GEOHERITAGE RECLAMATION OF MINE INCEPTISOL WITH AMELIORANT OF ORGANIC WASTE TO INCREASE C AND CATION EXCHANGEABLE CAPACITY AT INDONESIA

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ABSTRACT

The mining soil on agriculture was caused by physical and chemical properties of soil damaged. The effect of mine was limited alternative crops. The ameliorant by organic waste was alternative for recovery of damage. The organic matter will decreased in the longer periode for growth by paddy soil. The organic matter was natural resource energy in the soil, which is very important for source of soil fertility. The content of organic matter less than 1% causes soil nutrients to become unavailable. Theoretically, to increase 1% of soil organic matter, it is necessary to add an absolute dry organic fertilizer of at least 20 tons / ha, even if the fertilizer is 100% organic component. Thus the provision of organic fertilizer does not automatically increase the soil organic matter content, considering the components of organic fertilizer is organic material that easily decay or remodel (manure, non-wood material for compost). Thus, the agricultural system can be sustainable if the content of soil organic matter is more than 2%. Organic material added to the soil significantly improves soil functions, the process of decomposition of organic matter leads to changes in the chemical composition of complex compounds into simple compounds.

The utilization of organic wastes with pyrolysis (biochar) as a ameliorant of soil needs to be developed to improve soil fertility by improving C absorption and soil cation exchange capacity. The soil was content C more than 2% in the soil to sustainable agriculture.

Key words: Biochar, Carbon, Decomposition, Exchangeable Cation Capacity, and Organic matter.

Introduction

The population growth has brought consequences in the development of residential areas. The settlement development was required raw materials such as bricks, sand, and rocks belonging to C class. The brick industry is increasingly prevalent due to much needed in residential development. The bricks are generally made from soil taken from the top soil depht. The rampant conversion has agricultural land to non-agricultural land was to due the fact that the income from the brick industry was more promising than the selling value of agricultural crops. This is a problem related to the narrowness of agricultural land in Indonesia.

The mining of agricultural land was taked of soil material for non-agricultural purposes. Mining can result in decreased soil productivity. Rural areas of the post-mining process of land as the main raw material in brick making often cause various problems. The problem that arises is the act of neglecting the land after the brick mