in Austria. On the other side there are more harvests in Indonesia. Agriculture is the dominant sector in rural Indonesia

with 13.5percent share in GDP and tourism - probably one tenth of the services GDP - is still less than one third of this number.

Tourism is well developed and mature in Austria while it is a high growth potential industry in Indonesia with a planned doubling in international tourism during the coming decade. Tourism in Indonesia is widely based on air traffic and an increase in air traffic for further tourism growth while in Austria only a small portion of tourists is arriving by plane and ground based transportation in particular private cars are used to consume tourism. This infrastructure is not built in a comparable way in Indonesia. Roads in Austria are less affected by traffic jams. In Indonesia tourism is much better developed in targeted tourism resorts and regions. The shape of Indonesia with many remote islands makes it difficult to pursue an equal touristic development all over the country which is a declared goal of the tourism policy in Austria.

Sustainability is a repeated aim from its early beginning in the 1960ies and the publishing of "silent spring" (Carson R., 1962) to the "limits to growth" report (Meadows et al. 1972) the first UN conference of environment and development in Stockholm in 1972, the "Brundtland Report" (WCED 1987) leading to the establishment of the IPCC and international negotiations to climate change, the 2nd UN conference on environment and development in Rio de Janeiro, the United Nations Millennium Development Goals (2000) and their update "2030 Millennium Development Goals" (United Nations 2015). Agriculture was always in a very prominent place. The book silent spring blames pesticide or industrial fertilizer use and the death of birds after spraying pesticides from the air. This book can be regarded as a waking call for the environmental movement during the 1960ies. Food security, the eradication of famine and poverty is another major and repeated goal of sustainability.

While it seems clear what the term means for agriculture, sustainability is more difficult to define with regard to tourism and the term was developed isolated from overall aims outlined in the Brundtland Report (Hunter, 1997). In particular as the term sustainable tourism was used for marketing of smaller scale remote area tourism or to promote tourism in nature protected areas without giving any evidence in how far overall sustainability criteria are met. Green or rural tourism are perhaps better terms to describe non urban tourism. The very close dependence of agriculture and tourism was brought to attention by Sharpely (2004) when he analyzed the consequences of the foot and mouth disease in England. Emergency measuring like killing and burning infected life stock disturbed the romantic picture of sane country side promoted by tourist agencies. In addition precaution measures like prohibiting trekking tourism in affected zones stopped tourism almost entirely and made the economic importance of (non) tourism for rural areas noticeable. Similar problems were observed in other European regions e.g. the Danube Delta when avian flu affected tourism.

Recently a more elaborated approach was launched by the EU Directorate of Trade and Commerce by outlining a range of sustainability criteria that have to be met by tourist destinations to be named a sustainable tourist destination (European Commission 2016). However, primarily remote tourist destinations - that otherwise cannot compete in the dense European tourism market - overtook the guidelines and under casted themselves to voluntary reporting procedures. A stronger effect can be expected when an UNESCO award as a national heritage site is in sight. Better off and already famous tourist destinations in Europe do not need an additional instrument to promote them. Sustainability is not the most requested quality in tourism and in particular a chance for remote tourist destinations.

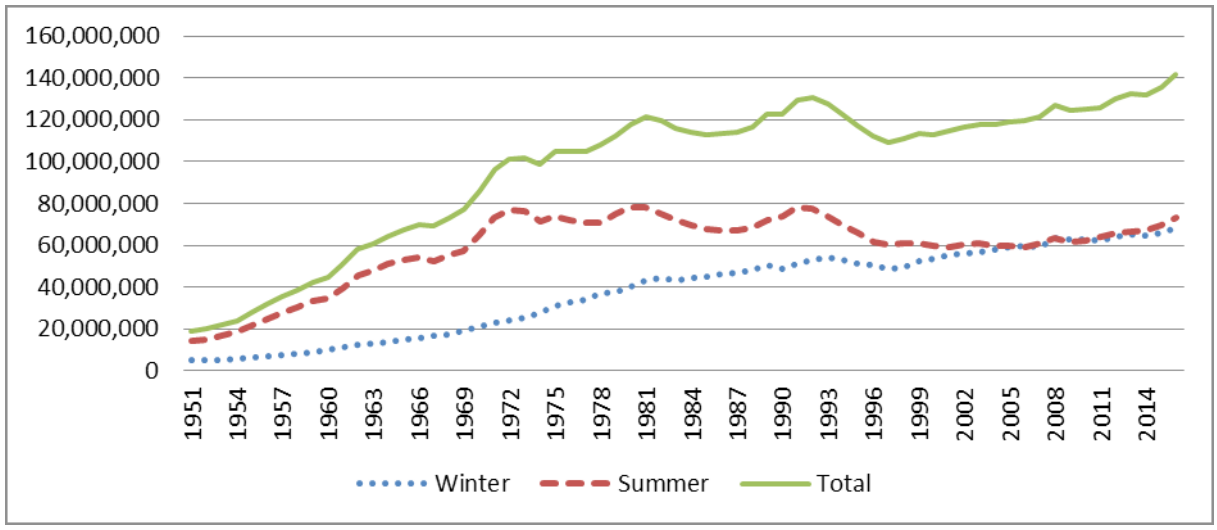
Climate change and climate protection is currently the most important topic within sustainability. Since 2005 the climate change performance index is measured by the Germanwatch Institute

in cooperation with Climate Action Network a global alliance with 300 national partners worldwide (Burck et al. 2016). So far no country does enough to stop climate change emissions and adverse land use changes like deforestation. The Paris Agreement (2015) set a new climate target that global warming has to remain within a 2°C range. All nations have to work 100percent or to score 100 to reach this aim. This year Indonesia ranks 22nd scoring 58.21 in the group of moderate performers, while Austria is in rank 41 with score 50.69 in the group of poor performers. It is obvious that both countries are not contributing enough to reach global sustainability.

3. Rural Tourism in Austria

Tourism can contribute to the wellbeing of farmers and to social and economic sustainability. Prices in agricultural commodities were continuously going down. Other means of income have to be considered. In urban near areas there is the possibility to look for a side job. The more remote areas cannot do this and have to go for other solutions. In Austria the poorest farmers high up in the mountains were the first ones to establish winter tourism. The productivity of their farms was very low. As farmers wanted to stay at their land they had to find other means of income and started tourism in a modest way. The first interest of tourists was in summer tourism and activities undertaken in summer. With higher incomes winter tourism developed later on when many people could effort a second holiday. Many poor mountain farmers became rich over time as the low productivity of their land in agriculture became high productivity in tourism.

Figure 2: Development of Austrian Tourism in Guestnights



Source: Statistik Austria, timeseries data 1951 to 2015

In Figure 1 we explain the tourism development with the indicator guest overnights per year. Austria would not be so successful in tourism if it would not have two tourist seasons. Austria is perhaps the best case study in Europe to investigate on how to keep rural land populated by a shift of economic activities from agriculture to tourism. Austria in the centre of Europe is an intensive tourist country. In 2016 USD 19 billion were earned in tourism or more than USD 2200 per person and year by each of the 8.5 million inhabitants. This relates to 6 percent of direct earnings in tourism, but with multiplications in other economic sectors and related indirect earnings this number reaches 15 percent (UNWTO 2016). In comparison agriculture and forestry account for USD 9.5 billion annual earnings (Austrian Ministry of Agriculture 2017) or half of the number earned in tourism. However, rural tourism is deeply rooted in agricultural activities. Rural areas in Austria are more populated than the rural regions of other

industrialized countries. So far outmigration to cities could be minimized as tourism provides more income possibilities for younger people.

The possibilities to establish tourism after 1950 were well taken in Austria, a landlocked country. More than 80 percent of tourism happens in rural areas. Less than a third (32.2 percent) of the 41.5 million Austrian tourists are local residents (Statistik Austria, 2017), the reminder originates primarily from within EU whereby Germany and Netherlands are the most important foreign groups of tourists. Each tourist spends in average 3.4 guest nights in Austria summing up to over 140 million guest nights. The 18.5 million tourists in winter period (November to April) spend more money than 23 million tourists during summer period (May to October).

Two thirds of the Austrian landscape is mountains and today we find two seasons, a summer season with a peak in August and a winter season with a peak in February. Summer tourism - coinciding with agricultural production - and winter tourism - primarily snow based activities - are quite different with regard to their touristic products. The rural landscape is a key asset of particular summer tourism. Here hiking, biking and swimming in lakes are major activities. Snow based winter tourism with skiing and other winter sports is more technology based and the management of winter resorts requires therefore extra skills.

The climate fluctuates according to the season and month and the altitude above sea level starting with 117m in the lowlands of Eastern Austria to 3797m, the peak of Mount Großglockner in the Alps. The mean altitude of Austria is 950m above sea level. The population lives in their majority with 56 percent under 400m altitude, 38 percent live between 400m and 800m altitude and 6 percent live above 800m (Breiling et al. 1997). The highest permanent settlement is situated in 1780m altitude. The highest hotel infrastructure is in 2400m altitude. Currently snow based winter tourism provides the highest income and there are more than 300 ski resorts with 25,000 ha ski tracks. The highest part of the Austrian landscape is only used by few mountaineers and more than 99.9 percent of tourism does not exceed 2.800m altitude. A climate change induced problem is that winters get warmer and we cannot rely on natural snow in particular in lower areas of the country. Snow making infrastructure was established at 17,000 ha ski tracks to adjust to the changed climate conditions and to secure income to rural areas during winters. Skiing requires today the highest amount of irrigation water and ponds to supply this water were established all over in the landscape.

There are about 80,000 tourism companies including 15,000 hotels in different categories, more than 2,000 mountain ropeways to transport tourist into high altitude resorts. Currently there are still 161,000 farm units in Austria (Austrian Ministry of Agriculture, 2017). Every 7th farm or more than 20,000 farms offer so called farm holidays. Each farm offering more than 20 beds, usually 10 rooms needs to have one family member or employee with a diploma from a special education in tourism and hospitality management to guarantee a high level of tourism. In many cases farm holidays are organized in online platforms (such as www.farmholidays.com), sometimes organized via farming organizations and otherwise via local tourist associations. Recently also large portals (like www.booking.com) have a direct link to offer farm holidays in Austria. The farms are members of an association and have to comply with certain criteria. The offer can include simple overnight services or include some particular experience products such as guided tours to mountains, courses on food production, degustation of cheese, wine, sausages and more agricultural products

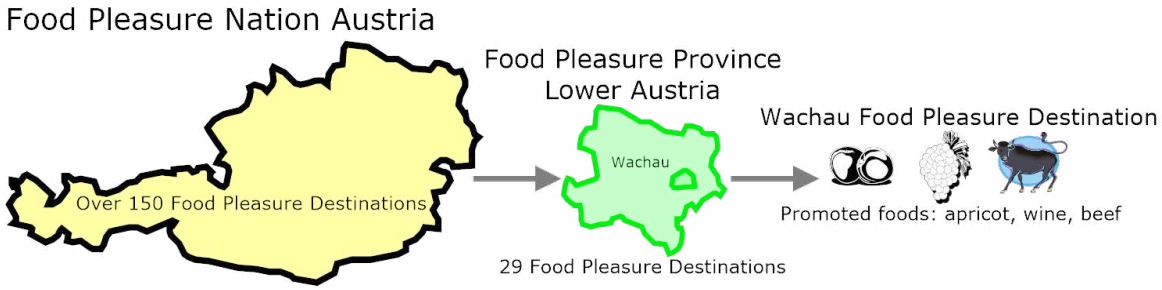
4. Food pleasure destinations as national or regional agro-touristic strategies

We give examples to alter the tourism value chain from inside a destination or country. Most aspects of tourism cannot be directly influenced from within the destination. The case is different if we consider the establishment of a food pleasure destination. The idea is to describe how a destination can earn considerably more money with more local resources and less imports by developing an appropriate business strategy and then to implement it in a concerted effort. The more destinations that follow the concept the better it is. Instead of one particular food pleasure destination we then get entire food pleasure regions. In addition the sustainability of resorts and destinations increase at the same time as more local resources is used at the expense of cheaper imports.

A long tradition, efforts often lasting decades and a continuous struggle to improve the quality of a typical product are signs in developing food to a trade mark and to an elevated touristic product.

We describe the local efforts in Austria to build up food specialities and to gain an important place in the international community. This in turn helps tourism and leverages destinations undergoing the process from more general to specific ones. Thereby the same marketing approach is used for the national, provincial and local destinations.

Figure 3: Food Pleasure as National, Regional and Local Concept



Source: Breiling 2016

The national webpage provides access to over 150 food pleasure destinations all over Austria (http://www.genuss-region.at). For the distant visitor from Indonesia or elsewhere it is important to promote Austria as a whole as a country of food specialities and make tourists curios on new food experiences as a part of their travel. For tourists who already know Austria this approach would be to general. Therefore in a next step the promotion of the province is targeted and the differences in different food traditions can be explored here. In Figure 2 we select Lower Austria province to give more information on 29 particular food pleasure destinations that can be visited. Lower Austria is surrounding the capital Vienna and the destinations aim to invite particularly citizens from Vienna to visit and explore them. Particularly well known is Wachau cultural landscape also a UNESCO World heritage. At this point we go into three awarded agricultural products, the local apricot variety, the "Wachauer Marille", the grapes for producing white wine like "Grüner Veltliner var. Federspiel and var. Smaragd" and the most recent local product the "Wachauer beef".

Wachau is since many decades well known for apricots and wines. Apricots flower in April and May and get mature during July. Wine grapes get mature during late August and September, young wine can be consumed during October. So during the entire vegetation period there is an incentive to visit the region in particular for the agricultural products. All year round popular is

the Wachauer beef, an invention made 25 years ago when a local inhabitant decided to start with cattle breeding on meadows that were sometimes flooded and not suited for fruit cultivation. The project was a great success; the demand after Wachauer beef is much higher than the supply. The production cannot be expanded as the available land limited and therefore the meat is not exported but has to be consumed within the region in one of the restaurants offering this speciality.

The food products, the life style of farmers and the production methods in rural settings developed into a set of touristic experience in the Wachau Cultural Landscape. This helped to mutually improve the agricultural and the tourism sectors. A set of businesses related to the food processing, the agricultural production, the selling and marketing of typical regional products, the local restaurants and the hotel owners and providers of other accommodation profited from the local cooperation in an extraordinary way. The value added to the local products by concentrating on business cooperation of the own region can be several times higher than what it would be otherwise.

This concept proven to work in Austria could be transferred to Indonesia. But Indonesia is much larger and considerable more diverse than Austria. The idea could be first introduced and administered in any of the more than 30 Indonesian provinces according to a developed set of criteria. Successful provincial concepts can be combined to a national one later on. In addition there might be other programs already in place that should be incorporated into a national program and modified according to a national or provincial joint agro-tourism strategy. One food related program outlined in the ASEAN Tourism Strategic Plan 2016-2025 are ASEAN food trails coordinated by the tourism board of Malaysia (ASEAN 2016). It was not possible to indentify all local and regional frameworks already in place. The 104 Indonesian universities offering agricultural education could be instrumental with their knowledge and direct contacts to farmers and local food producers to combine single initiatives to a large framework.

Provincial programs to support local food tourist destinations should be built up with government support. Each tourist destination should get the possibility to apply and a coordinating body situated in the provincial government or tourist board could propose food pleasure destinations. In a joint effort of local applicants, the tourism and agricultural department the exclusivity of the food product or suitability to elevate it to a special lead agricultural product could be tested. For example in Bali one can find rice products originating from the UNESCO protected agricultural heritage sites offered at a superb price. Luwak coffee is another candidate. Varieties of tropical fruits, different kind of sea foods are yet other suitable products that should be systematically presented to tourists as agricultural flagship products. As compared to the comparatively small Austria it is likely to come up with 2000 or more destinations in entire Indonesia. To keep an overview for visitors and to differ between domestic, ASEAN region and other international tourists, versions of different complexity could be established.

5. Conclusions

Indonesian and ASEAN tourist prospects can raise high expectations for any community currently not or not sufficiently participating in tourism. However, even in a situation of extraordinary growth it is not sure that those who need development most of all will participate in the wealth brought by tourism. The gap between investors searching for appropriate business opportunities and rural communities can be enormous or even unbridgeable. Income levels are rising even for middle and lower middle classes and they should spend their money for tourism in the vicinity. The standards of tourism products should be adjusted to the needs of the nearby middle class.

In comparison to Austria with an almost entirely endogenous tourism development building widely up on agriculture and the established agricultural infrastructure, Indonesian tourism develops more from outside regions and destinations. This means that large parts of tourism revenues can flow out again and expected multiplication effects for local communities are limited. In Austria a major touristic development started 1950 onward in a relative slow pace. In Indonesia the development period of tourism is much shorter. In Austria for decades we had regional visitors and the adjustment of people offering and selling tourism was not so difficult. With increased numbers of international tourism the rural tourism development can be challenged in particular due to different values and attitudes. A rural tourism policy with destinations for nearby domestic and distant international tourists may help here. Austria is particularly suited for tourism. It is surrounded by densely populated countries. The Netherlands have no or Germany has not sufficient mountains to host tourists in appropriate numbers. So the number of tourists depends highly on alternative offers in the region.

Tourism offers great potential for contributing towards eradicating regional poverty. Rural areas and the communities living in them are often the primary focus of tourism activity such as natural and cultural area sightseeing, trekking, hiking, mountain climbing, river and coastal recreation, swimming and sports. In the Indonesian tourism plan we find particular development zones outlined that can expect prioritization in planning tourism ventures. In general they have comparatively better access than many other locations. A more inclusive pattern of tourism like expressed in the vision for ASEAN tourism (2016), requires that marginalised communities are more engaged in the tourism economy at a destination level.

The agricultural sector can offer particular assistance in promoting tourism and vice versa can gain extra income provided by tourists. This potential seems currently underutilized in Indonesia due to lacking awareness of the interrelations of agriculture and tourism. More or more visible agro-touristic programs are required to enable an endogenous tourism development. This can guarantee that primarily local interests are considered and residents can take direct benefits. Such programs should differentiate between inviting local, regional and distant tourists as requirement for skills and investment will be different according to the targeted tourists. An inclusive destination policy and framework contributes new economic opportunities to rural and remotely located communities in Indonesia. Food and the exchange of food traditions can be very important in promoting local and regional tourism.

The broad network of agricultural universities in Indonesia should be used to promote agro-touristic programs. In parallel it is advisable to establish local and regional agro-tourism and hospitality educational programs. Each university can become a node for developing agro-touristic programs that go considerably deeper into rural areas than the current vision is. Touristic rural innovations – like farm home stay, food festival programs – can temper economic differences to urban areas and will help to keep rural areas populated.

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Study of Beef Supply and Demand inYogyakarta by Simultaneous Estimation Function Model

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ABSTRACT

The population of human in each districtin Daerah Istimewa Yogyakarta (DIY) always increase year to year. This condition makes the demand of food also increase, Recently it is not only for staple food but also for the secondary food like beef demand too. The Supply of beef in this area have not been balance with the demand of beef. This study purposed to analyze the condition of beef supply-demand in DIY, especially in Yogyakarta city, one of district of DIY and to identify factors that influence the demand and supply of beef. We incorporated one of econometric model called Simultaneous Estimation Function Model to approach the goal of this research by using secondarytime series data from 1995 through 2016 from Indonesia Statistical Bureau and Data Centre of Directorate General for Livestock Services of Indonesia. Many parameters observed are production and consumtion of beef. Many parameters are running in this model especially Two Stage Least Square (2SLS) methode. The result of this study indicated that all of parameter that include in this model were determined simultanouesly by demand and supply Linkage. This condition indicated that in the future time there will be increasing of demand of beef in Yogyakarta city. It must be fullfill with the availaibility of beef in this district. Goverment should make many policies if we need the condition will be better.

Keywords: Beef, Demand, Supply, Simultanoeous Model.

BACKGROUND

Recently, in Daerah Istimewa Yogyakarta (DIY) Indonesia the human population rises so that it makes changeof the food demand. This is not only for staple food but also for the secondary food, including beef, chicken and other meats. The increasing income per capita also could influence to change of the demand of meat. If the demand of beef change, the supply is expected be available to cover this condition. Production of beef asone of the parameters of supply must will be able to fulfil the demand of beef as long as the equilibrium condition goes well. In case of beef in DIY, especially in Yogyakarta which is located as central of DIYonly have small number of grassland to serve the feed of animal including beef. This condition maybe influence of the supply, shown on the production of beef. Many factorsare able to influence both the demand and also the supply of beef.

In supply side of beef as shown on the consumption of beef, many factors able to influence for example the beef production, price of beef, IB availability, grass feed availability, the amount of cow population, the import of cow and also the export of cow to this area. In other hand inthe demand side, many factors maybe influence for example human population, income per capita,

price of beef, price of other meat like chicken, price of cat fish, and price of soybean. If the supply not able to full fill the demand, the condition will not balance and will be any gap, both excess demand or excess supply of beef.

The condition of supply base on the production of beef di Yogyakarta city, it look increase year of year.

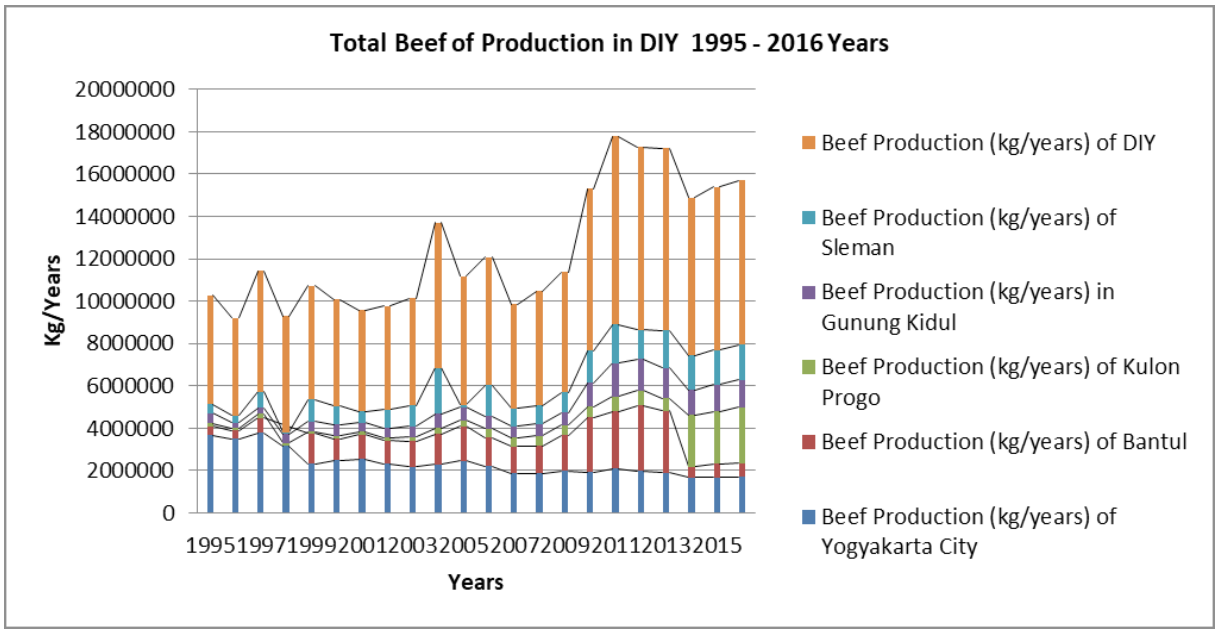

Figure 1. The Production of Beef in Daerah Istiewa Yogyakarta 1995-2016

Figure 1 showed that the supply of beef in DIY. The supply is meausrement by production data base 1n 1995 through 2016. In 1995 the production in Yogyakarata city is 3,666,827 kg, decrease by 2.449.600 kg in 2005 and decline at 1.691.020 kg in 2016. This condition showed that the production of beef in Yogyakarta city not higest in DIY. Share of the production of beef in Yogyakarta city only 21.77 % to Province of DIY on 2015-2016. Many factors that influence the supply. One of the rasional suggest maybe grassland that decrease year of year , according the high growth rate of land conversion from agricultural land to other many purpose of the economic destination.

In other hand , base on the demand of beef, figure 2 showed about the se condition in DIY. Yogyakarta city is the highest of the beef demand. Except the beef of consume of household, in Yogykarta city there are hight the improving of the beef agroindustrial with the many variation of the derived product of beef, especially demand of food arena, restaurant, hotel, guest house, public service make the demand will increase too. Yogyakarta is the main destination of touristm in Indonesia. Domestic tourism and also the foreign every year fulfill the space arena of Yogyakarta. This condition make the consume of beef higher than its year to before year .

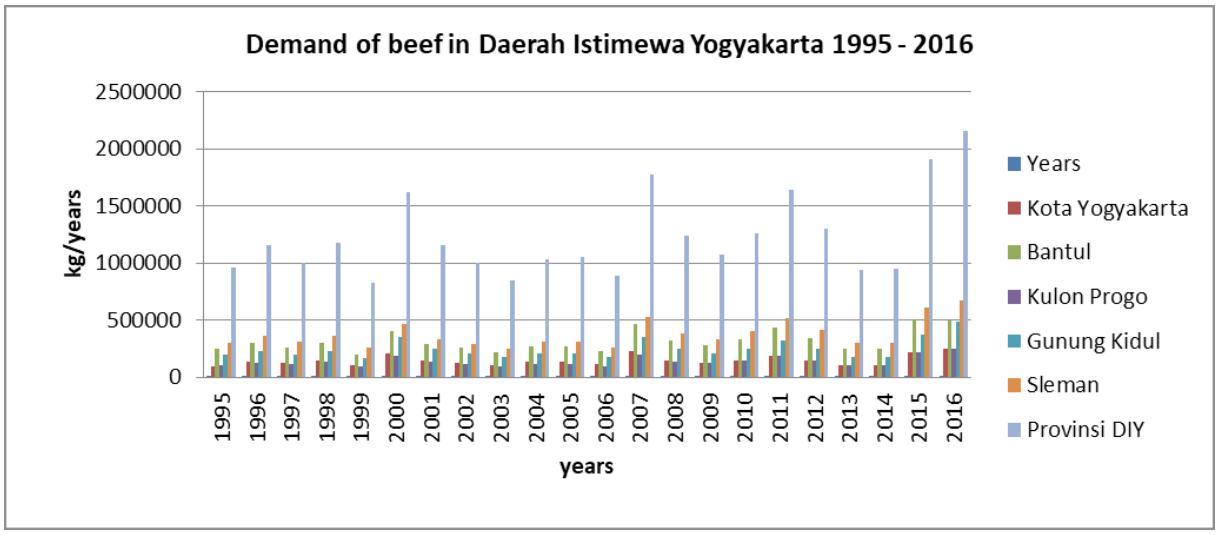

Figure 2. Demand of beef in Daerah Istimewa Yogyakarta 1995 -2016

Figure 1 and 2 showed that base on data from 1995-2016, the demand and suplly of beef and not going similarly.Growth rate of demand is 3.2 %/year and growth rate suplly is 2.08. It looks that there is not an equilibrium condition. Based on the background of the research it aims to analyze the factors that are abble to influence of demand of beef and also the supply of beef in DIY, especially the case on Yogyakarta city.

Method and Model Analysis of Beef in Yogyakarta City

We incorporated the simultaneous estimation function model to close the objective of the research. Simultaneous model is the part of econometric model especially in regression analysis model.A Simultaneous Equation Model (SEM) is a modelin the form of a set of linear simultaneous equations. The system is jointly determined by the equations in the system; In other words, the system exhibits some type of simultaneity or "back and forth" causation between the X and Y variables. As the name makes clear, the heart of this class of models lies in a data generation process that depends on more than one equation interacting together to produce the observed data. Unlike the single-equation model in which a dependent (y) variable is a function of independent (x) variables, other y variables are among the independent variables in each SEM equation. The y variables in the system are jointly (or simultaneously) determined by the equations in the system.

Compare the usual single equation.Notice that the first equation in the system has a conventional x variable, but it also has a dependent variable (y2) on the right-hand side. Likewise, the second equation has a dependent variable (y1) as a right-hand side variable. In a simultaneous equations system, variables that appear only on the right-hand side of the equals sign are called exogenous variables.

They are truly independent variables because they remain fixed. Variables that appear on the right-hand side and also have their own equations are referred to as endogenous variables. Unlike exogenous variables, endogenous variables change value as the simultaneous system of equations grinds out equilibrium solutions. They are endogenous variables because their values are determined within the system of equations. The equitation of the model is dividedinto three steps. As follow :

1. Formulated Demand of Beef in Yogyakarta city (Base on Consumption Data)
   Demand : QD

   $QD = f(X_i, X_2, X_3, X_4 \ldots\ldots\ldots\ldots\ldots\ldots Q_{t-1})$

   $QD = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + e$

   $\ln QD = \alpha_0 + \alpha_1 \ln X_i + \alpha_2 \ln X_2 + \alpha_3 \ln X_3 + \alpha_4 \ln X_4 + \alpha_5 \ln X_5 + \alpha_6 \ln X_6 + \alpha_7 \ln X_7 + e$

   where a Qd = Beef demand (kg/year)

   α = intercept

   $\alpha_1 - \alpha_7$ = Regression Cooeficient each variable

   X_{1-1} = Human population (people)

   X_{1-2} = Income per capita (Rp/capita/year)

   X_{1-3} = Price of beef (Rp/kg)

   X_{1-4} = Price of Chicken meat (Rp/kg)

   X_{1-5} = Price of "Lele" (cat fish) (Rp/kg)

   X_{1-6} = Price of soybean (Rp/kg)

   X_{1-7} = Beef production (kg/year)

   e = error

2. Formulated supply of beef in Yogyakarta city

   Beef Supply : QS

   $QS = f(X_{2-1}, X_{2-2}, X_{2-3}, X_{2-4}, X_{2-5} \ldots\ldots\ldots\ldots\ldots Q_{t-1})$

   $\ln QS = \beta_0 + \beta_1 \ln X_{2-1} + \beta_2 \ln X_{2-2} + \beta_3 \ln X_{2-3} + \beta_4 \ln X_{2-4} + \beta_5 \ln X_{2-5} + \beta_6 \ln X_{2-6} + \beta_7 \ln X_{2-7} + \beta_8 \ln X_{2-8} + \beta_9 \ln X_{2-9} + \beta_{10} \ln X_{2-10} + e,$

   Where as QS =Beef supply base on data beef production (kg)

   β = intersept

   $\beta_{2-1} - \beta_{2-10}$ = regression coefisient each parameters

   X_{2-1} = Cow population (number)

   X_{2-2} = Price of beef (Rp/kg)

   X_{2-3} = The availability of IB (packet)

   X_{2-4} = The availability of grassland (Ha)

   X_{2-5} =. The amount of slaughtered cow

   X_{2-6} = The amount of cow import to Yogyakarta city

   X_{2-7} = The amount of cow export from Yogyakarta city

   e = error

3. The next step is run the model by Simultaneous estimation function model. If the set of equations is exactly identified then we solve the reduced form parameters and then compute the structural parameters from the reduce form and if get the over identification we use Two Stage least Square (2 LS). In this research the model is over identification so we use 2 LS model.

4. The result of the model will be find , so we couldidentify many factors that influence beef demand and also beef supply as well.

5. Finally we reach the recommendation based on the result of the research and perform wise policy to improving of beef demand and beef supply in Yogyakarta city

Result and Discussion

1. Beef Production Growth Rate and Beef Consumption Growth rate of DIY

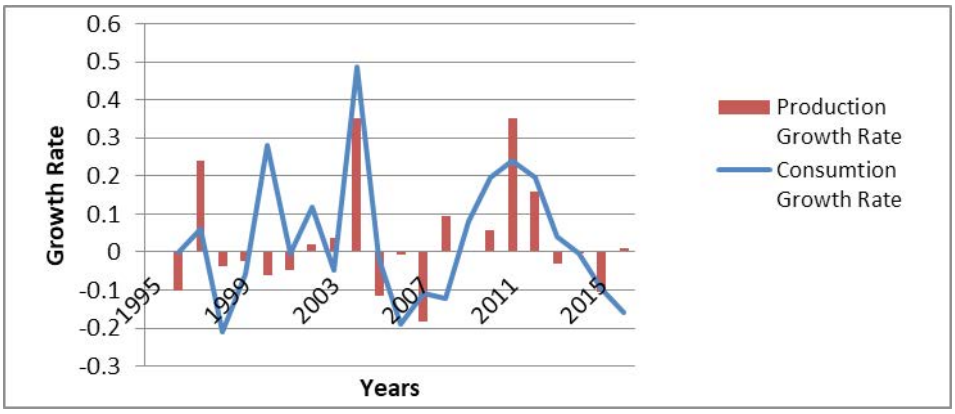

Figure 3.Beef Production and Consumption in DIY 1995 -2016

The rate of production growth of beef in DIY rises by 2.08 %/year. In Yogyakarta city. It is lower than the average of DIY in amount 1,98 %/year. In other hand , the consumption growth rate of beef in DIY in level 3.2 %/year , and Yogyakarta city by 3.9 %/year. This is the highest consumption in province DIY.

Demand of beef in Yogyakarta city increases year of year from 1995 -2016 because of in Yogykarta city many restaurants, food courts, hotel, motel, student resident, guest hoouses as DIY is one of the main tourist destination . in Yogyakarta city there are availability more than 200 foodcourt and more than 100 hotel , so it makes the demand of food also the demand of beef rises up year of year

2. The Factos that Influence of Beef Demand and Beef Supply in Yogyakarta city

The case of beef demand, many parameters used in the model as endogenous variable and also the exogenoeus varibel. Endogenous variable of beef demand is beef consumption . The exogenous variables areHuman population (people); Income per capita (IDR Rp/capita/year); Price of beef (IDR /kg/years); Price of Chicken meat (IDR/kg); Price of "Lele" cat fish (IDR/ kg); Price of soybean (IDR/kg) and Beef production (kg/year)

Demand of beef is simulated by all of beef consumption in Yogyakarta city. Table 1 showed the factor that able to influence of beef demand. We use simultaneous model of 2SLS methode We also had done test of model to get the model as Best Least Unbias Estimation (BLUE).

Many parameters also used in the model of beff supply in Yogyakarta city. The endogenous variable is the production of beef. The exogenous variables are Cow population (amount of cow);Price of beef (ID/kg);The availability of IB (packet); the availability of grassland (Ha); the amount of slaughtered cow;

The amount of cow import to Yogyakarta cityand the amount of cow export from Yogyakarta

city to other area. The supply also calculate bysimultaneous model of 2SLS methode . We also had done test of model to get the model as Best Least Unbias Estimation (BLUE).

Table 1. The Result of The Simultaneous Model of beef demand and beef Supply in Yogyakarta City

Variables	Notice	Parameters Hypothesis	Probability	Note
C	Constanta	- 0.133389	0.8958	Note
X_{11}	Human Population			R^2 = 0.8422219
X_{12}	Income per capita	-	0.00137**	Adjusted R^2=
X_{13}	Price of Beef	1.5732890	0.9396	0.913328
X_{14}	Price of Chickenmeat	0.077366	0.9902	DW = 2.045
X_{15}	Price of “lele” catfish	- 0.012536	0.4786	F Statistic = 32.6133
X_{16}	Price of Soybean	- 0.729786	0.1064	
X_{17}	Beef Production	1.736028		
X_{21}	Cow population		0.9252	
X_{22}	Price of beef	- 0.095736		
X_{23}	The availability of IB		0.0070**	
X_{24}		3.201171	0.6766	
X_{25}	The slaughtered cow	0.426021	0.0186**	
X_{26}	Cow import	2.662722	0.0809	
X_{27}	Cow export	- 1.881371		
	Grassland		0.0004**	
		4.579357		
			0.0023**	
		1.248874		
			0.6372	
		- 0.482122	0.3732	
		0.919893		

Source : Analysis Secondary , 2016

From table 1, showed in Yogyakarta city DIY the factors that influence of beef demand (the variable siqnificant by level 5%) are human population, beef production , price of beef

And the factors thatinfluence of beef supply andsiqnificant by level 5 % are price of beef, the availability of IB, The slaughtered cow and cow import from other district or other province or other country.

CONCLUSION

1. From The result of this study it is shown that in Yogyakarta city, one of the district of DIY having that beef demand and beef supply have been growing in the different number, whereas the beef demand growth rate higher by 3,9 %/year than beef supply growth rate by 1.9 %/ year.
2. The factors that influence beef demand in Yogyakarta city are human population, beef production and theprice of beef
3. The factors that influence beef supply in Yogyakarta city are price of beef, the availability of IB, The slaughtered cow and cow import.
4. Government of Province DIY is able to make any action to anticipate the increasing beef

demand by some policy to get good equilibrium market .

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The Appeal of Dawet Ireng Purworejo as a Natural Local

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ABSTRACT

ASEAN Economic Community as an effort for economic integration which isone of the characteristics that is the existence of market and single production. These include: free flow of product and investment and development of food-agriculture-forestry sector. Therefore, Indonesia's small and medium enterprises (SME's) products have challenges of quality and standardization, global issues (green product, HACCAP), and innovation creativity. This happens also on dawet ireng Purworejo as a natural local product. Whereas dawet ireng must compete also with local and national modern product. From the results of previous research it is known that product quality, image, price and promotion have a positive significant effect on the decision to buy dawet ireng Purworejo. Therefore, it is important to know how to improve the appeal of dawet ireng Purworejo as a natural local product so that it has high competitiveness and able to become regional icon that can be equated with modern beverage products. To support the brand image and bargaining power of dawet ireng as a unique icon, local government needs to set the standardization of product, promotion and uniqueness of dawet ireng as well as optimizing the development of related entrepreneurs.

Keywords: dawet ireng; natural local product

INTRODUCTION

UMKM as one of the important sectors in the Indonesian economy. Nowadays it is increasingly being taken into account. Not only support the Gross Domestic Product, MSMEs has also been able to absorb a lot of manpower. But the enactment of ASEAN Economic Community (AEC) since end of 2015, finally become a challenge for SMEs to be able to compete in the global market. AEC as an effort for economic integration of ASEAN region, has characteristic that is existence of market and single production. These include free flow of goods / services and investment / capital, free labor and integration of sector priorities and development of food-agriculture-forestry sector (AEC Blueprint, 2008). In addition to competing with products from other countries, Indonesia's Small and Medium Enterprises (MSMEs) have the challenges of quality and standardization, global issues (green product), creativity and innovation. This challenge must be passed if MSMEs wants to always exist and grow.

At the time through the challenge, Indonesian MSMEs were able to survive and keep growing in recent years. After Indonesia's economic growth has slowed since 2011, MSMEs sector is able to grow 2% from year to year. Even by the end of 2013, from 57.9 million MSMEs can contribute 99.9% of the total companies with 2.4% growth per year (Shinozaki et al, 2015). As growth in 2011, 77.6% is supported by primary industries (agriculture, forestry and serving) and trade. This shows that MSMEs have a strong enough supportability for the Indonesian economy.

Table 1. Development of MSMEs in Indonesia 2010 – 2013

No.	Indicator	Unit	2010	2011	2012	2013
1	Number of MSMEs	Units	53 823 732	55 206 444	56 534 592	57 895 721
2	Growth of MSMEs	Percent	2.01	2.57	2.41	2.41
3	Number of UMKM workers	Person	99 401 775	101 722 458	107 657 509	114 144 082
4	Growth of MSME Workers	Percent	3.32	2.33	5.83	6.03

Data source : bps.go.id, accessed on September 28, 2017

With a large carrying capacity at the national level, it can be ascertained that the existence of MSMEs give full support for regional economic development. Various local potentials have been developed by MSMEs into competent superior products. It is not uncommon that these local products have been able to penetrate national and international markets. But on the other hand must be acknowledged that there are still many products based on local potential MSMEs also has not been able to develop optimally.

This condition is one of them occurred in Purworejo Regency Central Java Province, Indonesia. Currently Purworejo has a variety of local products that have penetrated national and international markets. Among these products are VCO (Virgin Coconut Oil), processed products of mangosteen peel and coconut sugar powder. For example, in August 2017, Purworejo's sugar ants successfully penetrated Sydney Australia and Colombo markets in Sri Lanka. Purworejo ant sugar currently reaches up to 220 tons per month which is exported to various countries (krjogja.com - August 11, 2017).

The success of SMEs product was not yet able to be followed by the products that became the icon of Purworejo. Until now, the typical Purworejo icon product has not been able to develop properly. In addition to clorot food and cake lompong, other products in the form of a typical local drink that is dawet ireng. Dawet ireng has become a trend and is widely known in various regions in Purworejo and outside Puworejo since several years ago. The carrying capacity for the regional economy can not be considered trivial either. As result of research of Setiawati et al (2013), contribution of agroindustry revenue of dawet ireng to family income in Butuh district Purworejo Regency as the main center included in high category because reach 70,68%.

Reality is not directly proportional to the current conditions. The number of modern and contemporary products has gradually shifted the existence of dawet ireng as a typical drink product Purworejo. When dawet ireng increasingly known widely, it is in the internal Purworejo own dawet ireng increasingly perceived to be an ordinary product and far from the typical impression. On the other hand, the emergence of business actor dawet ireng in some areas, also increasingly enhance the level of competition among sellers dawet ireng. These conditions ultimately impact on not paying attention to product quality and dawet ireng image as a typical product Purworejo.

The position of dawet ireng increasingly much different from modern beverage products. This is evident from the more interested in similar drinks than dawet ireng. Though dawet ireng is a local product with natural ingredients that are very distinctive. If this is left then dawet ireng will increasingly displaced from society and its brand image as a Purworejo special drink become unclear. Therefore, it is important to know how to improve the attractiveness of dawet ireng Purworejo as a natural local product so that it has high competitiveness and able to become regional icon that can be equated with modern beverage products.

LITERATURE REVIEW

Marketing holds an important role in business operations in various fields. In consumer convenience store research at Bekasi area of West Java Indonesia, it is known that price, promotion, and quality of service have the greatest influence to consumer purchase decision. In this case the standard price, attractive promotions, discounts, and good customer service can encourage awareness and more visitor participation thereby increasing consumer buying intentions (Zhafira et al., 2013).

While research on influence of promotion mix and price to consumer decision of fast food sector through survey to university student in Jakarta, Bogor, Depok, Tangerang and Bekasi Indonesia found that promotion mix and price only require 37,2% consumer purchase decision to fast food (Sagala, 2014). So there are other factors that influence consumer purchasing decisions against the possibility of price increases, products, and more. Compared to the promotion mix and the price, personal selling has the most significant impact on consumer purchasing decisions.

The decision-making by consumers consists of problem identification, information retrieval, and alternative evaluation, purchase, and post-purchase evaluation. But the buying decision process is possible not through all these stages (Pride & Ferrell in Sagala, 2012). The purchase of a product is precisely influenced by promotion and price. Merging advertising with sales promotions and other marketing mixes can have an ongoing effect.

In a study on the influence of brand image and promotional mix on beverage purchase decisions in Lagos State Nigeria it was found that brand image and promotion mix influenced consumer purchasing decisions (Oladepo, 2015). Therefore, promotion mix is the right marketing communication tool to influence consumer purchase decision continuously. In the study concluded that the brand image, advertising, sales promotion and personal sales have a significant effect on consumer purchasing decisions. Therefore a combination of product promotion with a good brand integrity will make consumers buy it and make repeat purchases, and also increase the chances or other prospects. Business actors can adopt a combination of promotional mix with the aim of, among others, to produce different turnover, increase market share, customer retention, profitability, and productivity.

Lin (2007) in his research found a significant difference in the correlation between brand image and consumer purchase intentions. Consumer buying intentions are influenced by brand image where the higher the status of brand image, the more buying intention that exists. There are several things that must be considered business actors in marketing their products that is (Lin, 2007):

1. Brand image indeed increases consumer purchase intention due to the formation of positive image. Business actors can take advantage of added value, such as expanding product line or save promotion cost when entering new market.
2. Consumers with different levels of product knowledge will use different methods to evaluate a product so that complete product information is indispensable in marketing.
3. The discounted price leads to interference the correlation between brand image and purchase intention. So companies should discount prices carefully, such as reasonable arrangements regarding the price and the appropriate discounted price range for a product.

Consumer studies in Puerto Rico show that both monetary and nonmonetary promotions can increase brand loyalty and this is in contrast to previous research findings. If a few years ago promotions were deemed less effective when done traditionally through ad campaigns or sales promotions, this has now changed with sales promotions leading to local and national marketing

solutions (Mendez, 2015). Even sales promotion has become one of the most preferred marketing communication methods.

Synergistic with Mendez's research, in Chakrabortty et.al. (2013) it is known that sales promotion is most effective on the traveling consumer. In addition promotions and advertising sales are much more effective where simple promotional signals can lead consumers to buy products. However, advertising activities should be integrated with other promotional activities to increase product sales growth.

Advertising is increasingly playing an important role in the modern era for shaping the attitudes and perceptions of individuals and societies that prominently affect consumer buying behavior. Research on consumers in Gujranwala Punjab Pakistan, the results show that advertising and consumer perceptions both have a significant positive relationship to consumer purchasing behavior (Malik, 2014). It is also known that the impact of advertising on consumer purchasing behavior is greater than the impact of consumer perceptions. Consumer purchasing behavior can be enhanced by quality and creative advertising and by building positive consumer perceptions through strong marketing strategies.

In addition to the strengthening of marketing through various media and tools, SMEs still need support from the government. As Anton (2015) studies on the competitiveness of SMEs in Indonesia, SMEs need government assistance to develop marketing networks and access to financial institutions. Some of the competitiveness sources include innovation, entrepreneurship, human capital, financial resources, market potential and business strategy. Karaev et.al. (Anton, 2015) recognizes that SMEs face challenges in today's global business competition. In addition to responding to wide open business opportunities, SMEs must create and maintain business networks in order to expand their business.

However, support and guidance from the government to Micro and Small Enterprises (MSEs) should be done and followed up with continuous empowerment. Several factors related to the sustainability of MSE empowerment, especially through the implementation of CSR, namely: (1) the individual character of MSE entrepreneurs (2) the intensity of empowering entrepreneurs of MSEs; and (3) environmental quality that supports MSEs (Faisal, 2014).

DISCUSSION

Product Quality, Image, Price, Promotion and The Decision to Buy Dawet Ireng

Dawet ireng as one of Purworejo's unique natural products is not entirely comparable with modern beverage products. As regional icons, dawet ireng compete with modern beverage products. Moreover, modern drinks come with professional marketing tools to attract consumer interest. As a traditional drink, dawet ireng should be more appeal for the consumer. This appeal is developed through modern marketing media and tools, both conventionally and techologically based.

From research of Repastiningsih (2013) to consumer of dawet ireng merchant in east of Butuh bridge Purworejo, it is known there is significant influence between price and product quality to purchasing decision dawet ireng. Simultaneously there is also a significant influence between price variables and product quality on purchase decision dawet ireng. With the value of determination coefficient of 0,597 then purchase decision of denget ireng 59,7% can be explained by using price variable and product quality.

The speakers also conducted research on the influence of quality, product price and promotion

of purchase decision dawet ireng. The result shows that the significance value of image variables (X_2), price (X_3) and promotion (X_4) <0,05 so have correlation (influential) positive significantly to the dependent variable purchase decision (Y) (Yanto & Bachtiar, 2017). Positive influence is dominantly shown by promotion variable (X_4) with t_{count} of 6,820. While product quality (X_1) is not correlated (influence) positively significantly to dependent variable of purchasing decision (Y) because having significance value of each> 0,05. The quality of product, image, price and promotion together influential positively and significantly to purchase decision of dawet ireng because $F_{count} > F_{table}$ (46,451> 2,40).

In this study found results that are different from other previous studies by Respatiningsih (2013) because the quality of the product does not have a significant influence directly to the purchase decision dawet ireng. This is quite reasonable because the study involved 375 consumers from 40 sellers of denget ireng in Butuh, Kutoarjo, Bayan, Kemiri, Gebang, Purworejo, Grabag and Purwodadi districts. So consumers as respondents have different references and more diverse about dawet ireng and more able to represent the description of the appeals of dawet ireng in Purworejo District.

Brand image of Dawet Ireng

Based on the above statistical data and observation results of real conditions in Purworejo region dawet ireng need special attention in order to actually present as a quality product. Therefore it is necessary to coach the MSMEs of dawet ireng programmed and continuous.

With the support of Local Government and other relevant agencies, the strengthening of dawet ireng competitiveness today can be more optimized. Through the synergicity of coaching and empowerment program, dawet ireng will really be able to present as a special culinary icon of Purworejo which boasts. Strategic steps that can be done by local government to strengthen dawet ireng brand image are as follows:

1. Public perception about dawet ireng should be changed continuously. Therefore, the correct information about dawet ireng must be delivered properly to the public. One of them is information that dawet ireng is a local product with natural ingredients.
2. the community, especially the students and the younger generation should be routinely invited to prefer dawet ireng. This is in accordance with the results of field observations that 61.33% of consumers buy dawet ireng <3 times in one month. As many as 66.66% of them actually buy a similar drink at least three times in one month (Yanto & Bachtiar, 2017). Such drinks include juice, instant beverage manufacturer, fruit soup and the others. Though the price set in the range 3.000IDR to 4.000IDR each serving of the bowl. While similar beverage products sold at 5.000IDR to 10.000IDR each serving of the bowl.
3. Encourage the community to engage in productive business dawet ireng professionally, qualified, ethical and high-conscious that dawet ireng business not only prioritize the commercial aspect to earn income but also participate develop a typical product of the region that boasts. Professionalism is among others shown through good marketing activities and modern but still heeding the typical and traditional aspects.

Price Determination of Dawet Ireng

The price of dawet ireng can not be separated from product, brand image, promotion activity or other related matter. Therefore, MSMEs can give more attention to aspects of product prices to strengthen the attractiveness and consumer decisions in buying dawet ireng. With the reality that in the Purworejo area, other similar beverages are sold at a minimum price of 5.000IDR each

serving. Dawet ireng should also be sold at relatively similar prices. It should be remembered that in this case the price is not cheap or expensive, but the price appropriate for dawet ireng products with attention to various aspects.

Especially with the lack of consumption dawet ireng by the community today, it can be deduced that dawet ireng not be the main choice compared to similar drinks. Dawet ireng has been known as a unique drink but even fewer demand. In some culinary centers in Kutoarjo and Purworejo, the others drinks more in demand.

Therefore, SMSEs ofdawet ireng should be able to take part in similar beverage market. Even if the price should be more expensive than usual, it does not become an obstacle when they must decide to buy dawet ireng than others. The price should be expected by the consumer and appropriate for the seller.

As found by Shirai (2014), that marketers often attract consumers through high quality gestures and low prices placed in retail advertising or the "high quality and low price" (HQLP) approach. It is also known that for an expensive store, the HQLP appeal produces expected price and willingness-to-pay (WTP) or willingness to pay, higher purchase intentions for expected prices, and lower quality perceptions.

To further strengthen the bargaining power, the price of dawet ireng can be adjusted as follows:

1. The price should estimate the level of demand, expected price and sale level at different prices. The new price should see the reaction of competitors from similar products, replacement or different products.
2. New price dawet ireng can be set at least 5.000IDR by considering the aspects of product added value, quality, appearance, and presentation.
3. Price strategy can also use various options such as rebates, promotional prices, or wholesale prices

Some technical issues related to product and price adjustment can be done in the following ways:

1. Dawet Ireng does not use chemical dyes. The black color should use a safe natural dye that is the result of immersion of burned rice stems.
2. Sauce or syrup is not mixed with artificial sweeteners but using pure coconut sugar. Sauce is used after one week of cooking to produce a distinctive aroma of Java sugar and more delicious.
3. Coconut milk has been boiled cooked so it is more hiegienis.
4. Dawet ireng servetion using bowls and placemat from clay to give more distinctive and traditional impression. If possible also use a spoon from the coconut shell.
5. To increase the sensation of taste, appearance and nutritional content, dawet ireng can be varied with some nutritious supporting ingredients such as sweetened condensed milk, grated cheese or chocolate, cocochip, kaling fruit, bread or biscuit, young coconut, slices fruit, or glutinous tape. Even dawet ireng also very fitting combined presentation with ice cream. With the combination and variation with these support materials, dawet ireng can be offered at price of 5.000IDR to 10.000IDR.

Pricing can also be done along with various changes that may be applied to dawet ireng product. These changes include product quality, material composition, materials or auxiliary materials, portion sizes, equipment and serving methods. Changes in products with such price adjustments can have a positive impact:

1. Increase the value of profits because consumers become more interested in buying dawet ireng.
2. Increased attractiveness strengthens the brand image as a natural local product of Purworejo.
3. Dawet ireng as an icon Purworejo better able to align with modern and contemporary drinks so as to penetrate the various circles of society and have a wider market share.

Optimization of these measures should get real support from the Local Government of Purworejo so that dawet ireng Purworejo really present in the society as a product worthy of pride. Therefore it is necessary to coach MSMEs and educate the society to love dawet ireng programmed and sustainable.

Fig. 1. Comparison Of Dawet Ireng With Other Similar Products
(Pictures: personal documents and from various sources)

Strategic Promotion of Dawet Ireng

The results of the research also showed that promotion (X4) has significance value <0,05 so it has significant (positive) correlation to purchase decision (Yanto & Bachtiar, 2017). So the dawet ireng promotion must be really more planned and programmed. Although the majority of dawet ireng is still a micro or small business, the aspect of promotion can't be considered trivial if want to be able to compete with similar modern products.

Seeing the current conditions, modern drink comes with a variety of interesting media campaigns. Due to changes in the pattern of dawet ireng promotion with various media should be done. For example tea drinks have long been present with an attractive cart and eyecatching. So are drinks like capucino grass jelly, instant ice, fruit soup, or juice. Carts have been designed in such a way that brings its own characteristics and more modern.

Packaging is also more prominent as a classy beverage because it uses branded plastic cups and plastic press cover so it is easy to carry. This is in accordance with Ahmed et.al. (2014) which shows that the essential factors that drive purchasing behavior, packaging are the most important and dominant factors with elements including color, packaging materials, wrapper design and innovation.

while promotion activity dawet ireng still limited to conventional media with simple design and not memorable typical. For example The place to sell and promotions through banners are simply. If this is allowed to happen sustainably, dawet ireng will be increasingly eliminated and do not have a special position as a special product of Purworejo.

Fig. 2. Logo Branding of Purworejo

In order to be able to increase sales and represent the typical product image Purworejo, MSMEs should improve aspects of dawet ireng promotion that is:

1. Standardization of general promotio tools should be more highlighting Purworejo. One of them is with a promotional device that includes branding logo "Purworejo Typical Products" with Purworejo writing form as in the figure above. It is applied to banners, plastic bags, plastic cups and more.
2. Uniform cultivated to represent the characteristics of "regionalism" or traditional, such as wearing surjan and headband for men and kebaya for women.
3. Provide special plastic glass packaging logo as brand as well as product promotion for dawet ireng which is not eaten in place.
4. Sales activities supported by modern tools but still attention to local aspects and the specificity of the past in it. For example to put dawet ireng do not use glass or plastic jars but use a clay barrel. Gayung can also use traditional products from coconut shell.
5. MSMEs is encouraged to utilize information technology and social media online to promote dawet ireng.

CONCLUSION

From the description of the discussion can be concluded several things as follows:

1. The role and support of Local Government and related institutions, the strengthening of dawet ireng competitiveness among modern beverage products will now be optimized.
2. Coaching and empowerment program by the government, universities, private institution and community is needed so that dawet ireng become the icon of natural local products from the proud Purworejo.
3. Integrated marketing mix of dawet ireng should be applied in real terms by SMEs with the other business aspects to improve competitiveness, profit, welfare and the carrying capacity for the regional economy.

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Conflict Mitigation Approaches in Humans-Wildlife Conflict Management

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ABSTRACT

Human-wildlife conflict has been in existence for as long as humans and wild animals have shared the same landscapes and resources. The conflict has important consequences for local populations in terms of food security, safety and well-being, for the micro and macro economy, and also for wildlife conservation. Considering the current human population growth rate, the increasing demand for natural resources and the growing pressure for access to land, it is clear that the human-wildlife conflict will not be easily eradicated in the near future. Conflict between humans and wildlife is one of the most popular issues facing conservation and animal based tourism actors today. This issue encompasses a huge diversity of situations and species. On the face of it, conflict resolution should be a relatively simple endeavor, with the expectation that once the appropriate strategies have been put in place to deal with the reported issue, animosity towards the species concerned should abate. Evidence shows that complete, long-term conflict resolution is rare, even where such strategies have been implemented. Despite most people citing direct wildlife damage as the reason for their antagonism towards wildlife, the causes of conflict are often complex and deep-seated, and a broader approach must be utilized in order to ameliorate such conflict fully in the long term. Human-wildlife conflict can be managed through a variety of approaches. Prevention strategies endeavor to avoid the conflict occurring in the first place and take action towards addressing its root causes. Protection strategies are implemented when the conflict is certain to happen or has already occurred. Mitigation strategies attempt to reduce the level of impact and lessen the problem. This paper will describe the conflict mitigation approaches to reduce the people-wildlife conflict. These approaches could use for the management of wildlife, conservation area and animal based tourism, ranged depended on the complexity of interaction between humans and wildlife.

Keywords: Wildlife, conservation, animal based tourism

INTRODUCTION

In many cases, the interface between humans and wildlife are increasing by number, because the growing human population and settle into wildlife habitat have simply augmented the incidence of contact between people and wildlife. Similarly, the harvesting of wildlife has increased, leaving less natural prey for wild animal. Obviously, the probability of clashes between people and wild animal now tends to be higher and often and more becoming conflict, and as an enemy each other. Long established traditional ways of deterring fierce, fully-grown animal might become partly ineffective, and lethal methods are not always acceptable by modern standards.

Human-wildlife conflict happened in one form or another all over the world. Conflict between

human and crocodiles, between human and elephants, between human and monkeys, between human and tigers and soon, has been reported in countries spanning the tropics and subtropics, and the problem probably exists in many more. Are traditionally seen as the animals representing the greatest threat to human and responsible for the majority of human-wildlife conflict. This may be due to the fact that local communities often regard the large wild animals as government property, and therefore fell prohibited from dealing with the problem themselves (WWF SARPO, 2005). Human-wildlife conflict stemming from overlap of human and animal habitats is a recognized threat to effective conservation of natural resources for future generations. Besides the damage to crops or livestock directly affecting food availability, the consequences can be the damage to capital intensive goods such as houses, or even injury or death of a family member resulting in serious psychological trauma and adverse effects on food security for a long period.

Human–wildlife conflict is one of the most critical threats facing many wildlife species today both in developed countries and less developed countries, and the topic is receiving increasing attention from conservation biologists, foresters, and animal based tourism practices and experts. Direct wildlife damage is commonly cited as the main driver of problem and conflict, and many tools exist for reducing such damage. However, significant conflict often remains even after damage has been reduced, suggesting that the conflict requires novel, comprehensive approaches for long-term resolution and should be well planned. Humans and wildlife should stay in harmonization, integrated in biodiversity of natural resources.

Although most mitigation studies investigate only the technical or physical aspects of conflict reduction, peoples' attitudes towards wildlife are complex, with social factors as diverse as religious affiliation, ethnicity and cultural beliefs all shaping conflict intensity. Moreover, human – wildlife conflicts are often manifestations of underlying human-human conflicts, such as between authorities or local government and local people, or between people of difference social-cultural backgrounds, or between people with the same interests and resources. Despite evidence that social factors can be more important in driving conflict than wildlife damage incurred, they are often ignored in conflict studies. Developing a broader awareness of conflict drivers will advance understanding of the patterns and underlying processes behind this critical conservation issue.

HUMAN-WILDLIFE CONFLICT MANAGEMENT

Human-wildlife conflict can be managed through a variety of approaches. Prevention strategies endeavor to avoid the conflict occurring in the first place and take action towards addressing its root causes. Protection strategies are implemented when the conflict is certain to happen or has already occurred. Mitigation strategies attempt to reduce the level of impact and lessen the problem. The main difference between the options is the moment at which the measure is implemented. By definition management techniques are only cost-effective if the cost of implementing the technique is less than the value of the damage, taking into account the fact that a short period of active management may have a continued effect, by instating longer-term protection of crops or herds. The various management possibilities are presented according to the characteristics of conflict (whether they relate to humans, production, animals and the environment), rather than according to their ability to prevent or mitigate damage.

Where alternative land and incentives are available, the voluntary relocation of local communities to areas offering better access to natural resources and improved socio-economic opportunities can offer an adequate solution to managing human-wildlife conflict (Madhusudan & Rahman, 2003). In fact, resettlement schemes aimed at preventing the overlap of wildlife and people

can be successful in the long run if some essential assumptions are met: the villagers must gain substantial benefits, such as better access to resources; they should be relocated to an area where the

The solutions are often specific to the species or area concerned, and are often creative and simple. An important aspect of the work is that it benefits both the animals and local human communities, and actively involves these communities. This is about finding solutions that lead to mutually beneficial co-existence.

The work has also often led to people being more enthusiastic and supportive of conservation, and has demonstrated that people can live alongside wildlife while developing sustainable livelihoods.

TYPOLOGY OF HUMAN-WILDLIFE CONFLICT

Typology of human-wildlife conflict are 1) human deaths and injuries, although less common than crop damage, are the most severe manifestations of human-wildlife conflict; 2) Destruction of crops; crop damage is the most prevalent form of human-wildlife conflict. The occurrence and frequency of crop-raiding is depend upon a multitude of conditions such as the availability, variability and type of food sources in the area, the level of human activity on a farm, and the type and maturation time of crops as compared to natural food sources; 3) Attacks on domestic animals: the number and type of domestic animals killed by wildlife varies according to the species, the time of year, and the availability of natural prey; 4) Transmission of diseases to livestock and/or humans; 5) Adverse interaction with other species (endangered or highly valuable); and 6) Other manifestations of human-wildlife conflict.

MITIGATION CONFLICT HUMAN-WILDLIFE MANAGEMENT:

An integrated effort

In order to be truly effective, prevention of human-wildlife conflict has to involve the full scope of society: international organizations, governments, non-governmental organizations (NGOs), communities, consumers and individuals. Solutions are possible, but often they also need to have financial backing for their support and development.

Protected area/zone

Ensuring that both humans and animals have the space they need is possible. Protecting key areas for wildlife, creating buffer zones and investing in alternative land uses are some of the solutions.

Community Participation

The local community is key since they are the ones who may wake up in the morning with a tiger or bear in their back yard. But they are also the people who can benefit the most from this. If people are empowered to manage their relationship with wild animals, these “unwanted” neighbors can become allies in bringing income and promoting a better quality of life for all.

Wildlife friendly products

Consumers is distant countries also have a role to play. Always look for products that are environmentally friendly and recognized by serious organizations.

Field/problem based solutions

There are a number of practical field-based solutions that can limit the damage done both to humans and human property, and to wildlife, by preventing wildlife from entering fields or villages. However, such solutions can only be applied on a case-by-case basis. What people see as solution in one place, they may resist in another. And what works in one place, may have the opposite effect somewhere else.

Intensifying human vigilance

Vigilance is an important component of crop or livestock protection and human-wildlife conflict management. The fear of humans normally dissuades animals from committing damage (Naughton-Treves, 1998; Barnes et al., 2003)

Guard animals

Guard animals provide an alternative to a herder monitoring, a flock, which is labor intensive, time consuming and costly. To be successful, a guard animal must bond with the animals they are to guard.

Fencing

If they properly designed, constructed and maintained, fences can be almost completely effective in preventing conflict between people and wild animals. Several types of fences can be use such as traditional barrier, artificial fences, electrical fences

Translocations

Translocation consists of moving a certain number of animals from a problematic zone to a new site. However, this strategies can bring a number of problems (Conover, 2001; Omondi et al., 2002; Stander, 1990).

ADOPTION OF A HUMAN-WILDLIFE MITIGATION POLICY

There needs to be a very clear and concise policy on Human – Wildlife conflict which will guide Directors and decision makers at provincial or district level. The proposed draft for such a Policy is as follows: The policy of the Government towards animals that conflict with the safety and food security of people outside conservation areas and the agricultural objectives of the country, will be as follows: The Government accepts the responsibility of resolving those human-wildlife situations where the lives of its citizens, their food security and the agricultural objectives of the country are at risk. Land-use planning will be done in the districts with high degrees of human-wildlife conflict. The planning will determine the optimum development of the district and will incorporate wildlife conservation and sustainable utilization wherever it is economically viable and will benefit the communities. If viable populations of problem crocodiles, lion, elephant or other wild animals cannot be managed outside conservation areas so that the economic benefits of living with these species are greater than they would be if they were absent, these populations will be removed in the most humane and cost-effective manner. In the interests of developing an agricultural export industry, the buffalo populations will be prevented from contact with cattle by the most cost-effective means possible. The monitoring and enforcement of the policy will be implemented by local government.

CONCLUSION

Policies should be designed through a bottom-up approach involving all stakeholders and particularly local communities. It should be supported by the appropriate government department

or other legal authorities. This is the best approach in designing transparent and workable policies to manage human-wildlife conflict. Human-wildlife conflict policy should also provide the authorities, managers and local populations with a decision framework. The framework would help people identify and implement appropriate management strategies which may differ depending on prevailing conditions (ecological, socio-economic, etc.). Collaboration among all stakeholders involves: primarily the local populations, possibly through a community-based organization; local government representatives; any private-sector tourism operators involved within the areas where conflict occurs; and scientists.

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Stabilization of Organic Matter in the Reclaimed-mine Tropical Soils: Influence of the Types and the Amounts of Organic Matter

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ABSTRACT

Reclamation of mined-soils aims to establish a vegetation cover and replenish soil organic carbon (SOC) pool through the stabilization of organic matter (OM). Therefore, assessing the influence of OM application on SOC stabilization is essential to improve SOC contents of the reclaimed-mine soils. We studied the addition of four different types of OM (albizia, acacia, *Calopo* and mixed-albizia-acacia-*Calopo*) to a 3-years reclaimed-mine soil with 4 different rates: 0, 0.5, 1.0 and 1.5 of maximum sorption capacity (Q_{max}), and the OM stabilization was quantified after 12 weeks of OM addition. Results of the study showed that the addition of Albizia resulted in the stabilization of 54.8% added OM, while the stabilization of 41.9% added OM was observed when *Calopo* was applied to the soil. Differences in the OM stabilization with different types of OM was related the chemical composition of added OM. Addition of albizia at the rate of 0.5 Qmax resulted in the stabilization of 61% added OM, while only 50% and 47% of added OM was stabilized when albizia was added to soils at rates of 1.0 and 1.5 Qmax, respectively. This study showed that the stabilization of OM in reclaimed-mine soils was influenced by the chemical composition of OM and the amounts of added OM.

Keywords: OM sorption; carbon sequestration; carbon mineralization; carbon protection

INTRODUCTION

The presence of organic matter (OM) is crucial for reclaimed-mine soils due its function to improve the chemical, physical and biological properties of the soils (Saidy et al., 2003). The results of the previous study also showed that reduction of toxic and soluble Cr (VI) to Cr (III) which is insoluble and less–toxic in the soils increases with increasing soil OM contents (Mariana et al., 2010; Saidy and Badruzsaufari, 2009). These results suggest important role of OM in maintaining fertility of reclaimed-mine soils. However, several studies indicate that mining areas in the South Kalimantan Province that have been reclaimed and revegetated with acacia and albizia for 3-7 years contained only 2.70–8.40 g C kg^{-1} soil (Saidy et al., 2007) and ranged from 4.60 g C kg^{-1} soil to 15.70 g C kg^{-1} soil in the 3–11 years of reclaimed–mine soils (Arifin et al., 2008). Results of this study indicate that the stabilization rate of organic matter in the reclaimed-mine soils is very slowly.

Increasing soil organic matter was determined by the degree of stabilization of organic carbon by soil minerals (Baldock, 2007; Flessa et al., 2008). The stabilization of organic matter on the soil can be defined as the equilibrium between the input of organic matter to the soil and the amount of organic matter lost from the soil through organic matter decomposition (Bruun et

al., 2010; von Lutzow et al., 2006). The amount of organic carbon stabilized by soil minerals is controlled by several factors such as the chemical structure of organic matter, clay mineralogy and the presence of iron–oxide and aluminium–oxide.

Study conducted by Saidy (2005) showed that the chemical composition of organic matter determines the stabilization of organic carbon in the soil. Organic carbon with C–O–alkyl structure is positively correlated with organic carbon stabilization in the soil. In contrast, organic carbon with C–alkyl structure has a significant negative correlation with carbon mineralization (Saidy, 2005). Results of this study indicate that C-organic with C–alkyl structure is more resistant to microbial decomposition than C–organic with C–O–alkyl structure (carbohydrate). The results of this study imply that soils with similar physical–chemical properties but planted with different vegetation will have different degree of organic matter stabilization. In this study we measured the stabilization of organic carbon of reclaimed–mine soils applied with different types and amounts of organic matter.

EXPERIMENTAL SET UP

Soil, Fly-ash and Organic Matter Sampling

Soil sample for this study was collected from reclaimed-mine soils of the PT. Arutmin Indonesia Site Satui, Kabupaten Tanah, South Kalimantan Province. The site was reclaimed and revegetated with albizia and acacia in 2013, and *Calopogonium muconiodes* was grown as soil cover crop. The soils were sampled at a depth of 0-20 cm using a soil auger at several different points. After removing plant debris remains, the samples were homogenized, air-dried and then ground to ≤ 2 mm. After that the soils were stored at 4 ^{o}C until used for the experiment.

Fresh organic matters (OM): albizia, acacia and *Calopo*, which were collected from the reclaimed-mine soils of the PT. Arutmin Indonesia Site Satui, Kabupaten Tanah, South Kalimantan Province were oven-dried and then ground to <2 mm. Chemical analyses were conducted for all OM to determine contents of organic C, total N, hot water soluble C, cellulose, hemicellulose and lignin (Bremer and Malvaney, 1982; Chesson, 1991; Nelson & Sommers, 1996). The chemical composition of OM used in this study is described in Table 1.

Incubation Experiment

Air dried soils were mixed homogenously with each OM (the amount of added OM was equal to 0.5 capacity of soil for adsorbing organic matter) in the PVC tube (radius 1.95 cm). The mixtures were then compacted to a give a depth of 2.0 cm to obtain a bulk density (BD) of compacted soils similar to the BD measured in the field. Distilled water was then added to obtain 70% water-filled pore space (WFPS). The PVC tubes were then transferred into 1 L Mason jars containing 5 mL deionised water in a 20 mL plastic vial to maintain humidity. The jars were sealed with air-tight lids with rubber septa to allow sampling of gas from the jars and incubated in the dark at room temperature for 12 weeks. For each treatment, three replicate samples were prepared and incubated. Organic C stabilization was measured by determining the headspace CO_2 concentrations within each jar, using a Servomex 1450 infra-red gas analyser (Servomex, UK). Carbon dioxide was measured repeatedly for each sample over the duration of the experiment.

RESULTS AND DISCUSSION

Organic matters used in this experiment were albizia, acacia, *Calopo* and mixed-albizia-acacia-*Calopo*. These four types of organic matters have relatively equal organic carbon contents,

ranging from 319 to 370 g C kg^{-1}. However, the total nitrogen content of these organic matters was different, in which the total nitrogen content of acacia and the mixed-Albizia-Acacia-Calopo were relatively equal. The highest total nitrogen content was found in Calopo. Complete analysis of the chemical composition of the organic matter used in this study is presented in Table 1.

Table 1. Chemical composition of organic matters used in this experiment

Characteristics	Acacia	Albizia	Calopo	Mixed Acacia-Albizia-Calopo
1. Organic C (g kg^{-1})	343.5	318.7	370.4	324.5
2. Total nitrogen (g kg^{-1})	18.8	21.5	28.5	18.9
3. Hot water soluble C (g kg^{-1})	16.5	22.5	27.3	17.4
4. Cellulose (g kg^{-1})	31.3	36.5	37.2	31.3
5. Hemicellulose (g kg^{-1})	25.4	21.3	31.5	33.5
6. Lignin (g kg^{-1})	19.7	26.1	14.9	16.7

Analysis of variance showed that the types and amounts of applied organic matter had significant effect (P <0.001) on the stabilization organic matter quantified using carbon mineralization data. Carbon mineralization of reclaimed-mine applied with different types and amounts of organic matter is described in Figure 1. Carbon mineralization of reclaimed-mine soils applied with albizia, acacia and mixed albizia-acacia-Calopo is no different. Regardless of the amount of applied organic matter, carbon mineralization applied with these three organic matters ranged from 259 to 2109 mg CO_2-C kg^{-1} soil (Figure 1). However, the addition of *Calopogonium muconiodes* to the soils produced the highest carbon mineralization compared to other types of organic matter. This is thought to attribute to the relatively low C/N ratio of *Calopogonium muconiodes* so that the carbon mineralization process proceeded very quickly. Thus, for the purpose of stabilizing organic matter in the reclaimed-mine soils, it is recommended that organic materials to be able to increase soil organic matter contents are acacia or albizia.

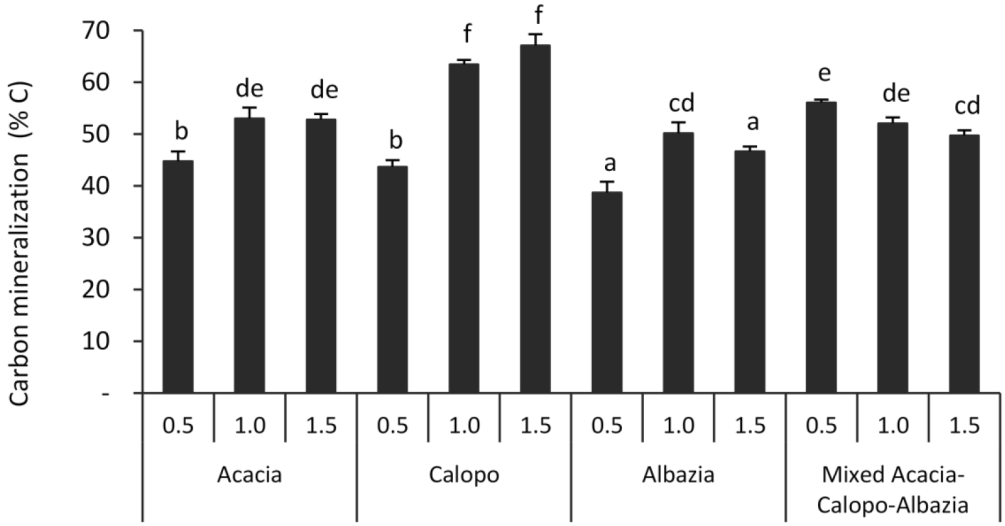

Figure 1. Effect of the types and the amounts of organic matter on carbon mineralization. Vertical bars are standard deviation of mean (n=3). Similar litters above the columns show no statistical difference between the treatments at P<0.05.

The amount of organic carbon stabilized by soil minerals was calculated using the data of the amount of soil organic carbon, the amount of organic carbon from added organic matter, and the amount of carbon mineralized from soil and added organic matter. The amount of carbon stabilized by soil minerals from different types and amounts of organic matter is shown in Figure 2. Figure 2 showed that in all types and levels of the amount of added organic material, the amount of carbon stabilized by soil minerals ranged from 33% to 61%.

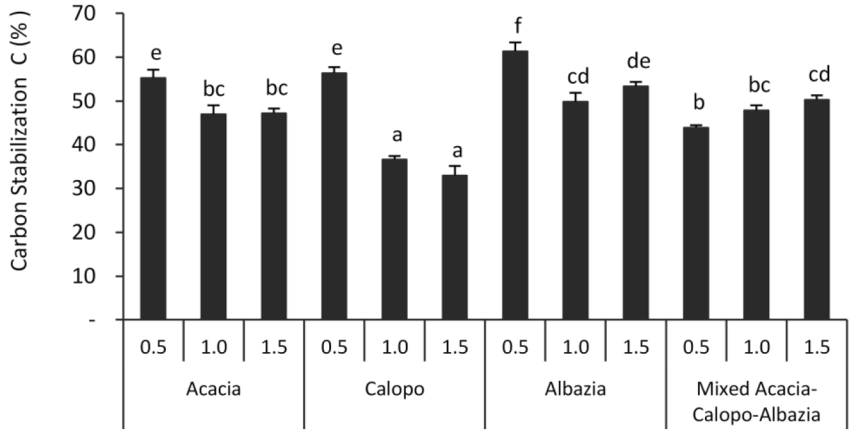

Figure 2. Effect of the types and the amounts of organic matter on carbon stabilization. Vertical bars are standard deviation of mean (n=3). Similar litters above the columns show no statistical difference between the treatments at $P<0.05$.

Regardless of the level of organic matter addition, albizia had the highest stabilization of organic matter (average 54.8%), followed by acacia (49.8%) and mixed albizia–acacia-Calopo (47.4%). Calopo had the lowest organic matter stabilization (average 41.9%) compared to other types of organic matter. Differences in the stabilization of organic carbon for different types of organic matters are related to differences in chemical structure (chemical composition of organic matter). Calopo has the lowest stabilization rate among the organic matter applied to the soil because its lowest C/N ratio and relatively high hot water soluble organic carbon. This is in agreement with the theory of organic matter decomposition that suggested that the water-soluble compounds such as glucose and other simple compounds are the first compound utilized by soil microorganisms during the organic matter decomposition (Schöning and Kögel-Knabner, 2006).

Organic matter from albizia had the highest organic carbon stabilization compared to other organic matters. Table 1 shows that albizia had a relatively high lignin content. Organic matter with high lignin compounds generally have a low decomposition rate compared with organic materials with low lignin content (Jacob et al., 2010; Rahman et al., 2013; Zhang et al., 2008). The effect of lignin on the rate of organic matter decomposition is also reported in other studies. For example, Yuwono (2008) reported a significant relationship between the lignin content of organic matter and the decomposition rate of organic matter, in which a relatively high lignin content of organic matter resulted in a decrease in the rate of organic matter decomposition. In another study, Aprianis (2011) found that younger A. Crassicarpa litter with low lignin contents had faster decomposition rate than the older A. Crassicarpa litter with relatively high lignin contents. Results of this study imply that revegetation of reclaimed-mined soils with albizia produces a higher organic carbon stabilization than revegetation with acacia.

Figure 2 also shows that addition of albizia at the level of $0.5Q_{max}$ (the amount of organic material added is half of the maximum capacity of soil in absorbing the organic carbon), 39% of the added organic carbon has decomposed and returned to atmosphere in the form of CO_2. Non-decomposing organic matter (61% of added organic carbon) has been stabilized by soil minerals, which eventually increase soil organic matter contents. At the level of addition of 1.0 Q_{max} and 1.5 Q_{max}, 50% and 47% of the albizia added to the soil was decomposed and returned to the atmosphere in the form of CO_2 gas (Figure 2). Thus, only 50% and 53% of the albizia added to the soils were stabilized by soil minerals. Based on these calculations, it appears that the application of albizia at the 0.5 Q_{max} level results in the highest stabilization of organic matters. Therefore, it is recommended that the amount of albizia to be applied to the reclaimed-mine soils to lead an increase in the soil organic matter is equivalent to 0.5 Q_{max} (half the maximum capacity of soil in absorbing organic matter).

CONCLUSION

Results of the experiment showed that among several types of organic matter studied (albizia, acacia, Calopo and mixed albizia–acacia–Calopo) applied to reclaimed-mine soils, *Calopo muconoides* yielded the lowest stabilization of organic carbon. On the other hand, albizia is the organic matter with the highest level of organic carbon stabilization. The low stabilization of organic carbon of *Calopo muconoides* is attributed to its chemical composition that containing a relatively easy decomposed compounds as shown by the low C/N ratio of *Calopo muconoides*. The amount of organic matter applied to reclaimed-mine soils to produce maximum stabilization is equal to 0.5 Q_{max} (half of the soil's ability to absorb organic matter).

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Application of Verticulture and Biopore Technology to Increase Revitalization of Gajahwong River Flow Areas, Pedakbaru Village, Banguntapan, Bantul, Yogyakarta

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ABSTRACT

The goal of this research is to know its application of verticulture and biopore technologies in order to improve revitalization of Gajah wong river flow areas, Pedak baru village, Banguntapan, Bantul, Yogyakarta. Utilization of organic and inorganic waste is very important for the cultivation of horticultural crops with verticulture and biopore technology. The methods that used in this activity are: Lecture, discussion, training, practice and mentoring. The results of revitalization activities of Gajah wong river flow areas through the application of verticulture plant cultivation technology and biopore can restore the function of the river to be green and clean.

Keywords: verticulture, biopore, revitalization, Gajah wong river, pedakbaru

INTRODUCTION

Pedakbaru Village, Banguntapan, Bantul, Yogyakarta, which is located on the East of Campus UIN Sunan Kalijaga Yogyakarta, opposite of the Gajahwong river, and South of Affandi Museum and Yogyakarta AMPLAS Mall, Yogya highway, and the government center of Yogyakarta, escape from the problems caused by the growth of the city due to the high population growth. The priority programs of the Yogyakarta Government are primarily concerned on addressing the quality decline of the environment due to the reduced green open space, health problems due to the poor sanitation, economic and social problems.

In addition to programs designed to address the various identical problems of urban areas, the programs are also aimed to maintain and improve the image of Yogyakarta as a center of education and culture. The number of cultural centers in Yogyakarta provide great potential as a major tourist destination in Indonesia, so it needs to realize programs that are able to optimize the role of tourism. However Yogyakarta also has natural characteristics that are vulnerable to disaster. Yogyakarta is an area prone to earthquakes (the largest of 2006), eruption of Mount Merapi, flood, cold lava flood, and tornado. With such diverse challenges, Yogyakarta, which tends to rely on tourism, education and trade services, is very vulnerable to environmental damage due to natural disasters. With all the characteristics of the problems and potential of Yogyakarta, especially the Government of Bantul has established the long-term development vision of the region (RPJPD) to be achieved in 2005 - 2025, namely: "The realization of Bantul as a Tourism Area of Quality Education, Character and Inclusive, Cultural Based Tourism,

Services, Environmentally-Responsible and Community-Driven Economy and Resilient Areas". In order to achieve the development vision (RPJPD), then the second phase of RPJPD is set forth in the RPJMD 2012-2016, the people living around the river banks. as a priority for the development of watershed revitalization capable of comprehensively supporting the achievement of the vision.

Given the importance of the role of the river that is capable of affecting the wider community, one of the main priority programs is the revitalization of watersheds, the focus of watershed revitalization from 2012 aimed at Gajahwong River. Gajahwong River has historical value related to the Yogyakarta Palace which is currently the condition of the river has been increasingly polluted and degraded. Gajahwong River plays an important role for the people of Yogyakarta city as it passes through densely populated areas in three districts (Sleman, Yogyakarta and Bantul). The increasingly poor condition, the government together with the people who live along the Gajahwong River Flow Areas in the River Stream Communication Forum (FORSIDAS) together with the Government and Universities, commits to restore the function of the river to be green and clean.

The effort that has been tried to be done by the community of Mothers concerned with the environment, by naming it self as "WANTRABAT" skilled and great woman, that is the area of Pedakbaru, Banguntapan, Bantul, Yogyakarta which have tried to optimize waste plastic packaging bottle drinking water and other plastic waste as planting medium (commonly called agua punik), and underneath there is a fish pond. As shown in Figure 1.

Figure 1. The "WANTRABAT" or Skilled and Great Woman, in Pedakbaru, Banguntapan, Bantul, Yogyakarta which has been trying to optimize waste plastic bottles of drinking water packaging and other plastic waste as planting medium (commonly called agua punik), and underneath there is a fish pond.

But the efforts that have been done by this group is less optimal because the cost of aqua punik requires electrical power, thus burdening members. Therefore, vertikulture cultivation technology is expected to be a solution, and it can support the revitalization of Gajah Wong Watershed which will restore the function of river into green and clean, able to reduce degradation of river function and community problems, which will further improve their quality of life.

Due to the development priority related to the watershed, then this research will be focused on the revitalization activity of Gajahwong River Flow Areas by applying vertikulture cultivation

technology that will restore the function of the river to be green and clean so it is expected to be able to reduce the degradation of river functions and the problems of people living in the watershed, which in turn will improve their quality of life. Gajahwong River has historical value related to the Yogyakarta Palace which is currently the condition of the river has been increasingly polluted and degraded. Gajahwong River plays an important role for the people of Yogyakarta, because it passes through densely populated areas in three districts (Sleman, Yogyakkarta and Bantul). The increasingly poor condition, the government together with the people who live along the Gajahwong River Flow Areas in the River Stream Communication Forum (FORSIDAS) together with the Government and Universities, commits to restore the function of the river to be green and clean.

The existence of development priorities related to watersheds, on the revitalization of the Gajahwong River Flow Areas through the application of vertical plant cultivation technology and the making of biopori will restore the function of the river to be green and clean so it is expected to reduce the degradation of river function and the problems of the people who live in Gajahwong River Flow Areas, which will further improve the quality of life of residents in the area of Pedak Baru, Banguntapan, Bantul, Yogyakarta.

METHODOLOGY

The method used in this activity is the method chosen in accordance with the objectives to be achieved are: Lectures, discussions, training, practice and mentoring. Lectures and discussions are held for the delivery of materials directly to the community by competent sources in their fields as needed.

Training is done to improve knowledge and skill about: Organic waste processing for composting/ organic f e rtilizer as planting medium in vertikultur cultivation. Crop culture technology vertikultur. Training and Practice implemented for community skills: Organic waste processing, so that people can make organic fertilizer for vertikultur planting medium and making biopori. Assistanc e is also done through apprenticeship program by students under the guidance of program managers in the process of making organic fertilizer and making handicrafts. In this program motivate the public to always maintain the cleanliness of the environment, utilizing appropriate technology for biopori on their own yard to reduce the runoff of rainwater, so that its area can be free from flood hazard. The result of making biorrhoe makes the soil structure more preserved so it can absorb water and filter the ground water well.

RESULT

Making compost from oragnic waste can be done by chopping or cutting with organic waste knife into a smaller size (2 cm). Incorporate 10 kg pieces of organic waste into a plastic bucket. Add 5% manure, 2% lime and diluted bioactivator with 2% concentration. Closes a plastic bucket with plastic sheets that have been hollowed and tied. Let the compost be remodeled for 1 month by stirring every 7 days. The composting process is completed after one month. The results of Saidi's (2009) study showed that laboratory analysis of liquid compost component from household waste showed that high organic C content (23.94%), high organic matter (41.17%), high total nitrogen content (1 , 61%), low C/N ratio (14,87), Phosphorus available (P_2O_5) high (14,66%). Plant growth is strongly influenced by composting combined with manure (Saidi and Purwanto, 2015). The quality of compost from several kinds of organic waste from laboratory analysis results can be seen in the following table:

Table: Results of compost laboratory analysis of some organic wastes

No	Origin compost	pH	C Org (%)	N tot (%)	Rasio C/N	P_2O_5 (%)	CaO (%)
1.	*Sawi* leaves waste	9,07	7,74	1,20	6,45	0,22	0,025
2.	*Celery* leaves waste	9,13	6,77	1,40	4,84	0,13	0,025
3.	*Duku* leaves waste	8,78	30,85	2,15	14,35	0,43	0,008
4.	*Pineapple* leaves waste	9,77	25,17	0,22	114,4	0,32	0,008
5.	*Straw* waste	9,01	26,33	0,49	53,74	0,29	0,007
6.	*Ketapang* leaves waste	8,80	21,04	0,44	47,82	0,26	0,008
7.	leaves waste on campus	8.15	22.69	1.015	22.35	0.35	0.005
8.	No:70/Permentan/ SR.140/10/2011	6.8 - 7.5	9.8 - 32	> 0.4	10 - 20	> 0.1	< 25.5

Source: Saidi, D and Lagiman (2016)

Compost produced from market organic waste has characteristics: above-standard alkaline pH, sub-standard liquid but solid C content of standard, total under-standard nitrogen content, carbon and nitrogen compost ratio of pineapple, straw, ketapang leaves on top standard, phosphorus levels are available above the standard, CaO lime content meets the standards.

Utilization of compost as a planting medium for verticulture cultivation, ranging from nurseries in the river area Gajah Wong as one of the efforts of land use and optimization of potential in the existing environment.

Figure.2: Utilization of Compost for vertikultur cultivation media

Waste utilization for biopore making is done through the preparation of tools and materials. The material used in the manufacture of biopore is very simple and easy. These materials include: (4-dimensional paralon pipe, Biopore Rescue Hole Drill Tool Find the right location to create a biopore infiltration hole, i.e. in rainwater flowing areas such as parks, parking lot, etc. which will be perforated watered so that it is easy to be perforated Put a drill bit perpendicular to the ground to start drilling Hole ground with Biopore drill, (Biopori drill is drill for mineral soil, (drill Biopore is drill for mineral soil), with drill press right whilst rotating right into drill into the ground, to facilitate drilling, watering with water during drilling, every 15 cm or as deep as the drill bit stop, drag the drill while keeping it in the right direction, to clean the soil inside the drill bit Clean the soil from the inside of the drill bit using a knife or other puncture, starting with pressing the soil from the inside of the drill bit so that nah easily released. Perform

continuous soil perforation process until reaching depth of approximately 100cm. If the soil is rocky or gravel, so the drilling hampers, the drilling can be stopped until into the deep that can be penetrated by the drill only, although only reaches a depth of approximately 50 cm. input paralon then fill with organic waste and give bio-activator as much as 2% already diluted. The results of Saidi and Lagiman's research (2016) in Figure 3. show that the average moisture content in biopores (132.5%) is greater than the average moisture content outside/without biopori (21.26%), because the organic matter in biopore able to store water, organic matter/ compost able to bind water because it has bigger surface area than land. Average moisture content : Biopori = 132,5%, without biopori = 21.26%

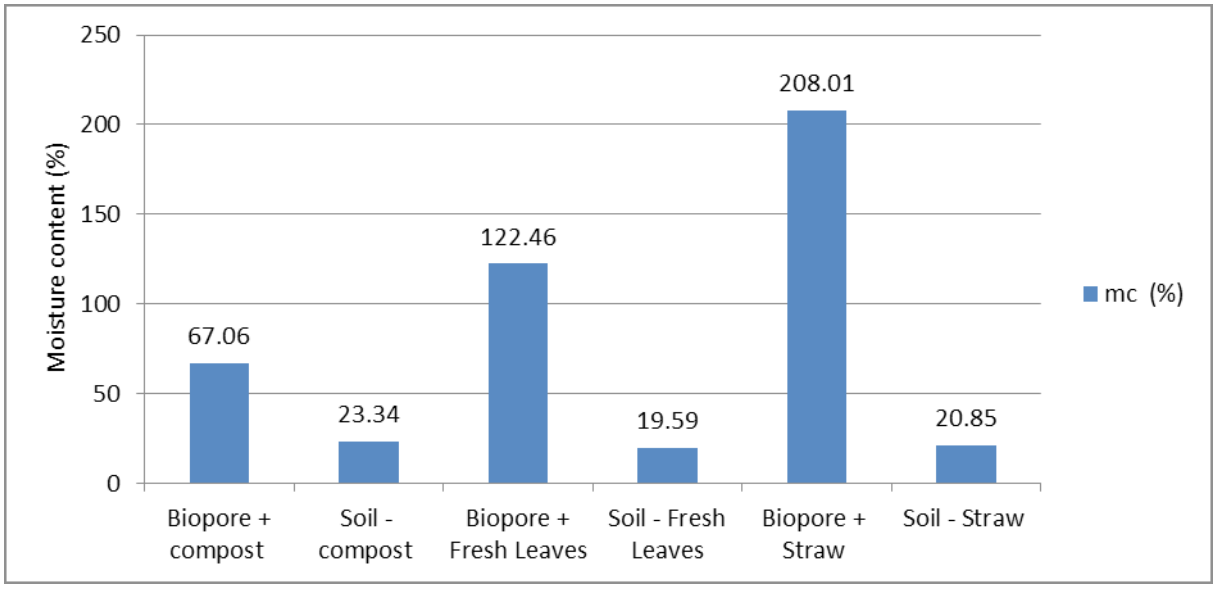

Figure.3: The result of moisture content analysis on biopore given compost and moisture content without biopore (Saidi, D and Lagiman, 2016)

Figure.4: Creation of biopore

Optimization of WANTRABAT Activity by performing organic and inorganic waste sorting through garbage bank, organic waste is used as planting medium for verticulture cultivation and material to fill biopore, while that can not be used as planting medium such as glass bottle,

cardboard , iron will be sold as capital to support verticulture and biopore activities. Wantrabat activities can be seen in Figure 5.

Figure.5: "WANTRABAT" (Skilled and Great Woman) in the Pedakbaru area, Banguntapan, Bantul, Yogyakarta which has tried to collect used goods and sort out which ones can be used for planting media, the rest is sold for other household chores.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The verticulture and biopore technology can improve the revitalization of the Gajahwong River Flow Areas , Pedakbaru, Banguntapan, Bantul, Yogyakarta through:

1. Utilization of compost from organic waste for medium planting of vertical cultivation plants to cooling the yard of house, in addition, the compost can be used to fill the biopore to increase the ground water availability
2. Optimizing WANTRABAT activities by separating organic waste through waste banks as a planting medium of verticulture cultivation. While, the waste that can not be used as planting medium, for example glass bottles, cardboard, iron will be sold as capital to support verticulture activities and biopore maker.

Recommendations

For the integrated management of organic and inorganic waste, it is necessary to form a business entity in the form of a waste bank recognized by the government.

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Effect of Improved Cropping, Fertilization and Supplemental Water Application on Rainfed Lowland Rice

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ABSTRACT

Rainfed lowland is one of potential land resource that needs to be utilized optimally to contribute the increasing food crop productions. This research was conducted to evaluate the yield performance of the use of combination balanced fertilization based on soil test, new superior variety, double row planting system, and supplemental ground water pumping irrigation under rainfed lowland rice cultivation at Gunungkidul, Yogyakarta Special Region, Indonesia during second growing season period, February to June 2015. The soil at the research location was categorized of Typic Hapludert with low N, P, and K status levels in relation to rice crop nutrients requirement. The field experiment was arranged in randomized complete block design with five treatments and four replications. The treatments consisted of existing farmer's technology as control, namely Ciherang variety, tile planting system of 20 cm x 20 cm, and fertilization of 450 kg Urea and 250 kg Phonska (15N:15P_2O_5:15K_2O:10S) ha-1, compared to the four introduced technologies treatments which are combination technological components of Inpari 19 new superior variety, tile planting systems of 20 cm x 20 cm and 25 cm x 25 cm, double rows planting system (40 cm-25 cm x 15 cm), and less supplemental ground water pumping irrigation. All the introduced treatments were applied by N, P, and K fertilizers based on soil test and leaf color chart recommendations, namely 200 kg Urea, 250 kg Phonska, and 37,5 kg MOP ha-1. The results showed that all introduced treatments produced significantly higher grain yield, ranging 11,0 to 23,0 %, compared to control (5,15 ton ha-[1]). The use of double rows planting system indicated the higher grain yield than the both tile planting systems. On the other hand, the application of less supplemental pumping irrigation was not significantly different compared to the more intensive pumping irrigation as farmer's practice.

Keywords : rainfed lowland rice, interval pumping, balanced fertilization, rice variety, planting system, grain yield

INTRODUCTION

The Agriculture on Gunung Kidul Regency is largely dominated by dryland rainfed, which depends on the climate, especially precipitation cycle. While irrigated land is relatively narrow and largely dominated by rainfed. The Optimization of paddy fields in the Gunungkidul area can be effort through improved and increased the carrying capacity of the land, so that it becomes farmland productive and sustainable. Increased productivity and optimization of paddy fields, among others, can be done with the application of technology planting system, balanced fertilization site-specific and intermittent irrigation system.

In the setting of appropriate cropping systems in addition to ensuring the optimal nutrient uptake per unit area per plant also improve the utilization of sunlight in the process of photosynthesis. Rice cropping systems are commonly applied to farmers are planting system tiles with a distance

of 20 x 20 cm or more tightly. However, when it has developed a new cultivation system is called Legowo planting pattern. According Pahruddin (2004), legowo planting pattern is a technological change the spacing of rice developed from tiles cropping systems that have developed in the community. The principle of Legowo planting system is the provision of the conditions in each row cropping to experience a side effect as a plant. In general, the edge of the plant showed higher yields than the existing plants in the inside row. Edge crop also showed better growth due to competition between rows of plants can be reduced. Application of planting method legowo system has several advantages, namely, sunlight can be utilized more to the process of photosynthesis, fertilization and pest control (OPT) becomes easier to do in the alleys between rows of plants.

Furthermore, the application of a balanced fertilizer in the rainfed areas is done with attention to the content of nutrients available in the soil and makro fertilizer application (NPKS) are balanced and in accordance with the needs of the rice plant. The goal of balanced fertilizer application is to improve the yield and rice quality. In general, rice plants require large amounts of nutrients including nitrogen (N), phosphate (P), potassium (K) and sulfur (S). Unless it is necessary secondary nutrients calcium (Ca) and magnesium (Mg) and micro nutrients which are very few such as zinc (Zn), copper (Cu), iron (Fe). The principle of balanced fertilization of paddy is the balancing between the availability of nutrients in the growth medium (wetland) and the need for the rice crop. Ideally the soil nutrient status known through laboratory analysis, but it will need more budget to analyze the soil samples. Another approach can be done using Rice Soil Test Kit (PUTS), which is relatively easy and inexpensive so that it can be applied by farmer groups as a reference for determining the recommended dose of fertilizer.

Application of intermittent irrigation or also called intermittent is setting the conditions of land in dry conditions and stagnant interchangeably, which aims to: 1) Conserve irrigation water so that the area can be irrigated become more widespread, 2) Provide opportunities for the roots to get air so that it can thrive deeper, 3) Preventing the emergence of iron toxicity, 4) Prevent the accumulation of organic acids and H_2S gas that inhibits root development. Intermittent irrigation provide an opportunity for the roots to grow better, and reduce of lodging, activate microorganisms beneficial microbes, reducing the number of chicks that are not productive (not produce panicles and grain), uniform ripening grain and accelerate the time of harvest, facilitate embedding the fertilizer into the soil (topsoil), facilitate pest control snails, reduce the spread of brown planthoppers and stem borer, reduce the damage to rice crops due to the rat.

The farmer community in rainfed areas of Gunung Kidul district in general have not utilize and optimize water use efficiently. Watering is done by the method of flooding still intensively without taking into account the needs of the actual water by rice plants, so it can be said that local farmers are still wasteful in the use of water for irrigation rainfed. Therefore, research on raninfed low land rice through the application of the introduced tajarwo system, balanced fertilization specific location and intermittent irrigation system needs to be done. The purpose of this study was to evaluate the performance results of the application of tajarwo technology planting system, balanced fertilization specific location as well as intermittent irrigation in rainfed lowland rice on the productivity of Inpari 19 rice variety.

MATERIAL AND METHOD

The location and time of the study

This research was conducted in the rainfed lowland rice of mineral clay mixture of 2: 1 on a Vertisol soil types in Sumberwojo, Sidorejo village - Ponjong districts of Gunungkidul regency on the growing season (February - June 2015).

Materials of the research

Materials needed for research, include: (a) Inpari 19 rice seed (b) Inorganic fertilizer / chemical single source of N, P and K in the form of urea, SP-36 and KCl (c) compound fertilizer NPKS (Phonska) as levels of 15: 15: 15: 10 (d) of pesticides to reduce the pest, (e) plastic bags, (f) plastic sheeting, (g) the plastic bucket, (h) plastic straps and (i) manure organic fertilizer

Experimental design

The experimental design which used in the experiment was a complete randomized block design (Randomized Complete Block Design) with 5 replications. Following the experimental plot size of land area farmers, sizely 400-600 m2. The various treatments are: A) the cropping system tiles 20x20 cm, without SP-36, KCl 37.5 kg / ha B) Tile planting system 25x25 cm, without SP-36, KCl 37.5 kg / ha C) Tajarwo system 2: 1 (40-15-25 cm), without SP-36, KCl 37.5 kg / ha D) tajarwo system 2 : 1, with application SP 36 25 kg / ha and 87.5 kg KCl / ha and E) tajarwo system, without SP-36 and with application KCl 37.5 kg / ha and intermittent irrigation every 8 days. All treatments fostered Urea based Leaf Colour Chard (about 200 kg / ha), Ponska 250 kg / ha and application organic manure 5 tons / ha. All treatments are not fertilized with SP-36, except for treatment D at a dose of 25kg / ha, all fostered Urea based LCC (about 200 kg / ha), Ponska 250 kg / ha and manure 5 tons / ha. The Urea fertilizer is given three times, which are 7 DAT, 21 DAT and 45 DAT (phase primordia), KCl fertilizer was applied twice, whicha are 21 DAT and when rice plant at primordia phase (45 DAT).

RESULT AND DISCUSSION

The result of soil laboratory analysis is presented on Table 1 as bellow :

Table 1. Soil chemocal characteristics on its research location

No	Chemical soil characteristics	Soil value
1.	Soil pH (H_2O)	7,46 (slightly alkali)
2.	C-organik (%)	1,03 (low)
3.	C – organic content (%)	1,87 (low)
4.	N-total (%)	0,093 (slightly low)
5.	P-potential (mg / 100 g)	172 (high)
6.	P-available (mg / 100 g)	12,8 (low)
7.	K_2O content (me/100g)	26,9 (moderate)
8.	Ca content (me/100g)	38,74 (high)
9.	Mg content (me/100g)	32,85 (high)
10.	Sand fraction (%)	12,6
11.	Dust fraction (%)	28,2
12.	Clay fraction (%)	59,2
13.	Soil CEC (me/100g)	37,5 (high)

Based on Table 1 above shows that the rainfed lowland rice on Siderorejo village Ponjong district, Gunungkidul Regency has a neutral to slightly alkaline pH, soil organic matter content is low (<2%), while the levels of N total is low (<0.2%) with the C / N ratio of 11.18 or classified as moderate, meaning there are a lot of decomposed organic matter into nutrients and depleted absorbed by plant roots, the potential P_2O_5 levels in soil is very high (> 60 mg / 100 g soil), it is due to the accumulation of inorganic P fertilization continuous and tightly bound in the clay soil sorption complex. While K_2O levels were moderate (> 20 mg / 100 g soil) and its average CEC is high (> 25 me / 100 g soil). Generally, the condition of soil fertility on the location of assessment is classified as moderated. The organic matter content and soil N needs to be improved by application of the crop biomass crop residues and manure into the rice field on each planting season so that soil microbes can grow more and soil structure become more improved. This is consistent with the statement of Atmojo (2003), which states that in addition to material orgnic effected on soil nutrient supply, also affect the physical, biological and other chemical soil. characteristics. The role of organic matter mainly is affected on the physical soil properties, which includes :soil structure, consistency, porosity and water holding capacity. The. effect of organic matter to the soil structure improvement with regard to the level of aggregation in the land field.

The next analysis result was the rice growth components which is stated on Table 2 as bellow :

No.	Treatment code	Plant high at 21 DAT (cm)	Plant high at 45 DAT (cm)	Plant high at 70 DAT (cm)	The number of panicle at 21 DAT	The number of panicle at 70 DAT
1	A	47,93 a	72,40 c	91,18 d	7,23 c	10,96 b
2	B	47,62 a	76,21 ab	96,55 ab	7,45 bc	10,05 b
3	C	48,12 a	77,10 a	95,17 b	8,25 a	11,98 a
4	D	47,87 a	78,67 a	98,31 a	7,83 b	11,12 a
5	E	47,19 a	74,92 b	93,83 c	7,92 b	11,07 a

From Table 2 above plant growth observed on several crop growth phase (age 21 dat, 45 dat and 70 dat), number of tillers produktivif. While as the yield components include panicle length, number of panicles per hill, number of grains per panicle (the total amount of grain and the percentage of grain contains per panicle), 1000 grain weight and the weight of dry biomass harvesting. Furthermore the yield components include the results of dry grain milled rice harvest per rice field tile m^2 kg^{-1} and converted to dry grain yield of crops per hectare.

From Table 2 above can be explained that the application of tajarwo cropping system showed significant difference in the number of tillers growth component age 21 dat and 70 dat. This trend is also shown in Table 3 as bellow that the percentage of filled grain per panicle on Tajarwo cropping pattern applications (treatment C, D and E) was given higher yields than planting system tiles 20x20 cm and 25x25 cm (treatment A and B). This is consistent with research Ikhwani *et al.* (2013), which states that the use Legowo row planting system on the same rice varieties will provide the results of growth and production components higher than 20x20 cm

tile system or tiles 25x25 cm in rice fields area of Subang regency, West Java province.

Table 3 The yield rice component after harvesting

No.	Treatments	Length of panicle (cm)	The amount of panicle	The amount of total grain per panicle	Prosentage of filled grain per panicle	Weight of 1000 grains (gr)
1	A	26,57 a	10,53 b	108,87 c	9,13 bc	24,98 c
2	B	26,23 a	11,42 a	117,67 b	8,25 a	25,92 b
3	C	27,03 a	12,16 a	139,05 a	8,45 a	26,51 a
4	D	26,75 a	11,95 a	137,12 a	6,83 c	26,32 a
5	E	26,55 a	10,71 b	136,03 a	7,92 b	25,57 b

The above results are also consistent with studies of Aaron *et al.* (2012), which states that the treatment cropping systems Tajarwo 2: 1 in combination with fertilization Phosnka 190 kg / ha and Urea 180 kg / ha is able to provide plant growth components (number of productive tillers) higher compared to the combination of cropping systems tajarwo 4: 1 and the planting system tiles (25x25 cm) on rice growth component of tice variety Inpari 13 in Gorontalo.regency area.

To improve the level of productivity of crops and maintaining wetland productivity of the crop nutrient management technology should be improved through environmentally friendly technologies by applying a balanced fertilizer based on soil test combined with organic fertilizer (manure panen.dan residual biomass). Based on the results of the study demonstrated that increasing doses of fertilizer P and K or K high doses (treatment D) gives the same results (not significant) with rice field that is not application by P fertilizer. This indicates that its rice field as Vertisol soil types contains enough nutrients P_2O_5 total, which adsorbed in the clay complex bond in the soil. This is consistent with the statement of Al-Jabri (2013), who argued that using soil testing and application of a balanced fertilizer technology paddy soil specific location then the introduction of inorganic fertilizers become get rational yield according to the soil nutrient status and nutiend needs of plants, so that fertilizers used is more efficient and paddy crops growth to be more optimum.

The results of the analysis rice production parameters was shown on Table 4 as bellow,

No.	Treatment	Weight of biomass (ton. ha-1)	The yield of harvesting grain (ton. ha-1)	The weight of straw (ton. ha-1)	The weight of dried grain rice (ton. ha-1)
1	A	20,57 a	6,35 c	13,23 a	5,15 c
2	B	19,71 b	6,97 b	12,79 a	5,57 b
3	C	18,60 c	6,85 b	11,67 b	5,63 bc
4	D	18,65 c	7,83 a	10,87 c	6,42 a
5	E	18,09 d	7,45 a	10,65 c	6,31 a

From Table 4 above it indicated that the weight of the highest biomass obtained in treatment D (system tajarwo 2: 1, SP 36 50 kg / ha and KCl 88 kg / ha) and significantly different from other treatments. While the results of milled rice in different cropping systems show real tajarwo with tiles cropping systems. For the treatment of E (Inpari 19; tajarwo 2: 1, intermittent irrigation

8 days to dry wet, Urea with LCC, 37.5 Ponska KCl and 250 kg / ha) was not significantly different with treatment C and D are applying irrigation systems 3 days , during the growth period. This shows that the system of rice cultivation in rainfed in kecc. Ponjong - Gunung using intermittent irrigation system capable of efficient 8 days once the amount of irrigation water (source wellbore) and the results are not significantly different from the conventional way by farmers (irrigation 3-4 days). This shows that the system of rice cultivation in rainfed in kecc. Ponjong - Gunung using intermittent irrigation system capable of efficient 8 days once the amount of irrigation water (source wellbore) and the results are not significantly different from the conventional way by farmers (irrigation 3-4 days). The above results are consistent with studies conducted by Habibie *et al.* (2011), which states that pegeringan period of 5 days to produce the number of grains / panicle is higher than the drying period 0 and 3 days respectively by 23.7% and 16.2% in Ciherang rice variety

CONCLUSIONS

1. To improve rice productivity on rainfed lowland rice system of Ponjong distric, Gunungkidul regency can be obtained by using double row method 2:1 (tajarwo) of planting pattern, which increased yield (dried grain rice) up to 8.16% by the same variety (Ciherang), while if using introduced primary variety (Inpari 19) the yield can increase up to 24.66% compare to existing planting pattern method by local farmer (using tile method 20x20 cm and Ciherang variety).
2. Application of dosage N fertilizer (Urea), P and K anorganic fertilizer followed of LCC and NPK soil nutrient status in its rice field can be obtained more increase 16,4% dried grain yield compare to the existing farmer habit (applying about 400 kg Urea/ha/season)
3. The Applied intermitten irrigation method from groundwater pumping with duration every 8 days is more efficient . It can be saved water about 42% compare to the treatment with duration every 3-4 days irrigation of supplemental water use on rainfed lowland rice system of Ponjong, Gunungkidul

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Consumer Preference And Antioxidant Activity of Rubbish Drink in Various Instant Forms

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ABSTRACT

Rubbish drink or "WedangUwuh" is special drink from Yogyakarta, comprises some herbs that have been known very beneficial for health. The drink is available in syrup, powder and original herbs called "oprokan". The objective of this study were to determine the level of consumer preference based on the organoleptics quality of rubbish drink and to analyze antioxidant activity as well as vitamin C as antioxidant in the rubbish drink. Hedonic method for organoleptic test by using 90 untrained panelists was conducted for represent consumer preference to rubbish drink. Panelists were divided into 3 categories age (10-25, 26-49, ≥ 50 years old). The results showed that the most preferred rubbish drink by testing all ranges of age was "oprokan" and powder rubbish drink was least preferred. Meanwhile, antioxidant activity, vitamin C of syrup rubbish drink was (15.66%, 32.25mg/100g), powder rubbish drink was (6.57%, 43.18mg/100g) and "oprokan" rubbish drink was (68.19%, 228.3 mg/100 g), respectively.

Keywords : rubbish drink, antioxidant activity, consumer preference

INTRODUCTION

The increasing of community's awareness upon healthy lifestyle has encouraged producers to compete in offering herbal food and drink, and even herbal supplement. The herbal mix becomes herbal drinks, such as *kunirasem* (made from *turmeric* and tamarin),*beraskencur* (made from rice and *kaempferia galanga*), ginger and etc. Those herbal drinks have been prominent and alternative to prevent diseases since a long time. The reason behind is because they contain of active functionalingredients to prevent and cure various diseases.

WedangUwuh (Rubbish drink) is one of the special herbal drinks developed in Yogyakarta. It consists ofsappanwood, ginger, clove, the leaf of clove, lemongrass, cardamom, nutmeg, cinnamon andthe leaf of cinnamon. According to Rahmawati (2011), *WedangUwuh*is very potential to be developed as functional drinks since it contains of antioxidant. It has a good function to prevent some degenerative diseases such as coronary artery disease, cancer, stroke, and other complication. These diseases are mostly caused by free radicalabsorbed in human body. Free radicalis caused by air pollution from industry, cigarettes, pesticides, and alcoholic drinks. However, the dangerous of it can be neutralized by antioxidant, especially from the herbal one (Winarsi, 2007).

At the moment, the production of *WedangUwuh* in Yogyakarta is adequate, such as *WedangUwuh* under the brand of Sari Jampi produced by Female Farmers Community (KWT) "Lestari" in Pengasih Sub District, KulonProgo Regency, Yogyakarta. Considering the demand of *WedangUwuh* is quite high in which the demand also comes from outside Yogyakarta Province,

the producers provideinstant form of *WedangUwuh*to make it more practical in preparing. Some instant forms of *WedangUwuh* are syrup ,powderand along with its herbal components which can be intact or dried called as o*prokan*. Sugar is always added in all forms of them.These three instant form need different treatments therefore, the changes of its organolepticquality is still possible. It may influence some aspects such as consumer's preferences, vitamin C, or even the activity of antioxidant.

This study were aimed to analyze the consumer's preferences level towards those three instant forms of *WedangUwuh*, to find out the most instant forms of *WedangUwuh* preferred by the consumer, and to analyze the vitamin C and the activity of antioxidant in those three instant forms.

MATERIALS AND METHODS

A. Ingredients and Tools

The ingredients in *WedangUwuh* were ginger, cinnamon, clove, the leaf of cinnamon, sappanwood, cardamom, rock sugar and water. It was processed by KWT "Lestari", PengasihSubdistrick, Pengasih, KulonProgo.

The stages of producing*WedangUwuh*Syrup are as follow:

1. 1 kg of simplicia ginger is washed. Then, it iscrushed by a grater or blenderalong with 0.5 litres of water. After that, it is squeezed and filtered.
2. Crush cinnamon, clove, the leaf of cinnamon, sappanwood and cardamom. Then, boil those ingredients in 0.5 litres of water and wait until the water remains 0.25 litres.
3. Pour the filtrate of ginger and 3 kg of palm sugar or sugar cane. Add 2 litres of water. Then, boil it until condensed.
4. Pour it into glass bottle and close it. Then, sterilise it in 15 minutes.
5. To prepare the drink, pour 20.cc of water in180 cc of syrup.

The stages of producing *WedangUwuh* Powder are as follows:

1. 1 kg of simplicia ginger iswashed. Then, it is crushed by a grater or blender along with 0.5 litres of water. After that, it is squeezed and filtered.
2. 1 kg of palm sugar was boiled along with cinnamon, clove, the leaf of cinnamon, sappanwood and cardamom. Add 1 litre of water until it boilfor 10 minutes and then filter it.
3. The filtered component is added by 3 kg of sugar cane and filtrate of ginger. Then, simmer and stir it until it becomes a crystal.
4. Let the heat air go while stirring. After the heat air is gone and thecrystal.iscold, it is packed in the plastic bag. Then, seal it tightly.
5. To prepare the drink, add 200 cc of water in 75 gram of powder.

The stages of preparing*WedangUwuhOprokan* are as follows:

1. Packed 25 gram of rock sugar in the small plastic bag.
2. Slice simplicia ginger clove, cardamom, cinnamon, the leaf of cinnamon, and sappanwoodwere washed and dry those ingredients.
3. 10 slices of simplicia ginger, 3 cloves, 1 cardamom, 1 cm of cinnamon, the shavings of dried sappanwood and the packed sugar are put in the plastic bag and tightly sealed.
4. To prepare the drink, add 500cc of hot water for 1 plastic bag of *oprokan* along with the sugar.

The tools are stove, frying pan, pan, sieve, spatula, grater/blender, *tampah* (container made from rattan), plastic bottle and hand sealer. Meanwhile, a plastic glass and spoon were used to test its 0rganoleptic quality.

B. Time and Place

The study conducted from June to August 2017 in Laboratory of Agribusiness of Agriculture Faculty of UPN "Veteran" Yogyakarta.

C. Method

Vitamin C was analyzed by using Iodine method (Sudarmadji *et al*., 1996).The activity of antioxidant was examined through DPPH-RSA (Payet*et al.*, 2005) and hedonic test refer to Sukarto and Hubeis (1992) was used for determination the level of consumer preference. Hedonic test conducted by 90 untrainedpanelists divided into 3 groups based on their ages(10-25, 26-49and ≥ 50 years old).They were asked to assess theorganoleptics quality of the rubbish drinks based on colour, clarity, aroma, taste and the whole response (Laksmi, 2012, citSari*et al*.,2014). The assessment used 5 levels of score, 1 = really don't like, 2 = don't like, 3 = quite like, 4 = like, 5 = really like (Husni*et al*., 2015).The hedonic test data were analyzed using nonparametric statisticKruskal Wallis test at α 5% and continued by using Mann-Whitney test (Daniel, 1989).

RESULTS AND DISCUSSION

The panelists'percentage who like *WedangUwuh*on some types of instant form are shown in the following tables.

Table1. The Panelists' Percentage who are 10 – 35 years oldand the modus score on "like" leveltowards the three forms of instant ***WedangUwuh***

Number	Parameter Items	Score	The percentage of panellists' (%) and the forms of Instant *WedangUwuh*		
			Syrup	Powder	"Oprokan"
1	Colour	5	10	3.3	33.3
		4	60	20	50
		3	23.3	56.6	10
2	Clarity	5	10	6.6	23.3
		4	43.3	20	46.6
		3	40	56.6	20
3	Aroma	5	20	0	33.3
		4	43.3	13.3	36.6
		3	30	46.6	23.3
4	Taste	5	16.6	3.3	20
		4	36.6	43.3	40
		3	36.6	33.3	33.3
5	The Whole Responses	5	20	3.33	13.3
		4	40	23.3	60
		3	36.6	53.3	20

Note : Score 5 = very like. Score4 = like. Score3 = quite like

Table2. The Panellists' Percentage who are 36– 49 years old and the modus score on "like" level towards the three forms of instant *WedangUwuh*

Number	Parameter Items	Score	The percentage of panellists' (%) and the forms of Instant *WedangUwuh*		
			Syrup	Powder	"Oprokan"
1	Colour	5	13.3	10	33.33
		4	53.3	16.6	33.33
		3	20	46.6	16.6
2	Clarity	5	10	6.6	16.6
		4	56.6	20	36.6
		3	23.3	46.6	30
3	Aroma	5	23.3	3.3	33.3
		4	36.3	16.6	46.6
		3	30	53.3	10
4	Taste	5	10	6.6	30
		4	36.6	33.3	36.6
		3	43.3	43.3	23.3
5	The Whole Responses	5	10	0	20
		4	46.6	23.3	60
		3	36.6	63.3	13.3

Note : Score 5 = very like. Score 4 = like. Score 3 = quite like

Table3.The Panellists' Percentage who are ≥ 50 years old and the modus score on "like" level towards the three forms of instant *WedangUwuh*

Number	Parameter Items	Score	The percentage of panellists' (%) and the forms of Instant *WedangUwuh*		
			Syrup	Powder	"Oprokan"
1	Colour	5	13.3	6.6	36.6
		4	53.3	23.3	46.6
		3	23.3	50	16.6
2	Clarity	5	10	20	16.6
		4	50	26.6	40
		3	36.6	26.6	23.3
3	Aroma	5	16.6	3.34	36.6
		4	30	33.3	40
		3	40	23.3	16.6
4	Taste	5	33.3	23.3	30
		4	30	33.3	46.6
		3	36.6	33.3	13.3
5	The Whole Responses	5	16.6	10	20
		4	46.6	23.3	56.6
		3	33.3	46.6	16.6

Note : Score 5 = very like. Score 4 = like. Score 3 = quite like

Table4.The Response level of Panelists' Preferences who are 10-25 years old towards the three forms of instant *WedangUwuh*

Number	Parameter Items	The forms of Instant *WedangUwuh*					
		Syrup		Powder		"Oprokan"	
1.	Colour	3.73	b	3.06	c	4.10	a
2.	Clarity	3.56	b	3.16	c	3.83	a
3.	Aroma	3.76	b	2.70	c	3.96	a
4.	Taste	3.60	a	3.30	b	3.73	a
5.	The Whole Responses	3.76	a	3.10	b	3.80	a

Note : The numbers followed by the same letter in the same row shows that there is no significant difference based on the Mann Whitney Test at α 5%.

Table5.The Response Level of Panellists' Preferences in the group with age 26 – 49 yearsold towards 3 forms of instant *WedangUwuh*

Number	Parameter Items	The forms of Instant *WedangUwuh*					
		Syrup		Powder		"Oprokan"	
1.	Colour	3.67	a	3.10	b	3.76	a
2.	Clarity	3.67	a	3.06	b	3.50	a
3.	Aroma	3.73	b	2.96	c	4.03	a
4.	Taste	3.46	b	3.30	b	3.87	a
5.	The Whole Response	3.60	b	3.10	c	3.93	a

Note : The numbers followed by the same letter in the same row shows that there is no significant difference based on the Mann Whitney Test at α 5%.

Table 6. The Response level of Panelists' Preferences who are ≥ 50 years old towards the three forms of instant *WedangUwuh*

Number	Parameter Items	The types of Instant *WedangUwuh*					
		Syrup		Powder		"Oprokan"	
1.	Colour	3.70	b	3.10	c	4.20	a
2.	Clarity	3.60	a	3.40	b	3.50	a
3.	Aroma	3.50	b	2.97	c	4.27	a
4.	Taste	3.96	a	3.70	b	3.93	a
5.	The Whole Response	3.76	a	3.23	b	3.90	a

Note : The numbers followed by the same letter in the same row shows that there is no significant difference based on the Mann Whitney Test at α 5%.

Table 7.The Calories and Vitamin C and antioxidant activityof the Three Types of Forms of Instant *WedangUwuh*

Number	Parameter Items	The types of Instant *WedangUwuh*		
		Syrup	Powder	"Oprokan"
1	Moisture Content (%)	29.44	0.35	4.53
2	Calories (Kcal)	283.66	394.02	364.68
3	Vitamin C (mg/100g)	32.25	43.18	228.30
4	Antioxidant Activity (%)	15.86	6.57	68.19

Table 1, 2 and 3 shows that mostattributes of organoleotics quality in all groups of age were instant *WedangUwuh*oprokan since most panelists' gave score 5 for "very like" and 4 for "like". However, they chose instant *WedangUwuh* syrup for the colour and clarity related like on score 4..

Table4,5 and6shows that the panelists' from teenage to older groups chose instant *WedangUwuhoprokan* on all attributes of sensory quality.It is related to the condition of ingredients of *WedangUwuh*. For preparation, the o*prokan* ingredients are still original therefore the extraction of volatile component, colour, or even taste is more optimum in producing the combination of aroma, colour and taste which can stimulate the nerves of the brain to like it. This result supports statement of Meilgaard*et al*., (1991). The level of preference of *WedangUwuh*powder was the lowest among others since *WedangUwuhp*owderwas produced through destruction and heating. Thus, the volatile component was destructed so that the colour was turbid. Moreover, the herbal impression is low and the aroma is less strong. This condition couldn't stimulate the nerves to give the impression of likeliness. Regarding the quality of aroma, the percentage of*WedangUwuh*syrup in all groups is significant among others although it is still below the *Oprokan*. The researchers notion is that the heating process does not really destruct the volatile component in the ingredients. Therefore, the panelists' still like it.

As shown in Table 7, the highest percentage upon vitamin C and antioxidant activity is *WedangUwuhoprokan*. It shows that the heating process of the ingredients destructs the vitamin C as one of the antioxidant component in *WedangUwuh* and decreases the antioxidant activity. The result supports the preferencestestthat there is a positive correlation between the panelists' levels of preferences and the quality of *WedangUwuh*. Meanwhile, the differences of calories among the three forms of instant *Wedanguwuh*are influenced by moisture and sugar content in its form.

CONCLUSIONS

On the level of "very like", 26.41 % of consumers chose *WedangUwuhoprokan*; 15.53% of them chose *WedangUwuh*syrup; and 7.08% chose *WedangUwuh*powder. The most preferred rubbish drink by testing all ranges of age was oprokan and powder rubbish drink was least preferred. The Vitamin Cin o*prokan was*228.30 mg/100 g and the activity of antioxidant was 68.19 %. While, vitamin C and antioxidant activity of *WedangUwuh*syrupand powder were32.25 mg/100 g and 15.66 %as well as 6.57 mg/100g and 6.57 %, respectively.

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Physicochemical Characteristics of Snake Fruit Drink Incorporated with Mangosteen (Garcinia mangostana L.) Peel Extract as Natural Preservative

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ABSTRACT

Presence of yeast and lactic acid bacteria induced spontaneous fermentation, which lead to snake fruit drink spoilage. Mangosteen peel extract could be applied as natural preservative to preserve snake fruit drink. This current work aimed to investigate physicochemical characteristics of snake fruit drink added with different levels (0%, 1,5%, 2,5%, 3,5%, 4,5% and 5,5%) of mangosteen peel extract. In term of physical properties, lightness (L) of snake fruit drink ranged from 18,43±0,06 to 32,00±3,30, while reddish (a+) and yellowish (b+) value ranged from 23,03±1,21 to 30,67±0,21 and from 11,97±1,63 to 17,07±3,67, respectively. In term of chemical properties, pH and total dissolved solid of snake fruit were 5,72±0,02 - 6,53±0,04 and 10,00±0,10 - 11,77±0,06 ºbrix, respectively, while total acid ranged from 0,04±0,03 to 0,14±0,01%.

Keywords: snake fruit drink; mangosteen peel; preservative; extraction

INTRODUCTION

Snake fruit (*Salaca edulis* Reinw.) is an Indonesian indigenous fruit (Utama *et al.,* 2006). The fruit has been popular due to its sweet taste, crunchy, and nutritious. Snake fruit originated Bangkalan shows distinctive characteristics related to its greater moisture content, thus make it much fresher when consumed (Fatimah and Sucipto, 2011). The fruit has been used for sweet, pickles, syrup, chips, jam (Noerhartati *et al.*, 2009), artificial date, kismis and snake fruit drink (Chayati and Miladiyah, 2013).

Fruit-based drink is made from various fruit juices and water with or without addition of sugar and permissible food additives (Arinda and Yunianta, 2015). Properties of snake fruit drink are susceptible to degrade, represented by presence of alcoholic flavor, sour taste, and gas Sopandi and Wardah (2014) found that fruit drink was susceptible to spoilage by mold, yeast, and bacteria such as *Lactobacillus, Leuconostoc*, and *Acetobacter* spp. Therefore, preservation technique needs to be developed to retard the spoilage.

Fruit drink spoilage could be inhibited by means of heat treatment, freezing, and refrigeration (Sopandi and Wardah, 2014), ultraviolet-C treatment (Arinda and Yunianta, 2015), and natrium benzoate (Subani, 2008). However, heat treatment, freezing, refrigeration, and ultraviolet-C exposure require expensive investment, thus they are unfeasible for the developing small enterprises. Despite of a permissible food preservative, application of natrium benzoate for

fruit drink was reported to be added in a greater amount than recommended dose. In 2011, Jakarta Consumers Foundation reported that some fruit drinks contained excessive food preservatives (2 times greater than maximum dose). Hence, an alternative method for fruit drink preservation was required. Some local materials and agricultural by-products may be applicable for preservative agent.

The use of natural food preservative has been regarded to have better and safer effects on health, leading to exploration of numerous natural preservatives such as guava leaves, chili, cinnamon, garlic, and betel leaf. In addition, mangosteen peel could be a candidate for preservative agent. The mangosteen peel has been considered as an underutilized material and a problematic solid waste. Previous studies reported that the mangosteen peel contained xanthone, mangostin, garcinone, flavonoid and tannin (Heyne, 1987 in Naufalin *et al.,* 2013), which were associated with antioxidant and antimicrobial activity (Naufalin and Herastuti, 2012). Putra (2010) also found that anthraquinone represented a dominant compound (57,13%) in chloroform mangosteen peel extract. Anthraquinone is regarded as the key component of antimicrobial activity present in the fraction.

Materials and Method

Material

Mangosteen (Garcinia mangostana L.) peel was discarded from the ripe fruit. The fruit was obtained from Kamal District and Kyi Lemah Duwur market in Bangkalan Regency. Snake fruit was collected from farmers in Bilepora Village, Socah District, Bangkalan Regency.

Preparation of Mangosteen Peel Extract

The extract was prepared using modified protocol prescribed by Dyahnugra and Widjanarko (2015). The peel was discarded from the fruit and pericarp, small cut (0.50 cm2), crushed and oven-dried at 50 °C for 6 h. The dried peel was grinded and sieved at 60 mesh to obtain mangosteen peel simplicia powder. The simplicia powder was submerged in water solvent at ratio of 1:6 for 24 h at room temperature (25-27 °C). After maceration, the filtrate was obtained and evaporated using rotary evaporator at 60 mBar and 50 °C.

Preparation of Snake Fruit Drink

The peel and seed was discarded, while the fruit flesh was washed and crushed. The crushed fruit was added with water (1 kg fruit flesh : 3 L water). The mixture was then heated to obtain soft texture, drained, and added with sugar (42.5 g), and re-heated. The mixture was filtered and added with mangosteen peel extract at different concentrations (1.5%, 2.5%, 3.5%, 4.5% and 5.5%), cooled, and packaged using plastic cup.

Evaluation of Snake Fruit Drink

The snake fruit drink was analyzed for color (Wisesa and Widjanarko, 2014) and total dissolved solid (OBrix) (Muchtadi et al., 2010), pH (Muchtadi et al., 2010) and total acidity (Muchtadi et al., 2010).

Result and Discussion

Physical Characteristic of Snake Fruit Drink

Color evaluation represents the physical properties of preserved snake fruit drink. The color plays important role in the drink related to consumer preference. Attractive color leads to high

preference of the consumers, while discoloration leads to rejection by consumers. The colorful foods often result from presence of natural pigment or intentionally added colorants.

Table 1. Color profile of snake fruit drink incorporated with mangosteen peel extract

Concentrations of mangosteen peel extract	Warna		
	a+	b+	L
0%	12,33±2,05 [a]	23,03±1,21 [a]	32,00±3,30 [d]
1.5%	11,97±1,63 [a]	28,30±0,72 [bc]	28,63±1,79 [c]
2.5%	14,30±0,20 [ab]	30,10±0,87 [d]	21,87±1,14 [b]
3.5%	16,37±1,00 [b]	29,53±1,58 [cd]	21,40±0,66 [ab]
4.5%	17,07±3,67 [b]	30,67±0,21 [d]	21,10±0,26 [ab]
5.5%	16,47±1,06 [b]	27,67±0,50 [b]	18,43±0,06 [a]

Note: Different superscripts following the means in the same column showed significant difference at $p<0.05$

Reddish (a+)

Table 1 shows that greater concentration of the extract results in greater reddish value (a+) of snake fruit drink. The higher a+ value was caused by anthocyanin pigment present in mangosteen extract. Manurung (2012) reported that mangosteen peel contained anthocyanin pigment. The anthocyanin contained in other sources was also reported by Fitriyani et al. (2013), indicating that addition of natural colorant (angkak) caused higher red intensity.

1. Yellowish (b+)
   The results demonstrate that greater concentration of the extract results in greater yellowish value (b+) of snake fruit drink as presented in Table 1. The highest value was attributed to treatment of 4.5% extract, while the lowest one was attributed to control (without addition of mangosteen peel extract).

2. Lightness (L)
   Table 1 indicates that higher concentration of mangosteen peel extract reduced lightness value (L) of snake fruit drink. The reduction of lightness was associated with presence of anthocyanin. Greater anthocyanin resulted in more stability of anthocyanin, contributing to darker appearance. Arjuna (2008) also reported that higher concentration of bit extract reduced lightness of shrimp paste (terasi). This is in accordance with Farida and Fithri (2015), indicating that reduced lightness was caused by increased anthocyanin. Lower anthocyanin was responsible for higher lightness, conversely.

Physical Characteristic of Snake Fruit Drink

Table 2 exhibits the chemical properties of snake fruit drink naturally preserved by mangosteen peel extract.

Table 2. Chemical properties of of snake fruit drink incorporated with mangosteen peel extract

Concentrations of mangosteen peel extract	Parameters		
	pH	Total Dissolved Solid (°Brix)	Total Acid (%)
0%	6,53±0,04[c]	10,00±0,10 [a]	0,04±0,03 [a]
1.5%	6,05±0,01[ab]	10,37±0,06 [b]	0,09±0,01 [b]
2.5%	6,30±0,60[bc]	10,70±0,10 [c]	0,10±0,01 [b]
3.5%	5,86±0,03[ab]	10,77±0,06 [c]	0,09±0,01 [b]
4.5%	5,80±0,02[a]	11,37±0,15 [d]	0,10±0,01 [b]
5.5%	5,72±0,02[a]	11,77±0,06 [e]	0,14±0,01 [c]

Note: Different superscripts following the means in the same column showed significant difference at $p<0.05$

1. pH
   Addition mangosteen peel extract significantly affected pH level as presented in Table 2. Higher concentration of mangosteen peel extract lowered pH level, which was associated with acidity of the mangosteen peel extract. This result was in line with Izzati (2014), indicating that presence of mangosteen peel extract could enhance the acidity. The pH of mangosteen peel was 5.8 in ethanol. Suwardjono (2001) reported tannin compounds in mangosteen peel including catechin, leucoanthocyanin and some hydroxy acids (gallic acid and tannic acid).
2. Total Dissolved Solid
   Table 2 shows that addition of mangosteen peel extract affects total dissolved solid of snake fruit drink. Higher concentration of mangosteen peel extract enhanced total dissolved solid of snake fruit drink, which was linked to presence of sugar and acid compounds, as well as water-soluble fractions in mangosteen peel extract. Permana (2010) found that mangosteen peel powder contained 5.87% moisture, 2.17% ash, 6.45% lipid, 3.02% protein, 2.10% total sugar, and 82.50% carbohydrate.
3. Total Acid
   Total acid was conversely associated with pH value. Table 2 exhibits that addition of mangosteen peel extract altered total acid of snake fruit drink. Higher concentration of mangosteen peel extract resulted in greater total acid of snake fruit drink. High level of total acid is in line with lower pH, indicating higher acidity level. Such condition presumable resulted from presence of acid in mangosteen peel extract.

CONCLUSION

Physical properties (color profile) of snake fruit drink were significantly affected by mangosteen peel extract. The reddish color (a+) ranged from 23.03±1.21 to 30.67±0.21, while yellowish color (b+) ranged from 11.97±1.63 to 17.07±3.67, and lightness (L) ranged from 18.43±0.06 to 32.00±3.30. Chemical analysis showed that addition of mangosteen peel extract significantly influenced pH (5.72±0.02 – 6.53±0.04), total dissolved solid (10.00±0.10 – 11.77±0.06 ºbrix, and total acid (0.04±0.03 – 0.14±0.01%).

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Test of Eight Genotypes of Tropical Wheat in Gunungkidul

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ABSTRACT

Wheat (*Triticum aestivum* L.) is one of the foods that Indonesian people need and their presence is imported. Wheat imports tend to increase from year to year. The previously discovered M6 wheat mutants are a grain mutant tolerant to abiotic lowland environments. Therefore, need to be tested multi-location and one of them in the area Wonosari Gunungkidul. The aim of this research was to study the relationship between components yields and yields of M6 wheat mutants and their interaction with the environment. The research was conducted in July until September 2016. The experiment was arranged in a Randomized Completely Block Design with single factor that is eight wheat genotypes consisting of two genotypes of introduction (Selayar and WL-2265) and six mutant wheat genotypes M6 (PN-81/200/102/81, WL-2265/300/629/35; DWR-195/300/73/102; WL-2265/200/28/15 and WL-200) with three blocks as repeat. Conclusions: WL-2265 introductory wheat genotypes and M6 mutant wheat genotypes SA-75/200/132/81 and WL 200 are superior genotypes capable of adapting to agroclimate conditions in Gunungkidul and all three wheat are selected to be tested further in other locations in the lowlands .

Keywords: tropical wheat, lowland, introductory wheat, mutant wheat

INTRODUCTION

Wheat is an important food crop and ranks third after corn and rice (Anonymous, 2013). Wheat is not a indigenous plants from Indonesia but the need for wheat in Indonesia is quite high. This is related to food based on wheat flour are increasing. Wheat crops are sub-tropical and temperate, and in tropical areas wheat crops are found only in mountainous areas, where temperatures roughly equal air temperatures in sub-tropical and temperate climates. In Indonesia, wheat is grown an altitude of 800 meters above sea level. The minimum temperature of wheat growth is 2-4º C, the optimum temperature for wheat growth growth is 15-25º C and its maximum temperature is around 37º C. For tropical regions like Indonesia, it is necessary to introductory or find wheat varieties that are tolerant of high air temperature , so that the area of wheat cultivation can be lowered in locations with altitude below 800 meters above sea level (Wiyono, 1980).

In Indonesia, the development of wheat plants has many limiting factors. The most influential environments on the yield and quality of wheat grain are high temperature and drought stress (Pringgohandoko, 2001 and 2013). Air temperature is one of the most important environmental factors affecting the wheat yield (McDonald et al., 1983; Fischer, 1985; Pringgohandoko, 2013). Some researchers have concluded that high temperatures during growth lead to lower wheat yields, mainly due to an increase in the rate of growth thereby decreasing the amount of radiation, water, nitrogen and nutrients available to plants. Average temperatures above 15^0 C

during the filling period will decrease yield, especially as a result of decreased grain weight.

Several field studies have shown that the weight loss of wheat seeds reaches 3-5% for every 1^0 C temperature rise above the daily average temperature (15^0 C). Temperatures not too high after flowering may affect cell formation of endosperm tissue. The number of endosperm cells will not be altered by high temperatures (<30^0 C), but cells that develop under these conditions will be smaller or fail to replenish resulting in lower starch storage (Wardlaw and Wrigley, 1994).

Each wheat varieties have different adaptability in the environment. But with the discovery of some mutant wheat M6 that is tolerant with abiotic conditions in the lowlands then this gives hope for the future to grow tropical wheat in Indonesia (Pringgohandoko, 2013). However, for successful planting of M6 wheat mutants in the lowlands of Indonesia it is necessary to identify the genotype that can adapt to local agro-ecological conditions. Based on this, it is necessary to know the introductory genotype and the wheat mutants that are able to grow and produce high with the expected quality of grain (location-specific varieties).

Topographically, Wonosari sub-district is the middle zone of Gunungkidul district, with height 150-200 m above sea level. The soil type is dominated by red mediteran and black grumosol with limestone parent material. So despite the long dry season, the water particles are still able to survive. There is a river above the ground, but in dry season the depth of groundwater ranges from 60-120 m below ground level (BPBD, 2014). Air temperature is about 23-34^0 C.

MATERIALS AND METHODS

The study was conducted in April 2016 until July 2016 in Wonosari Gunungkidul District with a high place 200 meters above sea level. The experiment was arranged in a Randomized Completely Block Design (RCBD) with three replications. The result of observation is tested with 5% anova analysis and if there is any significantly different then continue with Duncan Multiple Range Test (DMRT) 5%. The eight genotypes tested were: Selayar, WL-2265, PN-81/200/132/81, WL-2265/300/629/35, DWR-195/300/73 / 102, WL-2265/200/28/15, WL-200. Each replica was planted in experimental plots 2 x 1 m using a spacing between row 25 cm and spacing in row 15 cm. After planting is continue with watering to accelerate germination.

Fertilization is done by using NPK fertilizer (1: 2: 1) with a dose of 400 kg/ha. So the fertilizer needs for each plot 400 g and the need for each line 50 g. Fertilization is done twice, ie at the time of planting using 1/3 part of NPK fertilizer and at the time of the plant aged 40 days with 2/3 parts of the remaining NPK fertilizer. Fertilization is done by making a long ditch with a 10 cm distance from the plant, the fertilizer was spread evenly and covered with soil. Weeding was done three times, the first at four weeks after planting, second at eight weeks after planting, and the third depends on the state of weed growth. Pest and disease control is done when there are signs of attack.

RESULTS AND DISCUSSION

Wheat crops tested in Gunungkidul district generally grow well, plant height varies between 41.67 cm to 52.00 cm. The wheat genotype mutant WL-2265/200/28/15 was significantly higher than Selayar and wheat genotypes WL-2265/300/629/35 but not significantly different from other genotypes. Table 1 showed that mutant genotype WL-2265/200/28/15 higher than the plants before the radiation, so it can be said that the mutant is able to adapt to the conditions agroclimate in the district of Gunungkidul.

Average length of panicle wheat ranged from 5.33 cm to 7.00 cm. The length of panicle

the genotype WL-2265/200/28/15 is significantly different than the WL-2265/300/629/35 genotype, whereas with the other genotypes not significantly different, the WL-2265/200/28/15 genotype have height posture.

The number of panicles per clump of wheat plants formed ranges from 4 panicles to 12 panicles per clump of wheat crops. The WL-200 genotype have the highest number of panicle is 12 panicles per clump significantly different from the SA-75/200/132/81 genotype, WL-2265/300/629/35 genotype, and DWR-195/300/73/102 genotype, but not significantly different from the WL-2265/200/28/15 genotypes, WL-2265 genotypes and Selayar genotypes. The WL-200 genotype has the capacity to produce more panicles than the genotype of the mutant, this phenomenon suggests that the WL-200 genotype has the potential to produce more panicles than the other genotypes tested in Gunungkidul district.

The phenomenon of growth and component of yield on the introductory of wheat genotypes and mutan M6 genotype can be explained that the phenotype appearance of plants is influenced by genetic factors and by environmental factors (Mangoendidjojdo, 2003). According to Fehr (1987) explains that plant environmental factors include predictable environmental factors such as soil type, planting season, population per plant and fertilizer application. While unpredictable environmental factors are fluctuating and inconsistent conditions include: rainfall, air temperature, air humidity. Based on the field observation that environmental factors in the experiment area are kept as homogeneous, so that the differences in the various parameters measured solely due to the genetic influence of each genotype tested.

Table 1. Average Plant height, length of panicles and number of panicles per clump eight wheat genotypes in Gunungkidul district

Wheat Genotype	Plant height (cm)	Length of panicles (cm)	Number of panicles per clump
Selayar	42.00 ab	6.33 ab	10.67 bcd
WL-2265	46.33 bc	6.00 ab	10.00 bcd
PN-81/200/102/13	50.67 bc	6.67 ab	9.67 bcd
SA-75/200/132/81	50.33 bc	5.67 ab	5.67 abc
WL-2265/300/629/35	41.67 a	5.33 a	4.00 a
DWR-195/300/73/102	43.00 abc	6.67 ab	5.00 ab
WL-2265/200/28/15	52.00 c	7.00 b	9.00 abcd
WL-200	43.67 ab	6.67 ab	12.00 d

Means in the same column followed by the same letters are not significantly different ($P<0.05$), according to Duncan Multiple Range test.

Parameter of yield component were number of flowers per panicle, number of flowers per clump, number of seeds per clump and percentage of flower to seeds in Gunungkidul district showed in table 2. DMRT test results showed the number of flowers per panicle of wheat plants grown in Gunungkidul district was not significantly difference. This phenomenon showed that the number of flowers per panicle is relatively similar, so to increase the breeder's yield is more concerned with the number of panicles produced per clump than the number of flowers per panicle.

This study showed that the number of flowers per clump of wheat crops planted in Gunungkidul district was significantly difference. The genotype WL-2265/200/28/15 was significantly

different from the WL-2265/300/629/35 genotype, but was not different from other genotypes. WL-2265/300/629/35 genotype was significantly different with Selayar, WL-2265, PN-81/200/102/13, WL-2265/200/28/15 and WL-200.

Table 2. Number of flowers per panicle, number of flowers per clump, number of seeds per clump and presentation of flower to seed in Gunungkidul district

Wheat Genotype	Number of flowers per panicle	Number of flowers per clump	Number of seeds per clump	Presentation of flower to seed
Selayar	25.00 a	264.67 bc	8.00 a	3.44 a
WL-2265	28.33 a	289.00 c	46.33 cd	15.88 abc
PN-81/200/102/13	29.00 a	278.33 c	15.67 ab	7.55 ab
SA-75/200/132/81	27.67 a	151.00 abc	35.67 abcd	24.08 cdef
WL-2265/300/629/35	19.00 a	70.67 a	22.67 abcd	32.64 def
DWR-195/300/73/102	24.67 a	124.33 ab	21.33 abc	16.62 abcd
WL-2265/200/28/15	26.33 a	234.67 bc	44.00 bcd	19.48 bcde
WL-200	24.67 a	290.33 c	70.67 d	37.37 f

Means in the same column followed by the same letters are not significantly different ($P<0.05$), according to Duncan Multiple Range test.

The number of seeds per clump of WL-200 was significantly higher than that of the selayar, PN-81/200/102/13 and DWR-195/300/73/102, but not significantly different from the other genotypes. The percentage of flowers to be seed of WL-200 is significantly larger than Selayar, WL-2265, PN-81/200/102/13, DWR-195/300/73/102 and WL-2265/200/28/15. Wheat crops with hollow seeds will affect crop production. Selayar genotypes, WL-2265 and PN-81/200/102/13 have many flowers but few seeds due to many hollow seeds. Wahyu *et al.* (2013) indicates that wheat in the lowlands causes a floret to be hollow and causes the number of seeds per panicle produced is also low. The greatest possibility of this is thought to occur because at high temperatures will cause pollen to become sterile so that fertilization can't take place (Kurnia, T.D., 2013)

CONCLUSION

WL-2265 introductory wheat genotypes and M6 mutant wheat genotypes SA-75/200/132/81 and WL 200 are superior genotypes capable of adapting to agroclimate conditions in Gunungkidul and all three wheat are selected to be tested further in other locations in the lowlands .

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THE *Callosobruchus spp.* CONTROLLED USING *Piper cubeba* and *Annona muricata* SEED EXTRACTS FOR INCREASING THE QUALITY OF MUNGBEAN STORAGED SEEDS

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ABSTRACT

The aims of the experiment was to find the optimum composition and concentration of *Piper cubeba* and *Annona muricata* seed extracts for decreasing *Callosobruchus spp.* development and to maintain the quality of mungbean storaged seed. The experiment was conducted at Plant Protection Laboratory, Faculty of Agriculture, UPN "Veteran" Yogyakarta from March to August 2013. It consisted of one factor: the composition and concentration of *P.cubeba* and *A.muricata* seed extracts : 2/0-5%, 2/0-7,5%, 2/0-10%, 2/1-5%, 2/1-7,5%, 2/1-10%, 1/1-5%, 1/1-7,5%, 1/1-10%, 1/2-5%, 1/2-7,5%, 1/2-10%, 0/2-5%, 0/2-7,5%, 0/2-10%, and one control treatment: no extracts application. It was arranged in Randomized Complete Design with four replications. Data collected was subjected to an analysis of variance followed by DMRT at 5% significance level. The results showed that: 1) The the composition and concentration of *P. cubeba* and *A. muricata* seed extracts: 2/1-10% ;1/2-10% dan 1/1-10% had the highest of *Callosobruchus spp.* mortality and better seed vigor than other treatments 2) There had been decreasing mungbean seed quality on 2 month storage period.

Keywords*: Piper cubeba* and *Annona muricata seed extracts , Callosobruchus sp., mungbean storage seeds*

INTRODUCTION

The production of mungbean is plagued by many different pests, with insects causing the worst damage. Field insect pests are the pests that affect these crops in field before harvest. The most important storage pest of mungbean is *Callosobruchus spp.* It belongs to the family Bruchidae. The larvae bore into the pea or bean throughout most of the tropics and subtropics (Hill and Waller, 1999). They develop inside kernel and feed on starchy interior. Adults hatch and eat their way out of the grain and continue to feed voraciously on the grain. They caused 50% seed weight loss of mungbean for 3 month (Priyono and Harahap, 1995).

Losses caused by storage pests include weight loss, loss in quality and market value, promotion of mould development, reduced germination in seed material and reduced nutritional value (Hill and Waller, 1999 *cit*. Asmanizar *et al*., 2012).

Synthetic chemical insecticides have been instrumental in the evolution of modern agriculture. Nevertheless, overuse and misuse of pesticides has sometimes resulted in problem of environmental contamination, poisoning, pesticides resistance and test resurgence. This issues,

consumer demands for low-risk product and legislative with drawal of older chemistries in many jurisdiction has resulted in increased attention towards reduced risk tactics for pest management (Faraone *et al*.,2015)

Although the pest can be effectively controlled by synthetic insecticides, but these insecticides cause serious problems of toxic residues, health and environmental hazards, in addition to development ofinsect resistance (Fishwick, 1988; Golob *et al*., 1982; Yusof& Ho, 1992 *cit.* Asmanizar *et al.,* 2012). The need to find materials that effectively protect rice grain that are readily available, affordable, relatively less poisonous and less detrimental to the environment had stimulated interest in the development of alternative method of control such as using of botanical insecticide.

Botanical insecticides are of great interest to many, because they are natural insecticides, toxicants derived from plants. Since the use of chemicals has so many adverse effects on the environment, the botanical insecticides has been adopted by the farmers to control the insect pest that attack cowpea. The effectiveness of botanical insecticides has been demonstrated in many studies. Many of the plant species concerned have also been used in traditional medicine by local communities and have been collected from the field or specifically cultivated for these purposes. Leaves, roots, twigs and flowers have been admixed as protectant with various commodities in different parts of the world (Asmanizar *et al.,* 2012).

Extract from plants material were tested in choice and no choice tests as oviposition deterrents for cowpea bruchid, *C. maculatus* on chickpea, cicer arietinum. Seed treatments with 0.1% crude extract of materials resulted in a significant reduction in ovipositional preverence of the bruchid (Elhag, 2010). *P. cubeba* was essential oils were investigated for repellent, insecticidal, antiovipositional, egg hatching, persistence of its insecticidal activities against rice weevils *Sitophylus oryzae* (Coleoptera: Curculionidae) (Su, 1990).

Grain protectants are defined as pesticides which are incorporated directly into the grain mass for protection against insect. This is also known as admixture treatment. The advantage of insecticide they are generally easy in preparing, inexpensive and a single application of an effective insecticide, correctly formulated, will give control of existing insect infestation (including, eventually, any insect stages within the kernels)and will protect the grain against re-festation for asubstantial period (Proctor, 1994). More information is needed regarding the effectiveness of the composition and concentration of *P. cubeba* and *A. muricata* extracts in controlling *Callosobruchus spp*. and mungbean seed quality in storage.

MATERIALS AND METHODS

The experiment was conducted at Plant Protection Laboratory, Faculty of Agriculture, UPN "Veteran" Yogyakarta. It consisted of one factor: the composition and concentration of *P. cubeba* and *A. muricata* seed extracts : 2/0-5%, 2/0-7,5%, 2/0-10%, 2/1-5%, 2/1-7,5%, 2/1-10%, 1/1-5%, 1/1-7,5%, 1/1-10%, 1/2-5%, 1/2-7,5%, 1/2-10%, 0/2-5%, 0/2-7,5%, 0/2-10%, and one control treatment: no extracts application. It was arranged in Randomized Complete Design with four replications. Data collected was subjected to an analysis of variance followed by DMRT at 5% significance level.

Bioassay (Mortality Test)

Into each of the plastic glass, 50g of seeds was mixed with *P.cubeba* and *A.muricata* seeds extracts; the composition and concentration of them depend of the treatment. Ten (10) newly emerged adults of *Callosobruchus spp.* was introduced into plastic glass. The glass were

covered with nets to ensure aeration. Percentage mortality was calculated on daily basis for four (4) days.

Evaluation of Seed Quality

After 2 months seed storage period, weight loss of mungbean seed was measured. For germination test, four replicated of 50 seeds from each treatment were planted on germination bag with sand-filled, allowed to germinated for 7 days and then all germination test parameters measured.

RESULTS AND DISCUSSION

Statistical analysis showed that the highest mortality of *Callosobruchus spp.* on 24 hours after treatment was 2/1-5% treatment. The observation on 48, 72 and 96 hours the highest mortality occured on 1/1-7,5% dan 10% treatments but not significantly difference with 2/1-10% and 1/2-10%. This showed that mixing *A. muricata* seeds extract with *P. cubeba* seed extract could increas insect mortality than was separated (Table 1).

The extract from *A. muricata* seed exhibited great toxic effects against *Callosobruchus spp.* adult. Londershausen *et al*. (1991) reported that the Annonaceous species such as *A. muricata* had the Annonaceous acetogenin, a class of natural compound with a wide varieties of biological activities. The acetogenin from *A. muricata* seed had been known to have substances that act as botanical insecticide.Acetogenins are mitochondrial poisons, inhibiting cellular energy production through a mode of action identical to that of the well-known botanical insecticide and fish poison, rotenone (More specifically, acetogenins block the respiratory chain at NADH ubiquinone reductase (complex I) and cause a decrease in ATP levels, directly affecting electron transport in the mitochondria, causing apoptosis. Acetogenins also inhibit insect development and behavior.

The content of *P. cubeba* fruits was lignan compound those were clusine, dihidroclusine and yatein, they had great activity to inhibit P450 cytochrome enzyme for degradating stranger compound including insecticide. Inhibiting that enzyme caused the combining insecticide with lignan had synegyze effect potentcially (Usia *et al*., 2005).. This research also showed that the combining *A. muricata* and *P. cubeba* extract could increase *Callosobruchus spp* mortality.

Table 1. Percentage of *Callosobruchus spp.* mortality on 24, 48, 72 and 96 hours after application

Composition and concentration of *P.cubeba:A.muricata*	Mortality on ... hours after application			
	24	48	72	96
2/0-5%	10,00 ab	13,33 b	23,33 ab	50,00 ab
2/0-7,5%	13,33 ab	23,33 ab	40,00 ab	63,33 ab
2/0-10%	0,00 b	0,00 b	10,00 b	33,33 b
2/1-5%	23,33 a	26,67 ab	43,33 ab	50,00 ab
2/1-7,5%	0,00 b	10,00 b	13,33 b	53,33 ab
2/1-10%	3,33 b	20,00 ab	50,00 ab	80,00 a
1/1-5%	6,67 ab	13,33 b	33,33 ab	70,00 ab
1/1-7,5%	13,33 ab	40,00 a	53,33 ab	73,33 ab
1/1-10%	13,33 ab	30,00 a	60,00 a	70,00 ab
1/2-5%	3,33 b	10,00 b	30,00 ab	46,67 b

1/2-7,5%	3,33 b	6,67 b	16,67 b	63,33 b
1/2-10%	10,00 ab	30,00 a	53,33 ab	80,00 a
0/2-5%	3,33 b	10,00 b	26,67 ab	43,33 b
0/2-7,5%	3,33 b	10,00 b	20,00 ab	60,00 ab
0/2-10%	6,67 b	10,00 b	30,00 ab	56,67 ab
Control	3,33 b	13,33 b	20,00 b	46,67 b

Note : Mean in row (a,b,c) followed by the same letters are not significantly different at 5% level Duncan test

The highest population of *Callosobruchus spp* was occured on 0/2-5% and not significantly different with control. This showed that *P. cubeba* extract didn't give effect in supressing *Callosobruchus spp*. population growth. Increasing *Callosobruchus spp.* population caused higher seed damaged and seed moisture content. (Table 2).

Table 2. *Callosobruchus spp*. population, Seed moisture content (%) and mungbean seed damaged (%) after 2 months seed stored

Composition and concentration of *P.cubeba:A.muricata*	*Callosobruchus* spp.population	Seed moisture content (%)	Seed damaged (%)
2/0-5%	69,33 a	11,27 cd	4,23 ab
2/0-7,5%	25,67 a	10,40 cd	1,19 a
2/0-10%	13,67 a	9,73 d	1,31 a
2/1-5%	34,33 a	10,40 cd	1,60 a
2/1-7,5%	10,67 a	10,13 cd	0,87 a
2/1-10%	0,00 a	9,07 d	0,00 a
1/1-5%	28,00 a	10,73 cd	1,96 a
1/1-7,5%	16,67 a	10,47 cd	0,87 a
1/1-10%	0,00 a	8,77 d	0,00 a
1/2-5%	82,00 a	11,67 cd	6,43 ab
1/2-7,5%	33,67 a	10,00 cd	2,25 a
1/2-10%	8,00 a	8,90 d	0,32 a
0/2-5%	473,33 b	16,93 a	37,84 c
0/2-7,5%	90,33 a	12,03 c	7,65 b
0/2-10%	13,33 a	10,57 bc	2,24 a
Control	492,67 b	16,47 a	48,98 c

Note : Mean in row (a,b,c) followed by the same letters are not significantly different at 5% level Duncan test

Table 3 showed the mungbean seed damaged after 2 months in storage connecting with the weight loss of seed. The mungbean seed damaged increased with increasing their weight loss. Weight loss on control and 0/2-5% treatment was higher than other treatments because the population of *Callosobruchus spp* was high so many material that was consumed.

Seed treatment with compotition and concentration of *P.cubeba* and *A.muricata* seed extracts 0/2-5% and control no pesticides gave higher seed conductivity than another composition and concentration. They had low concentration of *A.muricata* (5%) and no extracts as biopesticides so can not kept seed from *Callosobruchus* spp.

Conductivity test was based on the premise that as seed deterioration progresses, the cell membranes become less rigid and more water permeable, allowing the cell contents to escape into solution with the water and increasing its electrical conductivity. The conductivity of the solution reflected the general level of viability of seed (Copeland and Donald, 1995). Seed germination and seed vigor showed that on control and 0/2-5% treatment was lower than another treatment.

Table 3. Weight loss of mungbean seed (%); seed conductivity (m Hos); Percentage of seed germination and seed vigor after 2 months stored (%)

Composition and concentration of *p.cubeba:a.muricata*	Weight loss	Seed conductivity	Seed Germination	Seed Vigor
2/0-5%	1,27 bc	1,509 b	88,67 ab	82,67 ab
2/0-7,5%	0,66 c	1,495 b	93,33 a	88,67 ab
2/0-10%	0,48 c	1,450 b	95,33 a	90,67 a
2/1-5%	0,71 bc	1,437 b	94,67 a	88,00 ab
2/1-7,5%	0,41 c	1,499 b	95,33 a	89,33 ab
2/1-10%	0,14 c	1,382 b	84,00 ab	82,67 ab
1/1-5%	0,9 bc	1,571 b	85,33 ab	82,00 ab
1/1-7,5%	0,61 c	1,448 b	94,67 a	85,33 ab
1/1-10%	0,57 c	1,533 b	92,67 ab	83,33 ab
1/2-5%	1,85 bc	1,685 b	85,33ab	82,00 ab
1/2-7,5%	0,49 c	1,415 b	92,00 ab	89,33 ab
1/2-10%	0,47 c	1,461 b	93,33 a	86,67 ab
0/2-5%	8,13 a	2,927 a	72,67 b	70,00 b
0/2-7,5%	1,91 b	1,689 b	82,67 ab	80,00 b
0/2-10%	0,87 bc	1,493 b	90,67 ab	86,67 ab
Kontrol	6,42 a	2,484 a	64,00 b	54,00 b

Note : Mean in row (a,b,c) followed by the same letters are not significantly different at 5% level Duncan test

CONCLUSION

The conclusion were: 1) The the composition and concentration of *Piper cubeba* and *Annona muricata* seed extracts: 2/1-10% ;1/2-10% dan 1/1-10% had the highest of *Callosobruchus* spp. mortality and better seed vigor than other combination treatments 2) There had been decreasing mungbean seed quality on 2 month storage period.

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ENHANCING THE QUALITY AND QUANTITY OF SWEET SORGUM SAP FOR BIOETANOL

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ABSTRACT

Sweet sorghum is one of renewable bioethanol raw materials as an alternative energy substitution to fossil fuel which its existence is increasingly depleted. Several studies have been done to improve the quality and quantity of sweet sorghum stem sap. The research is conducted from 2013 to 2016. The result of initial study in 2013 shows that the dosage variation of mycorrhizal has an effect on the quality of stem rods i.e. stem weights and stem sap content. A second study (2014) shows an interaction between genotypes with husk-charcoal mycorrhizae in the sap sugar content (%) with the highest value obtained in a combination of a 30 g / plant-HZ-30 (P3G1) husk-charcoal treatment of 7.6144%. The third study (2015) gives the result that there is an interaction between varieties and the combination of inorganic fertilizer, organic fertilizer and husk-charcoal on the parameters of stem sap content (ml), sweetness level of sap (briks), and sap sugar content (%). The fourth research (2016) obtains a result that there is an interaction between treatment of varieties and the dosage of organic fertilizer on the weight of sorghum stem, starch content of sorghum stem, total sugar content of sorghum stem, and carbohydrate content of sorghum stem.

Keywords: quality, quantity, stem sap, sweet sorghum

I. Introduction

Sorghum *(Sorghum bicolor L. Moench)* is a grain cereal crop that belongs to the Graminaea family or grass. In Indonesia, currently sorghum plants provide opportunities to be developed as food crops, feed and bioethanol (bioenergy). Some countries, such as the United States, India and China have been using sardines from sorghum as raw material for bioethanol manufacture (Sukmadi, 2010). As a raw material for bioethanol, sweet sorghum does not compete with food crops or animal feed. Some of the reasons that support this include botanically most bioethanol is produced by the stem, while the seeds can be processed into bioethanol or for food and animal feed. These dual benefits make sweet sorghum a crop which capable to fulfill the needs of food, animal feed, and energy in a single dimension of space and time (Rajvanshi, 1989; Yudiarto, 2006 in Anonymous, 2013)

Sorghum is a plant that has big enough prospect to be developed as raw material of ethanol. Sweet sorghum stems, *bagase* (squeezed juice) and seeds can be processed into ethanol after under going through the extraction process. The high ethanol production per unit area of sweet sorghum stem sap besides influenced by ethanol content per kg of stem is also much determined by the production of biomass stems of each variety (Anonymous, 2011).

In the cultivation of sweet sorghum plants, the problem is the level of production which is still low for both quantity and quality. This is partly due to the use of fertilizers that have not been in accordance with the needs, soil poor nutrients, pest and disease control that has not been effective, agroclimate factors and lack of technical mastery of farming by farmers. To increase the production of sweet sorghum, various ways can be done through improvement of cultivation technology such as the use of superior varieties, fertilizer with organic and biological fertilizer, pest and disease control with biological pesticide, and post harvest improvement (Sukmadi, 2010).

To improve the yield of sweet sorghum biomass in addition to the use of superior varieties can also be done with the addition of arbuscular mycorrhizal fungi. Arbuscular mycorrhizal fungi are beneficial for plants in increasing nutrient uptake, especially phosphorus (P) and other nutrients such as zinc (Zn), molybdenum (Mo), copper (Cu) and potassium (K). In addition to nutritional improvements, arbuscular mycorrhizal fungi are also known to protect plants from drought and have the ability to increase plant resistance to root pathogens (Sukmadi, 2010; Kusnadi, 2010; and Yuwono, 2006).

Arbuscular mycorrhizal fungi as biological fertilizers can also be combined with husk charcoal as a soil enhancer. Husk charcoal as a soil enhancer, can bind carbon and improve soil function, help the soil to retain nutrients and water, improve soil moisture, reduce evaporation of soil water, suppress the development of certain plant diseases, create good habitat for symbiotic microorganisms and improve water quality and quantity (Kurnia Adhi, 2013; Nurida et al., 2015). The results of Nurbaity et al. (2011) demonstrates that a mixture consisting of inoculant fungi of arbuscular mycorrhizal mixed with husk charcoal and zeolite media (1: 3) gives better sorghum yield than inoculant fungi of arbuscular mycorrhizal mixed with only zeolite media.

The improvement of cultivation technology can also be done by adding combination of organic fertilizer, inorganic and husk charcoal as soil enhancer. Organic fertilizers apart of providing nutrients for plants also improve the soil physical properties. Inorganic fertilizers alone can provide nutrients for plants relatively faster than organic fertilizers.

II. Arbuscular Mikorisa Fungus

Biological fertilizer (biofertilizer) is a living microbial substance given to the plant to increase the ability of plant roots to absorb nutrients from the soil. Microbes help to decompose the elements present in the soil into compounds that can be absorbed by plant roots. According to Goenadi (2006) in Sukmadi (2010) biological fertilizer in principle is a microbe that can improve or enhance the availability of nutrients for plants. Due to the reduction of chemical fertilizer consumption, the technology of biological fertilizer is believed to be an important part in sustainable agriculture system (Sukmadi, 2010).

One type of microbe that can be utilized as a biofertilizer is arbuscular mycorrhizal fungi (AMF). AMF will grow on the roots of the plant as long as the plant is alive, so its application is only require once in a plant lifetime. AMF is a mutually-symbiotic fungus with plant roots that play an important role in the nutritional cycle in the ecosystem (Suhardi, 1990 in Sukmadi, 2010). Biofertilizer has been considered as an alternative input production in the cultivation of plants, especially those concerning fertilization activities. Biofertilizer formulated from microbial active ingredients plays an important role in the process of nutrient dissolution in the soil which is needed for plant growth, and can overcome the low carrying capacity of soil due to low microbial activity. This type of fertilizer does not contain N, P, K or other elements, but the microbes in it can increase the efficiency of fertilizer. Therefore, apart of the application

of biofertilizer technology is needed to support land rehabilitation activities, it also improves biodiversity of microorganisms (Sukmadi, 2010).

Biofertilizer arbuscular mycorrhizal fungi is one form of biofertilizer that can be applied to almost all types of plants. This fungus can increase the productivity of plants without damaging the environment because its natural provenance. Biofertilizer AMF also plays a role in maintaining the nutritional status of soil and soil aggregate stability by the presence of hyphae threads that continue to develop in the soil. It is therefore very appropriate to use AMF biofertilizer as an alternative to reduce the negative impact of chemical fertilizers and pesticides on environmental damage (Sukmadi, 2010).

Nurngaini and Riyati (2013), applying mycorrhizae to four genotypes of sweet sorghum and obtain the following results: Variation of dose of mycorrhizal shows no significant effect on plant vegetative growth, but significantly effects on the quality of sorghum stem i.e. stem weights and stem sap content. The comprehensive results can be seen in tables 1 and 2.

Giving of mycorrhizae was able to produce average stem weight of HZ-30 Varieties (255,600 g), Patir 3 (224,580 g) and Patir 9 (208,280 g) (table 1); with the average content of sweet sorghum juice of HZ-30 varieties (120,330 ml), Patir 3 (106,220 ml) and Patir 9 (95,560 ml) (table 2).

Table 1. Weight of the sorghum stem (g) in the treatment of genotype and dosage of mycorrhiza

Dosage of mycorrhizae	Genotypes				Average
	G1(HZ-30)	G2 (Mandau)	G3 (Patir 9)	G4 (Patir 3)	
D1 (0 g)	274,830 ab	92,730 e	173,130 cde	217,970 abc	189,670
D2 (5 g)	186,430 bcde	116,200 de	208,200 abcd	237,700 abc	187,130
D3 (10 g)	305,570 a	104,130 e	243,500 abc	218,070 abc	217,820
Average	255,600	104,360	208,280	224,580	(+)

Note: Figures followed by the same letter means that it is not significantly different according to the Duncant 5%
Sign (+) : There is an interaction
Souce: analysis of primary data

Table 2. Sorghum stem juice content (ml) on the treatment of genotype and dose of mycorrhizal

Dosage of mycorrhizae	Genotypes				Average
	G1(HZ-30)	G2 (Mandau)	G3 (Patir 9)	G4 (Patir 3)	
D1 (0 g)	130,670 ab	41,000 d	74,330 bcd	98,000 abcd	86,000
D2 (5 g)	76,670 bcd	67,000 cd	95,670 abcd	114,670 abc	88,500
D3 (10 g)	153,670 a	38,670 d	116,670 abc	106,000 abc	103,750
Average	120,330	48,890	95,560	106,220	(+)

Note: Figures followed by the same letter means that it is not significantly different according to the Duncant 5%
Sign (+) : There is an interaction
Souce: analysis of primary data

Sukmadi research (2010), showed that the application of biofilm biological fertilizers and biological pesticides Trichoderma sp. is able to increase the productivity of the sorghum

plant, and it is best combined with both organic fertilizer as well as with inorganic fertilizers. Meanwhile, sorghum cultivation with application of organic fertilizer, biological fertilizer and biological pesticide can produce the highest dry seed weight amounting 30 g per plant or equivalent to 3.42 ton/ha; stem weight 134,17 g/stem; and 725 ml sap content (54%) .

III. Charcoal charcoal

Activated charcoal (biochar) is a pyrolysis of charcoal at high temperature. The active material used comes from agricultural waste, such as wood waste, bamboo, rice husk, rice straw, corncobs, corn stalks, coconut husk, coconut shell, empty bunches and palm shells (Harsanti and Adiwinata, 2011). The addition of charcoal is possible in order to restore the soil fertility. This is due to the effective pore in charcoal is able for binding and storing soil nutrients that will be released slowly according to plant consumption needs (slow release).

Besides, charcoal is hygroscopic material making the nutrients in the soil are not easily washed and the land is always ready to be utilized. The thorough benefits of charcoal in agricultural purposes include: improving soil structure by maintaining nutrient availability, decreasing soil acidity and improving soil conditions, increasing groundwater flow, boosting plant root growth, absorbing pesticide residues and excess fertilizer in soil, increasing soil bacteria and as micro organisms media for symbiosis, preventing certain diseases, and improving the taste of fruit and production (Anonimus, 2002 in Gusmailiana et al., 2015; Nurida et al., 2015).

Furthermore, it was stated that in the plantation began to be developed bioactive compost charcoal (Arkoba). Arkoba is an advanced product of charcoal, a mixture of charcoal and compost from the composting process with the help of lignocellulolytic microbes that remain alive in the compost. Microbes have the ability as a biofungisida, which protects the plant from the attack of root disease and therefore it is called bioactive. The purpose of adding charcoal to the composting process apart from improving the quality of the compost, will also increase the number and activity of microorganisms that play a role, hence the decomposition process can be completed quicker. Charcoal also createas a neutral atmosphere on the process, charcoal pores become a place where microbes live and therefore the process becomes optimal. Wood charcoal, coconut shell, rice husk and sawdust charcoal can be used as additional sources of plant nutrients and they also have other advantages as soil enhancer (Soemeinaboedhy and Tejowulan, 2007; Gusmailiana et al., 2015).

Table 3. Sorghum stem weights in the treatment of husk-charcoal mycorrhizae and (g)

Husk-charcoal mycorrhizae	Genotypes				Average
	G1(HZ-30)	G2(Mandau)	G3(Patir 9)	G4(Patir 3)	
P1(mycorrhizae 10 g)	197.16667	167.63333	235.7	293.93333	**223.6083 a**
P2(mycorrhizae 10 g + Husk-charcoal 30 g)	217.16667	100.16667	157.96667	181.93333	**164.3083 a**
P3(Husk-charcoal 30 g)	206.26667	110.06667	208.26667	204.36667	**182.2416 a**
Average	**206.8666 p**	**125.9555 q**	**200.6444 p**	**226.7444 p**	-

Note: Figures followed by the same letter means that it is not significantly different according to the Duncant 5%, (-) : no interraction
Souce: analysis of primary data

The results of Nurngaini and Riyati research (2014), shows that the mycorrhizal treatment combined with husk charcoal gives average of sorghum rod weight of HZ-30 varieties of 206.8666 g, Patir 9 of 200.6444 g and Patir 3 of 226.7444 g (table 3); average sap content of

varieties HZ-30 (85.3333 ml), Patir 3 (97.3333 ml) and Patir 9 (82,5555 ml) (table 4).

Table 4. The content of sorghum stems in mycorrhizal treatment-husk charcoal and genotype (ml)

Husk-charcoal mycorrhizae	Genotypes				Average
	G1(HZ-30)	G2(Mandau)	G3(Patir 9)	G4(Patir 3)	
P1(mycorrhizae 10 g)	79.6666	63.6666	99.0000	108.3333	**87.6666 a**
P2(mycorrhizae 10 g + Husk-charcoal 30 g)	91.6666	41.3333	58.6666	81.6666	**68.3333 a**
P3(Husk-charcoal 30 g)	84.6666	36.3333	90.0000	102.0000	**78.2500 a**
Average	**85.3333 p**	**47.1111 q**	**82.5555 p**	**97.3333 p**	-

Note: Figures followed by the same letter means that it is not significantly different according to the Duncant 5%, (-) : no interraction
Souce: analysis of primary data

IV. Organic Fertilizer

According to Agriculture Ministry Regulation Number 2 year 2006 organic fertilizers are defined as fertilizers that are partly or wholly derived from plants and or animals that have been through engineering processes, in the form of solid or liquid, used to supply organic materials to improve the physical, chemical and biological properties of the soil (Sutanto , 2002 and Risnandar,?). Organic fertilizers have various types and variants. The types of organic fertilizers are distinguished from the raw materials, methods of manufacture and form. In terms of raw materials, some are made of manure, forage or a mixture of both. By the method of manufacture there are many varieties of fertilizers such as aerob compost, bokashi, and so forth. While in terms of form there are powder, liquid, granule or tablet.

The technology of organic fertilizer today is growing rapidly. This development can not be separated from the impact of the use of chemical fertilizers which cause various problems, ranging from the destruction of ecosystems, the loss of soil fertility, health problems, and also up to the problem of farmers' dependence on chemical fertilizers. Therefore, the use of organic fertilizers is again encouraged to overcome various problems (Sutanto, 2002 and Risnandar,?). Organic fertilizer is the best soil enhancer than any other ingredient. N, P and K nutrients contained in organic fertilizers are generally low and highly variable, but also contain micro nutrients (Sutanto, 2002).

One type of organic fertilizer is Petroganik. Indrati research results (2009) show that Petroganik super organic fertilizer has a significant effect on the weight of 100 seeds of corn. Moreover, the results of research by Wisardja (2011), the treatment of super organic fertilizer Petroganik gives very significant effect on dry weight of 1000 seeds of corn BISI-16 and also have a significant effect on the weight of the corn kernels per plant.

Table 5. sorghum stem weight (g) on the treatment of organic fertilizer and varieties dosage

Dosage of fertilize	Varieties			Average
	V1(Patir 3)	V2 (Samurai 2)	V3 (Mandau)	
D1 (20 g/plant)	170,2222 b	194,4444 a	99,1444 e	154,6037
D2 (40 g/ plant)	195,8222 a	166,4000 b	76,2222 e	146,1481
D3 (60 g/ plant)	204,8889 a	147,2000 c	117,555 d	156,5481
Average	190,3111	169,3481	97,6407	+

Note: Figures followed by the same letter means that it is not significantly different according to the Duncant 5%, (+) : there is an interraction
Souce: analysis of primary data

Nurngaini and Riyati (2016) apply Petroganik on three varieties of sweet sorghum yielded average yield of Patir 3 varieties of 190,3111 g, Samurai 2 varieties of 169,3481 g and Mandau varieties of 97.6407 g (table 5). Medium average volume of stirred varieties Patri 3 varieties of 48.8888 ml, Samurai 2 varieties of 38,0000 ml and Mandau varieties of 22.7037 ml (table 6).

Table 6. sorghum stem volume (ml) on the treatment of organic fertilizer and varieties dosage

Dosage of fertilizer	Varieties			Average
	V1(Patir 3)	V2 (Samurai 2)	V3 (Mandau)	
D1 (20 g/plant)	47,7777	44,1111	21,8888	37,9259 a
D2 (40 g/plant)	50,2222	30,4444	20,7777	33,8148 a
D3 (60 g/plant)	48,6666	39,4444	25,4444	37,8518 a
Average	48,8888 p	38,0000 q	22,7037 r	-

Note: Figures followed by the same letter (p,q,r) on the line and (a, b, c) in the same column means that there is no significant difference according to the Duncant 5%, (-) : no interraction
Souce: analysis of primary data

V. Conclusion

Efforts to improve the quality and quantity of sweet sorghum sap have been done in various ways, either by utilizing microorganisms, charcoal addition, and the use of organic fertilizers that provide mixed results in some varieties of sweet sorghum treated. Variation of doses of mycorrhizae significantly affect the quality of sorghum stem i.e. stem weights and sap content. There is an interaction between genotypes with husk-charcoal mycorrhiza on sap sugar content (%) with the highest value obtained in a combination of husk-charcoal treatment 30 g/plant-HZ-30 (P3G1) of 7.6144%. There is an interaction between varieties with the combination of inorganic, organic and husk-charcoal on the parameters of sorghum stem content (ml), sap sweetness level (briks), and sap sugar level (%). There is an interaction between the treatment of varieties and the doses of organic fertilizer on the stem sorghum weight, sorghum stem starch content, total sugar content, and carbohydrate content. Fertilization with arbuscular mycorrhizal fungi (AMF) can increase the weight of sweet sorghum stem and sap content. The addition of husk-charcoal is able to improve soil conditions resulting in increased yield of sweet sorghum on the parameters of stem weights and stem sap contents. Fertilization with super Petroganik has not been able to improve the results and the quality of sweet sorghum.

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Ongoing Evaluation of the Hybrid Power Plant in Pantai Baru, Bantul Regency, Indonesia

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ABSTRACT

Energy access is one of the first steps into eradicating poverty. This is why the Indonesian government has made rural electrification a top priority. The decentralized nature of renewable energy can assist in increasing the electrification ratio. Indonesia's high risk for climate change, increasing energy demand, high pollution rate and rural electrification goals all stress the importance of increasing the share of renewables in the energy mix. Unfortunately many renewable energy projects have failed to have the intended impact, which leads to a loss of confidence in the sector and therefore, less investment. This is why proper project evaluation is extremely important so problems can be prevented in the future.

To analyze the problems many renewable energy projects face, a case study framework was chosen. An extensive evaluation of the hybrid power plant, PLTH, in Pantai Baru was conducted. The institutions involved in the project were the Ministry of Research and Technology, the National Aviation and Space Agency, the Ministry of Marine Affairs and Fisheries, these three will be referred to as the consortium and the Gadjah Mada University and the Bantul Regional Government. The installation of the PLTH went (almost) without any problem. But during the operation and maintenance phase, various mistakes were made that led to serious decrease in capacity. No clear allocation of tasks and responsibilities between the involved institutions, led to a lack of incentive for various stakeholders to ensure sustainability of the PLTH project.

After the installation, the PLTH project was informally transferred to the Bantul Regency Government, who was not involved in installation, besides clearing the land. The Bantul Regency Government had no experience with renewable energy projects of this scale and no budget available for assistance. Which in practice meant the local community carried all technical and financial responsibility for operation and maintenance of the power plant. The local community did receive training in the technical aspects of managing the power plant but not on how to manage the financial aspects. When lightning struck the power plants, two high capacity inverters broke down. There was no budget to replace these inverters, furthermore the batteries deteriorated after three years. This has led to a severe decrease in capacity. The ice factory that was also constructed as part of the project was shut down because of the decrease of capacity and many food stalls were forced to arrange additional energy sources such as a diesel backup generator or connection to the PLN network, since black outs became frequent after the lightning struck.

Clear task and responsibility allocation between the different institutions involved should be included in the project preparation phase. Furthermore incentives for stakeholders should focus on project sustainability instead of the number of projects installed. More attention and budget should go to the operation and maintenance phase. If not, projects will continue to fail after only a few years. Before construction, financial feasibility studies should be conducted

to ensure the project's sustainability and to make a financial plan that includes better tariffing schemes to finance frequent battery replacement as well as saving funds in case of unforeseen events. Needs assessments should be conducted as well in order to guarantee the community will benefit from the project and that it fits their needs.

Keywords: renewable energy, project evaluation, hybrid power plant, maintenance and operation, financial feasibility, project sustainability, needs assessment, project responsibility

INTRODUCTION

Access to adequate, affordable and reliable energy is one of the first steps into eradication poverty. Energy access can help to increase productivity, employment and social welfare of a community. (Casillas C. and Kammen D, 2010) The Indonesian government has adopted the National Energy Policy stating Indonesia should approach 100% rural electrification by 2020. (Asian Development Bank, 2016) Right now the electrification ratio is roughly 90%. With only 3 more years to go, it will be a big challenge to reach this target.

The electrification ratio, economic growth, and the growing population all contribute to a growing energy demand. Indonesia's energy demand is growing with about 7% per year and the electricity demand will triple between 2010 and 2030, if growth continues at this rate. (Tharakan P.,2015) This, together with deforestation, peat fires, waste and agriculture will result in a doubling of Indonesia's greenhouse gas emissions over the next 25 years. Since Indonesia is extremely vulnerable to climate change and is already experiencing problems with severe air, water and soil pollution, action needs to be taken to decrease Indonesia's greenhouse gas emissions. (Case M.et al, 2007)

This all stresses the importance of increasing the share of renewables in Indonesia's energy mix. Furthermore, the decentralized nature of renewable energy technologies can also help to provide electricity for communities in remote areas and therefore contribute to rural electrification and poverty alleviation. Over the last decennial many projects have been carried out both to increase the amount of renewables in the energy mix as well as to electrify remote rural areas. Unfortunately many of these projects have failed to have the intended impact. Some renewable energy projects experience low efficiency rates, while others broke down completely within only a few years. Problems that often occur in these projects are financing mechanisms that only include upfront costs and exclude costs of maintenance and repair, lack of capacity and knowledge with both the installers as the local community, poor project evaluation by the government and communication problems and guidance within government institutions. (Budiarto R., et al, 2012) To learn from past mistakes it is extremely important to conduct project evaluation. This can help to prevent problems with future projects. (Engineering Programme Group, 2000) Unfortunately the importance of proper project monitoring and evaluation is underestimated. In this paper findings of the ongoing research about a hybrid power plant in Pantai Baru aimed to increase the share of renewables in the energy mix as well as rural electrification and community development are presented. A case study framework is chosen to analyze why certain problems occur and how these problems can be prevented in future projects.

Methodology

To analyze why certain problems occur the Responsible Innovation Framework was used. This framework provides concrete characteristics necessary to ensure sustainable functioning of

projects. The focus will be on i) anticipation of problems, ii) participation, iii) reflection, and iv) responsiveness.

Location Selection

The Hybrid Power Station, or PLTH, is a project that was initiated in 2010 and is located in the Poncosari Village at the Pantai Baru beach area in the Bantul Regency, Yogyakarta Province, Indonesia. Besides the construction of a hybrid power plant, many other investments were made to increase economic activity in the region. The infrastructure was improved, permits for starting food stalls were sold, an ice factory was constructed for supply to local fisherman, a freshwater pond was constructed to produce different types of fish, the construction of a water pomp delivered fresh water at a cheap price to the people and a biodigester was made to provide the many food stalls with biogas. There were clearly a lot of measures taking to not only provide the people with electricity, but to actively contribute to their economic activity. Unfortunately after only three years the PLTH started to experience major problems which affected other projects such as the ice factory and the food stalls.

This project was chosen because it is one of the largest PLTH projects in Indonesia and because there were many more measures taking to increase economic activity than merely providing electricity. But although this was such a large pilot project, the same problems as with many other projects in Indonesia start occurring during operation. Clearly a lot of effort was put into the project installation, but not enough attention went to operation and maintenance.

Data Collection

Various visits to the Pantai Baru area were made. Fortunately it is easy accessible from Yogyakarta. In depth interviews with food stall owners, fishermen, PLTH mechanics and farmers were conducted to understand how the project was developed and to understand which problems were occurring and why. Observation was used to see how the operation and maintenance is conducted in practice. Furthermore an interview with the head of the energy section at DINAS ESDM was conducted.

BACKGROUND

In the Pantai Baru beach in Bantul Regency a hybrid power plant (PLTH) consisting of a photovoltaic array of 25kW, 34 wind turbines with combined capacity of 61 kW and a battery pack of 4260Ah was installed. In Figure 1 the hybrid power plant is visualized. The PLTH was intended to be utilized for food stalls, to provide the installed ice factory with electricity, for animal husbandry, driving water pumps and for household needs. The institutions involved in the project were the Ministry of Research and Technology, the National Aviation and Space Agency, the Ministry of Marine Affairs and Fisheries, the Gadjah Mada University and the Bantul Regional Government. The goal of the project was to increase social welfare by not only delivering electricity access but also to contribute to regional/community development. Not only a power plant was constructed, the infrastructure of the region was also improved, an ice factory was constructed to provide ice for local fishermen to preserve their fish, permits for starting food stalls and other small businesses along the coast line were sold, three biodigesters were constructed to provide the food stalls with gas for cooking and domestic tourism was promoted to attract more tourists to the region. The biodigester system can be seen in Figure 2.

Figure 1: Hybrid Power Plant in Pantai Baru

Figure 2: Biodigester System in Pantai Baru

The local community living in the nearby hamlets did have electricity supply from the PLN before the PLTH arrived. But there was no electricity supply to the beach area yet. This is why the decision was made to deliver the electricity from the PLTH only to the beach area at a price of 5.000IDR per month, limited to 300Watt per consumer. The first two years of operation the PLTH only experienced minor problems and the local community clearly benefited from the arrival of the PLTH. After a lightning storm struck the wind turbines in 2012 the problems started. There were electricity rods present, these were however of such poor quality that the lightning broke both the rods and some of the wind turbines. And more importantly, the lightning broke the two inverters of highest capacity. There was no budget to replace the inverters with ones of equal capacity and quality, the operators were forced to replace the inverters by inverters of lower capacity. Other wind turbines broke down due to severe corrosion, caused by the salty sea wind. This is visualized in Figure 3. Although there was a workshop for spare parts, some spare parts required knowledge of advanced technology and were only available in Jakarta, which is expensive. The ice factory was shut down in 2013, because after the lightning struck, the PLTH could not deliver enough power for the food stalls, water pump and the ice factory. Since the local community benefited most from the food stalls, the decision was made to shut down the ice factory. After the wind turbines and inverters broke down the PLTH struggled to deliver sufficient electricity to its customers. Management was forced to increase the price to 10.000IDR per two weeks, to keep delivering electricity to all customers. The batteries have deteriorated over the years as well, which made it even more difficult for the PLTH to deliver sufficient electricity to its customers.

Figure 3: Corrosion on Wind Turbines in PLTH.

In 2016 the PLN decided to extend their network to the beach area. Many customers of the PLTH choose to connect to the PLN. Although the PLN was more expensive, the electricity supply was more reliable and the consumption was unlimited. While for the PLTH there was only limited electricity available. And after the lightning struck, problems with blackouts started to become common. Many customers now have a connection to the PLTH and the PLN and use both. Since the PLTH electricity is slightly cheaper, many customers kept using electricity from the PLTH and use the PLN connection as a backup. There are now two grids installed in the Pantai Baru area.

The biodigester-project was built as a prototype from Universitas Gadjah Mada (UGM) in 2012, financed by the government. Three biodigesters were installed and the local community was used as labor forces for the installation. After installation one person received a four day training on how to operate the biodigesters. Seven food stalls would be provided with gas and if the project was a success, this would be extended to other food stalls. After a while the project was transferred to the Indonesian Institute of Sciences (LIPI).

Project Functioning and Evaluation

This section will provide additional insights on the different phases of the project as well as an evaluation of the project and analyzation of the projects life cycle. There have been two evaluations of this project before, but these only focused on technical aspects and had the goal to unlock the full potential of the PLTH. These evaluations were both conducted within two years of construction, when the PLTH was still fully functioning.

Project Preparation and Installation

The project was initiated by the local community, who expressed its need for electricity at the beach area to the local government in order to provide food for the tourists coming to Pantai Baru for its beaches. Feasibility studies were conducted that focused on the technical aspects of the construction of the PLTH. Wind speeds and solar irradiation were measured. No feasibility study on the needs of the people was conducted. No interviews or questionnaires were conducted to assess the needs of the intended beneficiaries. Men of the local community were used as labor forces for the construction of the PLTH. Besides this, there was no further community involvement in project preparation and installation. The construction of the PLTH started in November 2010 and was paused on 25 December when a storm destroyed the roof of one of the operation chambers. Construction was restarted and the power plant was finished in February 2011.

Project Operation and Maintenance

After construction of the power plant two engineers stayed behind to train some of the local community members on how to operate the power plant. From the community members that were used as labor forces, a selection was made to operate the PLTH based on motivation and skill level. For the next three years the engineers transferred their knowledge and skills to the local operators. The training was mainly focused on how to operate the generator and on how to make blades for the wind turbine, since the engineers had anticipated these would often need replacement due to corrosion. According to the local operators, this training was still not sufficient. There was a lack of focusing on electrical equipment. When the engineers left, the local operators were able to fix minor problems, but when new problems started occurring the local operators did not know how to fix these. Especially problems with electrical equipment were difficult to fix. The local operators can contact the two engineers, but these are reluctant

to come visit the power plant. When the two engineers left the PLTH in 2013, all technical and financial aspects became the community's responsibility. Since the community has almost no budget for operation and maintenance, there is no financial incentive for the engineers to come visit the power plant. The help they provide is solely advice via the telephone, which is often not sufficient.

There is a similar (but smaller) project in the Bantul region and the personnel of this project often visits the PLTH operators to ask them for advice and help on how to operate and maintain their own installation. Since the beginning of 2017 the PLTH project also has a collaboration with UPC Renewables, which is an American company operating in Indonesia to construct power plants powered by renewable energy. Their first project is a power plant in South Sulawesi and data is being shared with PLTH. The local operators hope that this collaboration could help them in the future with financing problems and advice on how to repair certain parts.

Currently the main problems of the PLTH are not the broken wind turbines, the local operators know how to fix these and how to make the spare parts necessary to get them in operation again. The problem is the decreasing capacity of the batteries and the low capacity of the inverters. The local operators believe that fixing the wind turbines will be a waste of time since without a proper inverter and battery capacity this power cannot be used.

Fortunately the biodigesters have not experienced any major problems over the past five years. The operator, Hanin Diyo, has been able to fix every problem that occurred during the past years. He also trained other members of the community to help him with operation and maintenance of the biodigesters.

Benefits to the Local Community

The local community clearly benefited from the project. Tourism has increased greatly due to the emergence of the food stalls and technological tourism coming to visit the biodigesters and the PLTH. Tours are available wherein the operators explain and demonstrate the working of the installations. This has led to even more tourists coming to Pantai Baru. It has also led to schools visiting the installations on an educative field trip.

The income of the local community has increased, this was mainly due to the food stalls that allow the community to sell food to tourists. It has also expended the market for farmers and fishermen to sell their goods. With this income it is easier to pay for the education fees and to buy appliances, according to the beneficiaries. Many food stall owners have bought a blender, fridge and TV since the installation of the PLTH. The water pump has also contributed, it is easier to receive water for cooking and cleaning.

Unfortunately the ice factory failed to have the intended impact. The local fishermen need about 1000kg of ice per day to preserve their fish. However the ice factory cannot even deliver half of this and it needs 2 or 3 days to produce its ice. The ice factory can be seen in figure 3. The fishermen are dependent on the sea conditions and the weather, often they do not leave the coast for several days because the sea is too rough. If the fishermen depart or not is difficult to predict and is often a last minute decision. Since the ice factory needs several days to produce the necessary ice, the fishermen are forced to buy their ice from private companies in neighboring towns.

Figure 4: One of the three machines used for ice production in Pantai Baru Ice Factory

The biodigester delivers gas to only seven households. And although the test period has been over five years now, the local community has no idea if the project will be up scaled or not. The gas production is more than is needed for these seven households and with the proper pipe lining, the project could easily be up scaled.

Not only the owners of the food stalls have benefited from the installation of the PLTH, also the farmers and fishermen have greatly benefited since the market for their products has expanded. This has also led to the emergence of many freshwater pounds for the production of shrimps and lobsters that can be sold to the food stalls. These freshwater pounds are mainly small scale installations owned by local people who took a loan at the local bank to pay for the investment costs. The electricity they use to drive the rotators which increase the oxygen level of the water so the creatures can breathe, is delivered by diesel generators or the PLN. These freshwater pounds are located between 20 and 120 meters of the PLTH.

The Coming of the PLN Network

In 2016 the PLN extended their network to the beach area. Since the quality of electricity from the PLTH deteriorated over time, many customers choose to have a connection to the PLN network as well. Now there are two grids in the Pantai Baru area which is extremely inefficient. This can be seen in figure 3.

The coming of the PLN network to the beach has led to the emergence of even more food stalls. The PLTH could only deliver electricity for 60 food stalls. Other food stalls needed to use an expensive diesel generator for their electricity. With the coming of the PLN network, it was financially more attractive for others to start a culinary business in the area.

Although the electricity from the PLN is more expensive, it is more reliable. The PLTH customers have been experiencing black outs since the lightning storm in 2012. This is why many customers chose to have a connection to the PLN as well. Some customers switched entirely to the PLN, while others still use the cheaper electricity from the PLTH and use their PLN connection as a backup.

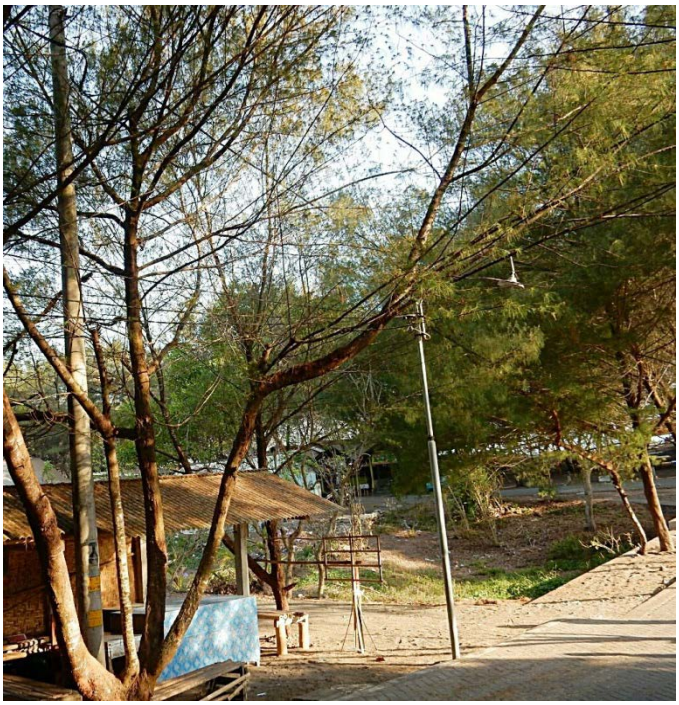

Figure 5: Two Grids in the Pantai Baru Area. On the left there is an electricity pole from PLN and on the right there is one from the PLTH.

Financing Mechanisms and Project Ownership

The project was designed and installed by the Ministry of Research and Technology, the National Aviation and Space Agency, the Ministry of Marine Affairs and Fisheries and the Gadjah Mada University. The role of the Bantul Regency Government was merely to provide the land permits and to clear the land. The installation of the PLTH was financed by the central government. After installation all assets remained property of the Central Government, but informal responsibility of the project was given to the Bantul Regency Government. Which in practice meant that it was the responsibility of the Bantul Regency Government to keep the project running, even though the Regency Government had no experience with these type of projects and was not involved in installation besides clearing the land. Besides providing the two engineers who were training the local operators, there was no further involvement or financial help from the Central Government. The Bantul Regency Government did not provide the local operators with any financial help since there was no budget for this. So in practice this meant the local community was responsible for maintenance and operation as well as for the resulting costs. The problems with the turbines and inverters have led to an increase in costs. The monthly fee of 5.000IDR was insufficient to cover even a part of these costs. The fee was increased to 10.000IDR per two weeks. With 60 food stalls connected to the PLTH, this resulted in 1.200.000IDR (75.35EUR) per month. This income is not enough to pay for the repairs necessary, and not nearly enough to pay the wages of the operators of the power plant. Some more income is generated by the entrance fee to visit the PLTH which is 3.000IDR.

The local operators did not receive any training in how to manage finances. With better understanding of financing mechanisms and the importance of savings, over time new batteries could have been acquired as well as a better inverter. The operators of the biodigesters work on a voluntary basis. Their wives receive the gas delivered by the biodigesters for free and the operators receive some money from the tours they provide for tourists.

In 2016 part of the project was formally transferred from the Central Government to the Yogyakarta Province Government (Local Government). Some assets, however, remain property of the Ministry of Research and Technology. It is still unclear if these assets will also be transferred in the near future. The seven local operator's wages are now paid for by the Local Government. Besides the payment of the wages, the Local Government has no budget available to assist in operation and maintenance and they feel it is not their responsibility to maintain the power plant but that of the consortium. Furthermore regulations the Central Government imposes on the Local Government change every year. This makes long term planning extremely difficult. It is unclear if the Central Government will allocate sufficient budget to the Local Government so the Local Government can allocate budget to operation & maintenance of the PLTH. Furthermore the Local Government does not have a clear incentive to invest in operation & maintenance of the PLTH. The Central Government imposes targets for the number of new projects on the Local Government and fines the Local Government if these targets are not reached. There is no mechanism in place that ensures project sustainability.

CONCLUSIONS

In contrary to other electrification projects in Yogyakarta Province, the government and the other involved institutions clearly realized that only providing electricity would not be enough to improve economic activity. The construction of the ice factory, the water pump, the biodigesters, the improvements in infrastructure and the availability of permits for food stalls clearly show a great improvement in development thinking. The three year training of operators for the PLTH and the four day training for the operator of the biodigesters demonstrate that the involved institutions were concerned with the sustainability of the project and wanted to invest in operation and maintenance as well. Unfortunately after this three year training, the involvement of the institutions disappeared. There was no budget available for further sporadic assistance by the two engineers whenever problems arise. There was no budget for new batteries or inverters. There hasn't been any project evaluation. While project evaluation is extremely valuable. There have been some sporadic visits of government personnel to the PLTH, but these haven't led to any action.

The problems started when the project was informally transferred to the Bantul Regency Government. Which in practice meant a transfer to the local community. The Central and Regency Government did not provide any assistance or help after the project was transferred. This has led to a serious decrease in the capacity of the PLTH. There should have been more attention and more frequent visits to the PLTH after the project was transferred. Battery deterioration seems to be a big problem with this project as well as with other projects in the region. The beneficiaries were not informed that this would happen and that they would need to replace the battery with their own money. In the project preparation phase financial feasibility studies should be conducted in order to make a financial plan to ensure the project's sustainability. This plan should include frequent battery replacement as well as saving funds in case of unforeseen events. Operators should receive financial management training so they will be able to follow the financial plan and extend or adapt it during project operation. Setting up saving funds and creating awareness about what future costs for operation and maintenance might be, could have helped prepare the communities for the battery deterioration and for other unforeseen events. A more appropriate tariffing mechanism to account for future expenses should have been put in place. Proper insurance could have helped in replacing the inverters after the lightning struck the PLTH in 2012. The whole thing could have been prevented if the lightning rods would have worked properly.

More attention should go to needs assessment of the local community before construction of a project. This could have prevented the construction of the ice factory. The fishermen clearly stated that they did not benefit from the ice factory since it could not produce enough ice and it took too long to make even a part of their ice needs. With proper needs assessment studies, either a more efficient better suitable ice factory could have been constructed, or no ice factory at all. This money could have gone to saving funds for new batteries instead.

Although the food stall owners received assistance in acquiring permits, there was no training on how to start or construct a food stall or how to deal with finances. Everything was self-taught and self-built. Workshops in how to start up a business for the food stall owners should have been provided.

The extension of the PLN network to the beach seems very inefficient. Since the PLTH only needed new batteries and a better inverter, it might have been better to invest in this instead of constructing a whole new network. Now there are two electricity grids in exactly the same area. Especially since the PLN is also state-owned and is not focused on making a profit but on delivering electricity to all Indonesian people and to reach the renewable energy targets. Investing in the PLTH would have seemed like a more sustainable option. When the PLTH was running on full capacity it had more than enough electricity to deliver to all food stalls and there was room for expansion. With a full functioning PLTH electricity could also have been delivered to the freshwater pounds.

There was no clear allocation in tasks and responsibility between the consortium, the Bantul Regency Government and the local community. Formal and informal project transfers did not include clear task allocation. This resulted in nobody taking responsibility for the project and no additional funds were allocated to operation and maintenance. It also made it extremely difficult for the operators to report problems, since it was not clear where to go to when problems occurred. Until today it remains unclear if budget will be allocated to restore the power plant. Furthermore, instead of focusing on the number of projects and fining the Local Government if these targets are not reached, the Central Government should focus on the number of projects that are still in operation. This will provide the involved stakeholders with a clear incentive to focus on project sustainability rather than installation.

For future projects clear task and responsibility allocation should be part of the process, as well as financial management training for the operators, needs assessment of the local community and a long term financial feasibility study to analyze the projects sustainability.

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POTENCY OF GROUNDWATER RESOURCES IN NGAWEN REGION, THE "NON GROUNDWATER BASIN" AREA, NORTH-EASTERN PART OF GUNUNGKIDUL

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ABSTRACT

The Ngawen area is located in the northeastern part of Gunungkidul Regency, Daerah Istimewa Yogyakarta. In Groundwater Basin Map, this area is considered to be a Non Land Basin Area (ESDM, 2008). The purpose of this research is to know the potential of groundwater in the area.

Ngawen area is composed by impermeable layer of Semilir Formation and permeable layer of Nglanggeran Formation, Oyo and Wonosari. By applying Darcy's Law and drilling wells it is known that the free shallow groundwater debit is 50,09 liters / sec and the depressed aquifer is 2,65 liters / sec. The quality of groundwater is in accordance with the quality requirements of drinking water.

Keywords: potency, groundwater, non-groundwater basin, well test, quality.

INTRODUCTION

Ngawen Sub-district is an area included in the Non-Basin Area of Groundwater (ESDM, 2008). The need for clean water in the Ngawen area from year to year is increasing in line with population growth and development activities. The need for clean water is filled from the groundwater present in the area. To meet the need for clean water and further management of groundwater it is necessary to know the potential of ground water in Ngawen and surrounding areas, which includes the amount of ground water reserves and their quality.

METODHOLOGY

To get the results in accordance with expectations, in this study conducted research methods in the form of literature study work, research in the field and in the laboratory. Library study work mainly to know the condition of geology and hidrogeologi; field work includes geological mapping, hydrogeology and wellbore testing; the laboratory work undertaken is a water quality test taken from deep groundwater present in the study area.

GEOLOGICAL SETTING

Geomorphology

Geomorphology of the research area is divided based on the geomorphological aspects. According to Verstappen (1983) aspects of geomorphology consists of morphology, morphogenesis, morphokronology and morphoconservation.

Based on the geomorphological aspects, the study area can be divided into 3 forms of land:

1. Stuctural hills
   The form of structural hill land is a morphographic form of hills, characterized by hills controlled by geological structures (slope of lap and rock) and erosion with a 20 - 40% (9^0-25^0) slope rate. This form of land occupies 15% of the research area.
2. Structural Slope
   The shape of the structural slope is a morphographic form of the slope of Mount Stage located in the southeast of the study area. The Structural Slope is controlled by geological structures (folds, stout and cesarean). This form of land has a level of 0 - 20% ($0^0 – 9^0$), which occupies 35% of the research area.
3. Kars plain eroded
   Landforms Kars plain eroded in morphography in the form of plains controlled by the process of karstification (dissolution) located in the middle and south of the research area. It is characterized by a slope of 2 - 20% ($1^0 – 9^0$), composed by lithologies of limestone, formed by the process of dissolution of rocks. occupies 50% of the research area.

Stratigraphy

Stratigraphy of research area composed by volcanic rock and carbonate consisting of several rock formations namely Semilir Formation, Nglanggeran Formation, Oyo Formation and Wonosari Formation.

1. Semilir Formation
   Semilir Formation are scattered in the northern and southern areas of research that form the morphology of slopes and hills in the Ngawen and Semin Regions with elevations between 200 - 365 meters above the surface of the sea. The formation is composed of lithology tuff, batulapili and volcanic rocks. This formation has a corresponding relationship with the Nglanggeran Formation that is above it.
2. Nglanggeran Formation
   Nglanggeran Formation are scattered in the northwest of a locally dispersed research area that forms the morphology of the hill in the Ngawen Region with elevations of 225 - 290 meters above sea level. This unit is fully composed by polymic breccia lithology with andesite and basalt fragments. This lineup has a non-aligned relationship with Oyo Formation above Ir.
3. Oyo Formation
   Oyo Formation is scattered in the valleys of Mount Baturagung in the northwest and Mount Stage in the southeast part of the Ngawen Region which has elevations less than 250 meters above sea level. This formation is composed by the lithology of sandstone that is generally more than 70% carbonate content composed by shells of fossil shells, little lithic fractions and feldspar. This lineup has a relationship that is consistent with the Wonosari Formation that is above it.
4. Wonosari Formation
   Wonosari Formation shows the syncline valleys that form the plains scattered in Ngawen and Semin. This formation is composed by layered limestone lithologies that generally comprise a repetitive calcarenite and chalcitite. Chemically This formation shows a limestone type with a carbonate content of more than 90% with compact physical properties and a growing pore of secondary pores resulting from dissolution. This formation is the youngest formation.

Geological Structure

In the study area there were five fold structures, two faults and three fractures direction.

1. Fold
   The position of rock layers found in the research area generally has a slope to the south-southeast. The position of the rock layers is the position of homocline with the direction of east-northeast stance with the slope to the south-southeast but in some locations has the opposite slope due to the structure of folds of synclin and anticline.
   In the form of a structural hillland the position of the rocks form the average layer of 27° maturity with a stance that is in line with the escape of the Baturagung Mountains. Whereas in the form of eroded plains of kars and slopes of homocline form a dip average of 14°.
2. Fracture
   From the results of the rosette diagram analysis of the measurements performed in several observation locations, there are three stylized direction f fracture: the Southeast-southeast (N314° E - N184°E), Northeast-Southwest (N270° E - N225° E) and North- South (N024°E - N305°E).
3. Fault
   In the research area, there are several pattern of the direction of the fault which is the North-South fault pattern which is the fault of the fault, which is identified from the appearance of the dispersion pattern of the rock in the area, and the North-east fault pattern which is characterized by right horizontal fault.

HYDROGEOLOGICAL SETTING

Shallow Aquifer

A shallow aquifer is assumed to be an aquifer in a dug well. The compilers are the soil of weathered rocks or rocks themselves. From field work, it was found that the depth of dug wells ranged from 6 meters to 27 meters. Water depth at dug wells ranges from 1 meter to 18 meters or water level at dug wells ranging from 150 meters to 325 meters.

Based on the dug well data it is found that generally shallow groundwater aquifer flows from northwest to southeast and from southeast to northwest. The imbuhan area is in the northwest of the study area while the discharge area is in the middle and to the south of the research area.

Calculation of shallow aquifer water flow discharge (shallow):

1. Oyo and Wonosari Formation: The size of the flow net 1 kilometer x 1 kilometer = 1 kilometer^2. The number of flow net 14. In a flow net found the ground hydrolysis water flow price (i) of 0.03; cross sectional area (A) = width cross section x thick aquifer = 1000 meters x 10 meters = 10,000 meters^2. The rock hydraulic conductivity (K) = 0.94 meters/day, then the groundwater discharge (Q) = K.i.A = 282 meters^3/day. Groundwater discharge in Oyo and Wonosari Formation as a whole = 14 x 282 meters^3/day = 3.948 meters^3/day or 45,69 liters/second.
2. Semilir Formation: The size of the flow net 1 kilometer x 1 kilometer = 1 kilometer^2. The number of flow net 9,5. In a flow net found the ground hydrolysis water flow price (i) of 0.04; cross sectional area (A) = width cross section x thick aquifer = 500 meters x 10 meters = 5.000 meters^2. The rock hydraulic conductivity (K) = 0.2 meters/day, then the groundwater discharge (Q) = K.i.A = 40 meters^3/day. Groundwater discharge in Oyo and Wonosari Formation as a whole = 9,5 x 40 meter^3/day = 380 meters^3/day or 4,39 liters/second.
3. Total shallow groundwater discharge = 4.328 meters^3/day or 50,09 liters/second

Inner Aquifer

The inner aquifer is assumed to be an aquifer existing in the wellbore. In the research area there are 3 (three) boreholes in the research area, the drill village of Kampung Lor village, the drilling well of Desa Sambeng 2, and the drilling well of Watu Sigar Village. The depth of the well is about 125 meters. Based on the wellbore data, it is known that the groundwater level ranges from 5 meters to 15 meters or the surface water level ranges from 200 meters to 233 meters. The number of aquifer layers is 4 with a total thickness of about 20 - 25 meters. Aquifer materials in the form of limestones and sand-limestone (**Figure 2**).

After a pumping test or aquifer tests on existing wells is known that the optimum discharge rate of groundwater wells of Watu Sigar village = 2,65 liters/second, for other wells can not be determined the optimum discharge rate of groundwater because no drilled well test.

Chemical analysis of groundwater quality performed on groundwater samples taken at Watu Sigar wellbore can be seen in Table 1. The results of anilysis show that all parameters analyzed indicate compliance with drinking water standard according to Minister of Health Regulation No.492/Minister of Health/Regulation/IV/2010.

At the drilling well located in Watu Sigar Village, Ngawen Sub-district, Gunungkidul District, Special Region of Yogyakarta, encountered aquifer on gray limestone unit, fine to medium sized with sub angular shape until sub rounded. At the drilling well located in Kampung Lor village, Kampung village, Ngawen sub-district, Gunungkidul district, Special Region of Yogyakarta, encountered aquifer in brownish white limestone unit, fine to medium sized with sub angular shape until sub rounded. At the borehole located in Sambeng II, Ngawen Village, Ngawen Sub-district, Gunungkidul District, Special Region of Yogyakarta, the aquifer was found in black limestone, the size of fine to medium sands with sub angular shape until sub rounded, see **Figure 2**.

Optimum discharge caculation:

Drilling well Watu Sigar Village, District Ngawen

Data Continues Discharge Test:

- ✓ Continues Discharge Test = 1,226 liters/second
- ✓ Pumping Duration = 4 Hours
- ✓ Static Water Level (SWL) = 6,13 Meters
- ✓ Final Pumping Water (PWL) = 8,56 Meters
- ✓ Final Draw Down (S) = 2,43 Meters
- ✓ Spesific Capacity (SC) = 0,5045 liters/second/meters

➢ **Permebility ceofficient calculation from long period:**

$$T = \frac{2{,}3\ x\ Q}{4\ x\ \pi\ x\ \Delta S}$$

$$= \frac{2{,}3\ x\ 105{,}9264\ meters^3 / day}{4\ x\ 3{,}14\ x\ 0{,}34\ meters}$$

$$= \frac{243{,}63072}{4{,}2704\ meters}\ meters^3 \Big/ day$$

= 52,6118444 meters^2/day

Q = 1,226 liters/second

= 105,9264 meters^3/second

ΔS = 0,34 meters (see **figure 3**)

$$K = \frac{T}{b}$$

$$= \frac{52{,}6118444\ meters^2 / day}{15\ meters}$$

= 3,50745629189 meters/day

b = 15 meters (see **figure 2**)

$$re = \frac{r\ hole + r\ filter}{2}$$

$$= \frac{5'' + 3''}{2}$$

$= 4''$

= 10,16 centimeters

= 0,1016 meters

= 0,1778 m

= 0,00004059555 meters/second

➢ **Optimum Discharge Calculation (see figure 4)**

$$Q\ maks = 2\ x\ \pi\ x\ re\ x\ b\ x\ \frac{\sqrt{K}}{15}$$

$$= 2\ x\ 3{,}14\ x\ 0{,}1016\ x\ 15\ x\ \frac{\sqrt{0{,}00004059555}}{15}$$

= 0,00406 meters^3/dt

= 4,06 liters/second

Q Opt = 2,65 liters/second

Q = 1,226 liters/second

S = 2,43 minute

Q/S = 0,5045 liters/second/minute

S/Q = 1,9821

The result of calculation based on pump test to Watu Sigar well is that optimum discharge = 2,65 liters/second.

Table 1 : Result of Soil Water Quality Analysis Watu Sigar Village, Ngawen, Gunungkidul

Watu Sigar Village, Ngawen, Gunungkidul				
No	Parameters	Unit	Test Results	Maximum allowed
		Physics		
1	Smell	-	no smell	no smell
2	Color	TCU	< 1	15
3	Total Dissolved Solids)	mg/L	349	500
4	Turbidity	NTU	3	5
5	Taste	-	no taste	no taste
6	Temperature	°C	26,1	± 3 C
		Chemistry		
1	Arsenic (As)	mg/L	< 0.005	0,01
2	Fluoride (F)	mg/L	0,3518	1,5
3	Total Chromium	mg/L	< 0.0213	0,05
4	Cadmium (Cd)	mg/L	< 0.0004	0,003
5	Nitrite (NO2)	mg/L	0,0046	3
6	Nitrate (NO3)	mg/L	< 0.01	50
7	Cyanide (CN)	mg/L	undetected	0,07
8	Selenium (Se)	mg/L	-	0,01
9	Aluminum (Al)	mg/L	-	0,2
10	Iron (Fe)	mg/L	< 0.0162	0,3
11	Hardness (CaCO3)	mg/L	321,61	500
12	Chloride (Cl)	mg/L	10	250
13	Manganese (Mn)	mg/L	< 0.0101	0,4
14	Ph	-	6,8	6.5 - 8.5
15	Zinc (Zn)	mg/L	< 0.0083	3
16	Sulfate (SO4)	mg/L	8	250
17	Copper (Cu)	mg/L	< 0.0069	2
18	Ammonia (NH3)	mg/L	0,0021	1,5
19	Air Raksa (Hg)	mg/L	-	0,001
20	Antimon (Sb)	mg/L	-	0,02
21	Barium (Ba)	mg/L	-	0,7
22	Boron (B)	mg/L	-	0,5
23	Molybdenum (Mo)	mg/L	-	0,07
24	Nickel (Ni)	mg/L	-	0,07
25	Sodium	mg/L	-	200
26	The rest of Khlor	mg/L	-	5
27	Lead (Pb)	mg/L	-	0,01
28	Uranium	mg/L	-	0,015
29	Organic Substance	mg/L	-	10
30	Detergent	mg/L	-	0,05

CONCLUSION

1. The shallow groundwater discharge of aquifer is 50.09 liters/second
2. Optimum Discharge Watu Sigar wellbore is 2.65 liters/second.
3. Ground water quality meets drinking water standards according to Minister of Health Regulation No.492/Minister of Health/Regulation/IV/2010.

SUGGESTION

Groundwater (shallow) and depressed feeding is advisable not to exceed free aquifer discharge (<50.09 liters/second) and optimum disrupted aquifer discharge (<2.65 liters/second).

THANK YOU NOTE

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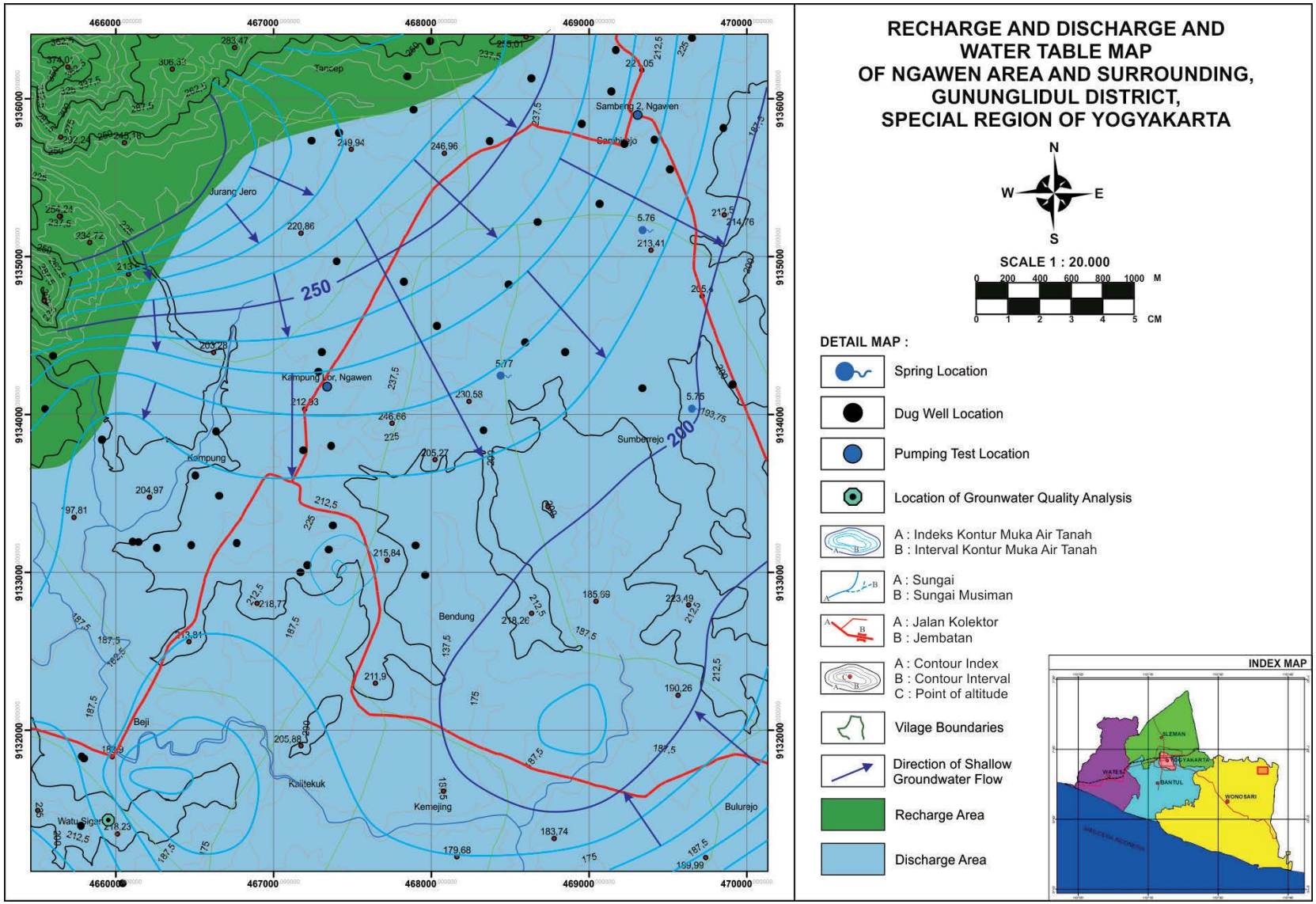

Figure 1 map of Recharge and Discharge areas and water table of research area

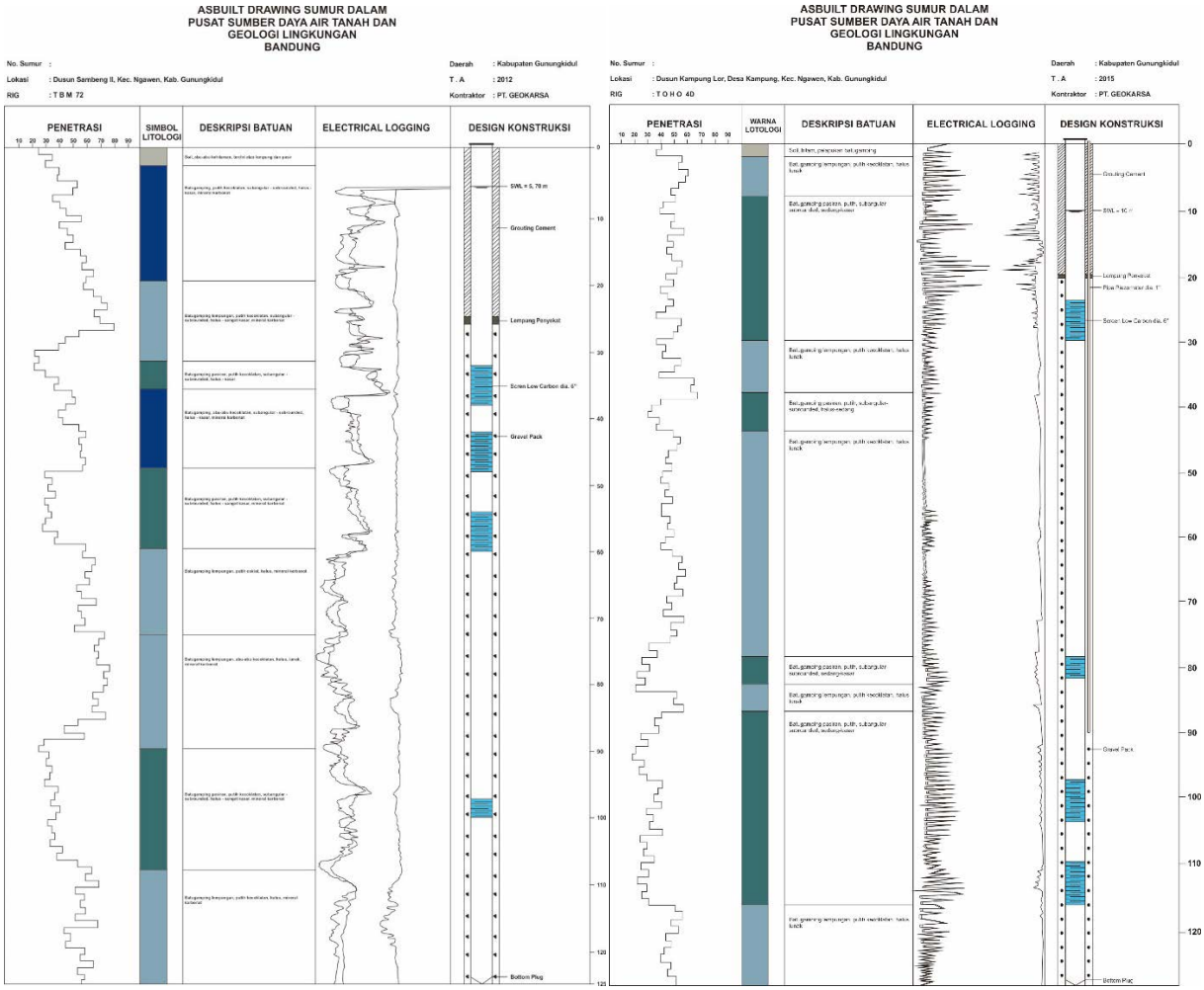

Figure 2 Electrical Logging of Sambeng II Region Coordinate X: 469309, Y: 9135896, Elevation 200 m (Left) and District of Lor Coordinates X: 467340, Y: 9134175, Elevation 225 m (Right)

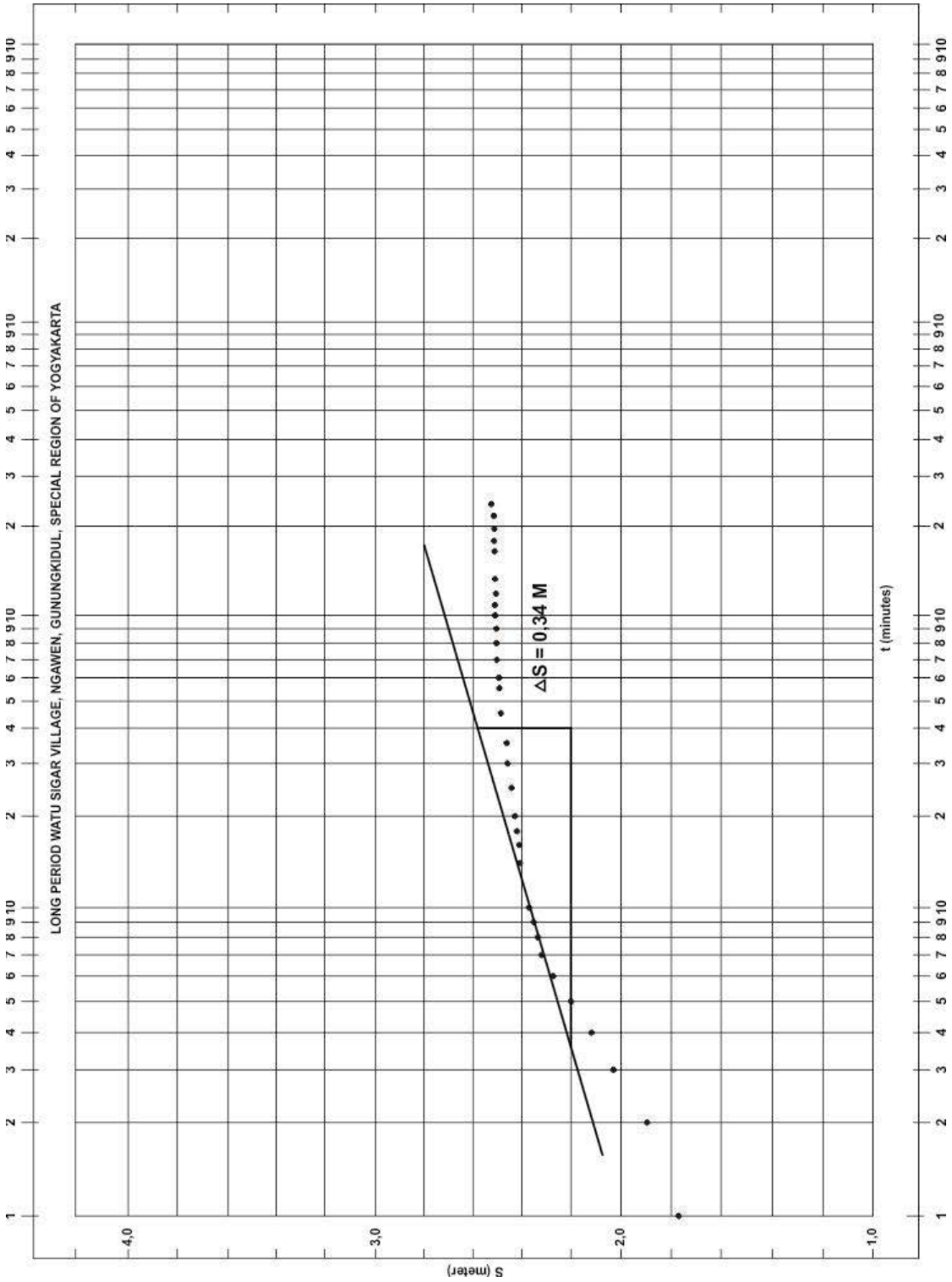

Figure 3 Long period Pump Testing in Watu Sigar Village

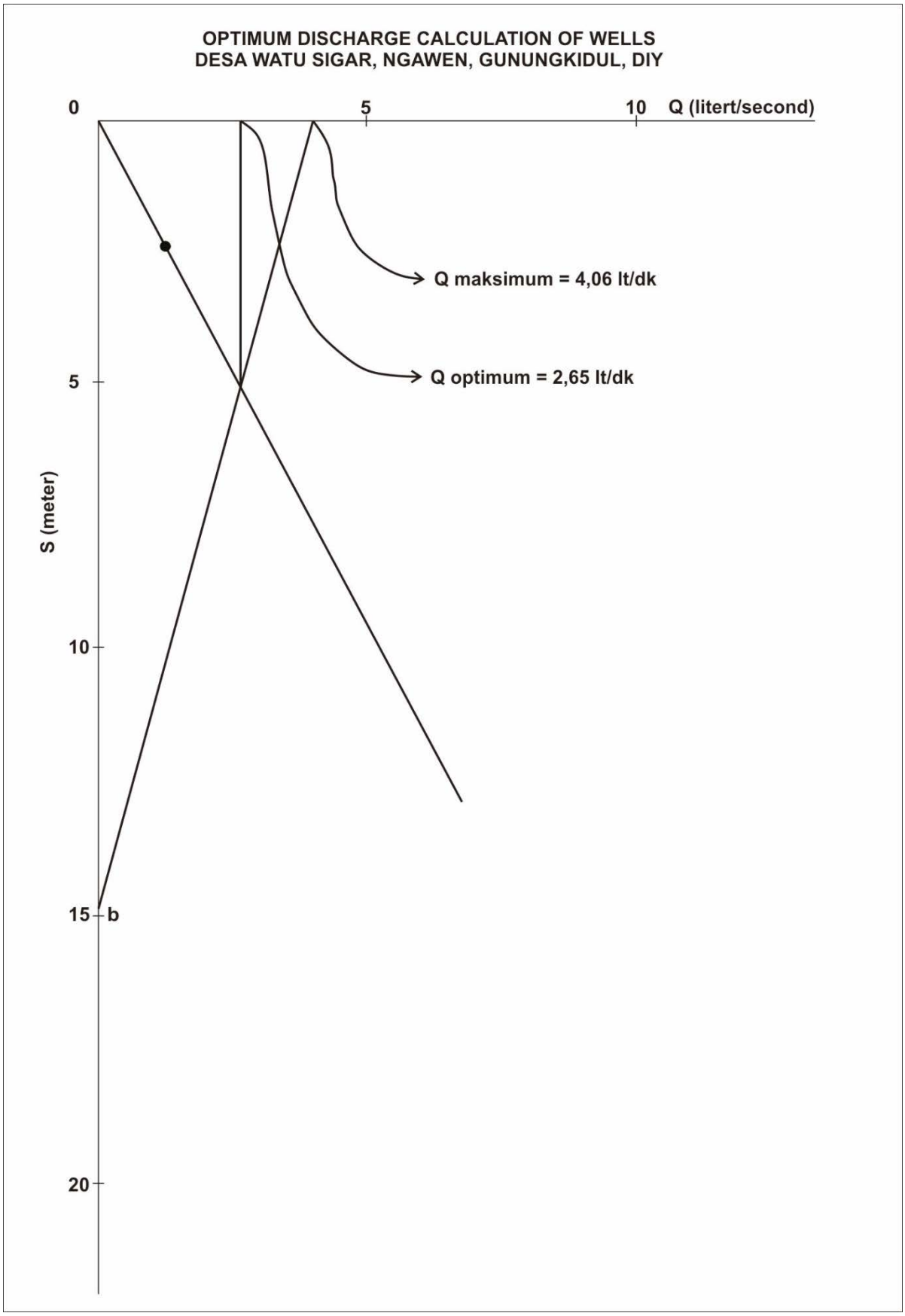

Figure 4 Optimum Discharge Calculation of Wells in Watu Sigar Village

PYRITE OXIDATION AND LEACHING AFFECTS AVAILABLE BASIC AND ACID CATION IN ACID SULPHATE SOIL, SOUTH KALIMANTAN

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ABSTRACT

The oxidation of pyrite in acid sulfate soila (ASS) produces high concentration of strong acid (H_2SO_4) in the soil. The acid reacts with soil minerals and dissolves aluminium and other acid-soluble metals. Therefore cations of H^+, Fe^{3+} and Al^{3+} urge out of Ca, Mg and K from the exchange complex and loss by leaching. The objective of this research was to observe of basic and acid cation at acid sulphate soil after continuos pyrite oxidation and leaching. An incubation-extraction of drying and wetting followed the leaching experiment was conducted at the Soil Laboratory of the Indonesian Swampland Agriculture Research Institute (ISARI) from September 2013 until August 2014 arranged in a factorial completely randomized design with three replications. The treatment were the initial drying (without drying, drying for 2 and 4 days at 45 ºC) and pyrite content (0.70% (low), 1.96% (moderate) and 4.39% (high)). In this study, the amount of extraction of each treatment is not the same. From the 31th extraction onwards all samples were dried for 4 hour at 105□C both in non-drying and drying treatment for 2 or 4 days at 45 º C. The results showed that the interaction between initial drying and pyrite content significantly different affect summation of available basic cation/sums bases (Ca+Mg+K+Na) and summation of available acid cation/sums acid cations (Al+H) in the soil. Concentration sums bases decreased due to initial drying at the low and high pyrite content. Initial drying did not have any significant effect on sums bases in the moderate pyrite content. Increasing of sums acid cations due to initial drying at the low and high pyrite content but not for moderate pyrite content 1.93%. Sums bases decreased while sums acid cations increased with initial pyrite content. Continuous of pyrite oxidation by drying and wetting followed the leaching of oxidation product caused sums bases decreased while acid cation increased. Compared to the total of sums bases and acid cations, percentage of sums bases on low, moderate and high pyrite were 61.87, 9797.38 and 45.86 decreased into 11.89-31.77, 1.74-2.15 and 7.36-13.49 respectively. On the contrary, percentage of the acid cations in the low, moderate and high pyrite content increase from 38.13, 2.62 and 54.14 into 77.96-88.11, 97.85-98.27 and 86.51-92.64 respectively. The suggest that the continuous of pyrite leaching-oxidation caused acid cation dominant in acid sulphate soil so need fertilizer and ameliorate to improve productivity.

Keywords: acid sulphate soil, pyrite, oxidation, leaching

INTRODUCTION

Acid sulphate soils form naturally in wetland environments when seawater or sulphate-rich water mixes, in the absence oxygen with land sediment containing iron oxide and organic matter is converted by bacteria to sulfide minerals, predominantly pyrite (FeS_2). Soil horizons that contain

sulfides with the potential to strongly acidify to pH <4 are called sulfidic material (Soil Survey Staff, 2010). Where acid sulphate soils remain in a reduced condition, the sulphidic material remain chemically inert. These soils are called potential acid sulphate soils. On exposure to the oxygen in air, due to drainage or disturbance, oxidation of the sulphidic material take places and can be environmentally damaging. The oxidation reaction generates acidic products, hence the term actual acid sulphate soils (Indraratna *et al*., 1999).

According Kawahigashi *et al* (2008), pyrite oxidation produce sulfuric acids and then release large amounts of metals by cation exchange or dissolution of minerals. Acid and soluble metal loads resulting from acidification proceded by severe drying of acid sulfate soils are fatal soil conditions for agricultural productivity and enviroments. Among the agronomy problems common in acid sulfate soil are Al^{3+} and Fe^{2+} toxicity.

Pyrite (FeS2), a highly insoluble mineral. Pyrite as a source of acidity can be removed from the land by oxidation process. Usually if the pyrite content reaching a value less then 0,75% and the EC is less than 0.5 $mS.cm^{-1}$ (Maas, 2003). Therefore, an important next step in the process of pyrite oxidation is leaching of pyrite oxidation products. However leaching to discharge acidity and other toxic compounds can cause nutrient leaching. The objective of this research was to observe of basic and acid cation at acid sulphate soil after continuos pyrite oxidation and leaching.

MATERIAL AND METHODE

The experiment was conducted at the Soil Laboratory of the Indonesian Swampland Agriculture Research Institute (ISARI) from September 2013 until August 2014. The experiment used potential acid sulphate soil containing different pyrite content. It was taken from Belandean Experimental Station, Barito Kuala on S 03˚17'01,46"; E 114˚60'19,9", Handil Maluka village, Tanah Laut on S 03º 34'38,1", E 114º 35' 54,6" and Jelapat, Barito Kuala, South Kalimantan on S 03º 14' 16.1", E 114º 31' 02", at a depth of 30-40 cm, 70-100 cm dan 35-65 cm respectively. The experiment was arranged in a factorial completely randomized design with three replications. The first factor was aeration by initial drying, namely : (a) control/no aeration (saturated with 1 cm of water above soil surface); (b) aeration by dried for 2 days at 45ºC; and (c) aeration by dried for 4 days at 45ºC. The second factor are the concentration of pyrite ; (i) 0,70% (low), (ii) 1,96% (moderate) and (iii) 4,39% (high).

Eight gram material sulphidic (potential acid sulphate soil) was placed in sentriguge tube (10 ml). To obtain the amount of soil samples for analysis then each replication consists of 4 tubes (32 g ground).The control treatment (without aeration), saturated with 1 cm of water above soil surface, aeration treatment, drying by oven at 45˚C for 2 days or 4 days. Incubation at room temperature. In this study, the amount of extraction of each treatment is not the same. From the 31th extraction onwards all samples were dried for 4 hour at 105 C both in non-drying and drying treatment for 2 or 4 days at 45 º C.

The leaching is done every weeks until the EC is less than 0.5 $mS.cm^{-1}$. First each centrifuge tube plus water aquades with 1: 2,5 ground and water ratio then shaked using a shaker at 180 rpm (Noor, 2004) for 1 hour (Rhoades, 1982) and centrifuged for 10 minutes. After leaching the remainder of the soil, the original condition was made by adding aquadest water to saturated (1 cm above the soil surface) in no aeration treatment, and drying using oven at 45 ° C for 2 and 4 days for aeration treatment then incubated at room temperature .

The observed variables were soil pH, sums bases (Na^{+}, Ca^{2+}, Mg^{2+}, K^{+}), sums acid cations (Al^{3+},

H^+) before and after leaching-oxidation.

Analysis of pH used a glass electrode pH meter HORIBA Model 9625 and analysis of EC used EC-meter glass electrode WTW Cond Model 3110. Cations such as Na^+, Ca^{2+}, Mg^{2+} were extracted using NH_4OAc pH7 and analyzed using AAS (Atomic Absorption Spectrometry) GBC Model 933 plus. Analysis of H^+ and Al^{3+} by titration used KCl 1M extracter. Analysis of the levels of pyrite oxidation method used H_2O_2 and was measured using Spectrophotometer Model Spectronic 20 (λ = 494 nm).

The data obtained in this experiment were analyzed statistically using SAS software Portable 9.1.3. Analysis of varian was done to determine the treatment difference. The duncan multiple range test (DMRT) was used to compare treatment means at $P<0.01$ or $P<0.05$.

RESULT AND DISCUSSION

Chemical properties of acid sulphate soils before oxidation-leaching are shown in Table 1. Table 1 shows that the pH of the soil under study ranged from 4.07 to 7.53. Its indicate of soil in used experiment is potentianl acid sulfate soil. According to the Soil Taxonomy (Soil Survey Staff, 2010), these soils can be classified as Typic Sulfaquent due to presence of sulphidic material within the depth of 50 cm and pH value >4.

Initial of sums bases at acid sulphate soil with low and moderate pyrite content higher than sums acid cations. Coversely, initial sums acid cations at acid sulphate soil with high pyrite content higher than summation of available bases cations. Probably, the acid sulphate soil with low pyrite content was taken from intensive management lowland. It has often received input from the outside either in the form of fertilizer or amelioran materials. The acid sulphate soils with medium pyrite content was taken from locations that often have seawater runoff rich in basic cations such as Na^+, K^+, Ca^{2+} and Mg^{2+}. The acid sulphate soils with high pyrite content are probably the pyrite has been exposed due to soil tillage so that it undergoes oxidation. The acidity generation from pyrite oxidation is probably to dissolve the previously precipitated Al-hydroxide so that the complex of exchange and solubility is dominated by Al.

Table 1. Characteristics of acid sulfate soil used in this experiment (wet soil)

Soil properties	Pyrite content		
	Low (<1.2%)	Moderate (1.21-2.4%)	High (2.41-4.5%)
pH H_2O	4.07	7.53	4.81
pH KCl	3.60	5.86	4.14
DHL (µS)	0.44	2.39	1.57
Organic-C (%)	9.43	3.92	10.88
Available basic cation:			
Available-Ca (cmol(+).kg^{-1})	2.86	8.19	0.75
Available-Mg (cmol(+).kg^{-1})	5.12	24.71	8.84
Available-K (cmol(+).kg^{-1})	0.09	5.64	0.23
Available-Na (cmol(+).kg^{-1})	1.59	46.23	3.19
Available-Fe (cmol(+).kg^{-1})	2.20	6.32	0.35
Sums of available bases	11.86	91.09	13.36
Available acid cation			
Available-Al (cmol(+).kg^{-1})	6.45	0	11.38
Available-Al (cmol(+).kg^{-1})	0.86	2.45	4.39
Sums of available acid cation	7.31	2.45	15.77
Pyrite content (%)	0.70	1.96	4,39

Note: Soils containing low, medium and high pyrite content were taken from Belandean Experimental Station, Handil Maluka village and Jelapat village, South Kalimantan at a depth 30-40 cm, 70-100 cm and 35-65 cm respectively.

Acidity generated by pyrite oxidation has impact on soil quality. Interaction between initial dyring and pyrite content were significantly different affects of sums bases. Initial drying negatively affects the sums bases at acid sulphate soil with low and high pyrite content. For acid sulphate soil with low pyrite content, the sums bases decreased after 2 or 4 hours of drying at 45ºC while at high pyrite content decreased after 2 hours of drying 45ºC. This is thought to be related to the reaction between H^+ and silicates. According to Maas (1989) and Sudarsono (1996), the reaction of H^+ with silicate minerals released basic cations such as K^+, Na^+, Ca^{2+} and Mg^{2+}. The released of base cation increases with increasing H^+ which is the result of pyrite oxidation.

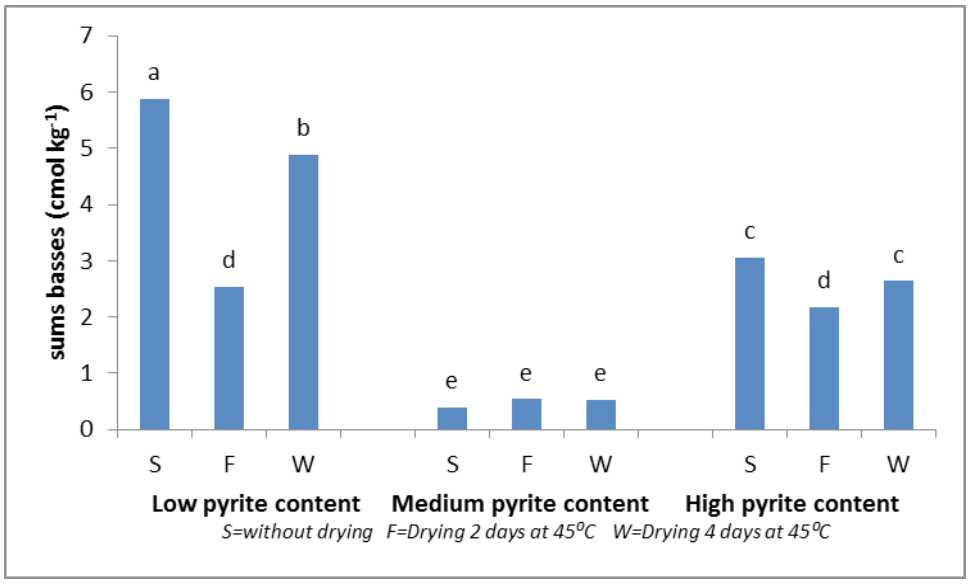

Fig. 1. Effects of initial drying on the sums bases in acid sulphate soil with different pyrite content

Fig 1. showed that initial drying did not have any significant effect on sums bases in moderate pyrite content. Probably, there was no difference in pyrite oxidation products (H^+ and Al^{3+}) due to the same drying process after the 31st extraction so as not to affect the sums bases.

Fig 1. also showed that the sums of bases decreased with increasing pyrite content. According Lestari (2016), the releasing H+ and Al3+ due to pyrite oxidation increases with pyrite content. Therefore, the acidic cations (H^+ and Al^{3+}) are strongly adsorbed by exchangeable cations complex so that the sums bases are easily released and leached (Bohn *et al*., 2001).

Sums acid cations

Statistical analysis showed that the interaction between initial drying and pyrite content significantly affected sums acid cations. On acid sulfate soils with low and high pyrite content, initial drying increase sums acid cations, but not significantly different between drying for 2 days and 4 days at 45°C. This is because drying can improve aeration so that pyrite oxidation becomes better and the solubility of H^+ and SO_4^{2-} increases (Yuliana,2012). The H^+ cations resulting from pyrite oxidation react with silicate compounds to form $Si(OH)_4$ weak acids and release acidic cations such as Al^{3+} and Fe^{3+} (Maas, 1989 and Sudarsono, 1996). In addition, high acidity can also speed up the dissolution process of Al-hydroxide which initially precipitates so as to increase Al-dd. Furthermore, Al-dd will further fulfill the soil with decreasing soil pH (Yuliana, 2012).

Sums acid cations increases with pyrite content in both the drying or without drying. According to Maas *et al*. (2000), that the higher pyrite content causes the final acidification to increase. Furthermore Anda & Siswanto (2002), suggested an increase in acidity due to oxidation of pyrite will release Al^{3+} ions from the mineral surface more and more. Therefore, the increased concentration of Al^{3+} ions increases the total acid cation.

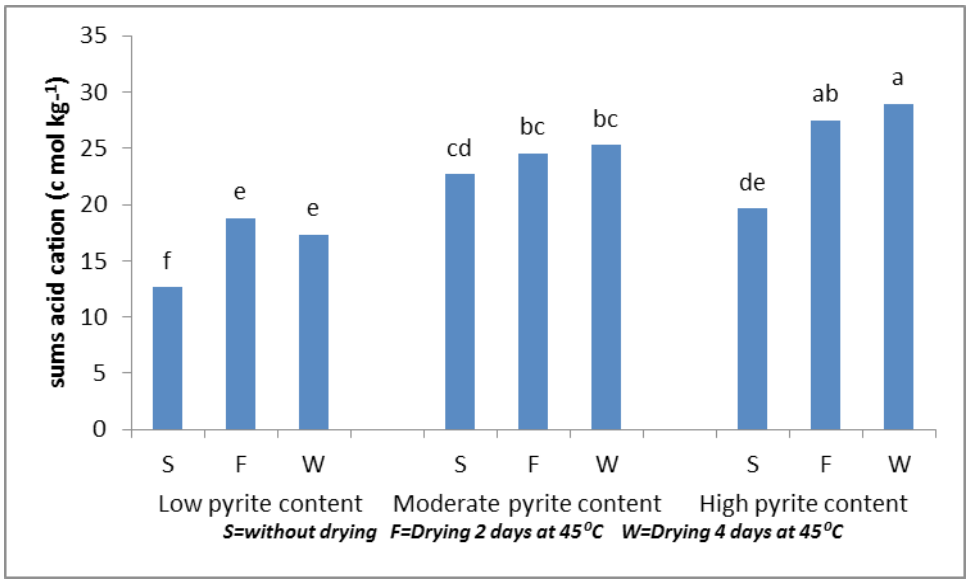

Fig 2. The influence of acid sulphate soil drying with different pyrite content to sums acid cation.

Soil pH

The interaction between initial drying and pyrite content significantly influenced at soil pH after leaching-oxidation. Initial drying of the experiment decreased soil pH on low pyrite content but not decreased on medium and high pyrite content (Fig. 1). The soil pH decrease was due mainly to release of acidity by continued material sulphidic and partly from the hydrolysis of acidic cations such as Al and Fe. On acid sulphate soil with medium and high pyrite content, initial drying not influenced at soil pH presumably due to drying at the same temperature after the 31st extraction at 105□C for 4 hours resulted not differ acidity.

Fig. 3 also showed that soil pH decreased with increasing initial pyrite content. pH values indicated the amount of hydrogen ion (H^+) concentration in soil. According to van Breemen (1973, the pyrite oxidation reaction is as follows:

$$FeS_2 + 15/4\ O_2 + 7/2\ H_2O \rightarrow Fe(OH)_3 + 2SO_4^{2-} + 4H^+$$

The equation showed that H^+ resulting from the pyrite oxidation increases with increasing pyrite content. pH value is defined as negative based 10 logarithm of the molar concentratiom of hydrogen ions ($pH=-\log_{10}[H+]$). Thus it can be said that the increasing concentration of H^+ represent the pH value is decreasing

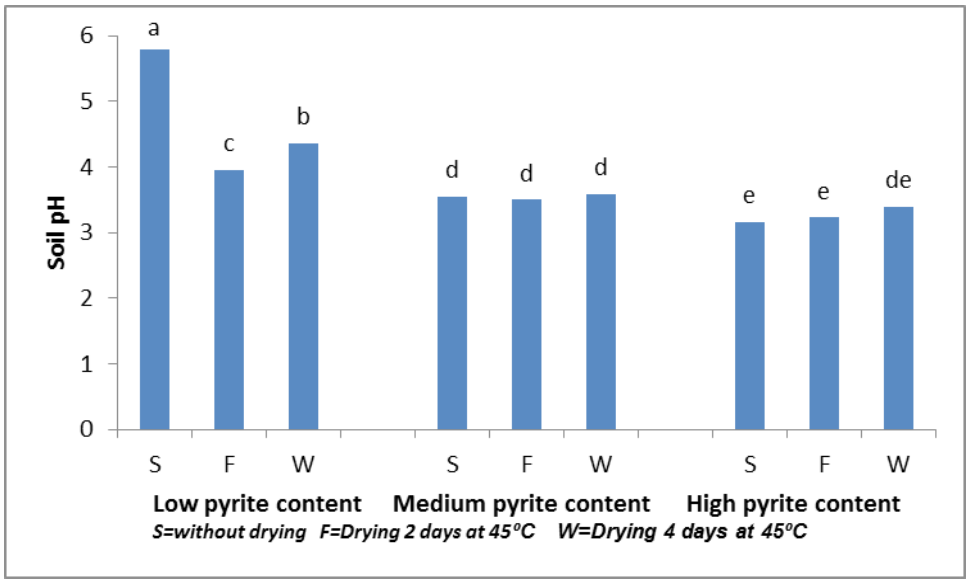

Fig 3. The infuence of pyrite oxidation-leaching on soil pH

Compared to the soil properties before experiment, continuos leaching-oxidation process decreased soil pH. The leaching process to discharge pyrite oxidation product caused remove bases cations such as Ca^{2+}, Mg^{2+}, Na^{+} and K^{+}. During leaching of basic cations from soil particles, their site are replaced by H^{+} ions, which accelerates the acidification process (Bolan and Hedley, 2003 *In* Fageria *et al*., 2010).

The treatment of without or drying for 4 days at 45□C increased soil pH from 4.07 into 5.79 and 4.36 respectively. Soil pH of acid sulphate soil with low pyrite content decreased from 7.53 to 3.5-3.58 increase from 4.07 to and high pyrite content were 4.07, 7.53 and 4.81.

Comparisons of sums bases and acid cation between before and after pyrite oxidation

Sums bases were higher in the material sulphidi (before experiment) than acid sulphate soil after experiment indicated that cations were leached. On the other hand sums acid cations (H+ and leaching process not only leached pyrite oxidation product but also essential nutrient for crop (sums bases). In addition, sums acid cations were dominated on acid sulphate after leaching oxidation. Hence, pyrite oxidation followed the leaching to discharge pyrit oxidation products caused the productivity of acid sulphate soil is low. To increase the productivity of acid sulphate soil after due to give ameliorant materials and fertilizer.

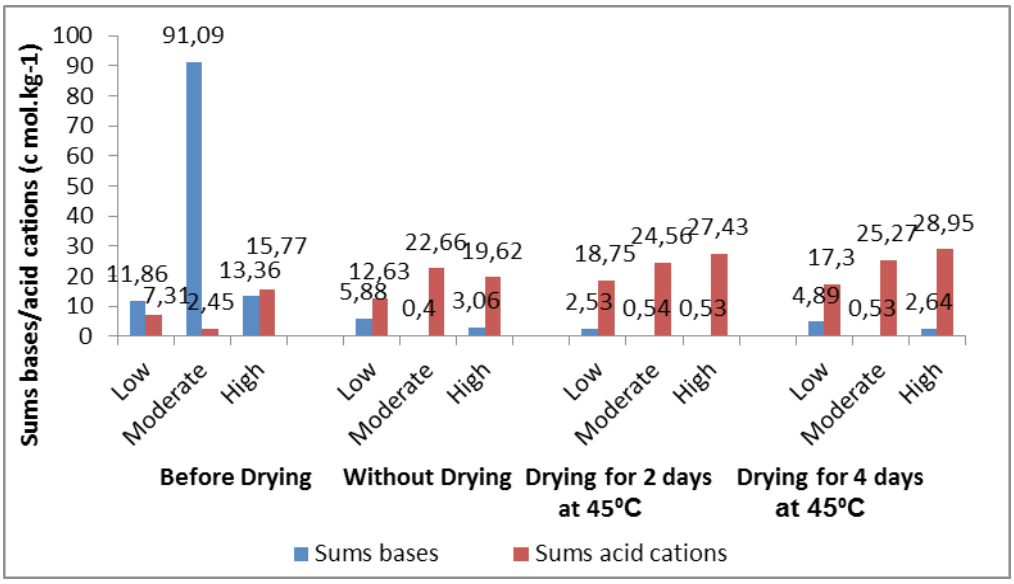

Fig 4. Comparsons of sums bases and acid cations between before and after pyrite oxidation.

CONCLUSION

Pyrite oxidation was carried out by drying and wetting followed the leaching of oxidation products caused sums bases decrease while sums acids cation increase. Sums bases decrease while sums acids cation increase with increase pyrite content. Drying impact sums bases increase at acid sulphate soil with low pyrite conten, therefore not influence at medium and high pyrite content. Summation available acid cation increases as pyrite content increase in both without or the drying treatment.

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CHARACTERISTIC OF CHEMICAL PROPERTIES OF RED SOIL FROM QUATERNARY AND TERTIARY VOLCANIC MATERIALS

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ABSTRACT

Parent material is one of soil forming factors. Red soil pedons developed from Tertiary volcanic materials and Quaternary volcanic materials morphologically have resemble color and thickness solum. The aim of this research compared the characteristics of soil chemical properties. Research was conducted in June 2016 to July 2017 in Tugu Village, Jumantono Sub-district, Karanganyar Regency, Central Java and Nglanggeran Village, Patuk Sub-district, Gunungkidul Regency, Special Region of Yogyakarta. The determination of soil profile is purposive. Parameters include Al total, Fe total, Fe extract dithionite, oxalate, and pyrophosphate, C-Organic, pH H_2O, pH KCl, pH K_2SO_4, exchangeable bases, and CEC. Based on the results, the Quaternary volcanic red soil has pH, saturation bases, and CEC are lower than the Tertiary volcanic red soil, but C-Organic is relatively higher. Fe total, Al total, and ratio of Fe amorphous and Fe crystalline suspected that weathering of the Tertiary volcanic red soil is further than the Quaternary volcanic red soil, whereas based on base cations is assumed that the Quaternary volcanic red soil have faster weathering.

Keywords: Red Soil; Volcanic; Quaternary; Tertiary

INTRODUCTION

Parent material is one of soil forming factors. Other soil forming factors are climate, relief, organism, and time. According to Geological Map of Indonesia by Geological Research and Development Center, red soil in Nglanggeran Village, Patuk Sub-district, Gunungkidul Regency, Special Region of Yogyakarta developed from Tertiary volcanic material of Nglanggeran ancient volcano, while red soil in Tugu Village, Jumantono Sub-district, Karanganyar Regency, Central Java developed from Quaternary volcanic material of Lawu volcano. According to Pratiknyo (2008), red soil from Tertiary volcanic material located in Nglanggeran formation geomorphologically arranged by andesitic volcanic, lava, agglomerates, polymix, sandstone tuffs, this formation deposited in Oligomiosen–Middle Miosen epoch, while according to Prawiradisastra (2008) red soil from Quaternary volcanic material formed from lava Lawu which arranged by andesite component, basalt, and a little pumice stone of various sizes and mixed with volcanic sand. These two pedons of red soil morphologically have resemble color and thickness of solum. Different environmental conditions and formation times are suspected to have relatively different properties. The aim of this research compared two red soil pedons developed from Quaternary and Tertiary volcanic materials by soil chemical properties aspect.

MATERIALS AND METHODS

The research was conducted in June 2016 until July 2017 in Tugu Village, Jumantono Sub-district, Karanganyar Regency, Central Java and Nglanggeran Village, Patuk Sub-district, Gunungkidul Regency, Special Region of Yogyakarta.

Soil analysis was conducted at Soil Chemistry Laboratory of Balai Penelitian Tanah Bogor. The research method is descriptive while profile selection method is purposive.

The results of laboratory analysis will be calculated using the Similarity Index, the principle of similarity index analysis is all values of a certain parameter owned by each layer is changed to relative price, then the largest price is assigned a value of 100 and the smallest is assigned a value of 0, the other value is assigned an equivalent value by way of interpolation.

The Similarity Index Formula (Buol *et al*., 1980):

$$I = \frac{2W}{A+B} \; x \; 100$$

Information:

I : the similarity index,
W : the least value of relative amount between two horizon parameters are compared,
A + B : relative amount of soil A and soil B,
Notes : if I > 80 means the two horizons compared are similar, 50 < I <79 means the two horizons are compared doubtful, whereas if I < 50 both the compared horizons are not similar.

Soil analysis includes: Texture using sedimentation method, soil color using Munsell Soil Color Chart, pH values include pH H2O, KCl, and K2SO4 using pH meter and pH stick, Cation Exchangable Capacity using NH4OAc extract pH 7, Exchangeable Bases (Ca, Mg, K, Na) using Atomic Absorbs Spectrophotometry, Bases Saturation calculate based on Exchangable Bases and Cation Exchangable Capacity, Al and Fe Total by strong acids destruction, Fe oxalate extract, Fe dithionite citrate bicarbonate extract, Fe pyrophosphate extract, and C-Organic using Walkley and Black method.

GENERAL CIRCUMSTANCE

The first field research location is in Tugu Village, Jumantono District, Karanganyar Regency, Central Java (Figure 1) at UTM 49 M, x 494256; y 9153819 with height 175 meters above sea level, it has volcanic system physiography, 11.25% slope, terraces topography, vegetation coveres sugar cane, teak, chilli, and shrub. The second field research location is in Nglanggeran Village, Patuk Sub-district, Gunungkidul Regency, Special Region of Yogyakarta (Figure 1) at UTM 49 M, x 446059; y 9131290 with height 234 meters above sea level, it has volcanic system physiography, 40% slope, corrugated topography, vegetation coveres acacia, banana and teak. Two soil profile show in Figure 3 and Figure 4. Jumantono Sub-district is relatively higher than Patuk Sub-district (Figure 2) this may affect to rate of weathering and developing of soil profile.

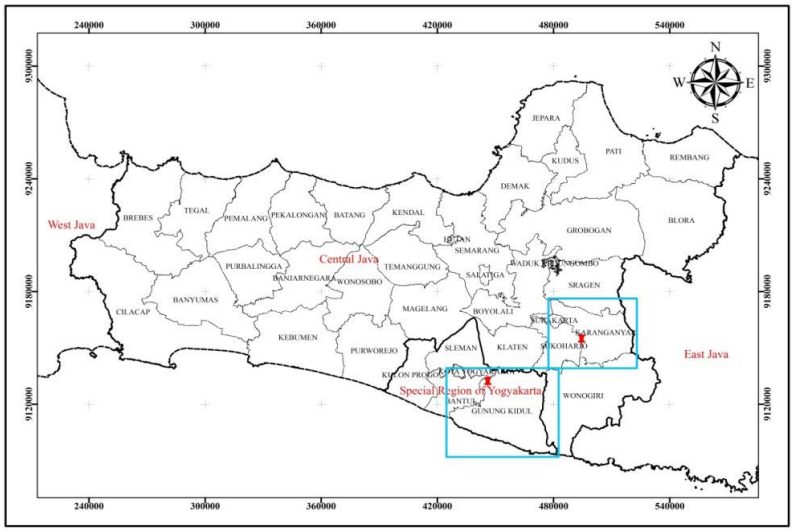
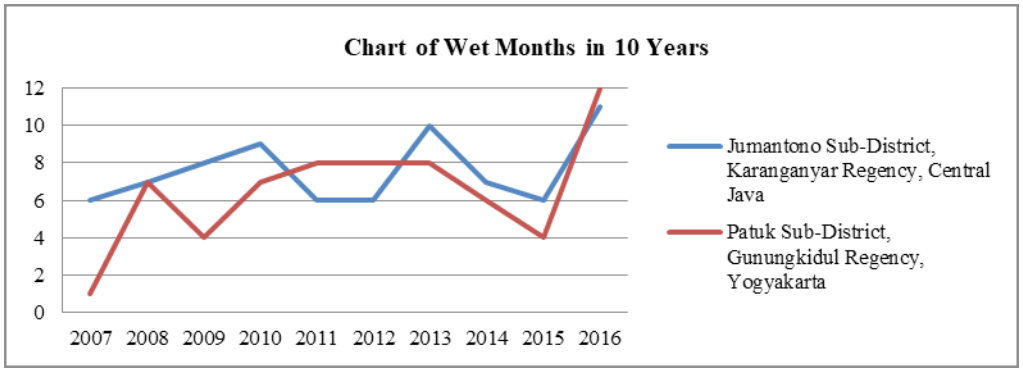


Figure 1. Map of Research Location



Source: Dinas Pekerjaan Umum Kabupaten Karanganyar (2017) and Badan Klimatologi D. I. Yogyakarta (2017)

Figure 2. Chart of Wet Months in 10 Years

A
0 - 20/15

BA
20/15 – 70/72

B1
70/72 -
123/125

B2
123/125
-187/181

B3
187/181 - 350

Figure 3. Soil Profile of Red Soil from Tertiary Volcanic Material

A
0 - 23/25

B1
23/25 - 53/58

B2
53/58 – 118/113

BC
118/113 - 320

Figure 4. Soil Profile of Red Soil from Tertiary Volcanic Material

RESULT AND DISCUSSION

Soil Color and Soil Texture

Table 1. Results of Soil Color and Soil Texture Analysis

Soil Profile		Color (Dry)		Tekstur (%)			Texture by USDA
				Sand	Silt	Clay	
				0,1-2	5-20	0,2-2	
				mm	µm	µm	
Red Soil from Tertiary Volcanic Material	A	10 R 3/3	Dusky Red	7,5	32,9	59,1	Clay
	BA	10 R 4/8	Red	2,2	39,5	58,3	Clay
	B1	10 R 4/6	Red	2,7	32,1	65,2	Clay
	B2	10 R 4/8	Red	2,2	32,3	65,5	Clay
	B3	10 R 4/6	Red	6	41,8	52,2	Silty Clay
Red Soil from Quaternary Volcanic Material	A	2,5 YR 4/4	Reddish Brown	4,7	28,6	66,7	Clay
	B1	2,5 YR 5/6	Red	3,2	32,6	64,2	Clay
	B2	2,5 YR 5/8	Red	3,5	35,9	60,6	Clay
	BC	2,5 YR 5/6	Red	2,9	32,1	58	Clay

Source: Result of Field Analysis in Nglanggeran Village, Patuk Sub-district, Gunungkidul Regency, Special Region of Yogyakarta and Tugu Village, Jumantono District, Karanganyar Regency, Central Java (2016) and Result of Soil Chemistry Laboratory Analysis at Balai Penelitian Tanah Bogor (2017)

Results of field and laboratory studies (Table 1) show that both soil pedons have very similar colors and textures. Very striking red color can show dominant of hematite iron oxide content

Table 2. Results of Soil Chemical Properties

Profil		pH			C-Organic	Exchangable Bases					CEC	BS	Al Total	Fe Total	Fe_d	Fe_o	Fe_p
		H_2O	KCl	K_2SO_4		Ca	Na	K	Mg	Amt							
					%	cmol/kg						%					
Red Soil from Tertiary Volcanic Material	A	5,6	4,8	6	0,97	10,78	0,15	0,21	4,16	15,30	22,91	67	5,19	8,05	0,62	0,46	0,35
	BA	6,0	5,0	6	0,15	10,79	0,12	0,27	4,03	15,21	20,80	73	9,96	8,87	0,76	0,55	0,47
	B1	5,7	4,7	6	0,10	9,88	0,11	0,29	4,11	14,39	22,90	63	8,45	8,19	0,62	0,51	0,32
	B2	5,7	4,6	6	0,11	9,97	0,15	0,27	4,22	14,61	22,77	64	8,34	8,03	0,61	0,48	0,36
	B3	5,5	4,4	6	0,09	8,13	0,13	0,28	3,41	11,95	19,94	60	8,10	7,57	0,69	0,41	0,26
Red Soil from Quaternary Volcanic Material	A	4,6	3,9	4,5	1,02	5,05	0,09	0,22	1,01	6,37	19,56	33	8,60	7,33	0,64	0,50	0,34
	B1	5,3	4,4	5	0,18	5,88	0,15	0,18	1,91	8,12	16,83	48	7,40	6,99	0,60	0,46	0,38
	B2	5,5	4,5	5	0,25	5,66	0,20	0,26	1,92	8,04	15,08	53	7,81	6,96	0,60	0,39	0,34
	BC	5,6	4,5	5	0,30	5,78	0,20	0,34	2,47	8,77	16,18	54	6,68	5,36	0,56	0,39	0,33

Source: Result of Chemical Soil Properties from Soil Chemistry Laboratory at Balai Penelitian Tanah Bogor and Soil Science Laboratory at Department of Agrotecnology Faculty of Agriculture University of Pembangunan Nasional "Veteran" Yogyakarta (2017)

(Torrent *et al*, 1980). Two pedons dominant with clay fraction because generally volcanic materials in Indonesia are basalt and andesite which are contain Si less than 60% and lots of bases, so they have strong weathering (Hardjowigeno, 2010).

Information: Amt: Amount; CEC: Cation Exchangeable Capacity; BS: Bases Saturation; Fe_o: Fe oxalate extract, Fe_d: Fe dithionite citrate bicarbonate extract; Fe_p: Fe pyrophosphate extract

Both pedons show relatively different of soil chemical properties (Table 2). Generally, red soil from Tertiary volcanic material has bases saturation, CEC and pH relatively higher than red soil from Quaternary volcanic material. It is assumed that rate of removal weathering cations red soil from Quaternary volcanic material is faster than red soil from Tertiary volcanic material. The high calcium and magnesium in red soil from Tertiary volcanic material can show relatively different parent material.

C-Organic

Red soil from Quaternary volcanic material has higher organic C-Organic than red soil from Tertiary volcanic material (Table 2), it indicates type of clay effect in soil charge, which is showed by lower CEC value of the red soil from Quaternary volcanic material.

Cation Exchange Capacity (CEC)

The value of the Cation Exchange Capacity (CEC) of red soil from Tertiary volcanic material is greater than red soil from Quaternary volcanic material (Table 2), this is inconsistent with the calculation of pH K_2SO_4 and pH H_2O that entire horizon of red soil from Tertiary volcanic material is oxic horizon that should has CEC values <16 cmol/kg. Soil CEC values > 16 cmol/kg were thought due to deprotonization processes leading to increased negative charge of extraction with NH_4OAc pH 7.

Exchangeable Bases

The value of exchangeable bases of red soil from Tertiary volcanic material is greater (Table 2) due to rain intensity in red soil from Quaternary volcanic material area is higher so leaching is more effective. Hudson (1995) in Mulyanto (2007) “The leaching process is quite effective in causing Na, Ca, Mg, and K much lost as well as Si. Losing these elements through leaching leads to relatively low increases Fe and Al in form of oxides and hydroxides”.

Bases Saturation

Bases saturation value of red soil from Tertiary volcanic material is larger than red soil from Quaternary volcanic material (Table 3) due to the more intensive mineral weathering process increases the number of bases in soil so basic cations are absorbed in negative colloids, this is supported by the statement of Ugolini and Dahlgren (2002) that warm or dry conditions increase the formation of crystalline silicate layers rather than non-crystalline form materials and unlimited leaching causes high base saturation.

Al and Fe Total

The average of Al and Fe total of red soil from Tertiary volcanic material is larger than red soil

from Quaternary volcanic material (Table 3) because red soil from Tertiary volcanic material has further progressed, leading to the suppression of large numbers of cations and Si, relative increase in the amount of Al and Fe in the form of oxides and hydroxides. The Formation of soil red color can be explained by ion mobility series proposed by Hudson (1995) in Mulyanto and Surono (2009) "In decreasing order ie. $Cl^- > SO_4^{-3} > Na^+ > Ca^{2+} > Mg^{2+} > K^+ > SiO_4 > Fe_2O_3 > Al_2O_3$, the more intensive leaching process results in suppression of the base and the weathering results as well as the relative increase in iron and aluminum concentrations. The accumulation of iron oxide affects the color, especially the red color of soil".

Difference of pH to Various Soil Extraction

Table 3. Difference of pH to Various Soil Extraction

		pH K_2SO_4 – pH H_2O	pH KCl - pH H_2O
Red Soil from Tertiary Volcanic Material	A	0,4	-0,8
	BA	0	-1
	B1	0,3	-1
	B2	0,3	-1,1
	B3	0,5	-1,1
Red Soil from Quaternary Volcanic Material	A	-0,1	-0,7
	B1	-0,3	-0,9
	B2	-0,5	-1
	BC	-0,6	-1,1

Difference value of pH K_2SO_4 with pH H_2O on red soil from Tertiary volcanic material shows positive value while red soil from Quaternary volcanic material shows negative value (Table 3). The positive value indicates oxic horizons, then red soil from Tertiary volcanic material has oxic horizons overall (Notohadiprawiro, 1985). The difference value of pH KCl and pH H2O < -0.5 indicates the permanent charge clay, thus red soil from Tertiary volcanic material and red soil from Quaternary volcanic material are dominated by permanent charge clay (Arvide *et al*., 2006).

Ratio of Fe_a/Fe_c Soil

Table 4. Ratio of Fe_a/Fe_c

Profil		Fe_d	Fe_o	Fe_p	Fe_c	Fe_a	Fe_a / Fe_c
		----------%----------					
Red Soil from Tertiary Volcanic Material	A	0,62	0,46	0,35	0,11	0,16	0,68
	BA	0,76	0,55	0,47	0,08	0,21	0,38
	B1	0,62	0,51	0,32	0,19	0,11	1,72
	B2	0,61	0,48	0,36	0,12	0,13	0,92
	B3	0,69	0,41	0,26	0,15	0,28	0,53
Red Soil from Quaternary Volcanic Material	A	0,64	0,50	0,34	0,16	0,14	1,14
	B1	0,60	0,46	0,38	0,08	0,14	0,57
	B2	0,60	0,39	0,34	0,11	0,16	0,68
	BC	0,56	0,39	0,33	0,08	0,21	0,38

Information:

Fe_d : Fe Dithionite citrate bicarbonate
Fe_o : Fe Oxalate extract
Fe_p : Fe Pyrophosphate
Fe_c : Fe Crystalline (Fe_d- Fe_o)
Fe_a : Fe Amorphous (Fe_o- Fe_p)

Both pedons have similar Fe_a/Fe_c ratio (Table 4), smaller value of Fe_a/Fe_c ratio indicates the rate of crystallization iron oxide increased with further soil development. Fe_a/Fe_c ratio between red soil from Quaternary volcanic material and red soil from Tertiary volcanic material is not much different because development of these pedons is further despite having different age of parent material. It seems that development of soil in red soil from Quaternary volcanic material area is strongly influenced by higher wet months.

According to Wiegner (1926) in Darmawijaya (1997), in tropical climates, silicates are hydrolysed because of free hydroxyl which makes the negative silica hydrate stable, making it easier to leach. Instead, these OH ions react with Al_2O_3 and Fe_2O_3 by forming stable coagulates and crystals, so older soils become more stable.

The Similarity Index of Soil Chemical Properties

Table 5. The Similarity Index of Soil Chemical Properties

		Red Soil from Tertiary Volcanic Material				Red Soil from Quaternary Volcanic Material			
	A	BA	B1	B2	B3	A	B1	B2	BC
A	100	75,48	82,71	86,48	71,17	46,56	59,53	55,65	52,69
BA	100	83,74	73,88	74,33	42,37	54,18	53,01	47,97	
B1	100	94,00	81,91	46,73	58,59	59,50	55,77		
Red Soil from Tertiary Volcanic Material	B2	100	82,22	45,12	65,74	65,15	59,22		
B3	100	41,12	61,51	65,75	59,42				
A	100	46,93	39,23	24,55					
B1	100	77,91	64,77						
B2	100	83,10							
Red Soil from Quaternary Volcanic Material	BC	100							

Information:

< 50	: Nothing Similar
50-70	: Doubtful Similarity
70-80	: Similar
>80	: Very Similar

Based on Table 5, red soil from Tertiary volcanic material has similar till very similar chemical properties by compared horizons because clay fractions of each layer does not differ greatly and it affects to chemical properties besides intensive soil formation process causing chemical reactions. In red soil from Quaternary volcanic material, B2 horizon and BC horizon is very similar because B2 horizon develops from the BC horizon so it has a character that is not much different, but comparison between horizons A to horizons B1, B2, and BC are nothing similar, it indicates this pedon have further soil development. The similarity index values between red soil from Tertiary volcanic material and red soil from Quaternary volcanic material are doubtful or even nothing similar, indicating that the age of the parent material affects the chemical properties of soil.

CONCLUSION

Based on the results and discussion, that two pedons have relatively different chemical properties. Red soil from Tertiary volcanic material have relatively further developing, but rate of soil weathering in red soil from Quaternary volcanic material is higher, it is in line with the

number of wet months and geomorphological history shows red soil from Quaternary volcanic material developed from andesitic rock which is not more dense than red soil from Tertiary volcanic material. Red soil from Tertiary volcanic material has an oxic properties, while red soil from Quaternary volcanic material has not developed into oxic.

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The Correlation of Ground Water Level with Hydrophobicity and CO_2 Emissions In Peat Soil

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ABSTRACT

Decreased groundwater levels cause the disturbance of water drainage capillarity to the surface of the peat soil. Drying of peat produces hydrophobicity causing the soil to be more susceptible to erosion and fires because peat be hydrofobicity. Decreasing groundwater levels to below (-40 cm) contributes to the release of CO_2 emissions from peat. Maintaining a peat surface with moisture (hydrophilic) conditions will reduce CO_2 emissions and avoid land fires. This study aims to examine the correlation between ground water level on hydrophobicity and CO2 emissions from peat soils. This laboratory-scale research was conducted at Indonesian Swampland Agriculture Research Institute (ISARI) Banjarbaru, South Kalimantan. This research using Factorial Randomized Design with 3 replications. The first factor is the type of peat namely: (1) Topogen peat, (2) Ombrogen peat. The second factor is the simulation of the ground water level namely: (1) -100 cm, (2) -70 cm, (3) -40 cm. The results show that there is a negative correlation between the ground water level with the hydrophobicity and CO_2 emissions. Increasing of hydrophobic functional group in ground water level shown in the treatment of -100 cm from ombrogen peat by 13.18% with emissions of 137.76 tons / ha / year and from topogen peat soils by 11.11% with emissions of 63.84 tons / ha / year

Keywords: Peat, Hydrofobicity, Hydrophilic, CO2 Emission, Ground water level

Introduction

Peat ecosystems have two main functions, namely the production function as a cultivation area, and environmental functions as a conservation and restoration area. Under natural conditions with intact peatland hydrological conditions, peatlands can provide a range of environmental benefits, including water regulation, carbon storage, and biodiversity maintenance. Peat is the result of the rest of the initial reshuffle of fresh organic material constituents. Nutrient carnability causes the peat in a natural setting and has a redox value <200 mV. Changes in land use especially from peat forests to agricultural land are always accompanied by drainage, because in its natural condition, the peat is inundated. Peat will begin to degrade in a more oxidative atmosphere that can occur when ground water levels fall due to drainage drainage (Maas, 2003). Drainage and soil treatment on peat will increase the release of CO2. In recent years, Indonesia has been accused of being one of the largest contributors to CO2 emissions due to the opening and expansion of peatland use. Based on data released by BAPPENAS (2009) it is estimated that the average annual emissions from peatlands in Indonesia in 2000-2006 are about 903 million tons of CO2, including emissions that may occur from peat fires. The decrease of the groundwater level with the aim of aeration improvement will also have an impact on the increase of microorganism activity which utilizes peat as energy which can eventually increase

carbon release to air and into water. Decreased groundwater levels can lead to the disruption of drainage of water from the groundwater to the surface of the peat. In the dry season it can happen that the flow does not reach the surface of the peat layer, and causes the peat to dry and hydrophobic (dry not behind), easily leached or burned. Keeping peat in wet conditions causes peat in the dry season is not easy to burn. The depth of peat soil water depends on environmental conditions. Results from several studies indicate that there is a positive correlation between groundwater depth <40 cm with no fire on peatland. Under PP 150 of 2000 for wetlands / swamps a water-level value is set to keep peat remains hydrophilic, maintained at <25 cm altitudes. While the 71st PP of 2014 set the value of water level to keep peat remain hydrophilic maintained at <40 cm height. Capillarity flow is determined by the height of the water table, the presence of continuous capillary pore, humidity and air temperature, and its land cover. For additional peatlands the parameters as determinants of capillarity capability include organic matter content, peat uniformity, peat maturity level, non-peat organic matter content (eg timber residue), and volume weight (density).

Peatland is known to be the largest source of greenhouse gas (GHG) emissions from agriculture and forestry because it stores huge carbon stocks of 550 Gt CO2, equivalent to 75% carbon in the atmosphere or equivalent to twice the carbon savings of all forests worldwide (Joosten , 2007). Based on the Indonesian Peat atlas (Wahyunto et al., 2003, 2004, and 2007) Papua has the largest peatland, but since peat is generally thinner in Papua, its carbon stocks are only 3,623 Mega tonnes (Mt) or 3, 6 Giga ton (Gt). Peat in Sumatra has a depth of between 0.5 and more than 12 m, and its carbon reserves reach 22.3 Gt and in Kalimantan the peat carbon stock of about 11.3 Gt. For the whole of Indonesia, peat carbon reserves are estimated at 37 Gt. The 37 Gt amount does not include above ground carbon. Peat forest contains about 200 t C / ha (Rahayu et al., 2005). Of the remaining peat forests about 60% (12 million ha) contained about 1.8 to 2.4 Gt of carbon. On productive plantation land contained about 100 t C / ha. Accordingly, based on this estimate the amount of carbon contained in Indonesia's peatlands is about 40 Gt (Agus, 2004). Although there is a difference in carbon content, but for shallow peat though, its carbon stock is higher than carbon present in above ground biomass. Peat with a depth of 1 m has a carbon content of about 600 t / ha (Page et al, 2002), while peat forest biomass contains only about 200 t C / ha. For comparison, mineral soils contain only 20 to 80 tons of carbon and the primary forest on it contains about 300 t C / ha (Agus, 2004). Maintaining a moist (hydrophilic) peat surface will reduce CO2 emissions and avoid land fires. This study aims to examine the correlation between ground water level on hydrophobicity and CO2 emissions from peat soils

Methodology

This study aims to examine the correlation between ground water level on hydrophobicity and CO2 emissions from peat soils. This laboratory-scale research was conducted at Indonesian Swampland Agriculture Research Institute (ISARI) Banjarbaru, South Kalimantan. This research using Factorial Randomized Design with 3 replications. The first factor is the type of peat namely: (1) Topogen peat, (2) Ombrogen peat. The second factor is the simulation of the ground water level namely: (1) -100 cm, (2) -70 cm, (3) -40 cm.

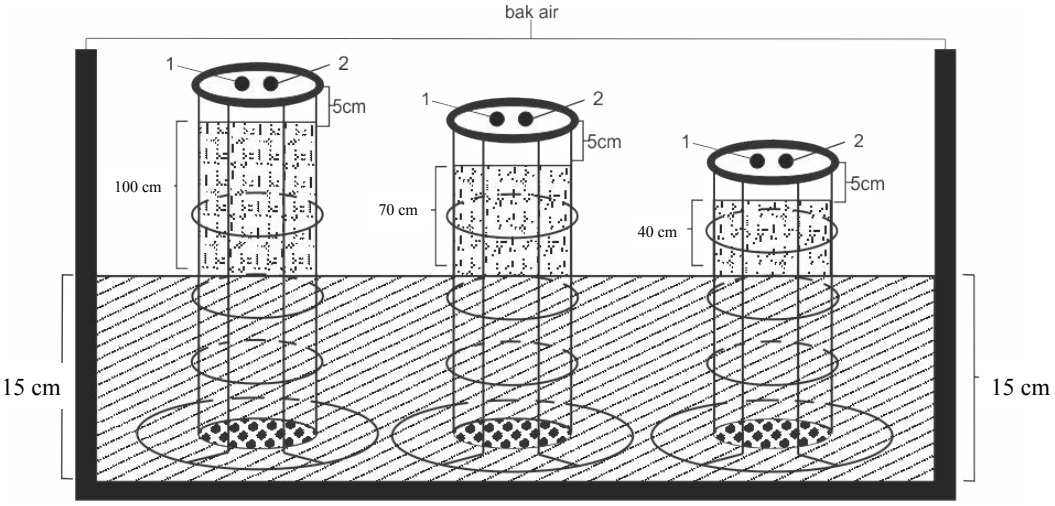

Figure 1. Design of laboratory treatment (1 = temperature capture; 2 = gas capture)

Paralon with a diameter of 8 inches made with 3 high sizes are: 120 cm, 90 cm, 60 cm. Then the paralon is supported by an iron frame and put into a water bath. Peat is inserted into each paralon up to 5 cm below the upper lip of the paralon. Tub filled with water so that the water level soaked paralon as high as 15 cm from the base of paralon. To determine the peat requirement in the capillary pipe, the first measurement of the pipe volume. The pipe volume is measured by the height of the pipe minus 5 cm (residual space at the top of the peat samples containing air for CO2 emission sampling). In addition, BV and peat water levels were measured before the peat was inserted into the capillary tube. The peat soil is then weighed and carefully inserted into the capillary tube. During the study period, the peat surface was left open (not covered), did not get water infiltration from above, so the peat evaporation relied solely on water capillarity. Observation of groundwater capillarity potential is done daily by measuring ground water content using sensor block (moisture gauge). Then also see the change of color of peat soil inside the paralon. At the time of soil moisture measurement, also measured the peat soil water level by taking the soil at the depth and mengoven peat soil with a temperature of 500C. CO2 gas sampling is done periodically every 2 weeks. For CO2 gas taking is done by using a 5 ml syringe with 5 time interval of gas taking: 3, 6, 9, 12 and 15 minutes periodic every 2 weeks. The calculation of subsequent carbon flux uses the following equation:

$$E = \frac{Bm}{Vm} \; x \; \frac{\delta \, Csp}{\delta \, t} \; x \; \frac{V}{A} \; x \; \frac{273.2}{T + 273.2}$$

Information :

E = emission of CO_2 (mg/m^2/minute)
V = chamaber volume (m^3)
A = large of area chamber (m^2)
T = temperature (^{o}C)
$\delta Csp/\delta t$ = rate of change of gas concentration (ppm/minute)
Bm = molecular weight wih standar condition
Vm = standard temperature and pressure (22.41 liter with 23^{o}K)

Results and Discussion

Soil Chemical Characteristics

Peat soil used in this study is a kind of peat ombrogen taken from Sebangau peat forest in Central Kalimantan and peat topogen taken from landasan ulin district in south Kalimantan. The dominance of vegetation on it is a fern (*Stenochalena palustris*) and plant Perepat (*Combretocorpus rotundatus*) in peat ombrogen and cassava plant in peat topogen. The results of the analysis of early peat soil chemical properties are shown below (Table 1). The maturity level of the peat used in this study is hemic in the upper layer (0-20 cm) and fibric in the lower layers (> 40 cm). The degree of soil acidity is very acidic ranging from 3.61 to 3.73. The pH value (H2O) corresponds to the natural peat pH value as shown in the peat extract from the selected peat forest of <4.0. One of the factors that determine the rate of decomposition of organic matter is the degree of acidity. Activity of microorganisms in the soil one of them is controlled by soil acidity. Tropical peat soils are generally composed of most wood pulp (lignin) and little polysaccharides (Maas, 2000). In aerobic conditions will be more intensive process of oxidation of materials that produce carboxylic groups and the higher the lignin content the lower the soil pH. Kurnain (2005) reported that the top fibric peat (0-15 cm) in selectively logged forests has a higher pH of 3.75 than that of hemic peat in the lower layers of 3.35. Soil analysis results show that ombrogen peat has a soil BV value of 0.15 g / cm3 and topogen 0.20 g / cm3. One of the factors that influence the value of soil BV is the level of maturity and moisture content. Tropical peat generally has lower BV values than nontropic peat.

Table 1. The results of Preliminary Analysis of Soil Chemical Properties

Parameter	Ombrogen Peat	Topogen Peat
pH	3.61	3.73
Ash content (%)	0.70	2.23
BV (g/cm3)	0.15	0.20
Hidrofilik component (%)	33.21	39.20
Maturnity	Hemik	Hemik
Soil Color	2.5 YR 3/4	5 YR 3/3

The basic description of hydrophobic and hydrophilic components of peat include CH, OH, C = C, C = O and CO are presented in Table 2. It is seen that the hydrophilic component of peat soil is greater than with hydrofobicity components. This is in line with that reported Utami et al (2009) that the incidence of peat causes increased hydrophobicity functional groups are hydrophobic and hydrophilic components decline. Ombrogen peat spectrograms show a strong uptake and very sharp at wave number 3300-3800 cm-1 with the percentage of the area ranges from 33.92 to 43.43%. (Figures 2a and 2b).

The absorption at wave numbers around 3425 cm-1 shows the presence of hydrogen bonding, the OH groups and free OH groups indicating a high cellulose content. Uptake of the hydrophilic nature is the area around the peak of the wave number 3340-3380 cm-1, 2600 cm-1, 1740-1710 cm-1, 1510-1560 cm-1, 1030-1080 cm-1, 900 cm-1 were identified as clusters functional from cellulose, proteins, polysaccharides and organic acid decomposition of organic material (Niemeyer et al., 1992; Cocozza et al., 2003; Gondar et al., 2005, Ibarra et al. 1996, Zaccheo et al., 2002, Grube et al . 2006). Winarna (2012) that the presence of OH groups at the highest reaching 20.60% compared sapric hemic peat. Peat maturity levels used in this study included hemic category. Krumis (2012) reported that the area of the OH group absorption decreases with an increase in the maturity of peat. It is associated with a decrease in water content in the

soil, followed by the diminution of the curve OH. Increased maturity extensive peat will lead to increased uptake of C-H group or aliphatic group and methyl and the decrease of lignin content.

Table 2. Description of basic components of hydrophobic and hydrophilic on topogen and ombrogen peat soil before incubation

Soil Component	Wave number	characterization	Peat soil	
			topogen	ombrogen
Hydrophobicity				
C-H	2850/cm	Fat, wax, lipids	0.17	0.16
CH aliphatic	2900-2940/cm	Fat, wax, lipids	0.03	0.05
Hydrophilic				
C=C	1600-1660/cm	Lignin, aromatic group	0.06	0.11
C=O	1720-1725/cm	carboxylic acid	0.00	0.00
OH	3300-3800/cm	Cellulose	0.29	0.31

Ground Water Level and Soil Hydrophobicity

Peat soils have a very large moisture retention capacity that is affected by the rate of reshuffle or peat maturity and the height of the groundwater level. The results showed that the highest increase in capillary water was shown in peat height 40 cm with peat density with water content value reaching 400.84% in ombrogen peat and 379.05% in topogenous peat (Figure 2). Kurnia et al. 2006 reported an overly deep groundwater depression affecting soil moisture distribution in all peat soil profiles. Low moisture content makes the soil susceptible to fire. Different types of peat soil affect the speed of capillary water rise, as it corresponds to the difference in density (BV) levels in the two peat soils. Capillary rise velocity increases with increasing soil BV values as they are related to the number of micro pores.

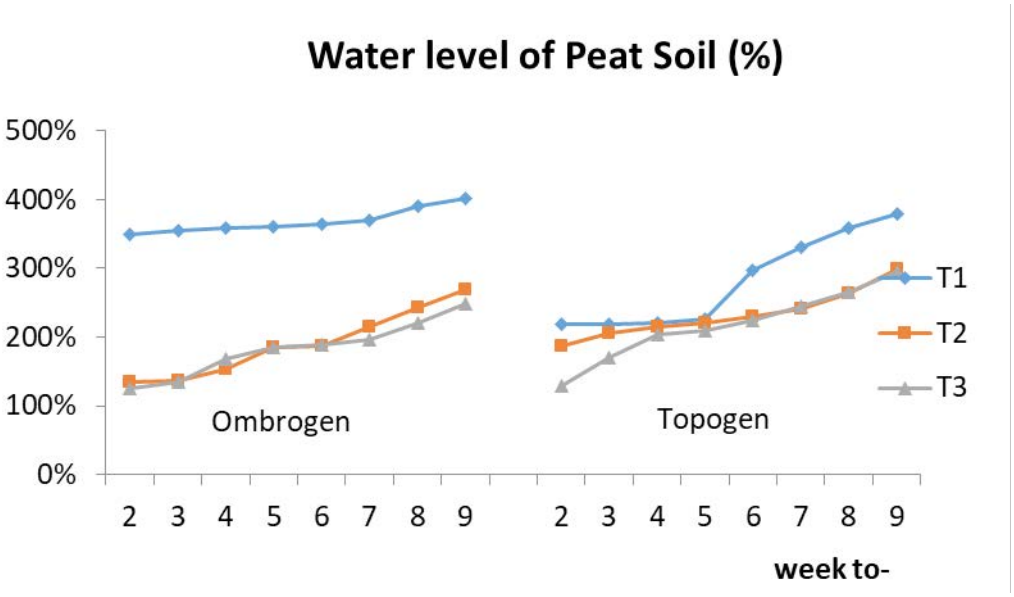

Figure 2. Ground water level with water content

The ground water level with -100 cm, increases hydrophobicity and reduce the soil wettability (Table 2). The highest increase in hydrophobicity that is the water level treatment -100 cm from ombrogen peat by 0.61% and 0.57% of the topogen peat. The lowest hydrophobicity value at

a water-height treatment of -40 cm by 0.36 in ombrogen peat and 0.39 on topogen peat. Deep water level decreases the flow of capillary water from groundwater to the surface of the peat. parameters affecting capillary water flow in peat soil are water level, organic matter content, peat type, peat maturity level, non-peat organic content, and volume weight (density).

Table 3. Description of basic components of hydrophobic and hydrophilic on topogen and ombrogen peat soil after incubation

Variable	Hydrophobicity (wave number/cm)	Hydrophilic (wave number/cm)
Ombrogen T1= -100 cm	0.54	0.56
Ombrogen T2= -70 cm	0.40	0.57
Ombrogen T3= -40 cm	0.36	0.73
Topogen T1= -100 cm	0.47	0.58
Topogen T2= -70 cm	0.42	0.64
Topogen T3= -40 cm	0.39	0.68

Potential of Co2 emission from peat soil

Potential CO2 emissions released at various water level treatments of both peat soil types are shown in Figure 3 and 4.

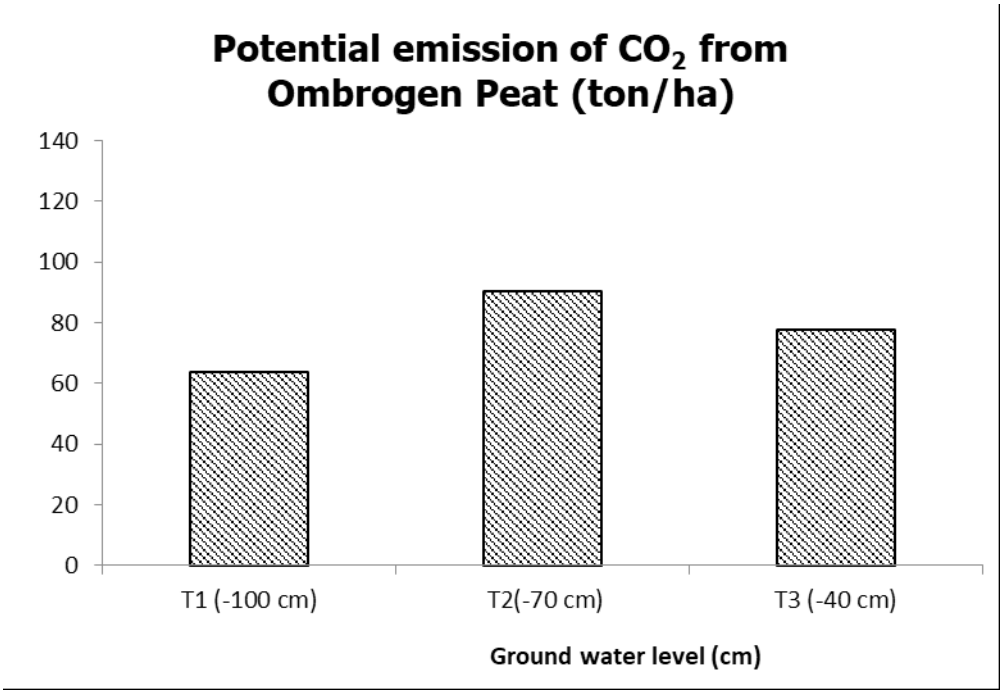

Figure 3. Potential emission of CO2 from Ombrogen Peat

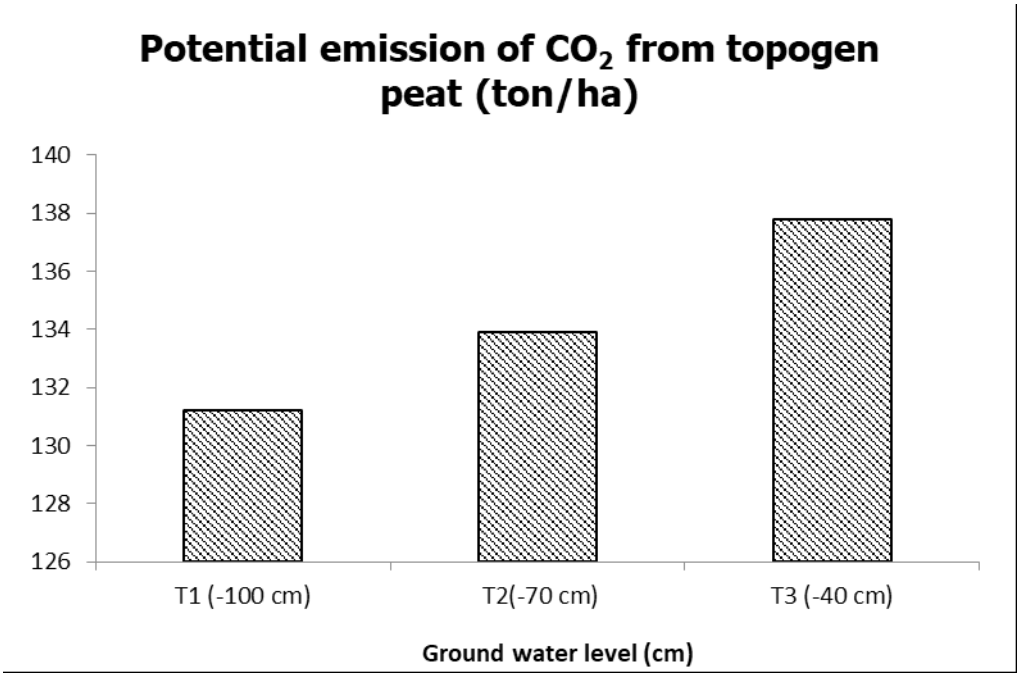

Figure 4. Potential emission of CO2 from Topogen Peat

The highest potential for CO2 emissions is released from the ground water level treatment -100 cm of peat at 137.76 ton / ha / year and the lowest is released from the ground water level treatment -40 cm of ombrogen peat at 63.84 ton / ha / year. Hooijer et al. (2006) showed that there is a linear relationship between drainage depth and annual emissions. It was found that for every 10 cm the depth of drainage will be emitted about 9.1 t CO2 / ha / year. Wösten (2001), with subsidence observational research method even estimated that for every 10 cm drainage depth CO2 emission of 13 t / ha / year. By using the first relationship (9.1 tons of CO2 emissions / ha / year for every 10 cm of drainage depth), this research results that have a drainage depth with water level -40 cm, emissions of CO_2 of 255.36 tons / ha / year at ombrogen peat and 551.04 ton / ha / year at topogen peat. And with water level -70 cm, emissions of CO_2 of 632.52 tons / ha / year at ombrogen peat and 937.44 tons / ha / year at topogen peat. While drainage or water level is made to -100 cm then emissions are generated to 775.80 ton / ha / year at ombrogen peat and 1312 ton / ha / year at topogen peat. Based on research data that the management of peat need to be careful

Conclussion

The ground water level have a negative correlation with the hydrophobicity and CO_2 emissions. Increasing of hydrophobic functional group in ground water level shown in the treatment of -100 cm from ombrogen peat by 13.18% with emissions of 137.76 tons / ha / year and from topogen peat soils by 11.11% with emissions of 63.84 tons / ha / year

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The Effective of Formula Inoculan to Improves the Quality of Wastewater In Acid Sulphate Soil

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ABSTRACT

The quality of waste water in acid sulphate soil needs to be recovered because the water drainage will bring nutrients and the result of pyrite oxidation and reduction as H^+, SO_4^{2-}, Al^{3+}, Fe^{2+} which pollute the environment. To improve water quality proficiency level can be done by microbes capable of oxidizing the metal and precipitate the metal ions on the surface of microbial cells to absorb metal ions. These bacteria get energy from the oxidation of ferrous iron, although classified as aerobic organisms that require oxygen to grow, but also can grow under anaerobic conditions. The bacteria can be used as an agent for cleaning compounds bioremediator polluters of the environment This research aims to study the effective formula to improve the quality of waste water in sulphate sulfate soil with environmentally friendly. This study conducted in greenhouse of Indonesian Swampland Agriculture Research Institute (ISARI). The design used in this study is a randomized factorial design of two factors repeated 3 replications. The water management with closed system. The first factor is the formula of inokulan namely: control (without inokulan), Inoculan A without carier, Inoculan B without carier, Inoculan A with Carier of wood charcoal husk, Inoculan A with carier of husk charcoal, Inoculan B with Carier of wood charcoal husk, Inoculan B with carier of husk charcoal, Carier of wood charcoal without inoculan, Carier of husk charcoal without inoculan. The second factor is plant of fitoremediation namely: Plant of rat purun (*Eleocharis dulcis*), Plant of sea urchins (*Eleocharis reflaxta*). The research result show that the Improved the quality of wastewater shown in the treatment of Inokulan with carier of charcoal husk with closed system of water management and eleocharis dulcis of fitoremediation plant could highest increased of water pH from 2.74 to 3.83 with redox potential until 247.90 mV and height plant of rice 44.67 cm at third periodic .

Keywords: Acid sulphate soil, Formula of Inokulan, Waterwaste quality, Eleocharis dulcis, Eleocharis reflaxta, ferro iron

Introduction

The reduction process in acid sulphate field takes place with the help of anaerobic bacteria and organic matter. In the flooded soil, organic matter is a substrate for Fe3 + reducing microbes. The results of Satawathananont et al. (1991) showed when the redox potential value decreased to -50 mV of Fe2 + concentration increased. Water has an important role in acid sulphate. The quality of water in the inlet on sulphate sour soil is influenced by the tidal dynamics of the river. Subagyo et al. (1999) reported that the washing of toxic materials went well with the presence of fresh water, both from rain and from the tide. The results of Hanhart & Ni (1993) research on

the water quality in the Mekong delta of Vietnam in drainage channels at 41 and 85 days after rice planting were worse than in the inlets indicated by pH values between 2.6-2.9, aluminum dissolved 57-148 mg. kg-1 and total acidity ranged from 11 to 26 mol L-1, whereas in the inlet pH water ranged from 6.3 to 6.8, the soluble aluminum ranged from 1.3 to 7.2 mg.kg-1 and the total acidity was 0.15-0.56 mol.L-1. This indicates that the toxic elements are washed and carried to the drainage so that the water quality of the drainage is low. There are several parameters that affect the Water Quality Criteria (KTA) for irrigation. For the water quality category is good, that is the range of pH value is 6 to 8.5, BOD concentration 20 mg / L and COD 100 mg / L. While the iron content of 10 mg / L and sulfate 7 mg / L. These parameters become an indicator of the quality of environmentally friendly waste water, so it can be reused as irrigation water.

Some aquatic plants have the ability to absorb or filter out toxic elements that exist in the water. Purun tikus (Eleocharis dulcis) is a water plant that grows predominantly in acid sulphate soil environment and can be an absorbing agent of iron through a certain mechanism because there is a symbiosis between plants and microorganisms. Thiobacillus ferrooxidans is a bacterium that has an iron oxidase, so it can metabolize metal ions, such as ferrous iron. Thiobacillus ferrooxidans can grow on oxidized soil or reduction (continuous flooding for 1 month) (Mariana et al., 2012). Based on the reaction of microorganisms to oxygen, Thiobacillus ferrooxidans bacteria are microaerophils (mandatory aerobic organisms that continue to grow well on low oxygen content). Thiobacillus ferrooxidans is able to oxidize Fe2 + to Fe3 + and oxidize reduced sulfur compounds and utilize this oxidant as its energy source. The utilization of Thiobacillus ferroxidan bacteria to improve the quality of waste water not only increases rice production but also reduces methane (CH_4) emissions from rice cultivation. This relates to the role of SO_4^{2-} as an electron acceptor so that CO2 reduction becomes CH4 inhibited. Methane thermodynamically (CH_4) is formed after most iron ferri (Fe^{3+}) is reduced to ferrous iron (Fe^{2+}). Soil microbes have a mechanism that causes changes in the mobility of metallic elements so that it becomes more difficult or easier to absorb plants. Changes in the mobility of metallic elements by microbes are grouped into two: redox changes of inorganic metals and changes in metallic form from inorganic to organic and vice versa, specifically this change is the process of methylation and demylation. Through the oxidation of metals such as iron, microbes can obtain energy. On the other hand, the reduction of metals may take place through the process of decimilation in anaerobic respiration, when microbes use metals as electron acceptor terminals (Atlas and Bartha, 1993; Santiniet et al. 2000; Stolz and Oremland, 1999; Niggemyer et al 2001; Irfan DP 2006). This research aims to study the effective formula to improve the quality of waste water in sulphate sulfate soil with environmentally friendly.

Methodology

This study conducted in greenhouse of Indonesian Swampland Agriculture Research Institute (ISARI). The design used in this study is a randomized factorial design of two factors repeated 3 replications. The water management with closed system.

The first factor is the formula of inokulan namely:

1. control (without inokulan),
2. Inoculan A without carier
3. Inoculan B without carier
4. Inoculan A with Carier of wood charcoal husk
5. Inoculan A with carier of husk charcoal
6. Inoculan B with Carier of wood charcoal husk

7. Inoculan B with carier of husk charcoal
8. Carier of wood charcoal without inoculan
9. Carier of husk charcoal without inoculan.

The second factor is plant of fitoremediation namely:

1. Plant of rat purun (*Eleocharis dulcis*)
2. Plant of sea urchins (*Eleocharis reflaxta*).

Figure 1. Desain of simulation water management for rice in acid sulphate soil

The plant of rat Purun rod and sea urchin grown first before the research is carried out until the age of two weeks because of sufficient time for plants to breed. Plants harvested and taken as phytoremediation materials to be grown in the waste channel (greenhouse simulation) possess: the same age, the leaves are fresh and high in purun mice 20-30 cm, while the piglets with the root length of 10 -15 cm. Without going through the process of drying the acid sulphate soil taken in the field at the selected site is put into a pot of 9 kg then chalked according to the optimum dosage. Basal fertilizers are given for all treatments according to recommended doses in tidal swamp land. Recommended dosage for basal fertilizer: urea: SP-36: KCl namely: 200 $kg.ha^{-1}$: 100 $kg.ha^{-1}$: 100 $kg.ha^{-1}$. Urea fertilizer is given 2 stages, ie at planting time and when the rice is 4 weeks old, SP-36 and KCl are given once at planting time. After incubation for 1x24 hours new planting of Rice seedlings with Variety of Inpara 2. Plants are maintained until vegetative maximum. Washing on rice plants is done periodically every two weeks by using river water. The leaching water comes from the rice plants collected in a tub treated with water plants as phytoremediation material. The observed of plant growth includes the height of rice plants and the number of tillers periodically every two week. The Observation of wastewater is intensively conducted every two weeks on pH, DHL and EH

Result and Discussion

Characteristics of the acid sulphate soil

Based on Soil Survey Staff (2010), this soil belongs to the Typic Sulfaquent subgroup seen from pH> 3.5, but after oxidized pH decreases to <3.5. The pyrite oxidation process produces Fe^{2+}

and SO_4^{2-} and H_2 which results in a decrease in pH. Dent (1986) reported that the pH value <2.5 or 3 after being given H_2O_2 indicates strong sulphate acidity. The pyrite oxidation process with H_2O_2 is described by Singer & Stumm (1970) in the form of the reaction equation:

$$FeS_2 + 7H_2O_2 \; Fe^{2+} + 2SO_4^{2-} + 2H^+ + 6\,H_2O \quad (R1)$$

In Table 1, the iron content of ferrous (Fe^{2+}) and sulfate content (SO_4^{2-}) was high at 269.9 ppm and 319.8 ppm. Aluminum saturation in the high root zone of 9.77%. Breemen, N.V (2002) reported that the solubility of aluminum will increase sharply in very acid conditions. The condition is also seen in the iron content of ferrous (Fe^{2+}) in the high root zone of 1005.0 $mg.kg^{-1}$. This is related to the high pyrite content. Based on characterization results, this land has a very acid sour soil acidity followed by Al saturation, pyrite content and high iron content of ferro and sulfate.

Table 1. chemical properties of acid sulphate soil

Varia-bel	pH	Org- C	N- tot	K-solu-ble	CEC	Al-soluble	H-soluble	P Bray 1 (ppm P)	Fe soluble	SO_4 soluble
		%			(cmol(+)/kg)				(ppm)	
Soil	3.56	3,67	0,25	0,35	46,9	9,77	6,08	10,59	269,9	319,8

Figure 2. Soil sampling for characteristic acid sulphate soil

Soil quality

Soil quality at simulation in greenhouse that is on paddy field and on drainage channel seen in picture below.

Figure 3. Greenhouse activities

The results showed that soil pH increased during the initial period of observation and then decreased and continued to increase until the fourth periodic to the observation. The decrease in the second periodic pH of the observations is related to the process of oxidation of the ongoing reduction in the presence of microbes in the drainage canal. And is inversely proportional to soil pH on drainage channels that continues to decline until the fourth period of observation. The highest soil pH values were seen in the treatment of inoculant A without carier and B inoculant without carier reached value of 5.02. This relates to the speed of adaptation and the effectiveness of higher inoculants because of direct contact with rooting

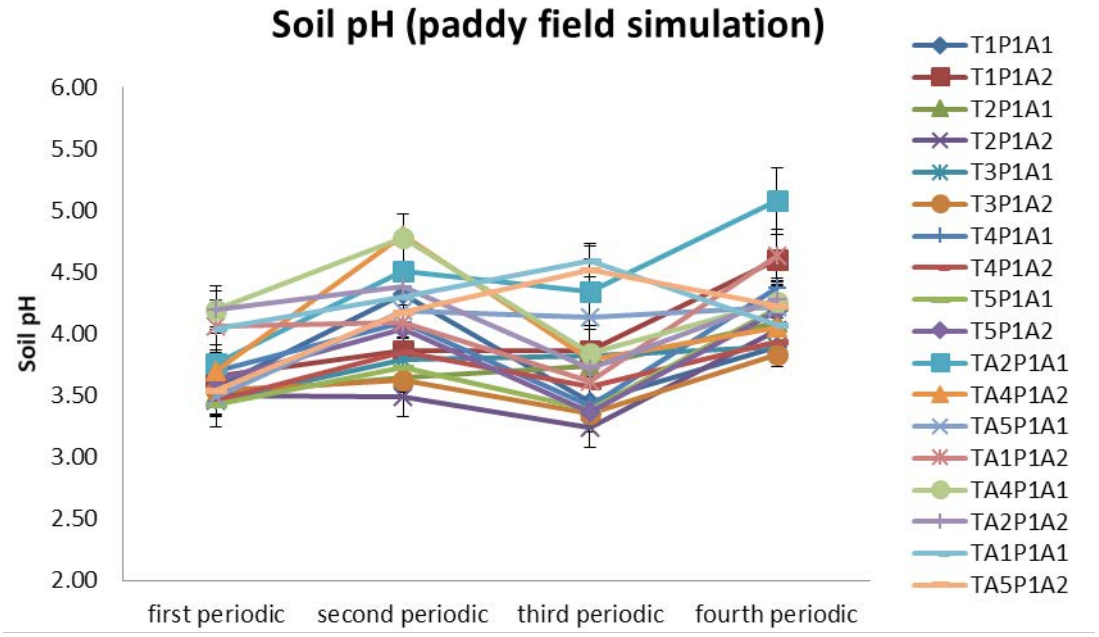

Figure 4. Soil pH periodically every two weeks after planting (paddy field simulation)

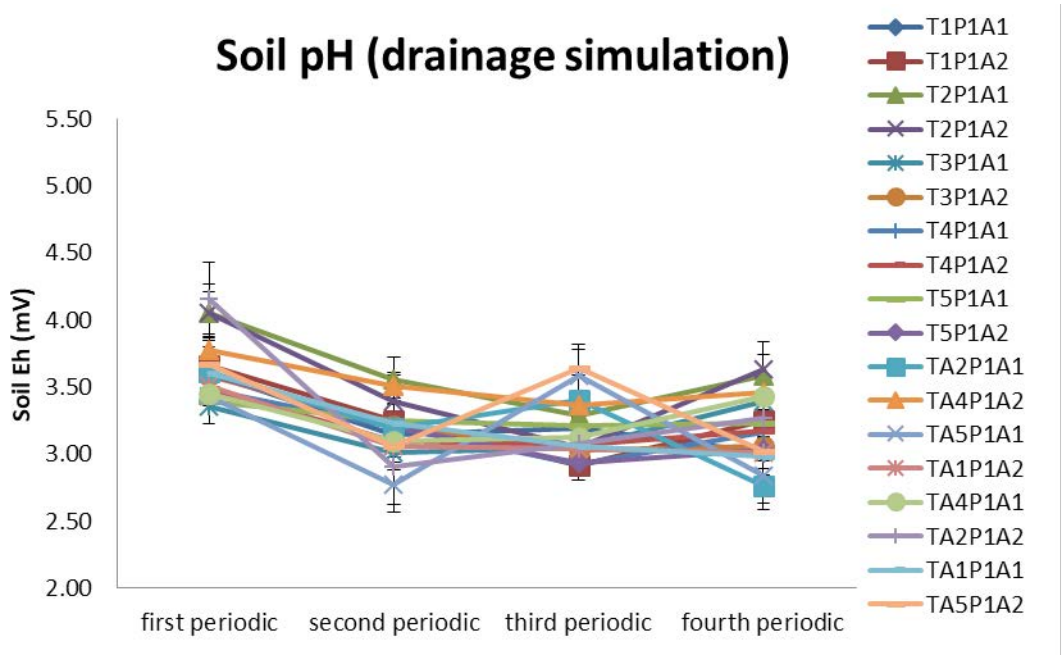

Figure 5. Soil pH periodically every two weeks after planting (drainage simulation)

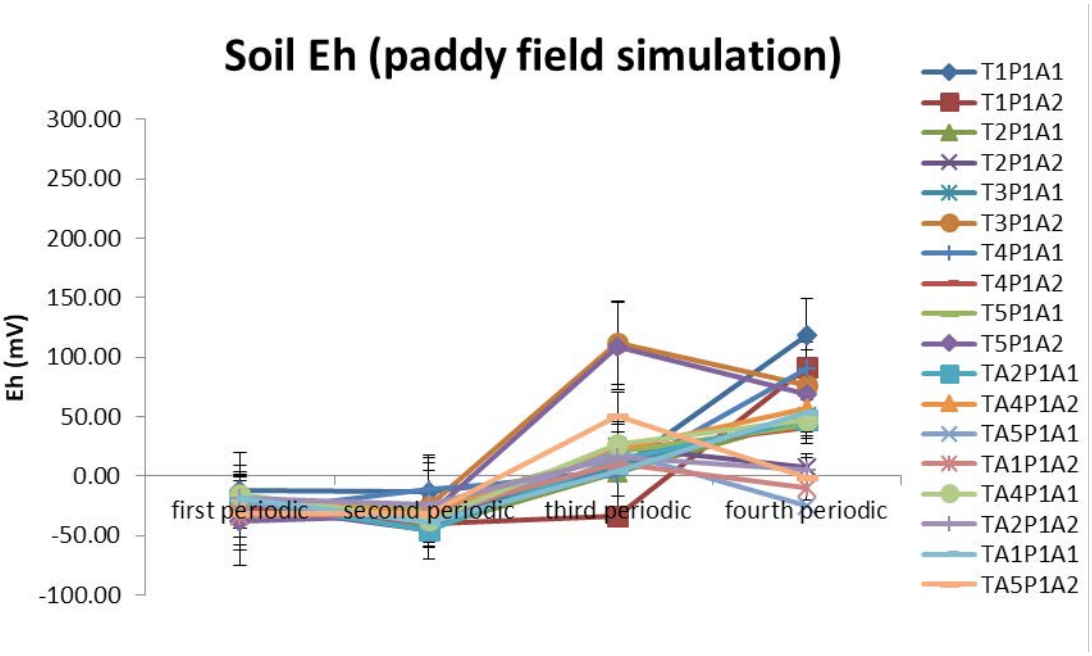

Figure 6. Soil Eh periodically every two weeks after planting (paddy field simulation)

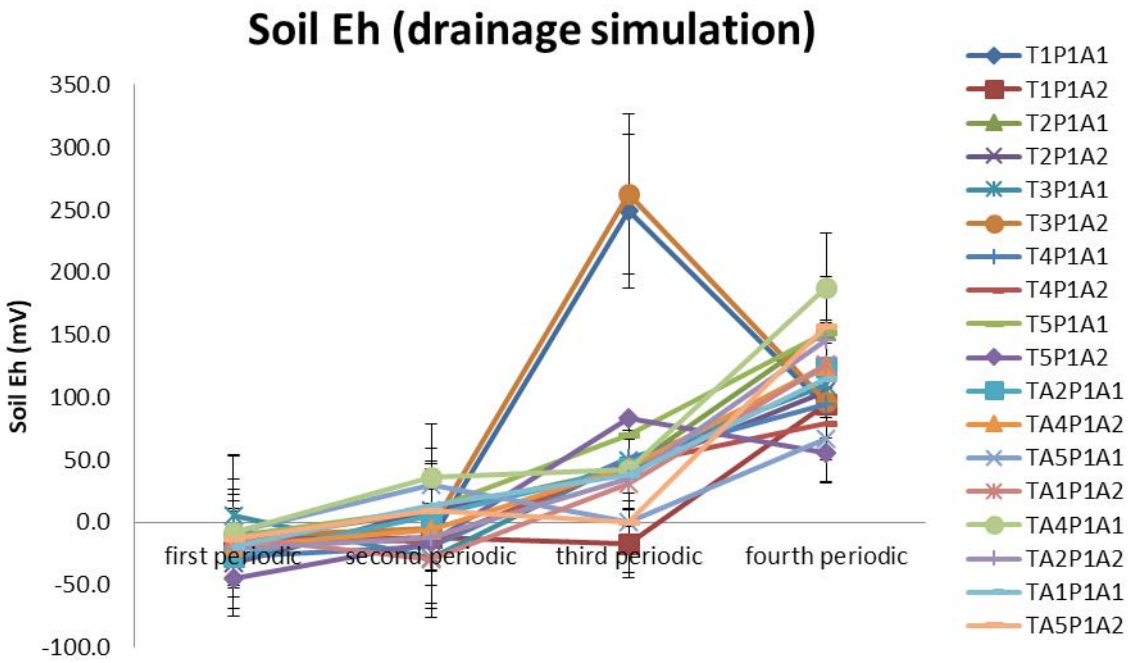

Figure 7. Soil Eh periodically every two weeks after planting (drainage simulation)

Water Waste quality

The quality of waste water in acid sulphate is affected by the biogeochemical processes occurring in the soil. Zedler (2003) reported that inputs provided to land on agricultural cultivation have a positive effect on the quality of waste water. The facts show that inoculant A with charcoal husk purers increase the pH of lindian water to a value of 5.03 with a potential redox value (Eh) of 98.8 mV and 100.9 mV (Fig 8 and Fig 9). This is related to the oxidation process which is effective in the presence of microbes. According to Atlas and Bartha (1993) bacteria that are resistant to heavy metals have survival mechanisms through bioaccumulation, bioprecipitation and bioreduction

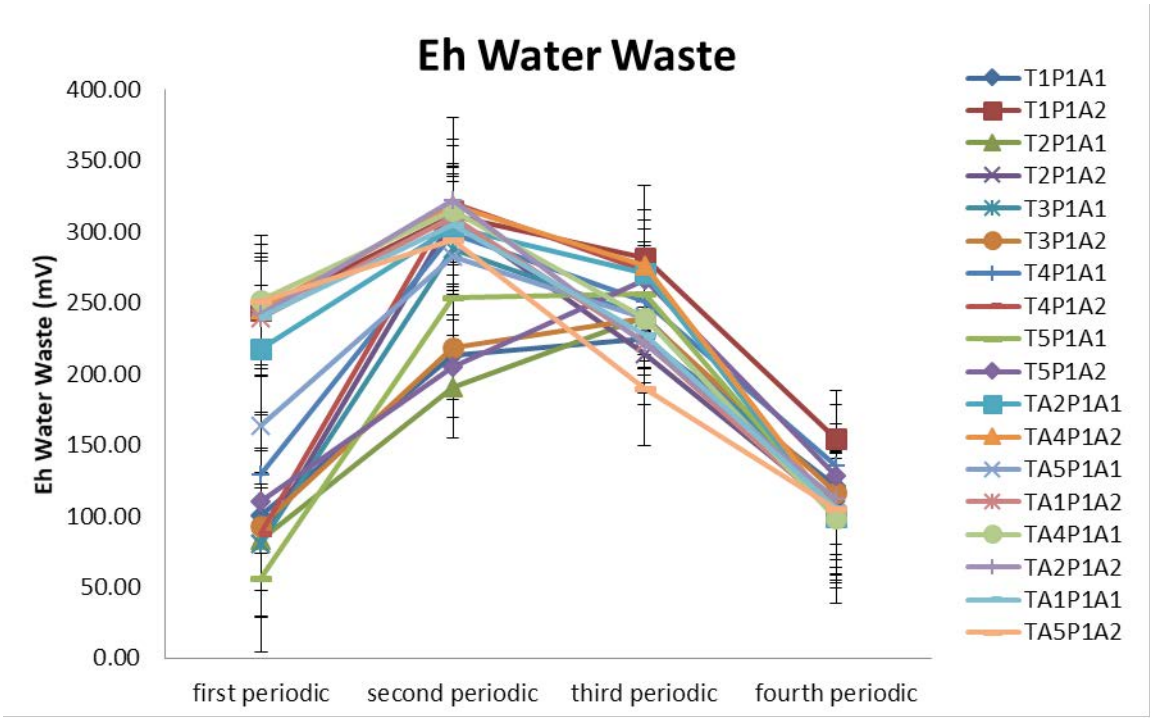

Figure 8. Eh water waste periodically every two weeks after planting

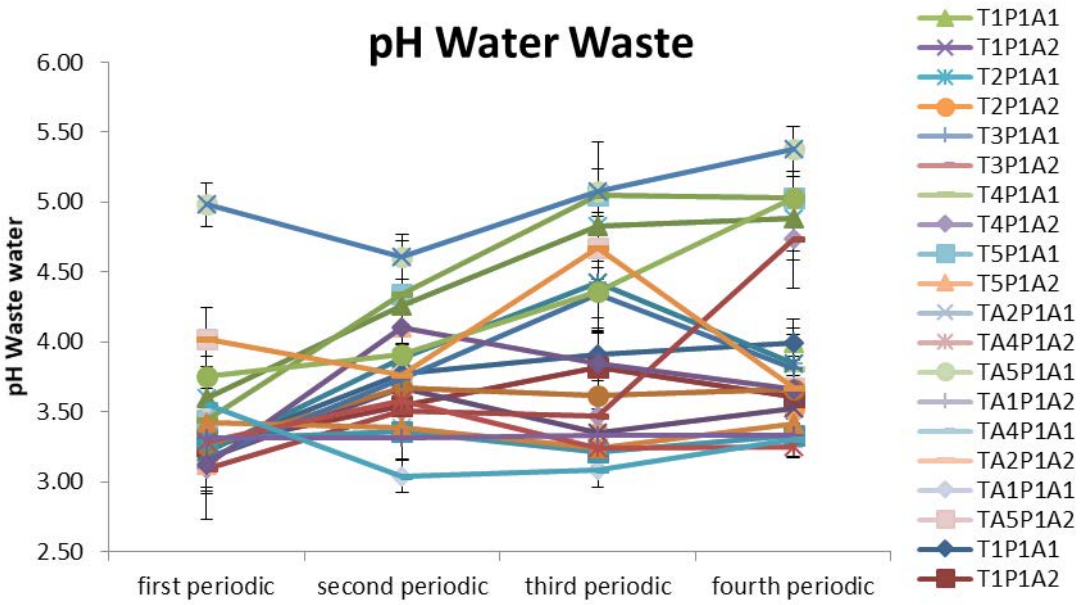

Figure 9. pH water waste periodically every two weeks after planting

The Growth of Rice

The height of the plants that drainage channel is given inokulan better than without inokulan. The highest plant height to the maximum vegetative phase seen in the treatment of inoculant B without carier reached 82 cm (Fig 12).

Figure 11. The growth of paddy in greenhouse

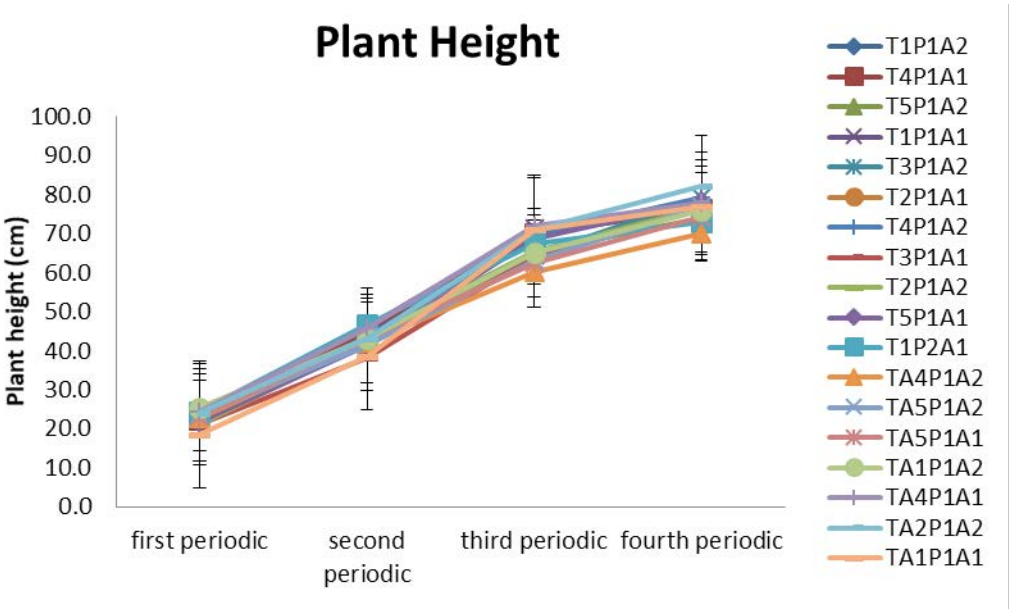

Figure 12. plant height periodically every two weeks after planting (drainage simulation)

Conclusion

The Improved the quality of wastewater shown in the treatment of Inokulan A and B with carier of wood charcoal husk with closed system of water management and eleocharis dulcis of fitoremediation plant could highest increased of water waste pH from 3.75 to 5.03 with redox potential until 98.8 mV and height plant of rice 78 cm at fourth periodic .

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ANALYSIS FINANCIAL OF SOYBEAN FARMING SYSTEM IN PLAYEN GUNUNGKIDUL DISTRICT

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ABSTRACT

Demand for soybean continues to increase, both for food and industry, so it is necessary to study soybean farming economics. The study of soybean farming is focused on farming system and economic analysis of farming. The study was conducted in March 2014 targeting Famers group located at Playen subdistrict which is one of soybean production center in Gunung kidul district. The respondents in the study were purposively determined by all farmers in the farmer group that planted soybean. The aimed of study is to determined the level of profit and feasible cultivated. The results showed that the average income per soybean farmer was Rp 1.608.000, -; the average cost is Rp 586,000 and the average income is Rp 1,022,000. R / C ratio and B / C ratio obtained by 2.74 and 1.74. Break Even Point (BEP) production is 73.25 kg, while BEP price is Rp.2,915.40/kg.This means the effort made feasible cultivated.

Keywords: Financial analysis, farming system, Soybean

INTRODUCTION

The aimed of development of food crops to meet the needs of domestic or self-supporting food, as well as improve the nutrition of the community through the provision of carbohydrates, proteins, fats and vitamins. One of agricultural commodities that plays an important role in the supply of protein, fats, vitamins and vegetable minerals is soybean (Suryana, 2003). Soy is a source of vegetable protein with 39% protein content and relatively cheap price that can be reached by wider community.

The highest soybean producer in Yogyakarta Special Region is Gunungkidul District, next Bantul and Sleman. Soybean variety cultivated in Gunungkidul is Grobogan variety.

The cultivation of soybean in Gunungkidul District has not been matched by the change of production improvement orientation toward increasing of farmer's income. In order to realize these changes, a proper farming system is needed, improving the knowledge and skills of farmers in identifying potentials, preparing farming plans, overcoming problems, making decisions and applying technology to make farming operations efficient, high productivity and sustainable. Some problems that happened in Gunungkidul District are difficulties to get the seeds in the growing season, fluctuating commodity prices, and the policy has not supported the development of soybean.

Considering that soybean is a strategic food commodity, it is very risky if it depends on import. Dependence on food imports, especially soy, can threaten food security. The instability of soybean prices from 2010 to the present time makes manufacturers tofu and tempeh confusion.

The abnormal price increase as happened in early 2011 has troubled the tofu and tempeh producers as the biggest consumers of soybeans. The increase of soybean price from Rp 5,000 to Rp. 7000 per kg at the beginning of February 2011 makes the producers tofu tempeh difficulty in production.

To maintain the stability of soybean prices, the government is trying to reduce imports. The government has declared food self-sufficiency such as soybean. To achieve self-sufficiency of soybeans, the government takes two main steps: intensification (productivity improvement, fertilizer use, farmer guidance, capital provision and aid of farming equipment) and extensification (planted area expansion). If you want to boost the production of this commodity, it is appropriate that the government should provide incentives for farmers. Farmers should be guaranteed that by planting soybean farmers will not lose. The soybean cultivation business should be able to generate the passion of the farmers, because otherwise the soybean will only be used as the second plant (Cahyadi, W. 2009).

According to Suratiyah, Ken. 2011 The most effective incentive to excite farmers to plant soybeans is price. The price of agricultural produce is a factor for producers and one of the guidelines for determining the type of plant to be planted and the area of planting. Some studies show that it is difficult to expect an increase in the area of soybean from farmers. Low productivity and unfavorable prices are increasingly making farmers reluctant to plant soybeans.

The only hope to increase the extent of planting (extensification) of soybean is to open a new planting area that is permanent by the government. To cover the national soybean needs by considering the low level of soybean productivity, it will take hundreds of thousands of Ha of new land to plant soybean. As an illustration that the extent of soybean cultivation in the Special Region of Yogyakarta increasingly declined. A decrease of harvest area that reaches 50% is a serious problem.

Many suspect that the decline in the area of this harvest is the impact of uncertain climatic conditions and prices that are no longer attractive to farmers. Looking at prices that fluctuate and climate change that does not hit many sides to sustain the success of soybean self-sufficiency. Yet soybean plants have the potential and a good prospect to cultivate, because the plant is relatively easy to cultivate. In addition, demand for soybean production continues to increase for both food and industrial needs (Sri Nuryanti, Reni Kustiari, 2008).

The efforts during this time that can be taken to encourage increased soybean production and at the same time increase the income of soybean farming is with the development program of soybean agribusiness by intensifying in the production process, post-harvest handling and marketing. This effort can be done through the commercial management of soybean farming.

METHODOLOGY

Research was conducted in March 2014 with target is famers group located in District Playen which is one of production center of soybean in Gunungkidul District. Respondents in this study were determined purposely, ie all farmers in farmer groups that plant soybeans.

Data collected were primary data obtained directly from soybean farmers through interviews with structured questionnaires (Singarimbun and Effendi, 1984). Secondary data is obtained from relevant agencies and agencies as well as various literature and information related to this research. Qualitative data analysis was done by descriptive approach, that was describing the process of implementation of soybean farming. Based on the data obtained, there will be

business analysis which includes input-output, R / C ratio, B / C ratio, Break Even Point (BEP).

RESULTS AND DISCUSSION

To support food self-sufficiency, it is necessary to increase the production of soybean in a sustainable manner by paying attention to the welfare of farmers. Farmer Group in Playen Sub-district has been one of the groups that has been able to help to fulfill food self-sufficiency for Gunungkidul District. The number of members of farmer groups is 40 people while the number of farmers who plant soybean there are 30 people. Average land area per farmer is 1,100 m2.

Soybean farming in the research location has been done with agribusiness system. Conceptually, the system of soybean agribusiness is the whole activities that are interrelated from the making and the procurement of agricultural production facilities to the marketing, both farming and processed products. According to Gumbira-Sa'id and Intan (2001) the agribusiness system consists of procurement and distribution subsystems of production facilities, primary production subsystems, processing subsystems, marketing subsystems and supporting institutions.

The relationship between one subsystem with other subsystems is very close and important, so that interference in one of the subsystems can cause the whole system is disturbed. The role of supporting institutions in the agribusiness system is very important in helping to strengthen the agribusiness system. These supporting institutions are mostly outside the agricultural sector such as land, puppets, research and others.

Soybean agribusiness includes the activities of each inter-related agribusiness subsystem. Activity subsystem manufacture, procurement and distribution of agricultural production facilities. In this subsystem in the area of research service provision of production facilities in general smoothly. Means of production needed in this soybean agribusiness include soybean seeds, fertilizers, pesticides, agricultural tools and others. Soybean seeds used are superior soybean seeds produced by the government, including varieties of wilis and lokon, the price of soybean seed is still quite expensive, therefore some farmers are still there who use local seeds from the harvest. Fertilizers, pesticides and agricultural tools are produced by companies except organic fertilizers. This means of agricultural production is obtained by farmers with the purchase system or with assistance in the form of partnership

Production subsystems in soybean farming in the research area include choosing soybean seeds, land preparation, planting, crop and harvest maintenance. In soybean seed agribusiness used by farmers in general using superior seeds, soybean planting preparation activities can be done in three ways Without Soil Exercise (TOT) practiced in the former rice harvesting land, the minimum soil treatment is practiced on sandy soils or soil- light soil and maximum soil treatment is practiced on heavier soils such as latosoldan grumosol soils. Soil processing is usually done at the beginning of the dry season is estimated 2 weeks before planting.

Soybean cultivation activities are generally carried out in the dry season, but there are enough irrigation conditions, though sometimes soybean cultivation is also done during the rainy season and usually has many obstacles such as being too saturated by water, susceptible to plant diseases and the production tends to decrease. Plant maintenance activities carried out by soybean farmers include embroidery that is replacing seeds that do not grow, die or grow abnormally. The irrigation activity is to provide sufficient water for the soybean soil, especially at the time of vegetative growth. Thinning plants is done by removing soybean plants that are not needed, so that in the planting hole only two plants left.

Weeding activity carried out by disposing of weeds or weeds as well as piling the base of the

stem of the plant. Fertilization activity in soybean crops is done when the soil is less fertile or plant growth is less normal with recommended fertilizer dose (Mulyadi, 2007; Adisarwanto, T. 2005). In small farmers this fertilization activity is not fully done so because of limited business capital owned by farmers.

Pest and disease control activities of soybean crops are conducted by integrated pest and disease control system by combining physical and mechanical control, technical culture, biological and chemical simultaneously or simultaneously to suppress pest population and plant diseases or crop damage level below the economic threshold . The control of pests and diseases of soybean crop is done with two approaches that is poreventif preventive action of pest and disease and curative diseases namely pest eradication and plant diseases (eradikatif) this is done if the pest and disease attacks have caused damage to reach the economic threshold. Soybean cropping activities are usually done manually by cutting the soybean stems using a sickle.

Activity on soybean yield processing subsystem in research area at farmer level generally only until threshing and drying. For the advanced level of processing done at the merchant or company level, so a large added value is usually located at this level.

The result of soybean in research area besides consumed directly as food is also used as industrial raw material like food industry, beverage, feed and other industries. The activities of soybean marketing subsystems through diverse soybean marketing patterns, usually soybean marketing is done directly or through collecting traders.

Institutional supporters of soybean agribusiness in the research area in general are institutions at the level of farmers and institutions outside the farmers. Institutions at the farm level consist of farmer groups and cooperatives, the role of this institution is mainly in the production system or farming and distribution of agricultural production facilities. Institutions outside the farmers such as government, financial institutions, companies and others, the role of this institution, among others, assist in the distribution of agricultural production facilities, capital, coaching, marketing and others. At the location of the research, the farmers have utilized the supporting institutions of soybean agribusiness in general which is done with the trading system and cooperation involving the institutions. To support food self-sufficiency, it is necessary to increase the production of soybean in a sustainable manner with attention to the welfare of farmers.

a. Farm Costs

The number of respondents 30 people, the average planting area of soybean per farmer is 1,100 m2.

Table 1. Average Variable Cost of Soybean Farming

Type of cost	amount (Rp)
Grobogan seeds 8 kg @ Rp 9.375,-	75.000
Phonska NPK fertilizer12 kg @ Rp 1.500	18.000
Atabron (Pestisida) 5.000 cc	17.000
Total of cost	110.000

Source: Primary Data Analysis (2014)

According to the farm cost structure, the largest expenditure of the cost is used for seed (68.18%). For fertilizer cost (16.36%) and pesticide (15.45%).

Table 2. Average Fixed Cost of Soybean Farming

Type of cost	Amount (Rp)
Labor	390.000
Grounding, planting, weeding, fertilizer, spraying, harvesting, threshing cost	
depreciation	86.000
Total fixed cost	476.000

Source: Primary Data Analysis (2014)

According to the farm cost structure, the largest expenditure of the cost is used for labor (81.93%). In the farming management, soybean farmers in Gunungkidul District mostly use labor in the family so as to save farm cost.

b. Farm income

The average production of soy per farmer per planting season is 201 kg. While the average selling price per farmer is Rp 8,000 so the average acceptance of soybean farmers is Rp 1.608.000.

Table 3. Farm Income

Dscription	Amount
Production (kg)	201
Selling price (Rp)	8.000
Revenue (Rp)	1.608.000

Source: Primary Data Analysis (2014

c. Farming income

Revenue is the difference between farm income and farm costs. The average income of soybean farming per farmer is Rp 1,022,000

Table 4. Farm income

Description	Amount
Income	1.608.000
Cost	586.000
Revenue/Profit	1.022.000

Source: Primary Data Analysis (2014)

Production Cost and Soybean Farming Income

Production cost of soybean farming consist of fixed cost and variable cost, while the income of soybean farming is the difference of total recipients and total production cost. The revenue

of soybean farming is the value of all soybean production based on the prevailing price at the time of the study. The average production of soybean farming is 201 kg / 1,100 m2, the prevailing product price is Rp 8.000 / kg. Recapitulation of soybean farming analysis results in one growing season per 1,100 m2 as in Table 5.

Table 5. Recapitulation of Soybean Farming Analysis Result in Gunungkidul District.

No.	Description	Amount(Rp)
1.	Fixed cost	476.000
2.	Variable cost	110.000
3.	Total cost production	586.000
4.	Revenue	1.608.000
5.	Revenue/profit	1.022.000
6.	R/C = 2.74	
7.	B/C = 1.74	
8.	BEP production = 73.25 kg.	
9.	BEP price= Rp.2,915.40/kg	

Based on Table 5 showed that soybean farming is still profitable with net income of Rp 1,022,000 / 1,100 m2 / planting season. The scale of soybean cultivation is the smallest amount of production or land area that farmers have to strive for in soybean farming so that the farming does not suffer losses.

The ratio between the gross receipts and the cost (R / C) is 2.74. While the ratio between profit / income and cost (B / C) obtained figure 1.74. Break Even Point (BEP), based on the calculation shows that the break even price is Rp.2,915.40/kg Rp.2,915.40/kg; while the breakeven point of production is 73.25 kg, while soybean production in 1 growing season can produce as much as 201 kg. This means that the efforts undertaken deserve to be cultivated.

CONCLUSIONS AND RECOMMENDATIONS

- Average income per soybean farmer is Rp 1,608,000; the average cost is Rp 586,000 and the average income is Rp 1,022,000. R / C ratio and B / C ratio obtained by 2.74 and 1.74. Breakeven Point or BEP price Rp 2.915,40/kg; while the BEP production is 73.25 kg, this means the effort made feasible cultivated.
- Soybean farming is an attractive business opportunity to be done both in terms of technical cultivation is relatively easy to do, and market opportunities are still very wide, soybean farming is still profitable so that soybean farming is very feasible to be developed.

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FREQUENCY AND OLIGO-CHITOSAN CONCENTRATION ON GROWTH AND RICE YIELDS

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ABSTRACT

The research methods was arranged with split plot design consisting of two factors. The main plot was the frequency of oligochytosan comprising of three levels, F1: application of oligochitosan 3 times during planting period, given at age 20 dap (days after planting), 40 dap and 60 dap. F2: application of oligochitosan 4 times during planting period, given at age 20 dap, 33 dap, 46 dap, 60 dap. F3: application of oligochitosan 5 times during planting period, given at age 20 dap, 30 dap, 40 dap, 50 dap, 60 dap. Sub plot is the concentration of oligochitosan, K1: 50 ppm = 5 ml/5l/16m2, K2: 100 ppm = 10 ml/5l/16m2, K3: 150 ppm = 15 ml/5l/16m2. The parameters observed were the average of plant growth components at 63 dap (day after planting), such as plant height, number of leafs, number of tillers, dry weight of plant. Component of rice yield, such as the number of panicles per hill, weight of 1000 seeds, weight of grain per hill, weight of grain, and weight of grain per hectare (ton).

Treatment frequencies showed significant differences in leaf number parameters, number of tillers, dry weight of plants, number of panicles per hill, weight of grain per hill and weight of grain per hectare. The parameterof plant height was not significantly different. Consentration oligochitosan treatment had no significant effect to all parameters except on dry weight plant.

Keywords: rice, oligochitosan, frequency and concentration

INTRODUCTION

The fulfillment of National rice needs sourced from sustainable domestic production had been declared by the President of the Republic of Indonesia. For this purpose, the National rice production target was only 71.801.000 ton / ha in 2015 and 67,102,000 ton / ha in 2014, so that the production rate would increased 6.64 percent in 2014-2015. The rate of increase in production was still not balanced with the rate of population growth reaching 1.49 percent per year. To fulfill the needs of rice should import as much as 1.5 million tons in 2015 (BPS, 2015).

Rice is a major component in the National food security system and determines National stability. The application of green revolution technology to rice crops is oriented towards increasing production, by relying on fertilizers and pesticides continuously resulting in decreases in soil productivity, one of which occurs nutrient unbalance (Padmini et al., 2013). Nutrient unbalance in the soil, causing low fertilizer efficiency and low microbiological population of the soil and the vulnerability of plants to pest attack. Subsequent impacts production slant (leveling off). Limited fertilizer subsidies and high fertilizer prices are encouraged to further improve the efficiency of farming systems, especially fertilizer efficiency in wetland rice. Therefore, the effort to increase the production is very interesting to be done fertilizer technique improvement,

that is substitution a part of inorganic fertilizer with application of Oligochitosan.

Oligochitosan is also known as chitosan oligomers which are obtained from the partial degradation of chitosan. Chitosan is the N-deacetylated derivative o f chitin which is a natural polysaccharide that occurs mainly in invertebrates, fungi and yeasts (Knaul et al., 1998). Chitosan (ˈkaɪtəsæn) is a linear polysaccharide composed of randomly distributed β-(1-4)-linked D-glucosamine (deacetylated unit) and N-acetyl-D-glucosamine (acetylated unit) (Darmawan et al. 2007; Ramadhan et al., 2010; Kim et al., 2011). Chitosan and its derivatives have shown various functional properties and made them possible to be used in many fields including, food cosmetics, bi,medicine, agriculture, environmental protection, and wastewater management (Deepmala et al., 2014). Oligochitosan was used with different molecular weight and different concentrations. Smaller molecular weight of oligochitosan with smaller concentration showed better result than bigger molecular weight of oligochitosan as a plant growth promoter. This study also showed that conventional growth promoter can be replaced with oligochitosan as it is more effective as plant growth promoter as well as more environmental friendly. In agriculture, chitosan is used primarily as a natural seed treatment and plant growth enhancer, and as a ecologically friendly bio pesticide substance that boosts the innate ability of plants to defend them selfes against fungal infections. The natural bio control active ingredients, chitin/chitosan, are found in the shells of crustaceans, such as lobsters, crabs, and shrimp, and many other organisms, including insects and fungi. It is one of the most abundant biodegradable materials in the world. Degraded molecules of chitin/chitosan exist in soil and water. Chitosan applications for plants and crops are regulated by the EPA, and the USDA National Organic Program regulates its use on organic certified farms and crops. (https://www.thcfarmer.com/ community/ threads/plant-hormones-and-growth-regulators.29938/page-2). The natural biocontrol ability of chitosan should not be confused with the effects of fertilizers or pesticides upon plants or the environment. Chitosan active biopesticides represent a new tier of cost effective biological control of crops for agriculture and horticulture.

Researcher indicated increased in grain yields of rice (10.29%), spring maize (10.93%), soybean (16.74%), winter wheat (28.81%) and vegetables (12.34-19.76%) after applying fertilizer together with nano-materials. As reported by Liu *et al*. (2009), Nano-materials could promote germination and rooting early for rice seeds and seedings and the growth of rice at tillering stage was affected obviously by nano-composites. They indicated that the grain yield of rice and nitrogen agronomic utilization efficiency was increased after applying nano-carbon-incorporated SRF. Chitosan possesses a high growth stimulating efficacy combined with antifungal and antibacterial activity of systemic character. **The aim of this research was to know the interaction of frequency treatment and olio-chitosan concentration, to get the best frequency and concentration on growth and yield of Diah Suci rice variety**.

RESEARCH METHODS

The research was conducted in Sentono village, Karangdowo subdistrict, Klaten Regency of Central Java Province. The study was prepared based on a separate plot design consisting of two factors. The main plot was the frequency of oligochytosan comprising of three levels, F1: application of oligochitosan 3 times during planting period, given at age 20 dap (days after planting), 40 dap and 60 dap. F2: application of oligochitosan 4 times during planting period, given at age 20 dap, 33 dap, 46 dap, 60 dap. F3: application of oligochitosan 5 times during planting period, given at age 20 dap, 30 dap, 40 dap, 50 dap, 60 dap. Sub plot is the concentration of oligochitosan, K1: 50 ppm = 5 ml/5l/16m2, K2: 100 ppm = 10 ml/5l/16m2, K3: 150 ppm = 15 ml/5l/16m2. The parameters observed were the average of plant growth components at 63

dap (day after planting), such as plant height, number of leafs, number of tillers, dry weight of plant. Component of rice yield, such as the number of panicles per hill, weight of 1000 seeds, weight of grain per hill, weight of grain, and weight of grain per hectare (ton). Analysis of varians at 5% level was used to observe the effect between treatments. Further analysis was done by using Duncan's Multiple Range Test at 5% level.

RESEARCH RESULTS

There were no interaction between treatment of frequency and concentration of oligochitosan to the all growth component. Frequency of oligochitosan had significant effect on the number of leaves, number of tillers and weight of stover, but did not significantly affect height plant. Concentration of oligochitosan treatment had no significant effect on all parameters expected weight of plant.

Table 1. Effect of frequency and concentration of oligochitosan to the all growth component

TREATMENTS		Components of growth			
		Plant height (cm)	Number of leaves	Number of tillers	Dry weight of plant (g)
Application of oligochitosan	Spraying 3 times	111,5 a	46,3 b	15,7 b	24.0 b
	Spraying 4 times	113,3 a	47,9 ab	14,9 b	22,2 b
	Spraying 5 times	119,9 a	67,5 a	20,5 a	30,2 a
Concentration of oligochitosan	Consentration of 50 ppm	112.3 p	54,4 p	15,3 p	22,7 q
	Consentration of 100 ppm	109,6 p	59,6 p	15,7 p	28,3 p
	Consentration of 150 ppm	114,7 p	63,9 p	17,6 p	29,4 p
Interaction		-	-		-

Note: Numbers of each column followed by the same letter show no significant difference in Duncan't at the level of 5%. (-) There is no interaction between the two factors

From table 1, was indicated that frequency of the five- olygochitosan spraying produced the number of leaves, number of tillers, and weight of plant better than the three and four times. Concentrations of oligochitosan 100 ppm and 150 ppm resulted in significantly greater dry weight than the concentration of 50 ppm oligochitosan.

There were no interaction between treatment of oligochitosan application and Concentration of oligochitosan to the all yield component. Oligochitosan application treatment had significant effect on the number of panicle, number of grain per hill and weight of grain per hectare. Concentration of oligochitosan treatment had no significant effect on all parameters

Table 2. Effect of frequency and concentration of oligochitosan to the all yield component

TREATMENTS		Yield components				
		Number of panicle	length of panicle (cm)	weight of grain per hill	weight of grain per ha (tons)	weight of grain (g)
Application of oligochitosan	Spraying 3 times	12,7 b	26,1 a	32,8 b	5,33 b	26.56 a
	Spraying 4 times	11,0 b	26,4 a	30,1 b	5,36 b	26.35 a
	Spraying 5 times	17,8 a	26,7 a	42,3 a	5,67 a	26.20 a
Concentration of oligochitosan	Consentration of 50 ppm	13,0 p	25,0 p	38,8 p	5,63 p	27.00 a
	Consentration of 100 ppm	13,0 p	26,4 p	38,6 p	5,92 p	26.45 a
	Consentration of 150 ppm	13,6 p	26,3 p	37,9 p	5,70 p	26.65 a
Interaction			-		-	

Note: Numbers of each column followed by the same letter show no significant difference in Duncan't at the level of 5%. (-) There is no interaction between the two factors

From table 2, was indicated that frequency of the five-olygochitosan spraying produced the number of panicle, weight of grain per hill, and weight of grain per hectare greater than the three and four times.

DISCUSSION

The result of the analysis using 5% level of verbalization, Duncan Multiple Range Test (DMRT) showed no interaction between frequency treatment and concentration oligochitosan in all parameters. Treatment frequencies showed significant differences in leaf number parameters, number of tillers, dry weight of plants, number of panicles per hill, weight of grain per hill and weight of grain per hectare. The parameters of plant height were not significantly different. Consentration oligochitosan treatment had no significant effect to all parameters except on dry weight plant.

The five-oligochitosan application is capable of producing better growth and yield compared to three and four times. The frequency of giving more means the plants get more oligochitosan. Chitosan increases photosynthesis, promotes and enhances plant growth, stimulates nutrient uptake, increases germination and sprouting, and boosts plant vigor. Chitosan stimulates the plants hormones responsible for root formation, stem growth, fruit formation and development (Deepmala et al., 2014). Chitosan effects on plant response were first characterized as an elicitor. Chitosan was also involved in the stomatal response where stomatal opening provides in the stomatal response where stomatal opening provides access to inner leaf tissue for plant pathogens. Chitosan increase respiration rate of germination seeds, root vigor, chlorophyll, protein content (Darmawan , 2015). Oligochitosan also contains phytohormone (auksin, cytokinin, giberelin). The hormones affects number of leaves. One of the functions of gibberellins affects the elongation and cell division that stimulates the growth of the leaves. Cytokines can delay the leaf's abortion by increasing the transport of the food substance to the organ.

Oligochitosan was also able to increase the photosynthesis of rice plants. According to (Zen et al. 2000), that if the results of photosynthate were more widely used for growth and

development of rice plants in the vegetative period, will affect the number of panicles that will be formed. Photosynthesis increases better cell differentiation resulting in increased number of leaves and number of tillers. The growth of the number of leaves per hill influenced by the nutrient content in oligochitosan, thus affecting vegetative growth of plants. Leaf number growth correlated with number of tillers. The availability of sufficient nutrients during plant growth will increase photosynthesis activities so that cell differentiation will be better and lead to increased number of tillers. The difference in the number of tillers per clump of rice is thought to be due to differences in the phyllochrons phases of each plant. According to (Barkelaar, 2001) phyllochrons is the period of time between the appearance of a single phytomer (a stem cell, a leaf and a root emerging from the based of the plant). The number of panicles per hill is correlated with the ability of the plant to produce the seedlings and the ability to maintain the various physiological functions of the plant. The more tillers were formed, the chances of the tillers formation that produce panicle was better. At the time the plant begins to bloom, almost all photosynthetic results were allocated to the plant's generative part. In addition, there was mobilization of carbohydrates, proteins and minerals in the leaves, stems and roots moved to panicles. Chitosan has an effect on agriculture, for example acting as a carbon source for microbes in the soil, accelerating the process of transforming organic compounds into inorganic compounds and helping root systems in plants to absorb more nutrients from the soil.

During seed filling, most of the assimilates formed in leaves and stems are used to improve seed formation (Gardner, 1991). The result of weight parameter analysis of 1000 seeds showed no significant difference because more determined by varieties used. Rafarahahly (2002), showed that the weight of 1000 seeds of rice was usually a stable feature of a variety, the grain size is also determined by the caryopsis size, consisting of lemma and palea. The development of caryopsis in the filling of the grains, depending on the assimilate yield that can be stored (Yoshida 1981). The highest concentration of oligochitosan treatment (150 ppm) was only able to increase dry weight plant, no effect on rice yield improvement. Dry weight plant describes assimilates content. High assimilates in the vegetative phase are not all translocate to the generative phase. Photosynthesis is still needed for vegetative growth of rice crops. The growth of rice crop is classified as sigmoid. At the time of primordial phase and the formation of panicles, the addition of plant height and even the number of rice leaves are still ongoing

The application of various oligochitosan consentration was not significantly different in growth and the result was probably due to inappropriate spraying time and kind of sprayer. Spraying on closed stromata is not very effective (Abdelbassed et al., 2010). Some oligochitosan does not enter the plant tissue. Automatic sprayer with smoother nozzle than manual sprayer. Solution exited like fogging more effective, because the solution can be entered to the leave effectively. Spraying on the wrong way (above the leaf surface). Stomata rice plants partially located on the lower surface of the leaves.also caused the oligochitosan solution does not to enter the plant tissue

CONCLUSION

There was no interaction between frequency treatment and concentration oligochitosan in all parameters. Treatment frequencies showed significant differences in leaf number parameters, number of tillers, dry weight of plants, number of panicles per hill, weight of grain per hill and weight of grain per hectare. The parameter of plant height was not significantly different. Consentration oligochitosan treatment had no significant effect to all parameters except on dry

weight plant.

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ANALYSIS OF FARMER ADOPTION LEVEL TO TECHNOLOGY COMPONENTS OF INTEGRATED PLANT MANAGEMENT (PTT) ON ICM-IM MAIZE IN YOGYAKARTA SPECIAL REGION

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ABSTRACT

One of the efforts to increase maize production is through Integrated Crop Management Application (ICM-IM). This activity is focused through an integrated regional pattern from upstream to downstream, increasing the number of aid packages as stimulant instruments, as well as support and guard support. The aimed of study is to analyze the level of farmer adoption of integrated crop management technology components (PTT) in ICM-IM maize Yogyakarta province. This research was conducted using survey method, through in-depth interviews using prepared questionnaires. The study was conducted from May to June 2016 in Kayuhan Wetan Village, Panjangan Sub-district, Bantul district and Tridadi Village, Sleman District,; with the number of recipients of 60 peasants. Selection of the location is done purposively (purposive) with the consideration of the location is the location of ICM-IM Maize. Data were analyzed descriptively in the form of frequency distribution and analysis with approach of before and after comparisons to compare maize production / productivity in Yogyakarta before and after GPT PTT implementation. The results showed that during GP PTT maize, most farmers adopted all components of PTT maize technology, the adoption level of farmers on the varieties of PTT maize technology varied, some were adopted entirely and some were adopted some component of PTT technology. In the implementation of ICM-IM maize there was a significant production difference between before ICM-IM and after ICM-IM maize in Yogyakarta province.

Keywords: Adoption, ICM-IM, Maize

INTRODUCTION

Maize is the second food commodity in Indonesia after rice as a source of calories and as a substitute for rice. In addition to being a source of carbohydrates, maize is also grown as animal feed (forage and tuna), taken from grain, made from flour (from grains, known as maizemeal or maizestarch), and industrial raw materials (from flour and tuna).

In the period of 2000-2004, maize demand for feed, food and beverage feedstock industries increased 10-15% / year. However, maize production in Indonesia is still relatively low and still cannot meet the needs of consumers who tend to continue to increase. According to Subandi et al, 1998, the national maize production has not been able to keep up with the demand that is partially spurred by the development of feed and food industries. The low production of maize is due to several classical factors and problems that are always faced, especially at the level of the map. Hard work to increase maize production, both through the expansion of planting areas and the use of hybrid and composite seeds has been done and proven to increase national maize

production. Although up to now has not been able to meet the needs of the community, so still needed imports.

The opportunity to increase domestic maize production is still wide open considering the interest of farmers for the cultivation of maize is still very large, but the productivity of maize is still low (3.3 t / ha) for that way need to improve the agribusiness system at the farm level and utilization of vast land potential, especially outside Java so that the need for maize commodity will be fulfilled and the import rate can be reduced.

Commodity of food crops has a main role as the fulfillment of food, feed and domestic industries which each year tends to increase along with the increase of population and the development of food and feed industry so that from the side of National Food Security function becomes very important and strategic. One of the growing food crops is maize. One of the efforts to increase production will be through the Integrated Crop Management (ICM-IM) movement, i.e. productivity improvement activities will be focused through integrated upstream to downstream area patterns, increasing the number of aid packages as stimulant instruments, as well as support and guard support. Through ICM-IM farmers are expected to apply the knowledge when they get SL-PTT activities, able to analyze, summarize and apply, face and solve problems especially in cultivation techniques by reviewing on site-specific basis. (http://tanamanpangan.pertanian.go.id/files/pednis_ICM-IM_Jagung_2015.pdf).

METHODOLOGY

This research used survey method, that is combining explorative and descriptive technique. Data collection by way of structured interview is a process of interaction and communication between interviewer with respondent to get information by asking directly (Singarimbun and Effendi, 2006). The data used include primary data and secondary data.

Data were analyzed descriptively in the form of frequency distribution. Frequency distribution is the grouping of data into categories that indicate the number of data in each category, and each data can not be entered into two or more categories (Suharyadi and Purwanto, 2003).

Determination of class category or class interval was determined by the following formula:

$$\text{Class interval} = \frac{\text{Highest value - lowest value}}{\text{Number of class}}$$

Data that has been classified, then presented in the form of tables or graphs.

RESULTS AND DISCUSSION

1. Characteristic of Respondents.

Characteristics of respondents of maize farmers include age, education level and land area. Respondent's age, respondent's level of education and ownership of ICM-IM participant farming land are presented in Figure 1, Figure 2, and Figure 3.

1.1 Age of respondent.

Based on Figure 1 shows that most respondents of Bantul and Sleman respondents are between 49 years old and 60 years old, while respondents who are old (61-72 years old) in Sleman Regency are 12% and Bantul 7%, while respondents are aged between 73 year up to 84 years (classified as very old) by 5% in Sleman District and 2% in Bantul. As well as very old

respondents (70 th - 80 th) by 5%.

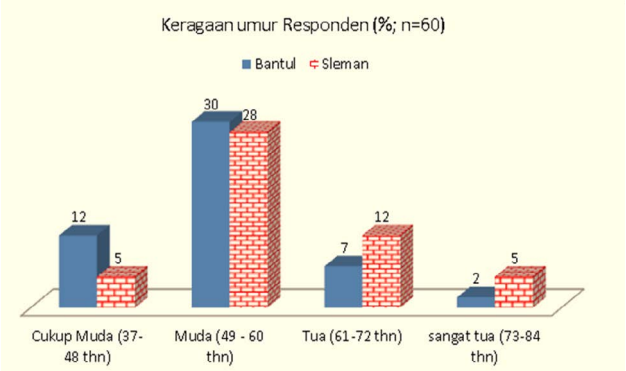


Figure1. Respondent's age.

1.2. Educational level of respondents.

The educational level of respondents is presented in Figure 2.

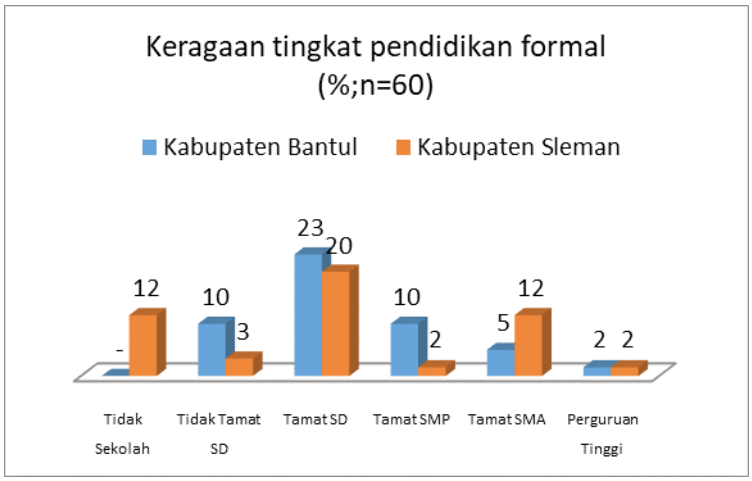
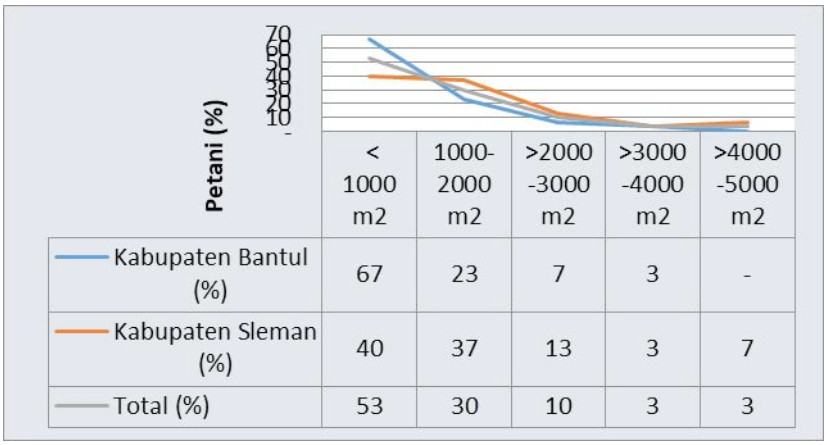


Figure 2. Educational level of respondent's

The education level of respondents varied from non-school to college as shown in Figure 2. Based on Figure 2 shows that most of the respondents had elementary school education (43%), junior high school 24%, high school 14% and D-3 5%.

1.3. Ownership of farm land.

Ownership of farmers' farming land in Bantul and Sleman districts is shown in Figure 5.



	< 1000 m2	1000-2000 m2	>2000 -3000 m2	>3000 -4000 m2	>4000 -5000 m2
Kabupaten Bantul (%)	67	23	7	3	-
Kabupaten Sleman (%)	40	37	13	3	7
Total (%)	53	30	10	3	3

Figure3. Responsible farm ownership land

Based on Figure 3. shows that most of the farmers of respondents in those two districts have less than 1000 m2 land. The farmers of respondents in Bantul Regency who have less than 1000 m2 of land is 67% while in Sleman Regency 40%.

2. Level adoption of ICM-IM Maize technology component (1. New superior variety, hybrid or composite, 2. Quality and labeled seeds, 3. Population 66.000-75.000 plants / ha and 4. Fertilization based on crop needs and soil nutrient status.

2.1. Level adoption of the use of new improved varieties.

Superior variety plays an important role in improving the productivity of maize farming. The adoption rate of New Superior varieties of maize during, before, and after ICM-IM Maize in Bantul and Sleman districts as Table 1.

Table 1. The rate of adoption of the use of varieties during, before, and after ICM-IM Maize in Bantul and Sleman districts.

New improved varieties are used	District					
	Bantul (%; n=30)			Sleman (%; n=30)		
	Before ICM-IM	During ICM-IM	After ICM-IM	Before ICM-IM	During ICM-IM	After ICM-IM
Bisi 16				60,0	100,0	100,0
Bisi 2	33,3	100,0	100,0	6,7		
Local	56,7			30,0		
Pertiwi	10,0					
Pioner P 21				3,3		
Total	100,0	100,0	100,0	100,0	100,0	100,0

Based on Table 1 shows that for Bantul district before ICM-IM, the farmers of respondents using BISI 2 maize varieties were 33.30%, local varieties 56.70% and the remaining 10% using the homeland variety. While at ICM-IM and after ICM-IM all farmers of respondents (100%) use BISI 2 varieties. In Sleman district before ICM-IM 60% of farmers use Bisi 16 varieties and the remaining 6.70% B2 Varieties 2 and 30% Local varieties and 3,30% of Pioneer-P Varieties 21, whereas during ICM-IM and after ICM-IM 100% Bisi Varieties 16.

2.2. The adoption level of seed treatment for the prevention of transmission of gallbladder disease.

The adoption level of seed treatment for the prevention of transmitted diseases on maize during, before, and after ICM-IM Maize in Bantul regency and Sleman as in Table 2.

Table 2. The level adoption of seed treatment for prevention of transmitted diseases during, before, and after ICM-IM Maize.

Seed treatment	District					
	Bantul (%; n=30)			Sleman (%; n=30)		
	Before ICM-IM	During ICM-IM	After ICM-IM	Before ICM-IM	During ICM-IM	After ICM-IM
No	60,0	86,7	80,0	100,0	100,0	100,0
Yes	40,0	13,3	20,0			
Total	100,0	100,0	100,0	100,0	100,0	100,0

Based on Table 2 it can be explained that the farmers of respondents in Bantul Regency adopt seed treatment rate to prevent transmission of gallbladder disease prior to ICM-IM by 40.0% at ICM-IM 13.30% and after ICM-IM 20%, while farmers of respondents did not conduct seed treatment before ICM-IM 60% at ICM-IM 86.70% and after ICM-IM 80%. Farmers of respondents in Sleman Regency adopt seed treatment rate to prevent transmission of gallbladder before, during ICM-IM and GPTT respectively at 100%.

2.3. Adoption level of the use of plant spacing, during, before, and after ICM-IM Maize.

The level adoption of plant spacing during, before, and after ICM-IM Maize in Bantul and Sleman districts as shown in Table 3. Based on Table 3 shows that the respondent farmers in Bantul District used 70-75x20 cm (1 seed / hole) before ICM-IM of 36.70%, ICM-IM 66.70% and after ICM-IM 56.70% while farmers of respondents who did not use spacing 70-75x20 cm (1 seed / hole) before ICM-IM amounted to 63.30%, ICM-IM 33.30% and after ICM-IM 43.30%. Respondent farmers using 70-75x40 cm plant spacing (2 seeds / hole) before ICM-IM 13.30% at ICM-IM 0% and after ICM-IM 6.70%, while farmers of respondents who did not use spacing 70-75x40 cm (2 seeds / hole) before ICM-IM 86% at ICM-IM 100% and after ICM-IM 93.30%.

Table3. The level of adoption of the use of plant spacing during, before, and after ICM-IM Maize in Bantul and Sleman districts

Application Distance Planting		District					
		Bantul (%; n=30)			Sleman (%; n=30)		
		Before ICM-IM	During of ICM-IM	After ICM-IM	Before ICM-IM	During ICM-IM	After ICM-IM
70-75x20 cm (1 seed/hole)	No	63,3	33,3	43,3	60,0	33,3	60,0
	Yes	36,7	66,7	56,7	40,0	66,7	40,0
	Total	100,0	100,0	100,0	100,0	100,0	100,0
70-75x40 cm (2 seeds/hole)	No	86,7	100,0	93,3	63,3	90,0	86,7
	Yes	13,3		6,7	36,7	10,0	13,3
	Total	100,0	100,0	100,0	100,0	100,0	100,0

Jajar Legowo (90-100x40 cm 2 seeds/hole)	No	96,7	100,0	100,0	100,0	100,0	100,0
	Yes	3,3					
	Total	100,0	100,0	100,0	100,0	100,0	100,0

Farmers of respondents using Jajar Legowo (90-100x40 cm 2 seeds / hole) before ICM-IM 4.80% at 0% and after ICM-IM 0% while farmers of respondents who did not use Jajar Legowo (90-100x40 cm 2 seeds / hole) before ICM-IM of 3.3% during ICM-IM and after ICM-IM no farmers respondents using.

Respondent farmers in Sleman District used planting distance 70-75x20 cm (1 seed / hole) before ICM-IM 40%, ICM-IM 66.70% and after ICM-IM 40%, while farmer respondents did not use distance planting 70-75x20 cm (1 seed / hole) before ICM-IM 60%, ICM-IM 33.30% and after ICM-IM 60%. Respondent farmers used 70-75x40 cm (2 seeds / hole) before ICM-IM 36.70%, when ICM-IM was 10% after ICM-IM 13.30%. Farmers of respondents in Sleman Regency 100% did not use. spacing 70-75x40 cm (2 seeds / hole).

2.4. Level of adoption of urea fertilizer before, and after ICM-IM Maize.

The use of urea fertilizer in maize before, during and after ICM-IM Maize is presented in Figure 4. Based on Figure 4 shows that in Bantul District 86.70% of farmers respondents used urea fertilizer before ICM-IM, ICM-IM and after GP- PTT of maize, while farmers of respondents in Sleman Regency 100% did urea fertilization before, at and after ICM-IM maize.

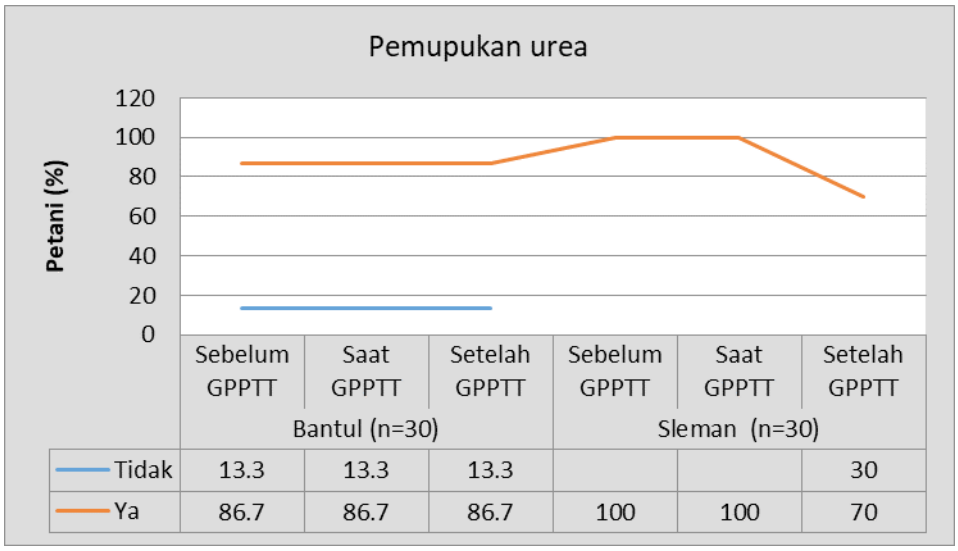


Figure 4. Fertilization of urea in maize crops before, during and after ICM-IM Maize.

2.5. Level adoption of the use of urea fertilizer based on the leaf color chart

The level adoption of Urea Fertilization based on leaf color chart (BWD) before, during and after ICM-IM Maize as in Figure 5. Based on Figure 5 shows that in Bantul District 3.30 farmers respondents using urea fertilizer based on leaf color chart well before ICM-IM, during ICM-IM and after ICM-IM of maize, while farmers of respondents in Sleman Regency 100% did not perform urea fertilization based on leaf color chart either before, at and after ICM-IM of maize.

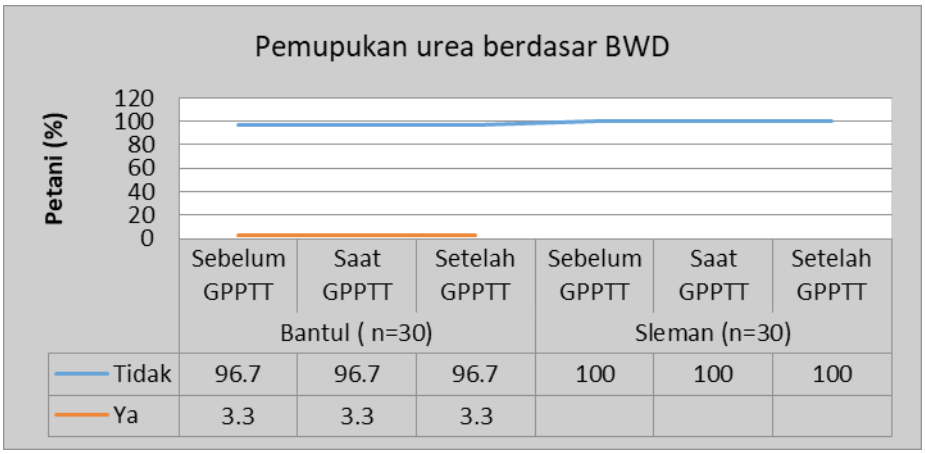


Figure 5. The level adoption of Urea Fertilization based on leaf color chart (BWD) before, during and after ICM-IM Maize.

2.6. KCL fertilizer adoption level

The level of KCL fertilization adoption before, during and after ICM-IM Maize is presented in Figure 6. Based on Figure 6 shows that in Bantul District 100% of farmers did not use KCL fertilizer either before ICM-IM, ICM-IM and after ICM-IM maize. While the respondent farmers in Sleman District who do KCL fertilization before, at and after ICM-IM maize respectively 6.70%.

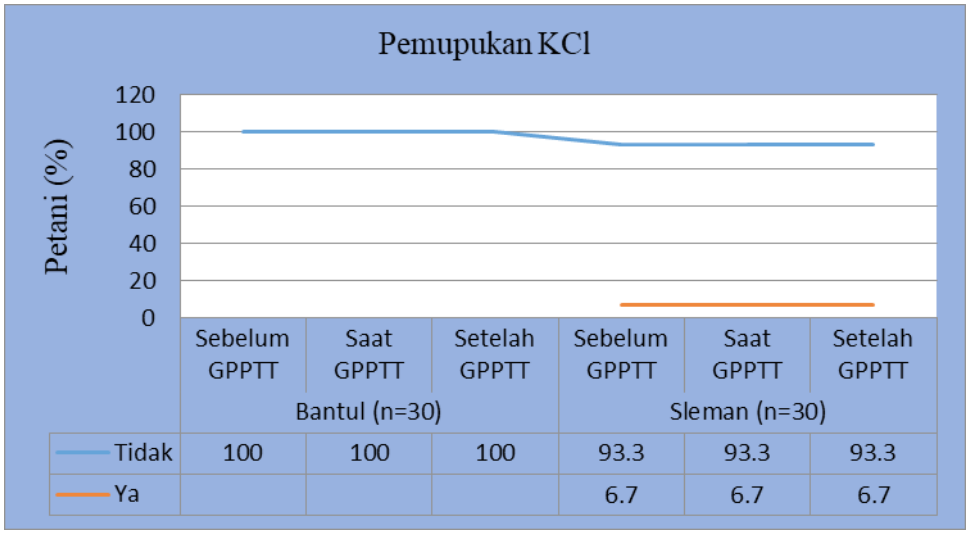


Figure 6 . KCL fertilizer adoption level, before, during and after ICM-IM of Maize.

2.7. TSP fertilizer adoption level

The level adoption of TSP fertilizer before, during and after ICM-IM Maize as shown in Figure 7. Figure 7 shows that in Bantul district, farmers of respondents who use TSP fertilizer before ICM-IM, ICM-IM and after ICM-IM maize respectively 13.30%, while farmers of respondents in Sleman district 100%) did not perform fertilization with TSP either before, during and after ICM-IM maize

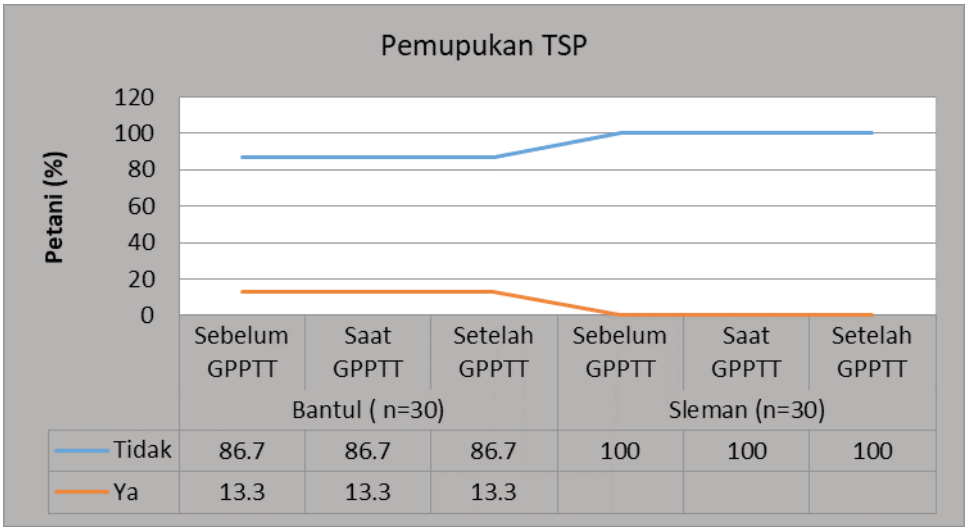


Figure 7. TSP fertilization adoption level before, during and after ICM-IM maize.

CONCLUSION

- Based on results of this study can be concluded that during ICM-IM maize, most farmers adopt all components of PTT maize technology, but after ICM-IM farmers adoption rate against the component of PTT maize technology varies there are farmers who adopt all and some who adopt some components PTT technology.

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Effect of Extraction Method of CNSL Production and Its Toxicity as Botanical Pesticides to Maize Weevil of Corn Seed Storage

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ABSTRACT

Corn seeds are often damaged by pests in storage which cause decrease in quality and quantity. Maize weevil, *Sitophilus* spp. is the leading cause of the loss of corn seed. The postharvest pest control efforts can use more environmentaly friendly materials like chasew nut shell liquid (CNSL) as a botanical pesticide. To obtain the CNSL there are several methods of extraction that would affect the characteristic of the resulted CNSL. The purpose of this study was to determine the most effective and efficient extraction method of CNSL as well as determine its toxicity to *Sitophilus* spp. and its effect on viability of corn seed. The method used was to compare mechanical and chemical extraction methods in producing CNSL, while toxicity testing used contact and feeding test. The results showed that the most effective and efficient CNSL extraction technique was the mechanical method and as a botanical pesticide, toxicity of the CNSL resulting from mechanical extraction to *Sitophilus* spp. was better than the chemical extraction. CNSL toxicity which mechanically extracted, indicated by dermal LC_{50} : 8.6524% and oral LC_{50} : 0.00123%. While the chemically extracted CNSL, had dermal LC_{50} : 5.0849 % and oral LC_{50} : 0.16 %.

Keywords: extraction methods ; toxicity of CNSL ; botanical pesticides ; maize weevil ; corn seed

INTRODUCTION

Corn is one of the grains belonging to the commodity store materials. Storage of this material may be aimed at food supply or seed stock. But in reality, this material often suffered damage in storage that caused a decrease in quality and quantity. The cause of this damage can be a biotic factor (disturbing organisms) or abiotic factors i.e. micro-environment factors in the storage.

Loss of corn yield during the storage period of the material is still quite high mainly due to insect, fungus and mouse attacks. Common types of the insects include *Sitophilus* spp, *Cryptolestes pussilus*, *Tribolium confusum*, *Rhyzoperta dominica*, *Corcyra cephalonica*, and *Sitotroga cerealella* (Samuel, 1974 *cit*. Saenong, 2005). Of the many pests that attack cereal commodities especially corn during storage periods, maize weevil *Sitophilus zeamais* Motch is the most heavily damaged, since it can attack from before harvest until the product is in storage (Saenong, 2009). The level of damage inflicted can reach above 50% (Saenong, 2005). While decreasing the quality of corn seeds due to *S. zeamais* attack negatively impacted the decrease of seed germination rate of corn until 43% after storage for three months (Dinarto & Astriani, 2008).

The purpose of seed storage is to maintain seed viability by suppressing as low as possible deterioration rate of the seed, so that when the seed is planted there is still a good crop performance. The seed saving period essentially occurs from the start of the seed reaches the physiological maturity in the field until the seed is planted by the farmer. Any environmental conditions that are not ideal for seed storage during this period will degrade seed quality (Dinarto, 2010).

Seed treatment is a means of plants protection using chemicals or biology applied to seeds or vegetative propagation organs to control the pests and diseases. Seed treatment can be differentiated into physical, biological, and chemical. The three types of treatment should consider the biological aspects of being effective, safe for human in handling and planting, compatible with other materials used for seeds, not causing residues on soil and crops, and also safe in the field.

In addition, biological and chemical seed treatment should have good quality in the application process and seed retention. One of the seed treatment is to use pesticide compound. Pesticides that play a role in the seed treatment may consist of bactericide, fungicide, and insecticide. In general, seed treatment is done on hard seeds such as corn, wheat, and beans that have a seed membrane that coating the embryo (Hot McGee, 2001).

From various ways of post harvest pest control, the most commonly used method is to use synthetic insecticides either with fumigant formulation or seed treatment, such as Cruiser 350 FS, Regent Red 50 SC, Marshal 25 ST, Carbosulfon or Ridomil (Isaskar *et al.*, 2010 ; Anonymous, 2010). In its application for long time this way has many weaknesses include food safety risks, the emergence of insect resistance and environmental pollution.

Selection of good pesticides for use in seed treatment is consider a material that can control pests effectively, harmless to seeds, economical, easy to obtain and use, non-destructive, stable for long periods, harmless / non-toxic to the environment (including humans and livestock) (Nugroho *et al*., 1999 *cit*. Asie, 2004).

Exploration of various kinds of plant as a source of botanical pesticides to control pest weevil and maintain viability of corn seeds had been done before. Kinds of botanical pesticides that had been studied include citronella grass, vetiver, cayenne pepper, pepper seed, sweetsops seed, soursop seeds, and various kinds of weed such as, goatweed and lantana. The results showed that those botanical pesticides could maintain pathological quality and viability of corn seeds (Astriani, 2010; Astriani & Dinarto, 2010a; Astriani & Dinarto, 2010b; Dinarto & Astriani, 2005; Dinarto & Astriani, 2008a).

The results of previous studies indicated that the storage of corn seeds mixed with botanical materials such as lemongrass leaves, garlic leaf, clove leaf, dringo leaf, goatweed and citronella grass, effectively suppressed insect populations of maize weevil and increase their mortality so that corn seed quality was maintained (Saenong, 2005; Surtikanti, 2004; Dinarto & Astriani, 2008).

Further exploration is more emphasized on botanical materials that are not or less useful but have high bioactivity to pests, such as some weeds and by product of agricultural cashew nut shells. Utilization is expected to provide added value of the botanical material and also does not conflict with other interests.

Cashew nut shell is actually a by product and so far has not been widely utilized by people. The shell of cashew fruit can be extracted to produce a liquid called or known as Cashew Nut Shell Liquid (CNSL). The content of CNSL in fresh cashew nut shells is about 25-30% (Kardinan,

2002). There are several methods of CNSL extraction, such as pressing method, frying method and extraction with organic solvent (Simpen, 2008; Sumangat *et al*., 2007).

CNSL is content of 90% anacardate acid and 10% cardol. As a botanical pesticide, CNSL can be used as an insecticide, bactericide and fungicide. CNSL with concentration of 1-2% able to kill caterpillar type pest and inhibit the hatching of eggs (Kardinan, 2002). According to Manaf *et al*. (1994), unsaturated anacardate acid can suppress oviposition rates and inhibit the oogenesis process of infertile pests of *Martianus dermestoides*.

The test results showed that CNSL was capable to kill larvae and imago *Sitophilus* spp. from 22.5-50% in the CNSL concentration of 6.25-50%, also cause of inhibition of development of larvae into pupa of 37.5-60%. It also inhibited the development of pupa into imago of 12.5-25%. In testing of *T. castaneum*, CNSL could kill 17.5-55% of larvae and 15-42.5% of imago, and can affect the success of development of larvae into pupa and pupa into imago. Test results of *C. trifenestrata* showed that CNSL could cause larval mortality between 37.5-87.5% with topical application, and 46.5-74% by leaf dipping (Iskandar, 2002).

Other part of cashew also have potential as a source of botanical pesticides. The seed is antiinsect, repellen, allelopathy and poisonous, while the leaf is antinematode (Kardinan, 2002; Grainge & Ahmed, 1988). The method of preparation or extraction of active ingredients in cashew plants, according to Grainge & Ahmed (1988) can be by water extraction or distillation for the oil. Application of liquid of CNSL extract as botanical pesticide in concetration 4-5% could also suppress pest attacks and increase the yield of peanuts (Astriani & Dinarto, 2010a).

From many studies on CNSL showing its potential as a pesticide, one of them as an insecticide that can interfere / inhibit growth, development until cause mortality of pests / weevil in the seeds. Therefore, CNSL is very potential for seed treatment, including seed treatment for pests on corn seed such as *Sitophilus* and *Tribolium*.

There are several method of CNSL extraction. CNSL extraction from cashew nut shells can be done by heating / frying method, forging / pressing or extraction with solvent. The use of the frying method can provide two advantages, namely the extraction of CNSL from cashew seeds and facilitate the process of seed peeling. However, CNSL extraction by frying requires a certain tool and process conditions so that a continuous frying method can be obtained (Sumangat, *et al*., 2007). In this study the main material are not intact cashew nut but the waste in the form of cashew nut shells, so the frying method is not considered to be implemented. The method to be tested was the method of extraction by pressing and the method of extraction with organic solvent.

Pressing method is done by inserting cashew nut shells in pressing machine and by manual pressing. The pressing result is the extract of cashew nut shells in the form of dark brown oil, known as Cashew Nut Shell Liquid (CNSL).

The method of CNSL extraction with organic solvent was carried out by dissolving in various organic solvents such as methanol and ammonium hydroxide (8:5) mixture then extracted with hexane. In addition, a mixture of 3:1 hexane-ethanol solvent was also used. From the results of this research, the solvent mixture was proved to be the most effective in obtaining the highest yield (44.38%) compared with a solvent mixture chloroform : ethanol, ratio of 3:1, 1:1, 1:3 and solvent mixtures hexane : ethanol, ratio of 1:1, 1:3 (Simpen, 2008).

The purpose of this research was to know the most effective and efficient method of extraction of CNSL as a botanical insecticide, and to know its toxicity to maize weevil and its effect on

corn seed viability.

MATERIALS AND METHODS

Materials used were cashew nut shells which are waste from cashew farmers, chemicals such as ammonium hydroxide, methanol, ethanol, acetone, and hexane. In addition to toxicity testing required materials such as corn seed varieties of Bisma, adult / imago *Sitophilus* spp., sand media, plastic bags, CNSL and water.

The tools used were pressing machine, and tools for chemical CNSL extraction such as distillation devices, rotary evaporator, measuring cups, pipettes, and others. While in toxicity test, the tool used include sealer, dropper drops, olfaktometer, plastic tub, hand sprayer, Ohaus scales, thermohygrometer, seed moisture tester and petridish.

Extraction method test was done by comparing CNSL production result using mechanical method and chemical method. The mechanical method was carried out by pressing using a pressing machine, while the chemical method is performed by extraction using an organic solvent mixture of chloroform-ethanol ratio (1:3).

The observations of CNSL producted were done on both quantity and quality variables which included rendement, viscosity and density. In addition also observed of supporting factors such as comparison of cost, time length of process and difficulty level in CNSL extraction process.

Testing of CNSL toxicity to maize weevil in corn seeds would be obtained by contact and feed testing. From the preliminary research that had been done then determined 3 levels of concentration for contact and feed test. The CNSL concentrations for the contact test were 60%, 30% and 15%, while the concentrations for the feeding test were 20%, 10% and 5%.

The research was a two-factor experiment which were arranged in Completely Randomized Design (CRD). The tested treatments were types of CNSL extraction method and CNSL concentration, with two comparators i.e. 0% concentration (solvent only) and control (without any chemical application). So in this study there were (2 x 3) + 2 = 8 treatments with 4 replications, so that there were 32 units of experiment.

Observations was made on the contact test and feed test on several variables i.e. mortality and population of *Sitophilus* spp., also on the seed germination and water content of corn seeds to see the effect of CNSL on seed viability.

RESULT AND DISCUSSION

In testing the CNSL extraction method, the rendement and quality of CNSL producted was shown in Table. 1.

Table. 1. Characteristics of CNSL extracted by Mechanical and Chemical Methods

Methods	Rendement (%)	Viscosity	Density
Mechanical	13.58 b	8.000 p	1.0084 x
Chemical	47.27 a	1.453 q	0.9942 x

Note: The mean value followed by the same letter in the same column shows no significant difference according to the t test of 5%

From results of the test of the two extraction methods, the higher rendement was obtained from the chemical method using chemical solvent, it was 47.27% (Table 1), while the mechanical method was only 13.58% (Table 1). The results showed that extraction by chemical method was

more effecient (3,48 times) than mechanical method.

The extraction of mechanical methods produced CNSL with higher viscosity and density than by chemical extraction (Table. 1). Qualitatively, better CNSL will have lower density and higher viscosity (Simpen, I.N., 2008).

The density of CNSL producted by the mechanical methods in this study was higher because it still had content of water (moisture content was still relatively high), or the water content of CNSL extracted with solvents was allegedly lower. But the difference in the value of density was very small.

Viscosity was determined to know the degree of consistency of CNSL. Generally, oil viscosity increases with increasing carbon chain length. The greater the viscosity, the quality of CNSL will be better because the water content contained in the sample is relatively fewer and the length of the carbon chain is longer (Simpen, I.N., 2008). The results showed that the viscosity of CNSL of mechanical extraction was higher (5.51 times) than chemical extraction result. This means that the extraction of CNSL by chemical method, the carbon chain was relatively shorter than CNSL extraction using mechanical method (Simpen, I.N., 2008).

The chemical method looks more effective at producing CNSL extract, but in terms of cost and time, mechanical extraction methods were more efficient and faster. From one kg of cashew nut raw material, the extraction with mechanical method will produce 12.096 liter CNSL, in total time (including 6 hours for preparation) about 8 hours, and the cost is only for one worker. While the chemical method will produce 48.326 liters of CNSL that was 3.48 times, but it takes longer time, that wasmore than 2.5 times (total time about 21 hours) and cost 10 times more expensive, because it requires chemicals which was quite a lot. So in general it could be said that in terms of quantitative chemical methods better than mechanical methods, but in terms of qualitative mechanical methods better than chemical methods.

The results of the contact test showed that CNSL had contact toxicity to *Sitophilus* spp. This was in accordance with the results of previous research which said that CNSL against pests could be as contact poison, cause mortality and inhibit egg hatching even at low concentrations (1-2%) (Kardinan, 2002; Priono, 2008; Grainge & Ahmed, 1988). The higher the CNSL concentration the greater the mortality of *Sitophilus* spp. (Table. 2.). It was allegedly because the content of insecticidal active ingredients also more and more. Cashew nut shell extract (Chasew Nut Shell Liquid / CNSL) has high toxicity mainly because it has the content of anacardic acid. In CNSL generally consists of 90% anacardic acid and 10% cardol (Kardinan, 2002; Priono, 2008).

Table 2. Mortality of *Sitophilus* spp. on test contact with CNSL

Concentration (%)	Mortality (%)		Mean
	Mechanical Method	Chemical Method	
0	0.00	0.00	0.000 e
15	86.25	87.50	86.875 c
30	91.25	92.50	91.875 b
60	100.00	98.75	99.375 a
Control	1.25	3.75	2.500 d

Note : The mean value followed by the same letter in the same column shows no significant difference according to the t test of 5%

The contact toxicity of CNSL from mechanical extraction on *Sitophilus* spp. calculated by probit analysis, and obtained regression equation Y = 1.7547 + 3.4630 X, so the amount of contact toxicity (LC_{50}) was 8.6524%. While CNSL of chemical extraction result, from probit analysis obtained regression equation Y = 3.2316 + 2.5038 X, so the amount of contact toxicity (LC_{50}) was : 5.0849%. It means that at concentrations of 8.6524% (mechanical method) and 5.0849% (chemical method) CNSL caused 50% mortality of *Sitophilus* spp. Toxicity will be greater if the LC_{50} value is smaller. This study showed that CNSL contact toxicity from chemical extraction was greater than the result of mechanical extraction which showed that chemical extraction was more toxic than mechanical extraction.

Table 3. Mortality of *Sitophilus* spp. on the feed test with CNSL

Concentration (%)	Mortality (%)		Mean
	Mechanical Method	Chemical Method	
5 %	86.25	87.50	86.875 c
10 %	91.25	92.50	91.875 b
20 %	100.00	98.75	99.375 a
Mean	92.50 p	92.97 p	92.710 B
Control			0 A
0%			0 A

Note : The mean value followed by the same letter in the same column or row shows no significant difference according to the t test of 5%. The uppercase notation behind the mean value indicates the difference of treatment to control and 0% CNSL concentration.

The results of the feeding test showed that CNSL had feed toxicity to *Sitophilus* spp. The higher the CNSL concentration the greater the mortality of *Sitophilus* spp. However, between the CNSL extraction methods of mechanical and chemical methods there was no difference (Table. 3.). CNSL proved capable of causing mortality in various types of pests, both caterpillars and ticks from 22.5 to 100% at low concentrations (Kardinan, 2002; Iskandar, 2002; Atmadja & Wahyono, 2009).

Besides having contact toxicity, CNSL also had oral toxicity. The result of probit analysis to obtain the regression equation for CNSL of mechanical extraction was Y = 7.1875 + 0.7516 X while for CNSL the result of chemical extraction was Y = 6.6665 + 0.9344 X. From the linear regression equation was known the amount of oral toxicity of CNSL from mechanical extraction (Finney, 1971), i.e. with LC_{50} value : 0.00123%, while LC_{50} CNSL by chemical extraction was 0.16%. The oral toxicity of CNSL by mechanical extraction had LC_{50} value much smaller than that of mechanical extraction which showed that the mechanical extraction results were much more toxic.

The oral toxicity of CNSL on *Sitophilus* spp. had a LC_{50} value smaller than its contact toxicity. This suggested that the toxicity of CNSL through the digestion of food was more effective than through the skin surface.

CNSL resulted from mechanical extraction, as a botanical pesticide material against *Sitophilus* spp. could be said to be better than CNSL chemical extraction results. This seen from the much higher oral toxicity of CNSL by mechanical extraction (LC_{50} was much lower : 0.00123%) than the CNSL of chemical extraction (LC_{50} : 0.16%), eventhough LC_{50} of contact (dermal) toxicity was more low but the difference was small.

Table 4. Moisture content of corn seed after storage

Concentration (%)	Moisture content (%)		Mean
	Mechanical Method	Chemical Method	
5 %	12.5000 ap	12.5250 ap	12.5125
10 %	12.7750 aq	13.1750 bq	12.9750
20 %	12.6000 aq	12.6000 ap	12.6000
Mean	12.6250	12.7667	12.6958 B
Control			12.2750 A
0%			12.5750 A

Note : the mean value followed by the same letter (lowercase) indicate no significant difference in effect between treatments according to the F test of 5% level. The uppercase notation behind the mean value indicates the difference of treatment to control and 0% CNSL concentration.

Seed treatment with CNSL solution turned out to affect the moisture content of the corn seed after storage. Overall the initial seed moisture content was 12%, and after storage in general would increase. The analysis also showed that there were interaction between extraction method and CNSL concentration. From the extraction of mechanical methods, 5% concentration of CNSL solution caused a lower moisture content than other concentrations, whereas from the CNSL chemical method the 10% concentration caused the moisture content higher than the others (Table. 4.). Increased seed moisture content from initial moisture content in storage occured because the seeds were still respirating which produced oxygen and would increase the moisture in the packaging (AOSA 1983). The seed would absorb water vapor so that seed moisture content would increase, while increase of the moisture content of the corn seeds treated was suspected to occur due to the unperfect drying during seed treatment process.

Table 5. Corn seed germination after storage

Concentration (%)	Germination potential (%)		Mean
	Mechanical Method	Chemical Method	
5 %	99.00	99.50	99.25 a
10 %	97.00	96.50	96.75 a
20 %	96.00	94.50	95.25 a
Mean	97.33 p	96.83 p	97.08 B
Control			99.50 A
0%			99.25 A

Note: the mean value followed by the same letter (lowercase) indicate no significant difference in effect between treatments according to the F test of 5% level. The uppercase notation behind the mean value indicates the difference of treatment to control and 0% CNSL concentration.

Corn seed germination after storage would be greatly affected by initial seed conditions and

during storage (AOSA 1983). Seed treatment with CNSL affected seed germination, but its value still showed good seed quality. Between mechanical and chemical methods had no effect on seed germination potential (Table. 5.).

CONCLUSION

1. The most effective and efficient method of extracting cashew nut oil (CNSL) was mechanical method by extraction using pressing machine.
2. As a botanical insecticide, CNSL toxicity to maize weevil *Sitophilus* spp., which resulted by mechanical extraction better than chemical extraction results.
3. Toxicity of CNSL from mechanical extraction, had LC_{50} (contact): 8.6524% and LC_{50} oral : 0.00123%. The toxicity of CNSL obtained by chemical extraction, had LC_{50} (contact) : 5.0849% and LC_{50} oral : 0.16%.

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Rural Household Industry Development with One Village, One Plan, One Budget, One Product Approach (Case Study in Ile Padung District Lewolema of East Flores; Oeletsala Village and Kuaklalo Taebenu District, Kupang Regency East Nusa Tenggara)

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ABSTRACT

Building a rural industry with the One Village One Product (OVOP) approach is an approach to regional development programs aimed at improving economic and community welfare by altering organized mindsets, plans and actions to cultivate abundant natural resources into more value-added products high. Japan-led OVOP program began to be implemented in Indonesia in 2008 through the Ministry of Industry and 2010 through the Ministry of Cooperatives and SMEs aimed at increasing the potential and participation of small and medium industries in Indonesia in development, including East Flores with the potential of cashew nut plantations and Kupang regency with the potential of cattle. Since the existence of the Village Fund in 2015, the government also through the Ministerial Regulation of the DPDTT requires a village of one product to improve the capacity of the regional economy on the assumption that if the village has succeeded, it will be upgraded to one district, and continuously upgraded to a larger scale. To that end, each village receiving the Village Fund is required to implement a plan and a budget that focuses on OVOP. This study aims to evaluate the implementation of government policies on OVOP in Ile Padung, Oeletsala and Kuaklalo since the Village Fund and provide recommendations to stakeholders, local government and village government. In addition, the importance of government consistency, village government compliance with higher institutions, and participation of village communities in implementing and supervising village development programs with one plan approach, one budget, one village one product. Finally, the one-plan program, one budget and OVOP is expected to improve the welfare of the community through increased revenues.

Keywords: One Plan, One Budget, One Village One Product, Village Fund, rural, industry, policy.

INTRODUCTION

The development of rural household industry with One Village One Product (OVOP) approach is one of the approaches taken by the government by inviting private and public participation to increase the added value of agricultural commodities, other products and services in rural areas, and increase the competitiveness more widely, and also withhold or reduce the rate of urbanization that resulted in villages being abandoned by their citizens to seek better income in the city while villages that have available potential have not been optimally utilized for better

life. All villages in East Nusa Tenggara are generally and especially in East Flores district with potential for cashew, coconut, cocoa, and home industry industries such as coconut oil, " tenun ikat", wood and bamboo handicrafts; while in Kupang district has the potential of large livestock (cattle) that should be developed into competitive commodities and superior products of the region.

The OVOP or SDSP approach was developed by Hiramatsu when it became Governor of Oita in 1979 which was practiced for six years (1979-2003) in order to reduce the poverty of its citizens with the main idea of developing local potential by involving all parties, especially the community in the region itself so that people are moved to building up the region to prosper and the welfare of society also get better. This OVOP / SDSP approach has been adopted and practiced in a number of countries and has been successful so that it is globally accepted as an alternative to alleviate poverty and enhance the competitiveness of products typical of villages, regions, regions and even countries.

The success of the OVOP / SDSP program in Japan attracts and encourages other countries, such as Thailand (One Tambon One Product, Taiwan (One Town One Product), Malaysia (One District One Industry), Philippines (One Barangay One Product), and Cambodia (OVOP), Vietnam, Cambodia, Laos and other Asian countries to develop them successfully, and the success of OVOP / SDSP in Japan as well as in other countries pushed the Indonesian government to implement it in 2008 through the ministry of industry and in 2010 through the ministry of cooperatives, Small and Medium Enterprises aimed at improving the participation of small and medium enterprises in rural industry development The basic principles of developing the OVOP / SDSP approach according to its penggas Morihito Hiramatsu which is then practiced in Indonesia are: (1) self-reliance and creativity (2) human resources development, and (3) thingking locally but acting globally, (Claymone, 2007); (Cahyani, nd) n OVOP / SDSP approach aims to improve, develop, market products that can be a source of local people's livelihoods, and increase the value added especially that can be marketed locally, regionally or overseas

The results of the BPS survey on cooperation with the Ministry of Village, Development of Disadvantaged Areas and Transmigration on the Potential of Villages (2014) reported that villages throughout Indonesia have various types of small and micro industries that have the potential to be developed into superior products, villages it became the top production centers of the various commodities (www.validnews.com , September 20, 2017). The existence of the type and scale of small micro industry in the village based on the survey results are 138,695 units dominated by food and beverage industry as much as 26 percent and wood industry by 25 percent, leather industry as much as 2 percent, industry of precious metals and materials of metal by 5 percent, wicker industry by 14 percent, vessel industry, ceramic / stone as much as 11 percent, industry of fabric / weaving as much as 10 percent, and other industries as much as 8 percent. All of the above mentioned industries are not yet included in the household industry so if they are recorded entirely then the number is more than presented.

> According to Nugroho (2017: 1-2) the existence of various types of small and micro industries, is basically one form of real resources owned by each village so as to produce various forms of products by utilizing as much of the raw materials from the village as well as involving as much as possible the labor of the village as well. Thus the products produced and marketed can be enjoyed by all villagers.

The emergence of one village, one product or popular approach to one village, one product or recently popular with the village superior product (Prudes) is based on the presence of resources

in the village and small and micro-scale industries at village level that need to be utilized and optimized as means and efforts to achieve the welfare of the village community through increased income which is derived from the increase of value added goods and services. The OVOP approach began in 2008 through the Ministry of Industry to develop the potential of micro industries (including household scale), small and medium enterprises in various sectors, such as handicrafts developed in a number of areas that have potential for handicraft (pottery / ceramic ornamental) in Purwakarta, Bantul , Tabanan, West Lombok, woven - in Bangli, Central Lombok, Ikat weaving - Lombok, East Nusa Tenggara) and other areas that have other potential such as agriculture and livestock, as well as other typical products that potentially serve the domestic market and international markets

Based on data of potential rural resources, BPS survey results and good practices and successful implementation of OVOP in other countries and some villages in Indonesia before the National Fund Village program implemented, the government through the Village Ministry, PDTT RI publishes the priority policy of the use of Village Funds in 2015 (Permendes -PDTT, No.5 of 2015) article 5 affirms that the priority of the use of the Village Fund is allocated to achieve the development objectives of the Village, namely improving the welfare of the village community and the quality of human life and poverty alleviation through: (a) the fulfillment of basic needs; (b) construction of village infrastructure facilities, (c) development of village potentials; and (d) sustainable use of natural resources and environment. Furthermore, Article 9 is affirmed that the priority of the use of the Village Fund is based on the condition and potential of the Village, in line with the achievement of Village Medium Term Development Plan (RPJM Desa) and Village Government Work Plan (RKP Desa) targets each year, which include: establishment and development of Village-owned enterprise (BUM Desa); development and management of village markets and village kiosks; development and management of food barns; collective cattle raising; mining grazing; village tourism development; and development of appropriate technology for the processing of agricultural and fishery products. Then, Village Ministerial regulation, PDTT No.8 in 2016 emphasized that the priority of the use of the Village Fund is based on the following principles: a. justice, by giving priority to the rights or interests of all villagers without distinction; b. priority needs, prioritizing more urgent village interests, more needed and directly related to the interests of most Villagers; and c. village typology, taking into account the circumstances and facts of typical geographical, sociological, anthropological, economic, and ecological characteristics of the village, as well as changes or progress of village progress. Furthermore, Village Ministerial regulation PDTT No.22 of 2016 concerning the Priority of Village Fund Usage 2017 which explicitly includes One Village One Superior Product is an effort to establish, strengthen and expand economic efforts that are focused on superior products in the Village area or in inter- Villages managed through inter-village cooperation. Four priority programs for the acceleration of village development (Ministry of Home Affairs, PDTT, 2017) Superior Product of Rural Area (Prukades), build embungs, develop BUMDes, and build Village Sports Facilities (Raga Desa).

The results of the Meirina study, et al (2012) as quoted by Cahyani (n, d) that "the determinants of the OVOP's implementation are: implementation objectives, OVOP initiators, funding sources, design and designers, form of mentoring and marketing channels. Meanwhile, based on Claymone research results (2007: 1-9) found that:

> The failure of the One Village One Product project from Indonesia and Thailand is due to the following three elements: 1) not properly understanding the philosophy and approach of the OVOP project 2) issues of policy from above, and 3) the quality of human resources. if Indonesia selectively uses the OVOP (SDSP) approach that has developed

a community base on the OVOP project, and should learn from the mistakes of Thai and Indonesian OVOP projects and seriously use the philosophy of OVOP in Japan as a model of community development in Indonesia.

Efforts to move the rural economy, especially the home industry in East Flores, have been done before the OVOP approach was introduced and applied in Indonesia but the results are still limited to fish, cashew and cashew, ikat and souvenirs because they do not focus on unique local potentials, market information limited and limited quality of human resources with high initiative and creations to create the distinctive product excellence of East Flores region that can be known globally. Similarly, in the Oletsala and Kuaklalo Villages which are the potential and livelihoods of the community debagai farmers have not focused on commercial cattle breeding efforts so that with the National Fund Village program is expected to encourage and raise the spirit of business from farmers to develop, produce and market One Product Featured Village or One Village, One Product. SDSP aims to develop one seed in one village, and excellent products are skill economics. The products developed have distinctive characteristics that distinguish them from other villages. If there is village-level prosperity, the rate of urbanization can be suppressed. Village soperior products (Prudes) and Superior product Rural area (Prukades) become government agenda with focus on these excellent products, income and income of village communities is believed to increase

Although the priority policy on the use of the Village Fund has been established since the first year of Village Fund funding until 2017 but the level of compliance and alignment of village development planning with national planning and priorities has not been synchronized due to the policy to develop one village or one village superior product, one is still "Top Down policy" means the government deciding superior product for a particular region according to the study of potentials and proposals of each region so that it is not in sync with the medium and long term plan has been prepared beforehand. Consequently the implementation of this approach may fail. The SDSP approach and movement has not been the full initiative of rural micro-small-scale micro-enterprises because of limited information and socialization by top-level governments.

With the policy of One Village, One Product requires that the planning and budgeting of the Village Fund is directed at the realization of these lofty ideals so that at the end of a certain period of time the results of development and use of the Village Fund can be measured clearly and the community can increase the results directly, ultimately each Village has a distinctive superior product that can distinguish one village from another. The purpose of this study is to describe and evaluate the implementation of the priority policy of the use of Village Funds by One Village approach, One Superior Product (SDSPU) through One Plan, One Budget in Ile Padung Village East Flores and Oeletsala and Kuaklalo Village Taebenu Sub-district, Kupang District.

METODE PENELITIAN

This study is a case study in Ile Padung Village in Lewolema Sub-district, East Flores Regency, which is a Village with the potential of cashew nut plantation that has export quality (America and India), while Oletsala and Kuaklalo Village are cattle breeding villages in Taebenu sub-district, Kupang regency dependable as a meat supplier for Kupang and Jakarta. This study has been conducted since 2015, 2016 and 2017 in all three villages. Primary data collection is done through interviews and direct observation of the teraktivitas implementation of development and community empowerment, while the secondary data obtained through searching documents RPJM Desa, RKPDesa and Village Revenue and Expenditure Budget (APBDesa) 2015, 2016

and 2017.

The main sources of information are the Village Head, Village Secretary, Head of Government Affairs, Head of Dusun and community leaders in each Village. The data and information obtained were analyzed descriptively. This review is limited to the determination and implementation of the Village work plan, the Village Fund Budget for the development of one village superior product in each village; and whether or not there is a match between the priority policy of the use of the Village Fund set by the Government with the priority of allocation and the use of the Village Fund in the three sample villages.

RESULTS AND DISCUSSION

The development of rural and small industry industries with One Village approach, One Superior Product is a strategic step because small micro industries have a big role in triggering and encouraging rural economy activity and rural development. Tambunan (2001) asserts that small industries have a strategic position in rural development because: first, small industries connect between agricultural and non-agricultural activities; secondly, small industries can create multiplier effects on the emergence of other non-agricultural activities such as services and trade so as to encourage rural economic growth. This means that the development of small micro industries (including home industries) is able to create a number of agricultural and non-agricultural employment opportunities and encourage and attract other economic activities that provide services that enable the creation of value added products and services of rural products.

> Malik (2015) states that there are four industrial groups in rural areas that dominate most of the absorption of non-agricultural, rural and urban workforce namely a) building materials industry, b0 agricultural processing industry that produces raw materials for other industries, c) food that cultivate agricultural products as ingredients consumption of various types of crackers and crispy peanuts, and d) making inputs and agricultural equipment. Therefore, in relation to the desire to accelerate rural development through the current decentralization of development, one of the economic potential of villages and areas that can be used as a spearhead is the empowerment of small industries and home industries. In the structure of the Indonesian economy, Small Industry (including Micro and Household) is a people's economic activity whose existence dominates more than 97% in the structure of the national economy.

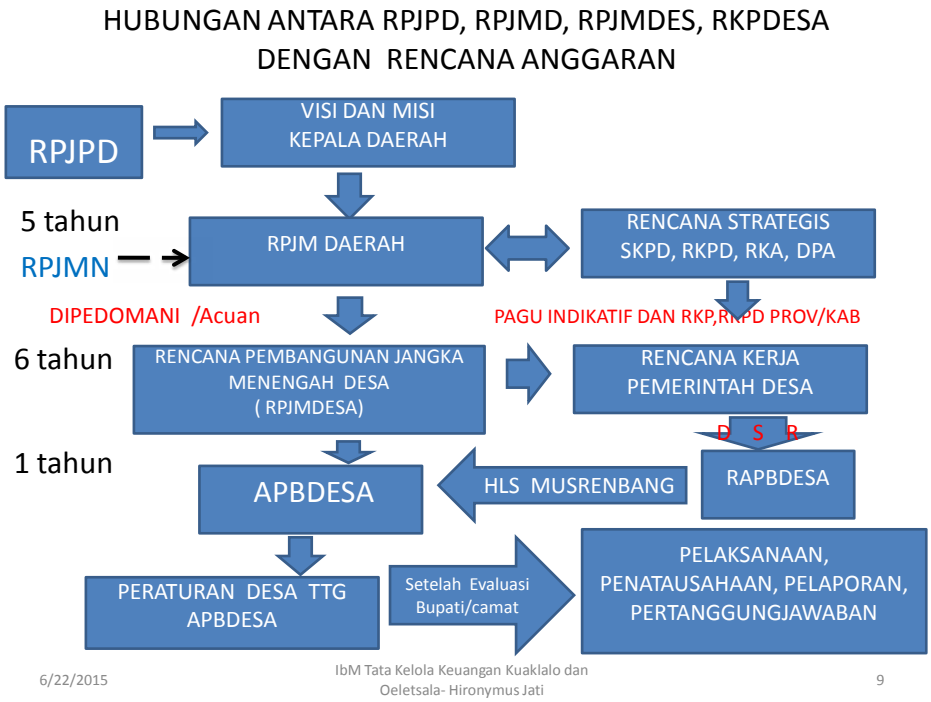
In terms of the potential for labor absorption, the existence of small micro and home industries can not be doubted, but on the other hand the sector faces various weaknesses internally, such as capital, financial management, business management, marketing, operational (production), and resource human; and external factors such as high level of competition, supply and availability of raw materials, business location, and uneven development and training of technical agencies in the region (Jati, Fernandez and Astuti, 2017a; 2017b). The National Fund Village Program is expected to help overcome the shortcomings and obstacles experienced by small and micro entrepreneurs in rural areas.

Therefore, since 2008 and also since the budgeted Village Fund in APBN 2015 in accordance with the Law No. 6 of 2014 on Village government using the approach One Village, One Product (SDSP) seed to accelerate the development of rural and poverty alleviation in the disadvantaged areas and remote. Thus, each Village of 74,954 Villages receiving Village Funds must plan within the Village RKP and budget funds in APB Each village will produce at least One Village, One Primary Product (Prudes) or One Rural Area, One Superior Product (Prukades) according to the potential and uniqueness of each village.

Here are the authors present the results of research and discussion about the practice of One Village, One Plan, One Budget, One Product that occurred in Oeletsala Village and Kuaklalo subDistrict of Taebenu -Kupang District and Village of Ile Padung District Lewolema Regency East Flores.

OneVillage,OnePlan,OneBudget,OneProduct-Village(OeletasalaandKuaklalo-KupangDistrict) Oeletsala and Kuaklalo villages are located in Taebenu sub-district of Kupang district, which is approximately 25- 20 kilometers from Kupang City and approximately 70 kilometers from Kupang Regency capital Oelamasi. The population of the village of Kuaklalo as many as 875 people while the village of Oeletsala has a population of 1,532 inhabitants. The main livelihoods of the population in both sample villages are the dominant of dry land farmers. The dominant livestock business is Cattle, and is supported by other agricultural commodities such as food crops and trade crops, such as bananas, maize, jackfruit, mango, while the household crafts are also dilakoni by the villagers is ikat. The agricultural produce, handicrafts and handicrafts produced are marketed in Kota Kupang and special cows are marketed through inter-island traders in Kupang which are further down into the Jakarta market.

During community service activities on Village Governance according to Permendagri No.113 of 2014 and Permendagri No.114 of 2014 in the villages of Kuaklalo and Oeletsala it is known that before the distribution of Village Funds from the government through the Regional General Cash Account of Kabupaten Kupang 2015 period, each village in the Kupang district (including the sample village) is required to “revise” or revise the Village Medium Term Plan (RPJM Village) Document in accordance with the new provisions. With regard to the priority of the use of the 2015 Village Budget Fund, in accordance with the Regulation of the Minister of Village, Disadvantaged Regions and Transmigration No. 5 of 2015 requires the revision of RPJM Desa to support the pre-eminent sector development targets in the RPJMN 2015-2019 and RKP annually, prioritizing: food, energy sovereignty, maritime and marine development, and supporting tourism and industry. In addition, the revised RPJM Village is also intended to re-adjust the areas of authority of the village government in accordance with prevailing laws and regulations so that the village government does not plan and implement programs and activities that are not authorized. The relationship between various planning documents and budgeting of village finances in projected One Village, One Superior Product can be displayed as follows:



Source: Good Governance of Village Finance Management Since the Enactment of Law no. 6 Year 2014 (Case of the Village of Kuaklalo and Oletsala of Kupang Regency, 2017

The Oeletsala and Kuaklalo Village Governments have revised the RPJM Village and made the RPK Village in 2015,2016 and 2017 but the document is not clearly defined for the superior products of each sample village because in the Village Ministerial Regulation, PDTT 2015 and 2016 are not given confirmation explicitly that each Village must plan a Product of Excellence that is characteristic of the Village concerned according to the dominant potential of both renewable and non-renewable. During the 2015 and 2016 fiscal years both villages focus on the development of village infrastructure both related to development. Thus, even though both sample villages have farm-livestock potential but in RKP Village during the period it is not planned and budgeted funds from the Village Fund as well as other sources for the development of cattle and other agricultural commodities.

The results show that in 2015 the two sample villages received Rp 260 million for each village fund for the village of Kuaklalo used to build one meeting hall and one drill bit; and Oeletsala Village of Rp 262.5 million for road construction in the form of paving roads connecting Kupang-Bismarak main road with two sub-villages within Oeletsala Village. The funds are fully absorbed for the construction of rural infrastructure in each village. Then in the fiscal year 2016 each village gets a Village Fund of Rp 629 million is also still focused on the development and construction of rural infrastructure, has not planned and budgeted Village Fund for general economic development and program One Village, One Superior Product.

Unplanned and budgeted Village Funds for the development of excellent products in both sample villages are due to ineffective socialization, less effective mentoring of sub-district and district governments related to the preparation of national, district and village priority programs that must be made in “revised RPJM Desa documents” which are subsequently included in RKP Desa and APB Desa every budget year, and limited quality of human resources of village apparatus. Thus, there are no synchronized plans and budgets between RPJM Desa and RKP Desa and APB Desa as the government hopes.

Furthermore, in 2017 every village in Taebenu sub-district of Kupang district receives an average of Rp 801,918,000 in Village Funds so that the Oletsala Village government plans and allocates Rp 105,000,000 of Village Funds for the procurement of 35 head of beef cattle distributed to farmers for further maintenance while the village of Kuaklalo planned and budgeted the procurement of 25 beef cattle with the allocation of Village Fund of Rp 75,000,000 for 25 farmers. In the Village RPJM and RKP of the current year is also not planned and budgeted Village Fund for the development of processing industries of agricultural products, except the processing of animal feed with Appropriate Techonology that has been initiated and held by the Faculty of Agriculture University of Nusa Cendana in fiscal year 2012 although the utilization is still limited to a few breeders only. For the future, more farmers are expected to use the technology for the development of agricultural and livestock enterprises on a larger scale.

One Village, One Plan, One Budget, One Product (Village of Ile Padung District Lewolema-East Flores)

The village of Ile Padung is one of the villages of cashew nuts production center in Lewolema District, East Flores regency with a population of 1,139 people with main source of income coming from the cultivation and production of Cashew that has entered the market of USA and India. Productive land area of Cashew Cashew ± reaches 200 hectares with cashew nut production reaches an average of 135.41 tons per season, which can be sold seacra logs at an average price of Rp 20,000 per ki1ogram, and if processed into cashew nut reaches Rp 180,000 per kilogram. In addition, the potential of cashew fruit cashew nuts that have not been processed secaa commercial as one source of additional revenue. The potential of all fruit every season is 1,187.75 tons per season and if only 50% is processed into syrup, the gross revenue per season reaches Rp 2.012 billion or net income of Rp 804,859,200 per year (Jati, Fernandez, and Astuti, 2016).

In Ile Padung Village there are two Processing Units that cultivate organic cashew systems, produce cashew nuts and handle cashew nuts cashew marketing for the export destination market of the United States. Both UPHs are each year able to export cashews ± 35 tons and cashew glondonga as much as 60 tons, while the fruits have not been processed by these two UPH. Based on the results of research and interviews with Village Head of Ile Padung and both Head of UPH Management known that the activity of cultivation, production and marketing of cashew nut (cashew nut and cashew nuts) is done at expense of each member and group, for the smoothness of the business activity of this UPH.

On the other hand, one of the potentials of a viable household industry in the village of Ile Padung is through other productive economic groups in every neighborhood that can process cashew fruit into various products, such as syrup, jam, chips, fruit juice, pickles, and various other products of high economic value. Household industry plays an important role in poverty alleviation due to its labor-intensive nature, real small capital with simple technology that makes it possible to be undertaken by lower classes especially in rural areas (Malik, 2015). During the year 2016 the authors and students participating KKN PPM in Ile Padung Village have trained the community and productive business groups to make syrup, cashew and cashew nut using simple simple technology so that people can do it with salable results in additional income for every household farmers.

A review of the 2015 RPJM dossier of Ile Padung village that was revised in accordance with the provisions of legislation does not include programs and activities either in the field of development or in the field of community empowerment related to the implementation of One Village policy, One Product as expected by the government. Thus the RKP and APBDesa Ile

Padung village during the period 2015, and 2016 unplanned programs and activities following the budget in APBDesa that focus on the development of superior products Village. Activity plans and budgets for the period of 2015 focus on infrastructure development in the form of construction of waves and abrasion walls in front of the Ile Padung Village Head Office with a budget of Rp 265,082,320 and in 2016 allocated Village Fund of Rp 625,710,500 used rehabilitation of drainage / flood retention in four hamlets and construction of Early Childhood Education (PAUD) building. Thus for two years the Village Fund budget in Ile Padung is used for the construction of village facilities, not yet allocated for the development of economic infrastructure that supports the development of rural households in general and the processing of cashew nut fruits (because of its potential is available even though seasonally) economic value as an implementation of the One Village approach, one superior product.

Then in 2017 the Village Fund is allocated for the Village of Ile Padung for ± Rp 714.350.000. The results of interviews with Village Head, Village Secretary and Head of Development Affairs are known that the Village Fund received in budget year 2017 is still used for the development of rural infrastructure. The Village Government has also started to allocate the Village Fund for the development of productive economic enterprises in groups, such as livestock business groups, woven crafts, sewing, cashew nuts, and cashew cultivation (organic cashew). Funds allocated for the development of micro-productive economic enterprises for all groups in the village of Ile Padung for fiscal year 2017 amounted to Rp 87,500,000 for all productive groups including women's group business.

Based on the information and data obtained can be explained that based on the resource potential owned by the village of Ile Padung is the dominant cashew plantation business, the superior product suitable to be developed because it has the advantage of organic cultivation in accordance with the demand of foreign markets is "cashew nuts and nuts cashew nuts ", so that in the program-activity plan and budget in the coming years should be focused on superior products cashew, cashew nuts and other processed products made from cashew pure fruit.

Therefore, RPJM Ile Padung Village must be revised to include program and activity of development, production, processing and marketing of cashew nuts, cashew nuts and cashew nuts and other processed products based on cashew nuts as superior products of the Village, which is then described in RKP village and APB Village every year. Thus, after the village government together with the community to build public facilities of the Village then in the next stage is to build and develop economic facilities in the sector of household-specific scale type of cashew nut processing planned in RPK Desa and budgeted APB Desa funded from the Fund Village as expected by the government so that within 5-10 years to come Village of Ile Padung famous with Superior Product of Cashew and processed cashew nuts.

However, to develop processed cashew nut products including the processing of all the cashew fruit of the village government is also planning and budgeting capacity building of human resources through training and apprenticeship of entrepreneurship, business management, marketing management, production management and financial management as one way to prepare human resources quality in managing small rural micro-industries in accordance with the potential owned by villagers and natural resources in Ile Padung village. Implementation of the training activities (community empowerment field), the village government can invite instructors from other regions who have succeeded in developing nationally, regionally and globally renowned Competitive Products of the Village so that villagers are interested and motivated to develop excellent products in each village.

To develop the superior products of the Village in Ile Padung, Oeletsala and Kuaklalo require

good and continuous cooperation between village government, local government, community and private sector so as to respond to local, national and foreign market needs and demand. The success of the One Village approach, one superior product (SDSPU) is largely determined by the consistency of policy and policy implementation from the government, local government and village government so that village governments together with the community can have an understanding, a plan and a budget to produce one or more excellent products which became the pride of their respective Villages and ultimately the Village community can develop superior household scale products.

However, it should be realized that the success of rural-scale industrial development by implementing SDSPU policy is determined by four things: 1) a correct understanding of the philosophy of the SDSP or SDSPU approach, 2) policies of the above nature that require each Village to focus on SDSPU should be issued since the beginning of the implementation of Law No. 2014 and PP No. 60 year 2014 and its changes through the RPJM revision of the village instead of each year issued a priority policy of the use of village funds that make the village government should revise the RPJM village each year, 3) the quality of resources human beings must be well prepared and sustainable, and 4) organized to be easily controlled. Claymone (2007) also pointed out that the failure of OVOP is caused by three elements, that is, the problem of not properly understanding the philosophy and approach of OVOP, top down policy issues, and the quality of human resources. Meanwhile, Chayani (n, d) also asserted that 1) the government not only opens the marketing channels through the participation of products at the exhibition but also provides the market, in cooperation with other government agencies or private parties, 2) programming is not only focused on development technical production, and marketing, but also must build more motivation and awareness of the community to be more creative in exploiting the potential possessed in producing good products and can compete in the global market.

According to Malik (2015), basic problems in the development of small-scale industry (including households), among others: “lack of basic skills needed to manage a business to succeed, in product, administration, finance, marketing, distribution, and so on, as well as the reluctance of employers to seek information about the institutions that can help it “. Village Government as a facilitator and developer of development at the village level so that it is obliged to plan, budget, coordinate, implement and control the movement of One Village, One Superior Product with the community to improve the welfare of its citizens through productive economic effort on the scale of household and small scale.

To increase the knowledge, skills and capabilities of human resources to develop rural industries should be planned and budgeted for training and apprenticeship for productive people. The village fund that has reached billions of rupiahs has been able to solve a number of problems experienced by domestic business actors, including capital, while knowledge and skills can be overcome through training funded by important Village Funds (included in RKP village) and budgeted in APB village current year. Thus, within 5-10 years the approach and movement of the SDDPU will be realized and the community will experience a better and prosperous life

CONCLUSION

Government policy for each village in Indonesia to produce a superior product of the village is one of the breakthroughs to accelerate the progress of rural development as well as to reduce the poverty rate and reduce the urbanization rate, but the lack of consistency in the implementation because when issued the policy so that all villages receiving Village Fund revise RPJM village early 2015 was not accompanied by a policy on the priority of using the Village Fund with the SDSPU approach so that three sample villages did not include SDSPU programs and

activities. As a result, RKP village subsequently no longer synchronized with RJPMN, RPJM of district and RPJM of the Village concerned, but the Village still planned and budgeted funds for programs and activities of SDSPU and have been implemented such as in Oeletsala and Kuaklalo while Village of Pad Padung not focus on superior products Cashew which is the largest potential in the village.

Implementation of the SDSPU policy in line with the Decree of the Minister of Village, PDTT 2016 still faces obstacles in coordination among agencies implementing the same programs, such as Cooperatives and SMEs, and Industry-trade, as Pasaribu, et al (2011) finds that "the limitations of internal factors in various forms which mengahmbat OVOP movement in improving the competitiveness of SMEs products in Indonesia, among others, the legislation and valleys coordination between related agencies, especially in financing that resulted in the tersatasinya implementation of activities in the field.

The problem of coordination in the implementation of SDSPU policy is still a barrier, especially on the technical institutions, namely the Department of Cooperatives and SMEs, the Department of Industry and Trade, the Department of Culture and Tourism and the Community Empowerment Board and the village government, and the village government, especially in determining the priority of the use of the Village Fund and coaching and mentoring. The approach and movement of the SDSPU has good prospects because funding issues can be solved with the Village Fund. Improvement of quality Human resources become the main condition of program success must be prepared while improving communication and coordination among related institutions.

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THE CORPORATE SOCIAL RESPONSIBILITY (CSR) ALBAZIA FACALTARIA SEEDLINGS ANALYSIS at BARECORE INDUSTRY (The case study was done at PT. Citra Rahardja Utama, district of Sleman)

Agus Surata* and IndahWidowati**

ABSTRACT

This study aims to: (1) Analyze the number of sengon trees needed to produce a meter cubic barecore, (2) Analyze the CSR of sengon seeds that need to be given to the farmers for raw materials of one meter cubic barecore, (3) Analyze the number of sengon seedlings should be provided by CSR of PT. Citra RahardjaUtama per year, and (4) Analyze the the number of sengon seedlings should be provided by CSR of barecore industry annually. A case study method with data collection was conducted in 2016 by interviewing the management staffs, and being analyzed by tabulating equation rendemen. The result indicated that for one meter cubic barecore needs four of seven years age trees. Five *AlbaziaFalcataria*seedlings supported by CSR was needed for farmer. For CSR activity, PT. Citra RahardjaUtama should provide 38823 seedlings for one years, and totally 12079416 seedlings should be provided by Indonesian barcore industry.

Keywords: Barecore, *AlbaziaFalcataria,*CSR, Trees, Seedlings.

INTRODUCTION

The Bare core is pieces of wood sengon (AlbaziaFalcataria) cut into strips-strip (korpis) with the same size and are bonded to each other with glue so that the sheet like playwood/ plywood. Based on the data export s/d September 2015 Total Export 31,050 countainer 40 [1] HC. That means a positive contribution towards the country's foreign exchange of around USD 468,618,275 (price rata2 USD 260/m^3) until September 2015 in 2015 will reach USD 625 million (Ibca,2015).

Innovation is very important for the company because most of the companies of the benefits derived from the results of innovation. The company may increase success effectively and quickly because innovation (Moore, 1993). Innovation is not only able to generate economic efficiency but also able to improve the company's ability in getting raw materials, either in quantity or quality (Schaper, 2005). Corporate Social Responsibility (CSR) is a social innovation to maintain the sustainability of the supply of raw materials industry barecore, so that the sustainability of the company's bare core. In addition the company responsible for the planet Earth, that is, to maintain and improve the quality of nature and the environment in which the company operates (Elkington,1977).

The *Corporate Social Responsibility (CSR)* according to Azhery (2012) is the company's commitment tothe obligations based on the decision to take the policies and actions having regard to the interests of the *stakeholders* and the environment in which the company performs

its activities based on the provisions of the applicable law. In that means emplisit vied for the company to seriously in an attempt to provide benefits over its presence for the uma human moment (Ranchman, 2011).To maintain a smooth corporate CSR bare core need regulation which gives the company CSR form guidelines and the numbers so that effective, CSR gives the benefit of all parties concerned.

Requires that Corporate Social Responsibility (CSR) for industry barecore is one of the efforts addressing the scarcity of raw materials through balancing growth (provision) and the demand of the plant raw material industry as sengonbarecore.Barecore Industry Association (Ibca) hope the Corporate Social Responsibility (CSR) is not merely a voluntary activity alone but to be a legal responsibility and are mandatory and can be sustainable.

The application of Corporate Social Responsibility (CSR) in Indonesia has been set up in some of the regulations and the decision of the Minister. The implementation of Corporate Social Responsibility (CSR) for a limited liability company (PT) is regulated in the law No. 40 Year 2007. The Act is in force since 16 August 2007. In article 74 paragraph (1) mentioned that a limited liability company that runs its business activities in the field and with regard to natural resources or mandatory social and environmental responsibility of carrying out

Development is the continuous effort of all intended to improve the lives of peoples and Nations which have not been good, or to improve an already good life be better again (Mardikanto, 2012). CSR sengon seedlings on farmers is a form of development that is centered or siding with the people. In addition it is the implementation of a model of sustainable agricultural development. The main focus of development centred on people is to increase the community's ability to manage and mobilize resources in the community to meet the needs. In other words that the agribusiness is people-centered empowerment (empowerment) which leads to the independence of the Community (Korten, 1984).

CSR issues i.e. yet how big a presence and CSR form, although the Government has published CSR legislation. For it needs improvement the Government Regulation. This paper is expected to inspire Government in order for CSR legislation published for bare core required to provide *AlbaziaFalcataria* seedlings to farmers . Therefore, this research aims at:

(1) Analyze the number of *Albazia Falcataria*s trees needed to produce a meter cubic barecore,

(2) Analyze the CSR of *Albazia Falcataria*s seeds that need to be given to the farmers for raw materials of one meter cubic barecore,

(3) Analyze the number of *Albazia Falcataria*s seedlings should be provided by CSR of PT. Citra Rahardja Utama one year, and

(4) Analyze the the number of *Albazia Falcataria*s seedlings should be provided by CSR of barecore industry annually.

RESEARCH METHODS

The research is a case study, case study is a research on the subjects of research with regard to the specific or typical of the overall personality (Maxfield, 1930 in Nasir, 1988). The subject of research is the company barecore in pt. Citra Rahardja Utama year 2016. Data collected through observations, recording and live interview, then analyzed according to the purpose, i.e., using analysis and yield calculation table.

RESULTS and DISCUSSION

Note that the yield of the production barecore Citra Rahardja Utama was 42%, meaning that one cubic meter balken produces 0.42 cubic meters barecore. To produce barecore of one cubic meter of needed raw materials balken of 1:0.42 = 2.38 m3. 80% production yield balken, meaning that one cubic logs produce 0.8 cubic meter balken.. To generate 2.38 m3 sawntimber (balken) need raw log of 2.38: 0.8 = 2.98 m3.

Tree rendemen 0,75 %, artinyasatupohonsengon yang berumur 7 tahunmenghasilkan 0,75 meter kubik log. Untukmenghasilkan 2,98 meter kubik log membutuhkanpohon yang harusditebangsejumlah 2,98 : 0,75 = 4 pohonsengon.

Dayahidup (viability) bibitsengonsebesar 80 % , artinyadari 100 bibit yang hidupmenjadipohonsengon yang berumur 7 tahunsejumlah 80 pohon, ataudengan kata lain yang mati 20 pohon, atautingkatkematian (mortality) sebesar 20 %. Untukmemperoleh 4 pohondibutuhkanbibit yang harusditanamsejumlah 4 : 0,8 = 5bibit.

Tree rendemen of 0.75%, meaning that one tree sengon (*Albazia Falcataria*) aged 7 years yielded 0.75 cubic meters of logs. To yield 2.98 cubic meters of logs felled should trees need a certain amount of 2.98:0.75 = 4 trees sengon. Vitality (viability) of 80% sengon seedlings, meaning 100 seeds of life becomes the tree that sengon 7 years a number of 80 trees, or in other words the 20 dead trees, or the death rate (mortality) of 20%. To obtain the required tree seedlings 4 that should be planted a number of 4:5bibit = 0.8.

Of a variety which has been described can be made as follows table 1.

Table 1. Rendemen Barecore, Balken, Log, Tree of Life, and Viability for Seedlings Sengon.

	Barecore (m3)	Balken (m3)	Log (m3)	Pohon (unit)	Bibit (unit)
Rendemen Barecore 0,42 **%**	1	1:0,42= 2,38	2,98	4	5
Rendemen Balken 0,80 **%**		2,38:0,80= 2,98	2,98	4	5
Rendemen log :0,75 **%**			2,98:0,75= 3,97=4	4	5
Daya Hidup Pohon 0,80 **%**				4:0,80=5	5
Bibit					5

From Table 1 it can be known that to produce 1 m3 barecore m3 2.38 company needs balken (sawn timber). To produce balken, 2.38 m3 craftsmen balken (sawmills) requires 2.98 m3 log. To yield 2.98 m3 log lumberjack need 4 tree sengon aged 7 years. To produce a 4-year-old tree farmer sengon requires 5 seeds sengon aged 3 months. To maintain the sustainability of the tree to keep continuity sengon raw materials company CSR required sengon barecore to farmers a number of 5 seeds per 1 m3 barecore of the resulting company. For it is necessary the effort of planting sengon involving factories, communities and Government. Government. Without the presence of planting sengon will the industry's difficulty procuring raw materials.

Production barecore Citra Main Rahardja 11 container per month (1 countainer = 58.8216 m3) or 647.04 m3 one month or 7764.45 m3 one year. For that number of seedling-planting required 5 x 7764,45 = 38823 seedlings.

Production of 3,450 container per month Indonesia barecore Association (Ibca, 2015). For that

it takes seeds sengon as follows:

- Volume 1 countainer = 58.8216 m3.
- Needs of sawn timber (balken):
  3450x58,8216:0.42 = 202934.52; 483177.43 = 0.42 m3 (rendemen 42%)
- Needs log: 483177,43:0.80 = 603971.79 m3 of logs (rendemen 80 %)
- Sengon tree Needs 7 years:
  603971, 790, 75 = 805294.67 = 805295 trees (rendemen 0.75%).
- Needs sengon seedlings (viability 80%) :
  805294.67 : 0,8 = 1006618 seedlings / month or 12079416seedlings one year.

CONCLUSIONS

The results showed that: (1) one cubic barecore need raw materials 4 sengon trees aged 7 years, (2) one cubic barecore need CSR 5 seeds sengon given to farmers, (3) CSR PT. Cita Rahardja Utama need to give seedlings sengon 38823 sengon seedlings.per year, and (4) the CSR Industry barecore Indonesia 12079416 need to give seedlings a year.

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The Land Degradation Based on Landslide Parameters in Clapar Area, Banjarnegara Regency, Central Java

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ABSTRACT

Clapar village is the largest village that produce salak in Banjarnegara regency. The plants has fibrous root that control the properties of soil. The condition of loose soil causes the bonding between grains in the soil weaken. It makes the water easily infiltrate into the soil that causes increase the soil mass and can move easily. The aim of this observation is to identificate land degradation based on landslide parameters in research area.

The observation was conducted for 2 months to identificate the direction and speed of landslide movement at 3 point of observation. From observation of land movements for 3 periods around 3 months, indicating that this observation points (P1, P2, P3) was move. In the first to second period P1 moved 1.43 cm with direction N 043^{o} E, P2 moved 1.17 cm with direction N 113^{o} E, and P3 moved 0.56 cm with direction N 045^{o} E. In the second to third period P1 moved 0.77 cm with direction N 094^{o} E, P2 moved 0.42 cm with direction N 054^{o} E, and P3 moved 0.28 cm with direction N 276^{o} E. In the first to third period P1 moved 2.0 cm with direction N 060^{o} E, point P2 moved 1.43 cm with direction N 098^{o} E, and P3 moved 0.45 cm with direction N 015^{o} E.

There are 1 soil samples on the slope of the landslide was taken to identificate the shear strength of soil. The results of geotechnical analysis of soil samples on the Clapar slope obtained the angle of direct shear is 27^{o} with safety factor value is 1.045, included into critical class. The observation results above are the parameters of landslide that cause land degradation in research area.

Keywords: land degradation; landslide; Clapar

INTRODUCTION

The research area is located in Clapar, Madukara, Banjarnegara District, Central Java. Physiographically, this research area l in the North Serayu basin. This research is based on the morphology that has the potentially slope to occur landslides. And proved by the existence of landslide that happened in March 24th 2016. The catastrophic effect caused 9 houses to be severely damaged and destroyed, 34 houses are threatened, and 237 people were evacuated. This study specifically analysis the potential of soil movement and the factors that influence it, then make a landslide zoning and inform it to do a disaster mitigation. The important aim of this research is able to give final result of quantitative analysis which is a combination data of landslide parameter values by scoring method. The analysis of landslide zonation using Geographic Information System (GIS) to scoring the factors that affect soil movement. In

addition, several soil samples were taken to determine the shear strength of the soil.

METHOD

Methods that use to collect the data for this research are survey along transect traversing through different vegetation on slope of Clapar area, geology observation, GPS geodetic measurement and soil sample direct shear test. The transect traversing used to find out how differentiation of vegetation affect land degradation. Geology observation used to collect lithology data in research area and along the transect. The data is needed for identificate the linkages between vegetation and lithology with land degradation. GPS geodetic measurements is used to determine the speed of land movement. The soil sample and direct shear test is used to identificate the angle of shear stength and safety factor value from the slope.

RESULT AND DISCUSSION

Result

Geology

The lithology in this research area consist of 3 lithostratigraphy units. This lithostratigraphy unit divide by characteristic of each lithology and fossil content to identificate the relative age.

1. Polimictic Breccia Totogan Formation. This unit lithostratigraphy consist of mud supported breccia with clay to boulder grain size and interbedded claystone and sandstone. The fragment of breccia consist of andesite, basalt, quartz and chert. From microfossil analysis, the relative age of this unit lithostratigraphy is Oligocene to Early Miocene and the depositional setting is upper to lower bathyal. Based on lithology characteristic Polimictic Breccia Totogan Formation is an olistostrom deposit caused by gravity flows sedimentation was influence by uplifting and rapid erosion of the source rock (Lexicon, 2003). This unit lithostratigraphy is located in north east of research area.

2. Volcanic Breccia Tapak Formation. This unit lithostratigraphy consist of grain supported volcanic breccia with massive structure and coarse sand-boulder grain size. The fragment consist of andesitic igneous rock, pumice and tufaceous sandstone, matrix consist of volcanic glass and clay with silica cement. The statement from previous research by Condon et.al. (1996) said that Volcanic Breccia Tapak Formation deposited in Pliocene. The depositional setting from this formation is tidal – marine zone in island arc tectonic setting (Lexicon, 2003). This unit lithostratigraphy is located in middle of research area.

3. Polimictic Breccia Ligung Formation. This unit lithostratigraphy consist of mud supported breccia with massive structure and coarse sand-cobble grain size. The fragment consist of andesite, tuffaceous sandstone, siltstone and matrix consist of clay with silica cement. The relative age of this unit lithostratigraphy is Late Pliocene – Pleistocene (Condon et al, 1996). The depositional setting is terrestrial in volcanic arc tectonic setting (Lexicon, 2003). This unit lithostratigraphy is located in south west of research area.

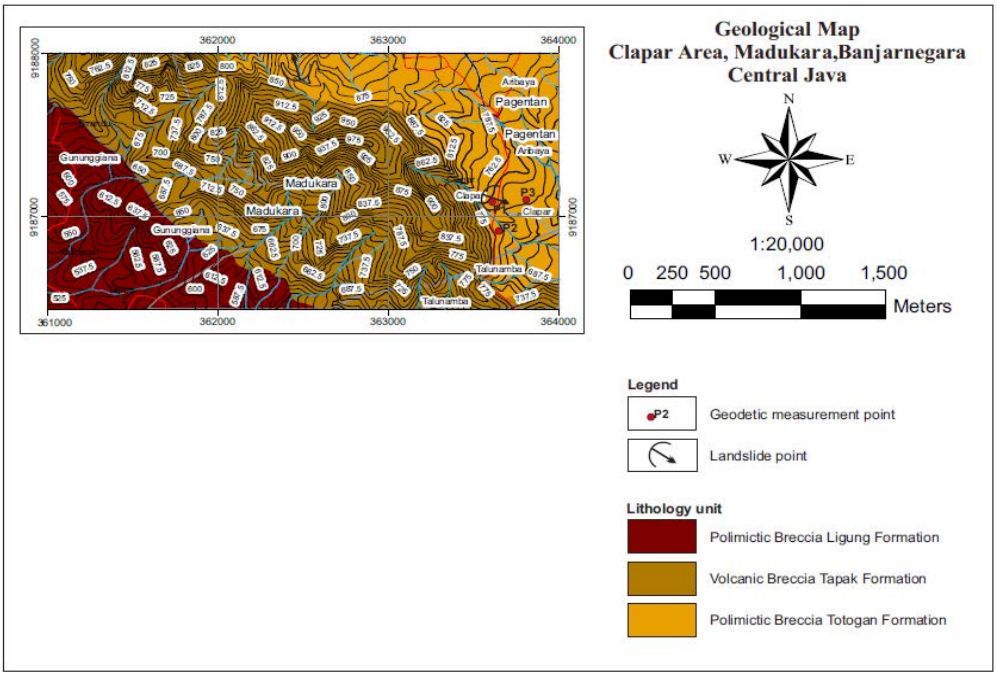

Figure 1. Geological Map of Clapar Area, Madukara, Banjarnegara.

Slope Stability

This analysis is obtained by landslide slope geometry measurement and taking soil sample from top and bottom of landslide slope in research area. Furthermore, this soil sample analyzed with direct shear test to obtaining the angel of shear strength and cohesion of soil. Those data then modeled to get the safety factor value and classification of landslide slope condition (Bowles, 1991). Angle of shear strength from direct shear test soil sample in Clapar slope is 27^{o} with safety factor value is 1.045 included in the critical class.

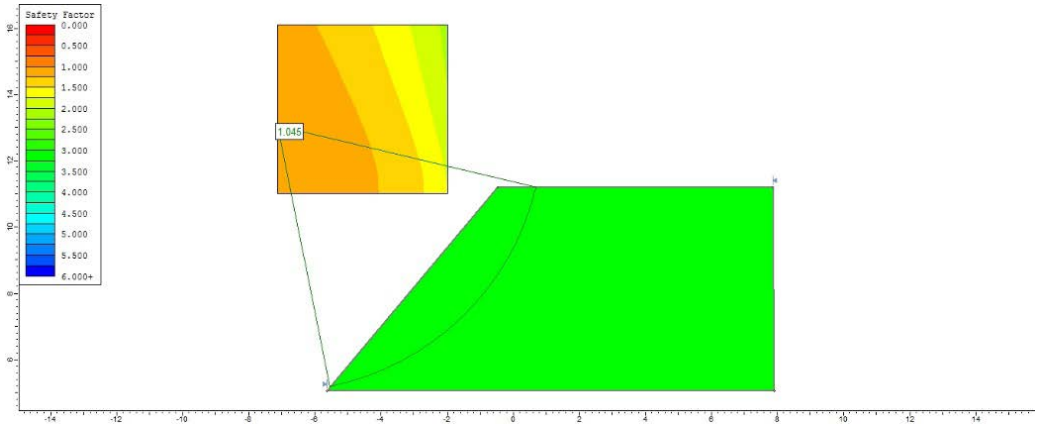

Figure 2. Slope stability analysis with Slide software.

Figure 3. Landslide slope in Clapar village.

Slope Steepness

Based on van Zuidam (1985) classification, the slope steepness on this research area divided into three classes. That are moderately steep class, steep class, and very steep class. Moderately steep class has slope 15 – 25 % cover 35% of region, steep class has slope 25 – 45% cover 15% of region, and very steep class has slope >45%, cover 50% of region. It can be said that Clapar area dominated with very steep area. This slope rate affects the speed condition of erosion and land movement.

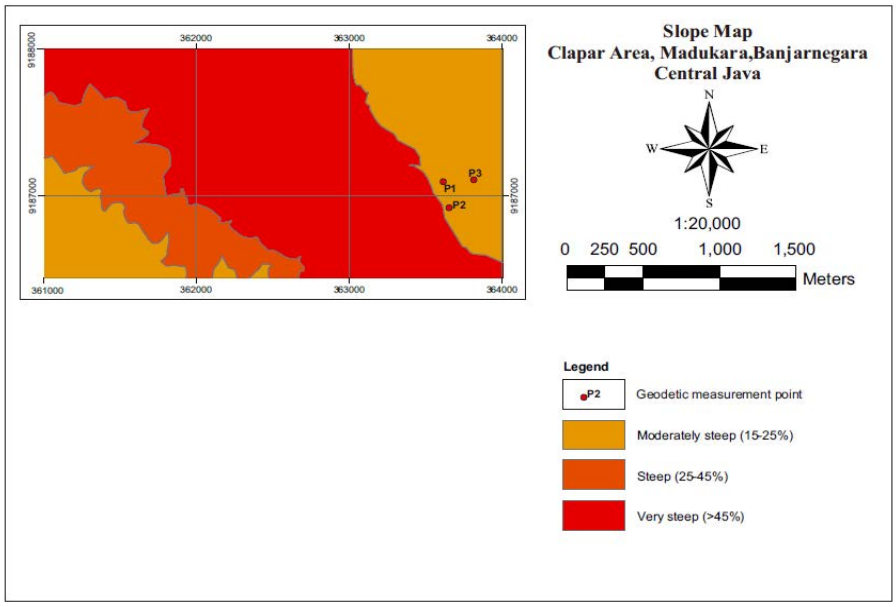

Figure 4. Slope Map of Clapar area, Madukara, Banjarnegara.

Land Use

One of the factor that controls the landslide is land usages. This research area divided into six land usages. That are scrub, forest, salak farm, settlement, rice field, and moor. Vegetation types in forest are pine trees and cocoa trees. Scrub and salak farm are vegetations that has fibrous root that contols the properties of soil. Meanwhile the soil type in research area is podzolic yellowish red.

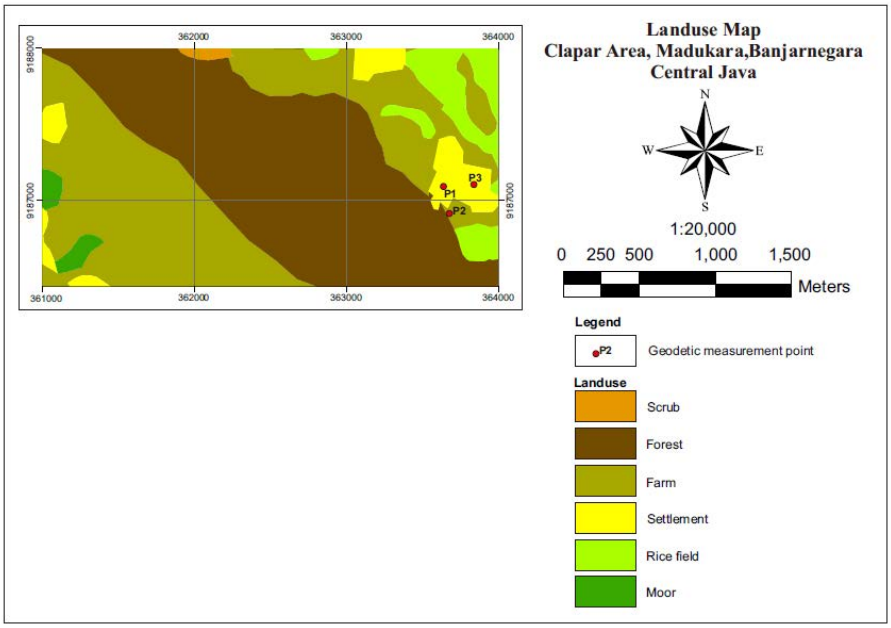

Figure 5. Land Use Map of Clapar area, Madukara, Banjarnegara.

Geodetic GPS Measurement

The geodetic GPS measurement did around 3 months for 3 periods. From this measurement indicating that this observation points (P1, P2, P3) was move. In the first to second period P1 moved 1.43 cm with direction N 043° E, P2 moved 1.17 cm with direction N 113° E, and P3 moved 0.56 cm with direction N 045° E. In the second to third period P1 moved 0.77 cm with direction N 094° E, P2 moved 0.42 cm with direction N 054° E, and P3 moved 0.28 cm with direction N 276° E. In the first to third period P1 moved 2.0 cm with direction N 060° E, point P2 moved 1.43 cm with direction N 098° E, and P3 moved 0.45 cm with direction N 015° E.

Table 2. Value and direction in first to second period of measurement

POINTS	HORIZONTAL MOVEMENT (CM)	VERTICAL MOVEMENT (CM)	DIRECTION (DEGREES)
P1	1,433404975	-3,000	43,07767
P2	1,167578707	2,400	113,0955
P3	0,564278254	-5,700	44,71281
P4	3,598374	-4,200	26,15204
P5	5,338993577	2,100	326,3814
P6	1,813891361	4,000	108,6147
P7	1,090240896	3,800	327,549
P8	7,52575182	-6,000	12,5478

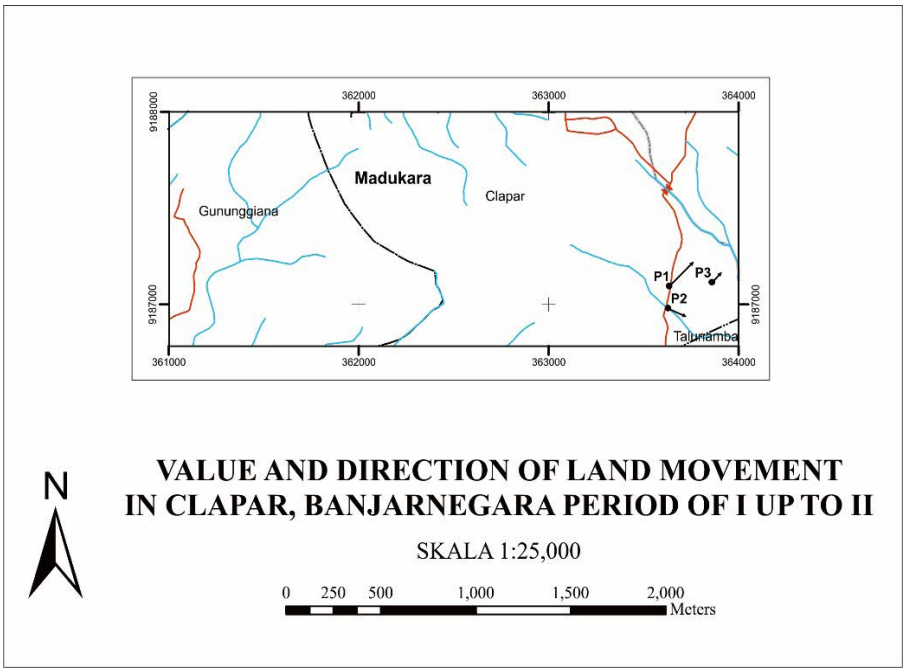

Figure 6. Direction of Land Movement Map periode I-II in Clapar area, Madukara, Banjarnegara

Table 3. Value and direction in second to third period of measurement

POINTS	HORIZONTAL MOVEMENT (CM)	VERTICAL MOVEMENT (CM)	DIRECTION (DEGREES)
P1	0,768346283	6,60000	94,4787815
P2	0,417825305	-4,40000	53,7609095
P3	0,277625662	4,20000	276,203476
P4	3,61670137	-3,50000	20,7099422
P5	2,641063819	-1,90000	74,3376969
P6	1,591578129	-1,80000	64,706907
P7	2,828338917	-7,80000	2,33028356
P8	5,37760285	8,90000	112,339569

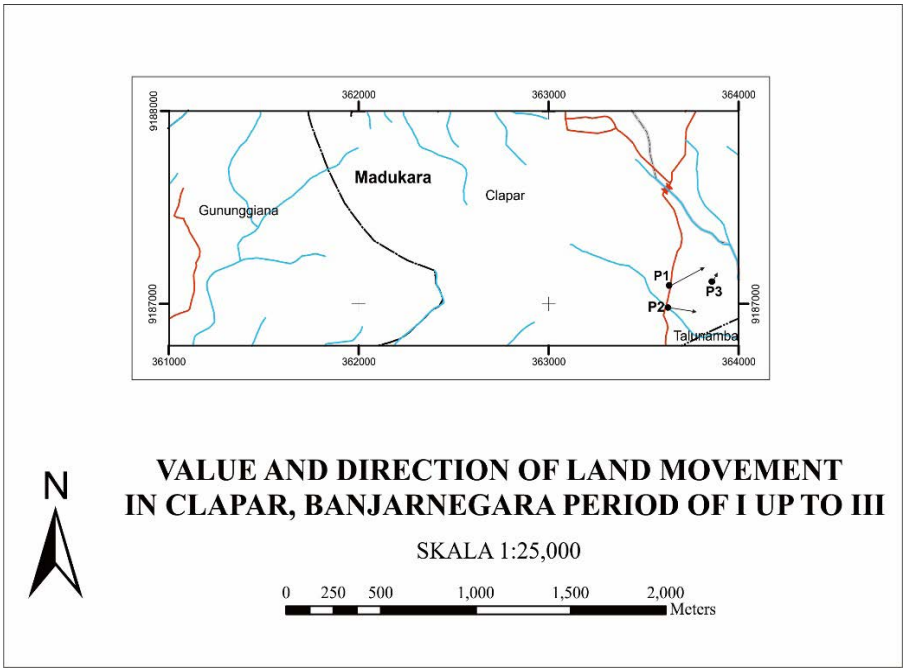

Figure 7. Direction of Land Movement Map periode II-III in Clapar area, Madukara, Banjarnegara

Table 4. Value and direction in first to third period of measurement

POINTS	HORIZONTAL MOVEMENT (CM)	VERTICAL MOVEMENT (CM)	DIRECTION (DEGREES)
P1	2,004792673	3,60000	60,50681
P2	1,426689184	-2,00000	98,50495
P3	0,447662886	-1,50000	15,68168
P4	0,343013076	-7,70000	116,4903
P5	5,175504927	0,20000	355,423
P6	3,159614689	2,20000	88,16817
P7	3,775369768	-4,00000	352,8486
P8	8,472902896	2,90000	51,26204

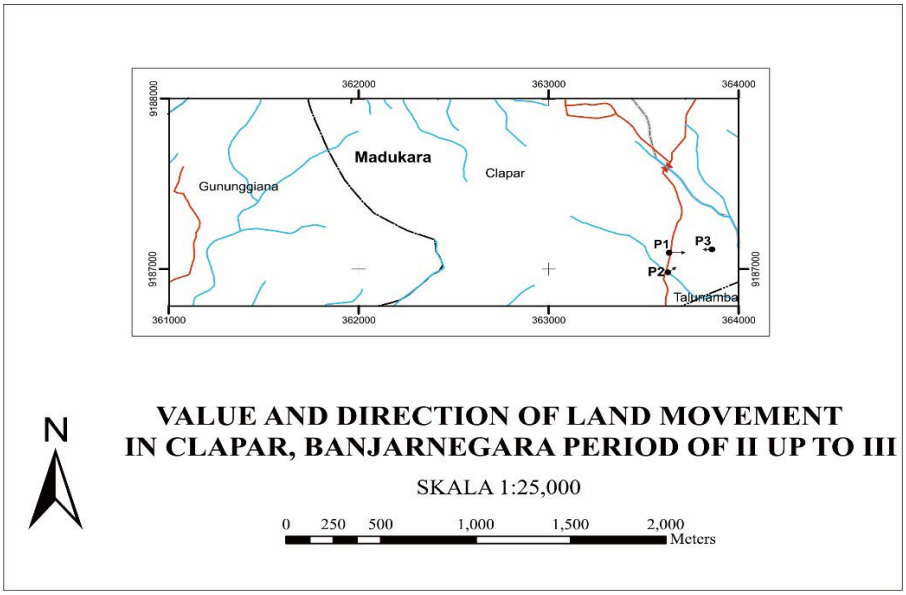

Figure 8. Direction of Land Movement Map periode I-III in Clapar area, Madukara, Banjarnegara

Linkages Between Vegetation and Land Degradation

In order to assess the magnitude of land degradation in different zone and vegetation types, a criterion was set based on field observation along transect traversing. In this case land degradation divided in 3 types that it no visible evidence of land degradation, slight land degradation and severe land degradation. Based on field observation along traverse, land degradation in Clapar Area varied with vegetation. Severe land degradation was in salaka and shrub vegetation. Slight land degradation was in pine tree and it was no visible land degradation in cocoa tree and paddy field.

Table 5. Vegetation types and land degradation zone

Vegetation	Land degradation
Pine tree	Slight land degradation
Salaka	Severe land degradation
Shrub	Severe land degradation
Cocoa tree	No visible evidence of land degradation
Paddy field	No visible evidence of land degradation

Discussion

The other factor of severe land degradation in this area is probably due to the high steepness of slope (30 – 70%) and the dominant lithology consist with clay. In area with high steepness

of slope, clay lithology and low safety factor value, salak and shrub that have fibrous root can make soil loosen and creating chance for water and wind caused degradation to take place. Those data above can be strengthened with geodetic measurement data. The measurement point that moved took place in very steep slope with the lithology consist of clay, the vegetation consist of salak farm and shrub.

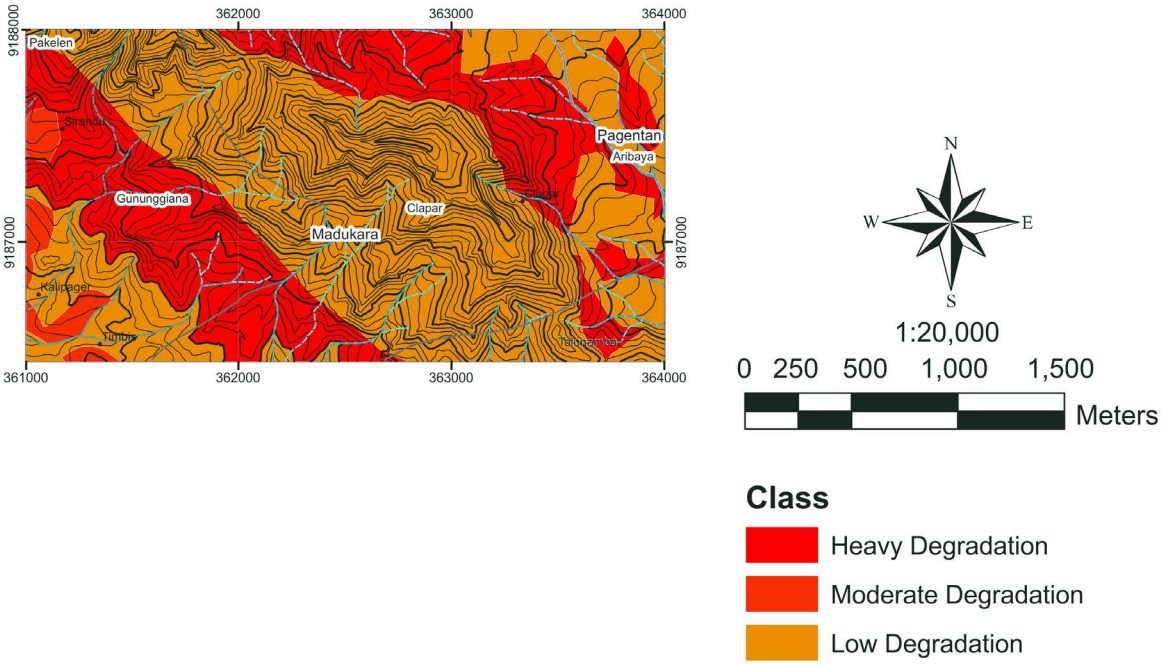

Figure 9. Classification land degradation in Clapar Area

CONCLUSION

- The research area divided into three slope class, that are moderately steep (15 – 25%), steep (25 – 45%), and very steep (>45%).
- The dominant lithology in land degradation area is clay breccia.
- The land usages are settlement, salaka farms, moor, shrub, and paddy field. Severe land degradation was in salaka farms and shrub.
- Rearrangement of slope into terraces with angle of slope <30^{o}, and cultivate tap root plant in landslide slope area.
- Build waterways around steep slope to manage rainwaters to decrease the water saturation of soil.

ACKNOWLEDGEMENT

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Exploring Biochar Potential For Alleviating Indonesian Soil Acidity - A Critical Review

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ABSTRACT

Acid soils occupy approximately 55% of Indonesian total terrestrial land (191.09 million ha). To support Indonesian policy on food and energy security, marginal soils such as acid soil has been established as the target of agriculture development. However, managing such soils for crop productivity with conventional amendments such as lime was challenged by the availability of lime or lime cost and over liming adverse effects. Biochar is alkaline in nature and recent research findings strongly indicated that with its liming effect, water and nutrient retention capability, highly recalcitrant nature, carbon sequestration capacity, and sustainable production of feedstock (e.g. biomass from agricultural residues, timber and forest waste, manure, and municipal solid wastes) biochar could be a potential amendment to acid soils. The objectives of this review were to explore the potential of biochar as an amendment to Indonesian acid soils, and to develop a research framework for biochar future studies in Indonesia. Articles and conference papers where selected, studied and critically reviewed regarding to the soil acidity problems and biochar liming effect, and summarized in this paper. A framework for biochar future research in Indonesia was also presented in this review.

Keywords: biochar, alkalinity, liming potential, acid soils, amendment.

INTRODUCTION

Acid soils occupy approximately 55% of Indonesian total land area (191.09 million ha). About 107.36 million ha of Indonesian acid soils were classified as dryland acid soils and the rest of 14.93 million ha as peat soils. Apart from sub optimal soils, acid soil was targeted for agricultural expansion land to support the government policy on the future food and energy security (Syakir and Nursyamsi, 2015). Acid soils in the Tropics are highly weathered, thus it generally characterized as low pH and CEC, low nutrient concentration and retention (high leaching), low beneficial microbe population, activity and diversity, high exchangeable Al, Mn and Fe, high P fixation, low Mo and other micro nutrients, and therefore could not support plant growth or productivity.

Liming the soils or added organic materials was the conventional amendment strategies. However, the adverse effect of over liming such as trace element deficiency and cation imbalances, the availability of liming materials, and the short-term beneficial effect of organic residues, required an alternative solution for alleviating the multiple constraints of acid soils for the future development.

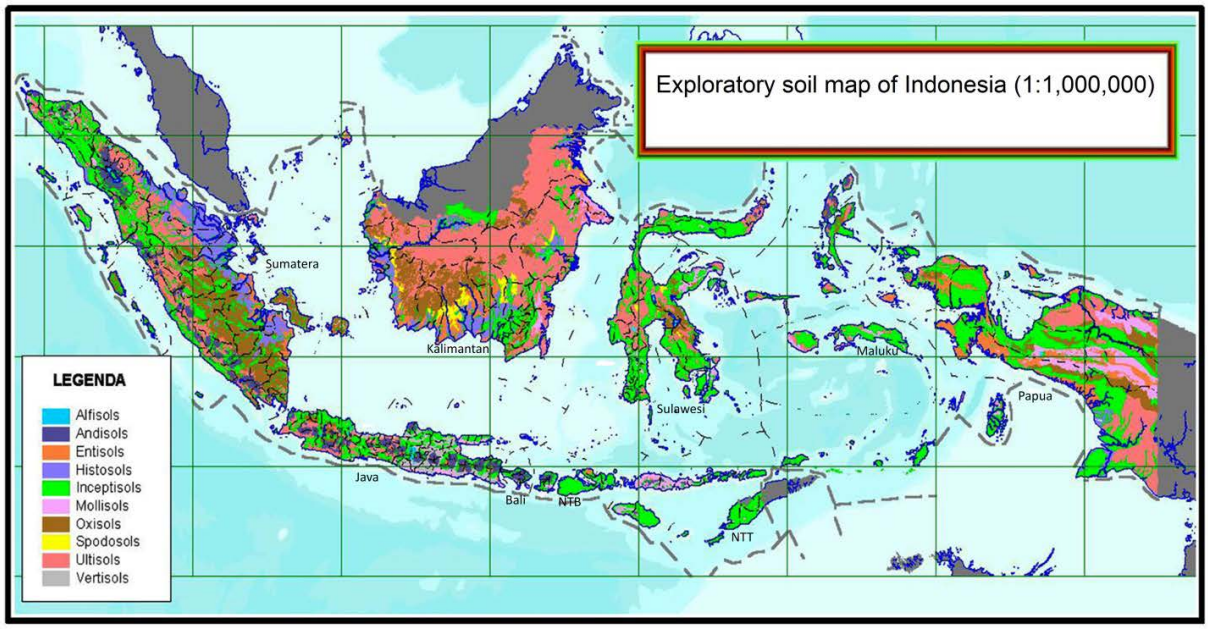
Biochar, the rich C solid product of pyrolysis under limited supply of oxygen has being established as a soil amendment and agent of carbon sequestration. It produced from single or mixture of

biomass materials at the high heat temperature of 300-700°C. Biochar is alkaline in nature. Its pH buffering capacity and alkalinity derived from basic cations and oxygenic functional groups has being established as the sources of its liming potential. In addition to its liming effects, biochar has also nutrient retention capacity derived from its porosity, surface charge and surface areas. The later characteristic could be potential for alleviating the leaching problem of highly weathered tropical acid soils, in addition to as nutrient sources for plant growth. With its high porosity brings about the biochar to be a secure habitat for soil microorganisms which in turn enhancing the soil and plant productivity. Biochar was also being established an agent of carbon sequestration, and therefore could be a good ameliorant for acid soils and climate change mitigation in acid soils.

The beneficial effect of biochar on acid soils has being attracted attention of researches worldwide and the research findings have being formulated to be government policies in some countries. And, there is a huge opportunity for alleviating Indonesian soil acidity and climate changes problems simultaneously by using biochar as an alternative acid soil amendment. However, there are very limited research findings on ameliorating the highly weathered acid soils with biochar in Indonesia. The objectives of this review were to summarize the beneficial effect of biochar on acid soils and to provide a framework for developing biochar as a sustainable amendment to Indonesian acid soils.

ACID SOILS IN INDONESIA

Total area of acid soils in Indonesia is 108.7 million ha or approximately 55% of Indonesian total terrestrial area (Syakir and Nursyamsi, 2015), and distributed out in most of the big islands, such as Kalimantan (39.42%), Sumatera (28.81%), Papua (18.03%), Java (7.77%), and Sulawesi (6.95%) (Fig.1). Most of the acid soils in Indonesia were derived from old volcanic and sedimentary rocks under a humid tropics condition (annual rain fall > 2.000 mm or udic moisture regime, and temperature >22°C), at the wide ranges of their development, and were dominated by ordo Ultisols (41.92%), Inceptisols (40.89%), Oxisols (14.14%), Entisols (3.8%), and Spodosols (2.08%) (Mulyani & Sawarni, 2013).



Source : BBLP, 2000

Upland acid mineral soils in Indonesia were characterized by low pH (<5), high to toxic level of

exchangeable aluminum (Al), manganese (Mn), and sometimes iron (Fe), low base saturation (< 50%) because of high leaching, low nutrient availability included molybdenum (Mo) for legumes, low organic matter content and cation exchange capacity (CEC), low pH buffering capacity, low water and nutrient retention capacity, low beneficial microorganism population, activity and diversity, and high phosphorous fixation, thus could not support plant growth and yield (Berek, 1993; Mulyani & Sarwani, 2013, Irawan et al., 2015; Wigena & Andriati, 2016). In some sites, such as Jasinga (Bogor, West Java) and Guradog (Lebak, Banten), the exchangeable Al was extremely high (8.7-14.0 $cmol_c/kg$) and the pH was also very low (3.9-4.0) (Berek & Hue, 2016), thus the ameliorant should also be applied at a highly rate for raising the pH and correcting the toxicity of Al. In addition to chemical constraints, water shortage was another problem of podzolic soils and podsols. The range of critical moisture content was narrow, thus improving water content of these soils could be considered for any amendment chosen (Notohadiprowiro, 1989).

Liming is a conventional strategy for correction soil acidity by increase soil pH to a certain level and precipitated soluble Al (monomeric hydroxyaluminum) to a non-toxic range, based on the following reactions.

$CaCO_3 + H_2O = Ca^{2+} + HCO_3^- + OH^-$ or

$CaSiO_4 + 2\ H_2O = Ca^{2+} + H_2SiO_3 + 2\ OH^-$.

$H^+ + OH^- = H_2O$

$Al^{3+} + OH^- = Al(OH)_3$

Those chemical reactions revealed that lime is the alkaline agent used to neutralizing soil acidity. Adding organic materials to acid soils can also raise soil pH and decrease the activity of Al^{3+} (Hue et al., 1986; 2011), in addition to increase soil organic matter and nutrients. Al-organic acids interaction or complexing Al by organic acids (at the binding sites) is the mechanism by which the phytotoxicity of Al is reduced and soil pH is increased (Fig.2).

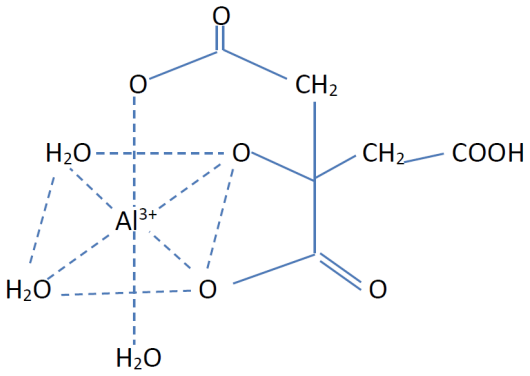


Figure 2. Al-Citrate (Adapted from Motekaitis & Mortell, 1983)

In addition to liming and organic amendments, silicon could also an alternative solution to Al toxicity alleviation. Silicon-aluminum interaction (such as formation of hydroxy-alumino-silicate) has also been shown its positive effect of reducing Al toxicity. The presence of Si in nutrient solution was significantly decreased monomeric Al concentration, and then supported corn root elongation (Barcelo et al., 1993; Ma et al., 1997).

BIOCHAR ALKALINITY, PH BUFFERING CAPACITY AND LIMING EFFECT

Biochar is alkaline in nature. The alkalinity of biochar is originated from inorganic and organic components of biochar (Fidel, 2012). Based on the method of quantification Fidel et al. (2017) indicated four partitions of biochar alkalinity: carbonates, other inorganics, low-pKa organic structural and other organics. The alkalinity of biochar is closely correlated with the basic cations contained by biochar (Berek & Hue, 2016; Fidel et al., 2017).

The alkalinity of biochar is attributed to the feedstock type and pyrolysis temperature (Wan et al., 2014). The alkalinity of manure biochar is higher lignocellulosic and other feedstock, due to the high basic cation and nutrient content (Singh et al., 2010). Among manure biochars the basic cation contents are quite different. For example, Ca content of dairy, paved-feedlot, poultry litter, swine solids and turkey litter biochars producet at 700^{o}C are 44.8, 35.0, 40.2, 61.5, 56.1 g/kg, respectively (Cantrell et al., 2012). Legumes biochar exhibits a higher alkalinity than non-legume one (Yuan & Xu, 2011). Biochar basicity of non-wood is higher than wood feedstock (Montes-Morán et al., 2004; Mukome et al., 2013). More specifically, carbonate content is responsible to the biochar alkalinity (Hass et al 2012; Mukome et al., 2013). The alkalinity of biochar is more pronounced at high pyrolysis temperature, perhaps due to the increasing of carbonate content (Yuan et al., 2011a; Hass et al., 2012). Oxygenic functional groups such as carboxylic acids and phenolic could also be responsible to the alkalinity of low pyrolysis temperature biochar (Keiluweit et al., 2010; Yuan et al., 2011a; Wan et al., 2014). Biochar pretreatment such as activation increases the alkalinity of biochar. For example, carbonate content and pH of activated chicken manure biochar produced at 350^{o}C are 22% and 9.9 which is higher than the corresponding values of non-activated biochar (9.5% and 9.9) (Hass et al., 2012).

Biochar liming potential is the capacity of biochar to increase soil pH and to alleviate the phytotoxicity of Al and to a lesser extent Mn in acid soils. It depends on the alkalinity of biochar which is originated from the basic cations in the ash, and the oxygenic surface functional groups attached at the surface of biochars (Tryon, 1948; Yamato et al., 2006; Nguyen and Lehmann, 2009; Novak et al., 2009; Joseph et al., 2010; Singh et al., 2010; Van Zwieten et al., 2010; Deenik et al., 2011; Yuan et al., 2011a; Streubel et al., 2011; Chintala et al., 2013; Slavich et al., 2013; Smider and Singh, 2014; Wan et al., 2014). During the pyrolysis, the major basic elements in the feedstock ash have been transformed to their carbonates or oxides, and then it can be referred to as calcium carbonate equivalent (CCE). The liming value (expressed as the cmol(OH^-)/kg biochar) of measured $CaCO_3$ equivalent, therefore, could be proportional to the liming value or alkalinity that was produced from the total basic cations in the biochars (Fig. 3) (Berek & Hue, 2016). The closed correlation (r^2=0.84) between alkalinity and basic cations in the biochars has also been shown by Fidel et al. (2017).

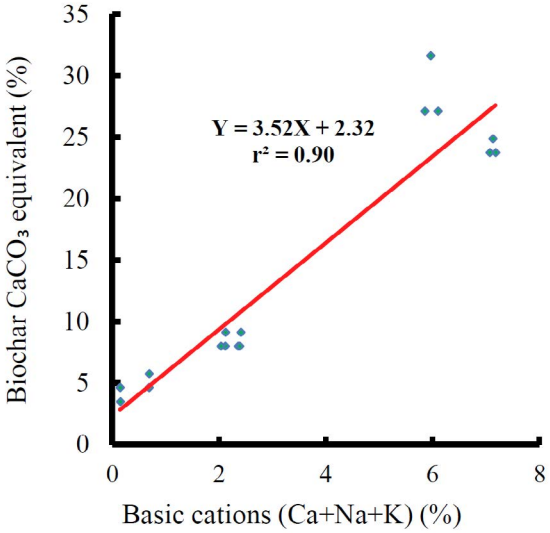


Figure 1. Relationship between biochars CaCO equivalent and basic cations (adapted from Berek, 2015)

The CCE of biochar is feedstock and pyrolysis temperature dependent. Biochar carbonates increase with pyrolysis temperature and responsible for the liming capacity of high temperature biochars. For example, carbonate content of canola straw biochar produced at 300 and 700°C were 15.3 and 165.2 cmol/kg, respectively (Yuan et al., 2011a). Biochar CCE is also affected by feedstock. Fidel et al. (2017), for instance, showed that the proportion of alkalinity contributed by carbonates of hardwood and mixed wood biochars were higher than red oak wood, corn stover and cellulose biochars. Legume biochars have been shown their higher alkalinity than non-legumes. For example, mung bean straw biochar alkalinity was 326.1 $cmol_c$/kg twice of rice straw biochar (162.7 $cmol_c$/kg) (Yuan et al., 2011b).

The liming potential could also be derived from the surface functional groups of biochar such as phenolic and carboxylic acids (Boehm 1994, Rutherford et al., 2008, Cheng et al., 2008, Keiluweit et al., 2010). Decarboxylation of organic anions and the negatively charged functional groups will consume proton then increase the soil pH (Wang et al., 2014). The surface oxygenated functional groups such as carboxylic can also complex with aluminum in the soil solution and reduced its toxicity to plant growth (Qian et al., 2013). However, the surface functional group of biochar is temperature dependent. For example, increasing pyrolysis temperature from 300 to 500°C or 700°C decreases the –COO- and –O- functional groups of biochar (Yuan et al., 2011b).

In addition to the liming effects, high silicon (Si) biochars derived from grasses feedstock in particular, exhibited an interaction Si-Al in the plant roots. For example, addition of rice straw biochar with high Si content to the Oxisol soil slurry reduced phytotoxic Al by coordinated with Al to form Al-Si compound in the epidermis of wheat root (Qian et al., 2016).

PH buffering capacity of biochars, the capacity of biochars to resist its pH change, is originated mostly from their high cation exchange capacity. The negative charge derived from the protonation/deprotonation of biochar surface functional groups and the carbonates of biochars are responsible to the high buffering capacity of biochar. Incorporation of biochar into acid soils increases soils capacity to maintain their pH change by the acidification processes (Xu et al., 2011). Thus, pH buffering capacity could be used to select suitable biochar for amending acid

soils. For example, Dai et al. (2014) showed that the addition of swine manure at 3% increased the soil pH more than rape straw, reed straw, pineapple peel biochars at the same rate, due to its high pH buffering capacity.

BENEFICIAL EFFECTS OF BIOCHAR ON ACID SOILS

A meta-analysis conducted by Biederman and Harpole (2013) revealed that biochar promote plant productivity and yield by short- and long-term effects. Improving water holding capacity and introducing nutrients such as K and P were the examples of short lived effects, while liming effect and nutrient retention were the examples of long-term effects of biochar. Alkaline biochar was more effective than acidic one at increasing soil pH, reducing exchangeable aluminum and iron, which in turn, increasing P availability in acid soils. More specifically, Jeffery et al. (2017) based on their global-meta analysis pointed out that enhancing crop yield by biochar in the Tropics was more effective through liming and fertilization of acid low nutrient soils received low fertilizer input. The effects and mechanisms by which biochar improving acid soils productivity with stressing on liming effects (soil acidity and Al toxicity), nutrient availability, and soil nitrification have been discussed in a critical review conducted by Dai et al. (2017). This review, therefore, will just summarize and then discuss other beneficial effects and mechanisms for Indonesian upland acid soils.

As it previously mentioned that correction soil acidity, alleviating Al toxicity and to lesser extent Mn or iron, and P fixation were the main beneficial effects of biochars addition to acid soils. Basic cations contained by biochars in their form of carbonates or oxides as a source of alkalinity will replace lime function in producing ion OH^{-1} to neutralizing excess ion H^{+} resulting in increasing soil pH (Berek & Hue, 2015). Alleviating Al toxicity could be attributed to the reducing activity of monomeric Al^{3+} and other species by precipitation due to increasing soil pH or undergo precipitation reaction with silicate, adsorption at binding site of biochar surface, complexation by oxygenic surface functional groups of biochar, or will be interacted with Si contained in the Si-rich biochar to form Al-Si compound in the epidermis root (Qian et al., 2016). Precipitation of Al and Fe will then releasing P fixation and provide P to plant. Micronutrient such as Zn and Mo will also be more available, and beneficial microbes (e.g. rhizobium, mycorrhizal fungi, and phosphate solubilized bacteria) activity will also be more pronounced after correcting soil acidity. Improving soil pH buffering capacity could be another benefit obtained by adding biochar to acid soils. Highly weathered acid soils in the Tropics such as Oxisols and Ultisols are low in pH buffering capacity due to low CEC and organic matter, and dominated by kaolinitic and haloyisite minerals, and therefore prone to soil acidification. Biochars had been shown their high CEC and pH, therefore, acid soils could be more resisted to pH change due to acidification processes when incorporated with biochar (Shi et al., 2017).

Biochars have been shown their capacity to improve water and nutrient retention of soils including acid soils in the Tropics. Jeffery et al. (2011) highlighted that one principle mechanism by which biochar enhancing crop yield was water holding capacity improvement. High water retention of biochar is mainly attributed to its large surface area and high porosity (Lua et al., 2004; Brown et al., 2006; Laird et al., 2010; Novak et al., 2012; Brantley et al., 2015), which is affected by pyrolysis temperature and feedstock (Novak et al., 2009; Karhu et al., 2011; Novak et al., 2012; Brantely et al., 2015). The magnitude of improving soil water retention by biochar is determined by biochar feedstock, pyrolysis temperature, and application rate, and soil properties. For example, additions of greenwaste biochar produced at 450^{o}C by a slow pyrolysis to an Alfisol increased field capacity water retained by the soils (Chan et al., 2007). Switch grass biochar produced at 500^{o}C applied at 40 Mg/ha increased water retention a loamy

sand soil more than poultry litter, pecan shell and peanut hull biochars (Novak et al., 2009). Water retention of Hapludoll from Iowa was increased by a mixed wood biochar (Laird et al., 2010). Water retention of clay soil was improved by added a mixed tree fruits biochar at 3% (Castellini et al., 2015). Soil water retention of a loamy sand texture was increased from 13.92% to 17-21.5% by added 5% of acacia wood, cashew wood or bamboo biochars (Rattanakam et al., 2017).

Highly weathered soils in the Tropics such as Indonesian acid soils are often poor in nutrients because of leaching. The loss of nutrients not only increases cost of plan production, but also causes environmental problems such as water pollution. Recent research revealed that additions of biochar reduced nutrient losses (Laird et al., 2010; Singh et al., 2010; Major et al., 2012; Ventura et al., 2012; Liu et al., 2014; Berek & Hue, 2015). Nutrient retention capacity of biochar could be attributed to its large surface area and surface charge, high porosity, and other factor such as pH and ionic competition. Thus, added biochar to acid soils could alleviate soil nutrient losses by electrostatic adsorption and physically entrapped inside the pores (Lehmann et al., 2003; Laird et al., 2008; Prendergast-Miller et al., 2011; Cheng et al., 2012; Jones et al., 2012; Kameyana et al., 2012).

In addition to improving acid soil productivity, biochar can also be acting as an agent of carbon sequestration and GHG emission mitigation. It can store and lock atmospheric carbon in the soil system for a long-term scale depending on its recalcitrant nature. Biochar can also reducing greenhouse gas emissions such as N_2O and methane via several pathways.

BIOCHAR BY DESIGN

Biochar is not a universal "one size fits for all" soil amendment and agent of carbon sequestration. The outcomes of its application can be widely varying depending on the agricultural and climate conditions (such as soil type, crop type, climate and social setting) (Abiven et al., 2014). For a specific purpose, biochar can be engineered by one of the four following modification methods : chemical modification, physical modification, impregnation with mineral sorbents, and magnetic modification (Rajapaksha et al., 2016). For example, blended pine chips (plant-based) and poultry litter (animal-based) biochars 80:20 (80% pine chips : 20% poultry litter) increased belowground biomass of winter wheat grown at a hard setting subsoil layer of Norfolk soil by 81% compared to 76% of that hardwood biochar or 9% of that 50:50 blended biochar (Sigua et al., 2016).

BIOCHAR OPPORTUNITY FOR INDONESIAN ACID SOILS

To support Indonesian policy on food and energy security acid upland soils-part of suboptimal soils has been targeted for agricultural land expansion, in one side. In the other side, biochar was being established as a sustainable amendment to acid soils and agent of climate change mitigation. This opportunity was also being supported by the increasing research interest of Indonesian scholars and research agencies, such as Indonesian Agency of Agricultural Research and Development (Balibangtan) Ministry of Agriculture, Indonesian Agency of Forestry Research and Development (Balitbanghut), including Indonesian Biochar Association (ABI) that was established several years ago.

Sustainable available of feedstock as an essential requirement for biochar development could be an opportunity for Indonesia. Potential feedstock for biochar, such as palm oil empty fruits and kernels, sugar cane waste, saw dust, rice husk, sewage sludge, manures and urines, municipal waste, are available abundance in Indonesia. Utilization of waste, municipal waste in particular,

as a potential biochar feedstock could be a comprehensive solution from the environment, health, climate change mitigation, and agricultural perspectives.

Economic and social viable and acceptance could be a noble chance for Indonesia small scale farmers as a way out to face with the high cost and availability of fertilizer and other amendments in rural areas. Most of Indonesia farmers experiencing the benefit of slash and burning traditional practices that provide short-term high yield resulted from the basic nutrient content in the ash. In many part of this country, people produce charcoal for energy purpose then it could also be opportunity for biochar development in respect to the familiarity of community to the production process.

FUTURE PERSPECTIVE

Initial biochar research reports, such as Yamato et al. (2006), Masulili et al. (2010), Islami et al. (2011), Sukartono et al. (2011), Pari et al. (2013), Martinsen et al. (2015), Berek & Hue (2016) indicated that biochar could be potential amendment for Indonesian acid soils. Therefore future research on improving crop yield, soil properties, and climate change abatement by biochar in Indonesia need to be developed. Thus, a research framework is required to be designed for researchers to go through. As it mentioned previously that managing acid upland soils in Indonesia one could be considering their multiple constraints that are varying from site to site because such soils and availability of feedstock were widely distributed among islands or even in the same island.

To overcome with these highly variability circumstances, the engineered/designer biochar concept could be the best choice for Indonesia. The Indonesian potential feedstock is essential to be mapped, followed by established the production pathways. The next step could be characterization of the products-biochars. To test the suitability of biochar or engineered biochar, a general or even a local standard for acid soils is also another work that should be established. Then, conducting pot/greenhouse and field trials is the next step to test the biochar effects on soil properties, carbon sequestration, greenhouse gases emission, and plant growth and yield.

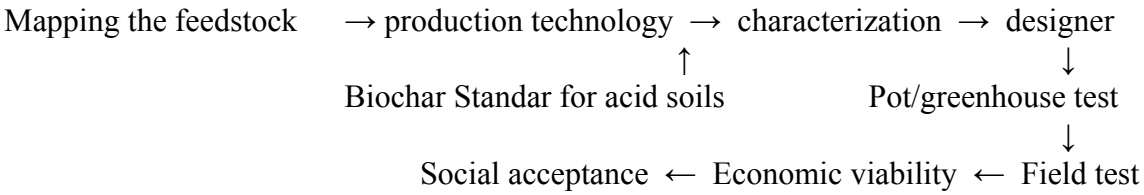


Figure 4. A simplified biochar research frame work for Idonesian acid upland soils

CONCLUSION

Biochar as a pyrolysis co-product is alkaline in nature, thus it could be a good amendment to acid soils, including acid upland soils in Indonesia.

Biochar could be potential for Indonesian acid upland soils which were being developed for agricultural land. The availability of biochar feedstock and its distribution, availability and cheaper production technology, high research interest, familiarity of community to the product utilization, could be opportunities for biochar development in Indonesia.

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Mapping the prediction of spatial and temporal soil organic matter variabilities based on spectroscopy method

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ABSTRACT

Precision farming practices requires that farmers are aware of with-in field variabilities of soil properties. An important variable in soil management is the soil organic matter (SOM) content. The problem is how to provide reliable, fast and inexpensive information of SOM in the subsurface from numerous soil samples and repeated measurement. The use of spectroscopy technology has emerged as a rapid and low-cost tool for extensive investigation of soil properties. The objective of this research was to develop calibration models based on laboratory Vis-NIR spectroscopy to estimate the SOM at four different growth stages of soybean crop in Yogyakarta Province. An ASD Field-spectrophotoradiometer was used to measure the reflectance of soil samples. The partial least square regression (PLSR) was performed to establish the relationship between the SOM with Vis-NIR soil reflectance spectra. The selected calibration model was used to predict the new samples of SOM. The temporal and spatial variability of SOM were in digital map format based on the prediction data with inverse distance weighted (IDW) interpolation method. The results revealed that the calibration model was good for SOM prediction. The SOM content at different growth stage and location with-in field were very low, varied from 0.6 to 1,8%.

Keywords: Precision farming; soil organic matter; Vis-NIR spectroscopy; partial least square regression (PLSR); inverse distance weighted (IDW)

INTRODUCTION

Soil organic matter affects the soil structure and porosity, the water infiltration rate and moisture holding capacity of soils, the diversity and biological activity of soil organisms, and plant nutrient availability. Various types of human activity decrease soil organic matter contents and biological activity. However, increasing the organic matter content of soils or even maintaining good levels requires a sustained effort that includes returning organic materials to soils and rotations with high-residue crops and deep- or dense-rooting crops (Bot & Benites, 2005).

The capability of soil to supply nutrient for plant growth is greatly influenced by the soil properties. Farmers should aware of with-in field variabilities of soil properties to manage their farms. Therefore, mapping and dating soil properties are vital to precise agriculture and soil evaluation.

Information of soil properties is important to support the agronomic decisions for farm management, i.e. applying the agricultural input with the right treatment, in the right place, at the right time and right amount. A soil management recommendation based on soil analysis is good only if the soil sample analyzed is representative of the field. The major problem is how to provide reliable, fast and inexpensive information of soil properties in the subsurface from

numerous soil samples and repeated measurement.

The development of sensing technology coupled with advances in information and communications technology is very supportive in the use of soil sensing. Soil sensing can facilitate the measurement and monitoring of the soil's physical and biochemical attributes to better understand their dynamics, their interaction with the environment while considering their large spatial heterogeneity (Rossel & Bouma, 2016).

Recently, visible and near infrared (Vis-NIR) diffuse reflectance spectroscopy has emerged as a rapid and low-cost tool for extensive investigation of soil properties. Spectroscopy in the ultraviolet (UV, 250–400 nm), visible (VIS, 400–700 nm), and near-infrared (NIR, 700–2500 nm) ranges allows rapid acquisition of soil information at quantitative, and qualitative or indicator, levels for use in agriculture and environmental monitoring (Islam *et al*., 2003).

Soil organic matters can have broad absorption bands in the visible region that are dominated by chromophores and the darkness of organic matter (Stenberg *et al*., 2010). Hedley *et al*. (2010) conducted proximal soil spectroscopy research for soil carbon estimation and the result was that soils with higher organic matter content exhibit less reflectance.

The quantitative spectral analysis of soil using Vis-NIR reflectance spectroscopy requires sophisticated statistical techniques to discern the response of soil attributes from spectral properties. Various methods have been used to relate a soil spectrum to soil attributes (Gholizadeh *et al*., 2014). The multivariate analysis is used because in fact the problem that occurs cannot be solved by simply link the two variables or see the effect of one variable to another. The most common calibration methods applied are based on linear regressions, namely stepwise multiple linear regression (SMLR), principal component regression (PCR), and partial least squares regression (PLSR). Rossel *et al*. (2006) agreed with Geladi and Kowalski (1986) that PLSR takes advantage of the correlation that exists between the spectra and the soil, thus the resulting spectral vectors are directly related to the soil attribute. The advantages of PLSR are that it handles multi-collinearity, it is robust in terms of data noise and missing values. They also found that spectroscopic analyses combined with PLSR were very attractive for modeling and precision agriculture.

The objective of this research was to develop calibration models based on laboratory Vis-NIR spectroscopy and partial least-square regression (PLSR) analysis to estimate the soil organic matter (SOM) content at four different growth stages of soybean crop in two small farms at Yogyakarta Province. The SOM was measured using Walkley and Black method, while the soil reflectance was scanned with an ASD Field-spec 3 (range from 350 nm to 2500 nm). The PLSR with full cross-validation was performed to establish the relationship between the SOM with the pre-treated Vis-NIR soil reflectance spectra. The selected calibration model was used to predict the other new samples of SOM. The temporal and spatial variability of SOM was performed in digital maps using inverse distance weighted (IDW) interpolation method. These maps gave much information to be interpreted carefully due to many factors affect the SOM. They were useful to support the process of decision making in field management.

MATERIAL AND METHODS

Site description

The research was conducted at soybean farms in two locations, i.e. Natah Village, Nglipar District, Gunung Kidul Regency (7°51'39.0"S, 110°39'19.4"E) and Jatimulyo Village, Dlingo District, Bantul Regency (7°55'22.5"S, 110°29'08.7"E) in Yogyakarta Province (Fig. 1). The

elevation of Nglipar ranges from 200 to 210 m asl., while Dlingo elevation ranges from 190 to 200 m asl. The slope varies between 5° to 10° which Dlingo was steeper than Nglipar. Soils in the study area were tentatively classified as *Hapludults* and *Dystrudepts* at Nglipar, while soils at Dlingo were classified as *Hapludalfs, Eutrudepts* and *Udorthents* (Table 1).

Nglipar and Dlingo had tropical climate and classified as *Am* by Köppen and Geiger. The average annual temperatures of Nglipar and Dlingo were 25.2 °C and 25.8 °C, and the average rainfalls were 2,083 mm and 2,019 mm (Merkel, 2017). Table 2 shows the average of monthly rainfall of the past 10 years. During the research, the monthly rainfalls from October 2016 to January 2017 were: 253, 526, 305 and 369 mm at Nglipar, and 232, 312, 420 and 411 mm at Dlingo (BMKG, 2017).

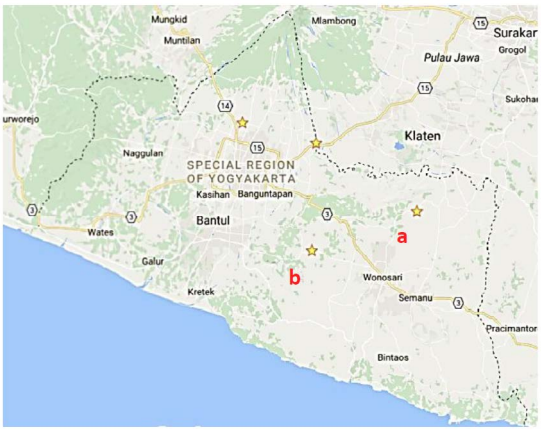

Fig.1: Location of the research area:
a. Nglipar, Gunung Kidul Regency; b. Dlingo, Bantul Regency
(Source: Modified from Google Map 2017)

Table 1: Soil class and landform of Nglipar and Dlingo

Soil Class (Great group)	Proportion (%)	Landform	Parent material	Relief (% slope)
Nglipar, Gunung Kidul: Tectonic Group				
Hapludults	50-75	Undulated tectonic plain	claystone, sandstone	undulated (8-15)
Dystrudepts	25-50			
Dlingo, Bantul: Karst Group				
Hapludalfs	50-75	Karst hill	limestone	Small hilly (15-25)
Eutrudepts	25-50			
Udorthents	10-25			

Source: Indonesian Center for Agricultural Land Resources Research and Development (BBSDLP, 2016)

Table 2: The monthly rainfall average of 2007-2016 (mm)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Location												
Nglipar	314	334	277	190	123	79	53	38	117	80	219	496
Dlingo	381	438	335	306	216	121	45	25	75	89	295	386

Source: BMKG, Sleman DIY (2017)

The activities in the farm at Nglipar and Dlingo were almost the same every year. Table 3 shows the crop pattern of both locations.

Table 3. The yearly crop pattern at Nglipar and Dlingo

Month / Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nglipar	GN	GN	GN	SB	SB	SB	-	-	-	SB	SB	SB
Dlingo	SB/C	SB/C	SB/C	VB	VB	VB	-	-	-	SB	SB	SB

GN: Ground Nut; SB: Soy Bean; C: Corn; VB: Velvet Bean

Soil sampling

Due to the irregular and terrace shapes of the fields, the layout of sample points was set up using the grid method combined with a transect line of 5 meter interval (Fig. 2). There were 30 sample points for each field marked with bamboo sticks. The soil was sampled 4 times according the growth stages within one cropping season of soybean from October 2016 to January 2017, i.e. before planting, vegetative stage, generative stage and after harvesting. Each point was taken using auger at a depth of 5-15 cm about 500 grams and stored in a labeled zip lock plastic bag. The total samples from 2 locations and 4 stages sampling were 80 samples for SOM analysis and 240 samples for spectroscopic measurements. All samples were air-dried, then gently crushed to break up larger aggregates, afterward removed the visible roots and each sample was sieved at 2 mm strainer.

Fig. 2: Field lay out
left: Nglipar field (1,500 m^2), right: Dlingo field (1,300 m^2)
(Modified from Google Earth 2012)

Soil organic matter analysis

The soil organic matter was analyzed by the Soil Analytical Services Laboratory at UPN "Veteran" Yogyakarta using Walkley and Black method, i.e. wet destruction using oxidizing agents through volumetric analysis.

Laboratory Vis-NIR Spectroscopy

The spectroscopy measurement was performed at the University of Palangka Raya, Central Kalimantan, using ASD Field-spec®3 350-2500 nm (Analytical Spectral Devices Inc., Boulder, Colorado, USA). Each soil sample was placed into a 5 cm diameter of ring sample (*Eijkelkamp*), and flattened the surface (Fig. 3).

Fig. 3: Soil reflectance measurement, *left*: soil in ring sample;
right: The ASD probe was inserted into a black aluminium ring plate on the sample surface

The reflectance of each sample was scanned 10 times with different positions by moving the ring sample circularly, and the results were averaged in post-processing. Every 15 minutes the instrument was calibrated by measuring the reflectance of the white panel as white reference. The reflectance value of each spectrum was recorded in the computer and translated from binary to ASCII using *ViewSpecPro* (2008).

Pretreatment, calibration and prediction process of spectral data

The first step in developing the prediction models was the pretreatment of the spectral data. The process of pretreatment, calibration and validation were performed using the Unscrambler X (2016). The measured reflectance spectra were transformed in absorbance through log (1/R) to reduce noise, offset effects, and to enhance the linearity between the measured absorbance and soil properties (Conforti *et al*., 2015). To enhance weak signals and remove noise due to diffuse reflection, the absorbance spectra were pre-treated using the second derivative Savitzky and Golay method (Gholizadeh *et al*., 2014). Moreover, both edges of the spectra were removed as these parts of the spectra were unstable and rich in noise (Aliyah *et al*., 2015).

The calibration models were subsequently developed by applying the partial least-square regression (PLSR) technique coupled with full cross-validation to establish the relationship between the amount of soil textures (reference values) with the pre-treated Vis-NIR soil absorbance spectra from the corresponding locations.

Two calibration models were developed, i.e. Nglipar and Dlingo SOM models. The models combined the dataset of spectra (600-2300 nm) and 40 reference values of each SOM model. In the PLSR analysis, sample outliers were detected by checking the residual sample variance plot after the PLSR. Individual sample outliers located far from the zero line of residual variance were considered to be outliers and excluded from the analysis. Due to the small number of data set for calibration (40 samples), the number of outliers was limited to 6 samples.

The selection criteria of any pretreatments were the largest coefficient of multiple determinations (R^2) and the smallest of Root Mean Square Error (RMSE). The full cross-validation ability of PLSR was given by the value of residual prediction deviation (RPD). The ability of NIRS to predict values of soil properties can be grouped into three categories based on RPD values: category A or excellent (RPD >2.0), category B or good (RPD = 1.4~2.0), and category C or unreliable (RPD <1.4) (Chang *et al*., 2001). RPD was given by the ratio of standard deviation (SD) of the reference dataset to the root mean square error of full cross-validation (RMSEval), as in equation (1) (Aliyah *et al*., 2015).

$$RPD = SD.\ RMSE_{val}^{-1} \quad (1)$$

The selected calibration models were used to predict the SOM of other new 160 samples.

Mapping the temporal and spatial of SOM variability

The support of GIS is very helpful in giving visual information to support the decision making in the management of site-specific farming. In this research, the ArcGIS (2013) was used to perform the temporal and spatial of SOM variability maps. The inverse distance weighted (IDW) method was applied to do the spatial interpolation.

RESULTS AND DISCUSSIONS

Crop and soil properties description

The farmers at Nglipar and Dlingo used the same variety of Soybean, *Grobogan*, which was ready to harvest after 80 days. They grew the soybean at the rainy season from October 2016 to January 2017, and soils were sampled before planting (October 28), at vegetative stage (November 14), at generative stage (December 1) and after harvesting (January 19).

All of 80 reference samples from Nglipar and Dlingo were classified as *clay* with very low organic matter content (< 2%), and neutral pH.

Soil reflectance can be influenced by a number of factors, such as soil texture, surface roughness, organic matter content, color and moisture content (Yin *et al*., 2013). Fig. 4 and 5 describe the soils reflectance of Nglipar and Dlingo at four stages of soybean growth. In Fig. 4, the sample G25 shows very different characters, this was possible because the soil color tends to be white compared to the surrounding soil.

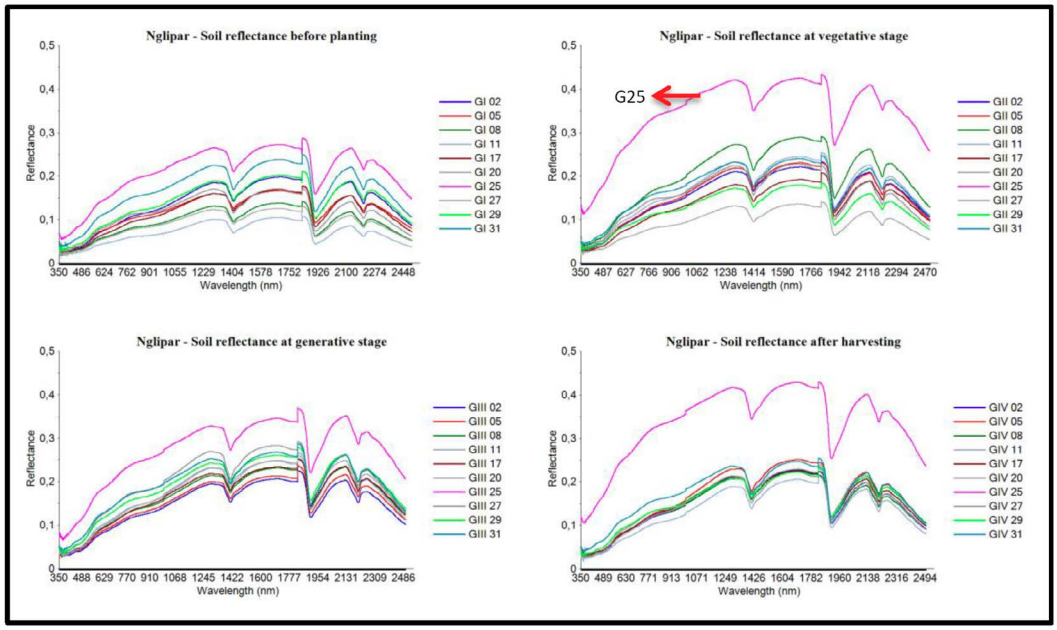

Fig. 4: The soil reflectance of Nglipar soybean field at four stages

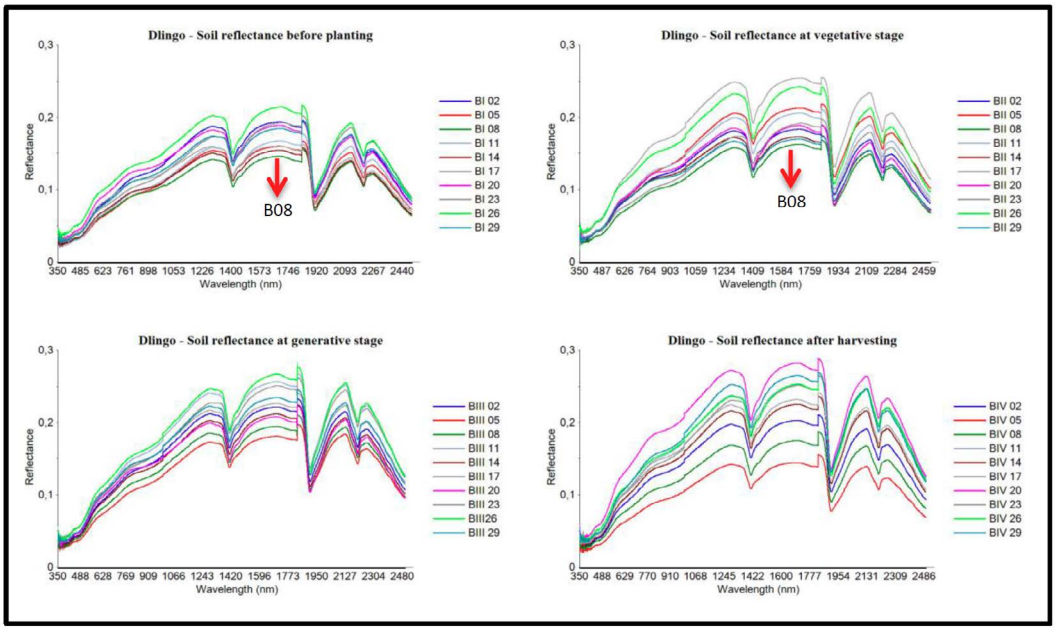

Fig. 5: The soil reflectance of Dlingo soybean field at four stages

Multivariate Statistical Analysis

There were four steps of pretreatment to the spectral data before proceed them for calibration to enhance weak signals and remove noise due to diffuse reflection, i.e.:

a. Spectroscopic transform: reflectance to absorbance
b. Derivative Savitsky-Golay transform: second derivative and 2 polynomial order
c. Remove both edge of the spectra (<600 nm and > 2300 nm)
d. Convert spectral data from 1 nm interval to 10 nm interval.

The summary of developing calibration models for SOM using PLSR method and the RPD category are shown in Table 4.

Table 4. Summary of PLSR results for SOM calibration models

PLSR results	Nglipar SOM model	Dlingo SOM model
Calibration samples	40	40
Prediction samples	120	120
Optimal factors	6	7
R^2_{cal}	0,96	0,99
$RMSE_{cal}$	0,04	0,22
R^2_{val}	0,58	0,59
$RMSE_{val}$	0,12	0,14
SD	0,18	0,24
RPD (SD/ $RMSE_{val}$)	1,54	1,77
RPD Criteria	B (good)	B (good)

The Vis-NIR predicted values using PLSR for SOM are described as regression models in Fig. 6. The data points of the measured SOM (reference) and the predicted are indicated “good”

model performance (RPD = 1.4~2.0). The two soils measured by the Vis-NIR reflectance sensor and by the Walkley and Black method are compared, and they are highly correlated (R^2 = 0.96 and 0.99).

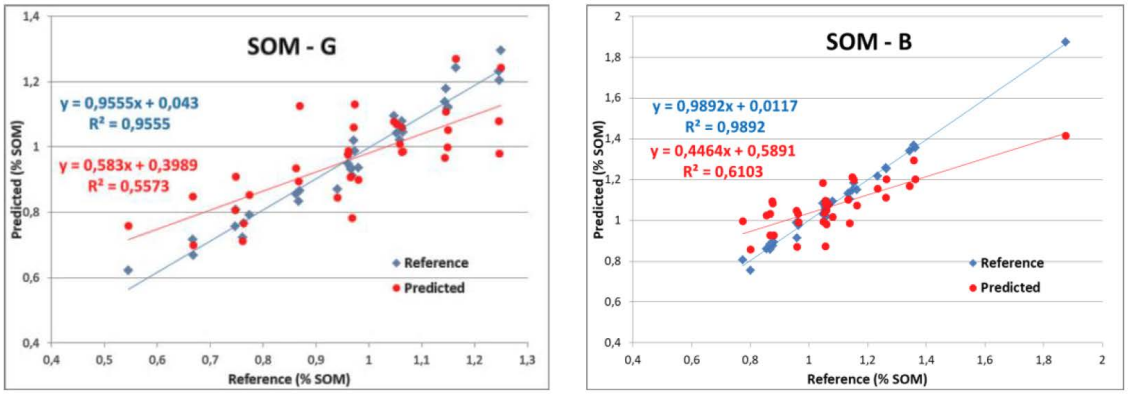

Fig. 6: The regression model of soil organic matter at Nglipar and Dlingo

The better results obtained by using the PLSR method are clearly due to the fact that PLSR takes advantage of the use of the entire spectral signature (Curcio, 2013). The regression coefficient plotted in Fig. 7 shows the investigated spectrum that should be considered important for the prediction of SOM. The size of the regression coefficients represents the importance of the absorption band.

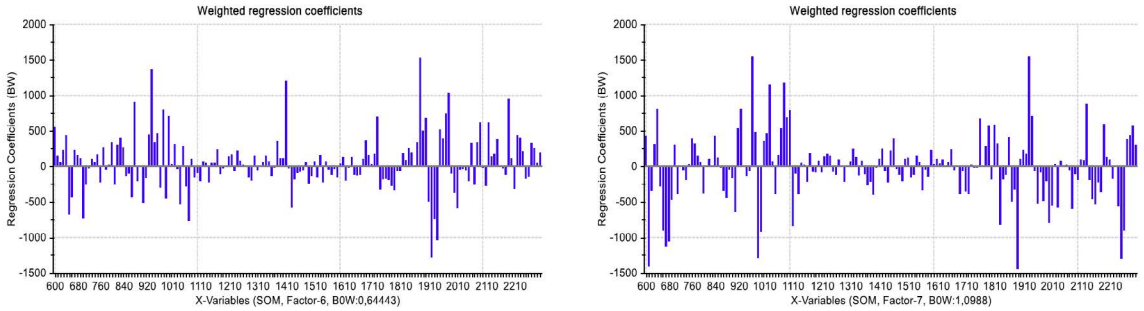

Fig. 7: The regression coefficients of SOM at Nglipar (left) and Dlingo (right)

Temporal and spatial map of SOM variability

The prediction value of SOM was then applied to generate temporal and spatial map of SOM. The inverse distance weighted (IDW) method was applied to do the spatial interpolation. Fig. 8 and 9 show the SOM variability map of Nglipar and Dlingo for each stage. In interpreting SOM, it should be considered other factors that affect the SOM, i.e. natural factors (texture, soil moisture, topography, temperature, vegetation, etc.) and human interventions or farming systems. Here some example of interpretation from the given maps associated with the condition in the field.

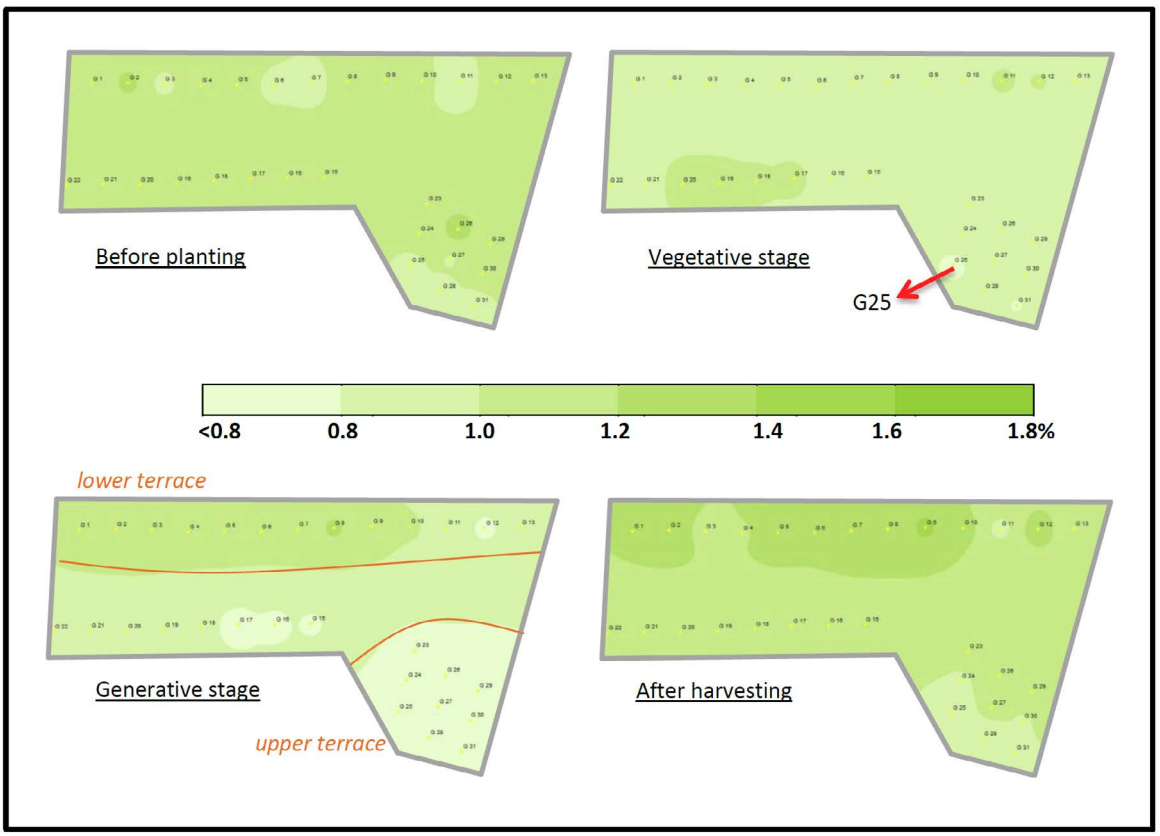

Fig. 8: The temporal and spatial map of SOM variability at Nglipar

Organic matter accumulation is often favored at the bottom of hills (Bot & Benites, 2005). There are two reasons for this accumulation: conditions are wetter than at mid- or upper-slope positions, and organic matter is transported to the lowest point in the landscape through runoff and erosion. Dlingo was steeper than Nglipar, and the SOM at Dlingo had wider range (0.7-1.8%) rather than Nglipar (0.6-1.3%) and higher content at the lower site.

Both farms in Nglipar and Dlingo had fallow systems (no crops from July to September). According to Luo et al. (2008), continuous cropping in dryland rotations may have benefits other than greater water utilization and erosion control. Rotations with fallow system produce less biomass and cover than the no-fallow system, and ultimately, fewer amounts of soil organic matter (SOM). The lack of cover can result in severe erosion and runoff when the rains start after the dry season (Bot & Benites, 2005).

Before planting, the soybean farm at Nglipar had been tilled using two wheels hand plow tractor, while at Dlingo almost zero tillage has applied. Tillage is one of the major practices that reduce the organic matter level in the soil (Bot & Benites, 2005). The average SOM at Nglipar (0.96%0) was lower than at Dlingo (1.31%).

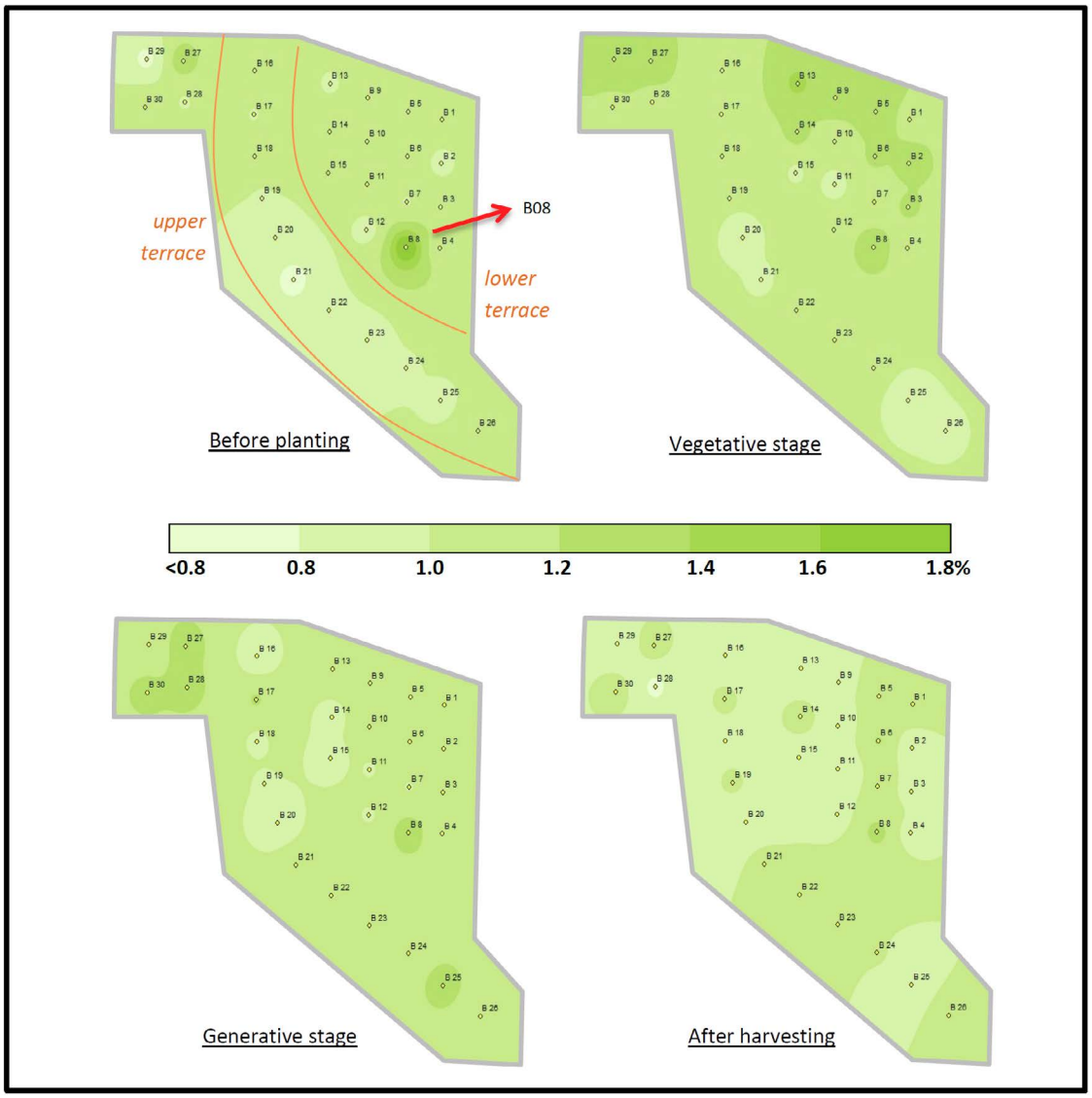

Fig.9: The temporal and spatial map of SOM variability at Dlingo

CONCLUSIONS

In this study, soil proximal sensing using Vis-NIR spectroscopy was a reliable tool to predict the soil organic matter of unknown soil samples.

It was proven from the RPD values that the calibration models were "good" to predict SOM.

Different pretreatment process should be performed in order to improve the correlations between the measured soil organic matter and the spectra.

The temporal and spatial maps of SOM variability gave much information to be interpreted carefully due to many factors affect the SOM. They were useful to support the process of decision making in field management.

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Performance of Chili Seedlings Given Various Types of Mycorrhizal Bio-Fertilizer in Inceptisol Krueng Raya Aceh Besar

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ABSTRACT

This research aimed to understand the performance of chili seedlings given various types of mycorrhizal bio-fertilizer in Inceptisol Krueng Raya Aceh Besar. The research was conducted in greenhouse, Faculty of Agriculture, Syiah Kuala University from April to July 2017. This research was arranged in a non factorial randomized block design with three replications. Types of mycorrhizal bio-fertilizer consisting of three level namely: *Glomus mosseae, Gigaspora sp* and mixture of *Glomus mosseae* and *Gigaspora sp***.** The parameters observed included the performance of chili seedlings following of growth potential, seedlings vigor, and seedlings height growth at 21 and 32 days after planting. The results showed that the types of mycorrhizal bio-fertilizer affected the performance and quality of chili seedlings. The inoculation of mycorrhizal with the types mixture of *Glomus mosseae* and *Gigaspora sp*. gave the best results and have the potential for further research to investigate the growth and yield of chili in Inceptisol Krueng Raya Aceh.

Keywords: Inceptisol, mycorrhizal bio-fertilizer, performance, chili seedlings, growth

INTRODUCTION

Mycorrhiza is one of the fungi that are symbiotic mutualism with plant roots. The role of mycorrhizae is very numerous, among others, as a nutrient absorber for plants, especially phosphorus. Many research has been conducted by (Safrianto et al., 2015; Syafruddin, et al, 2016; Syafruddin 2017) indicated that giving of mycorrhizal bio-fertilzer on Andisol and Entisol sites showed an increase in chili production. The role of mycorrhiza not only helps to increase the nutrient absorption process but also plays a role in the process of water absorption. Particularly on sub optimal soil the mycorrhizal is one solution to increase the productivity of soil and plants, include of Inceptisol.

The people in Aceh generally cultivated chili on the Inceptisol, Entisol and Andisol. Especially in the area of Krueng Raya, Aceh Besar, chili production is mostly cultivated on Inceptisol and Entisol. Inceptisol Krueng Raya Aceh Besar has not been widely used for dryland farming due to the limited availability of water in the dry season due to low rainfall in these area. The main constraint in the utilization of Inceptisol is the low nutrient and low water holding capacity that could not be utilized by plants (Muyassir et al., 2012).

Some Inceptisols have low nutrient content, especially nitrogen, phosphorus and potassium. In general, Inceptisol soil is an immature soil that is newly developed, large porosity and aeration (46%), medium-temperature permeability, low water holding capacity (Muyassir et al., 2012;

Syafruddin et al. 2012). In addition, the characteristics of Inceptisol are low of organic carbon content (C-organic), low of bulk density and CEC value as well as P (Hardjowigeno, 2008). If well-managed Inceptisol soils can increase plant biomass (Syafruddin and Efendi 2014), as well as N and P fertilizers (Syafruddin and Efendi, 2012).

Giving of fertilizer especially with the application of mycorrhizal bio-fertilizer can increase the potential of chemical, physical and biological properties of Inceptisol soil. Mycorrhiza will work effectively on poor nutrient soils (marginal) and can help the absorption of phosphorus, nitrogen and potassium effectively so that it is available to the plant. According to Pal et al, (2013) and reinforced by Prasetya (2011), the low organic material causes Inceptisol to be particularly suitable for the development of the AMF (Arbuscular Mycorrhizal Fungi).

One effort to increase the absorption of phosphorus and nitrogen in Inceptisol soil can be done through symbiosis between plants with arbuscular mycorrhizal fungi. Hypa mycorrhizal fungal plays a role in increasing the removal of N, P and K by extending the absorption area of the root system of plants, so that it can be used to re-mining the residual elements that accumulate in the soil. The presence of mycorrhizae for the availability of N, P and K on Inceptisols is absolutely necessary (Abdollahi et al., 2014; Medina and Azcon, 2014; Smith and Read, 1997; Agustina et al., 1997). Type of mycorrhizal bio-fertilizer inoculant greatly determines the performance of chili seedlings. The utilization of three types of mycorrhizal bio-fertilizer is expected to increase the growth potential, seedling vigor and seedlings height growth of chili. This research aimed to understand the performance of chili seedlings given various types of mycorrhizal bio-fertilizer in Inceptisol Krueng Raya Aceh Besar.

MATERIAL AND METHODS

Materials and tools used in this research were variety chili (Lado F1), Inceptisol soil, inoculant of mycorrhiza, NPK fertilizer, polybag, scales and ruler. The research was conducted in greenhouse, Faculty of Agriculture, Syiah Kuala University from April to July 2017. This research was arranged in a non factorial randomized block design with three replications. Types of mycorrhizal bio-fertilizer, including of *Glomus mosseae, Gigaspora sp* and mixture of *Glomus mosseae* and *Gigaspora sp***.** The parameters observed included the performance of chili seedlings following of growth potential, seedlings vigor, and seedlings height growth at 21 and 32 days after planting. Data were analyzed by analysis of variance (ANOVA) technique. The significance of treatment effect was performed by using the F test. The significant difference between treatment proceed with Turkey's HSD test at level 5% ($p<0.05$; HSD test).

RESULT AND DISCUSSION

Characteristif of Inceptisol Krueng Raya Aceh Besar

Characteristics of Inceptisol soil are shown in Table 1. In general, Inceptisol soils have low nutrients and must be increased in productivity, one of them with the using of mycorrhiza. This also applies to growth of chili. The performance of good seedling chili will determine the results of chili in the field.

Table 1: Characteristics of soil experiment (Inceptisol)

Parameter	Value	Method
pH H_2O	6,09	pH 1 : 2.5
pH KCl	5,01	pH 1 : 1.25
C-Organic (%)	0,97	Walkley and Black

N total (%)	0,07	Kjeldahl
P av (ppm)	5,95	Bray II
K (me 100 g^{-1})	0,46	NH_4OAc pH 7
KTK (me 100 g^{-1})	24,00	NH_4OAc pH 7
Texture	Clay loam	Pipette
	sand 34,00%	
	silt 30,00%	
	clay 36,00%	

Sources: Syafruddin Syafruddin, 2017

Growth Potential

The average of growth potential are shown in Table 2. Based on Table 2, the best of growth potential of chili seedlings was found in mixed type mycorrhizal inoculant (*Glomus mosseae* and *Gigaspora sp*) which is significantly different from other treatments.

Table 2. Average of growth potential of chili seedlings

Treatment (Types of mycorrhizal)	Growth Potential (%)
Glomus mosseae inoculant	90.00 b
Gigaspora sp inoculant	85.00 a
Glomus mosseae + *Gigaspora sp* inoculant	98.00 c
Turkey's HSD test ($p<0.05$)	3.23

Value followed by the same letter, the same columns is not significantly different at Tukey's HSD test ($p < 0.05$)

Vigor of Chili Seedlings

The vigor of chili seedling from various types mycorrhizal bio-fertilizer treatments are shown in Table 3. Based on Table 3 it is seen that the highest seed vigor was obtained on mixture mycorrhizal types and was significantly different from the other two treatments.

Table 3: Average of vigor of chili seedlings

Treatment (Types of mycorrhizal bio-fertilizer)	Vigor of seedling chili (%)
Glomus mosseae inoculant	80.00 b
Gigaspora sp inoculant, corn	75.00 a
Glomus mosseae + *Gigaspora sp* inoculant, corn	85.00 c
Tukey's HSD test ($p<0.05$)	3,54

Value followed by the same letter, the same columns is not significantly different at Tukey's HSD test ($p < 0.05$)

Seedling Height Growth at 21 and 32 Days After Planting

Average of seedling height growth are presented in Table 4. According to Table 4, the average height of seedling chili at 21 and 32 days after planting was the highest in the mixed mycorrhizal types and different from the other two treatments.

Table 4: Average of seedlings height growth at 21 and 32 days after planting (DAP)

Treatment (Types of mycorrhizal bio-fertilizer)	Seedlings height growth (cm)	
	21 DAP	32 DAP
Glomus mosseae inoculant	11,67 a	13,67 b
Gigaspora sp inoculant	10,33 a	12,00 a
Glomus mosseae + *Gigaspora sp* inoculant	13,67 b	16,23 c
Tukey's HSD test ($p<0.05$)	1,45	1,18

Value followed by the same letter, the same columns is not significantly different at Tukey's HSD test ($p < 0.05$)

Based on the results in Tables 2, 3 and 4 it is seen that the best seedling chili performance on Inceptisol soil was found in mixed type of mycorrhizal bio-fertilizer. It was mean the soil given mixed mycorrhizal biofertilzer type has a high adaptability. Syafruddin et al., (2016) showed that mixed mycorrhizas may live on soils that are pH sour and somewhat acidic. In addition, several studies have shown that types of mycorrhizal bio-fertilizer with mixed inoculant type has advantages in other adaptations, especially to increase the production of crops in conditions of temperature and water that are lacking and various other extreme conditions (Syafruddin, 2016; Liu et al., 2014; Chauhan, 2011).

CONCLUSION

Types of mycorrhizal bio-fertilizer really significant affected the performance of chili seedlings in Inceptisol soil from several parameters studied. The best growth potential, vigor of chili seedlings and seedlings height growth at 21 and 32 day after planting are found in types of mycorrhizal bio-fertilizer with mixture between *Glomus mosseae* and *Gigaspora sp* inoculant. Field research needs to be investigated to yield of chili on Inceptisol soil.

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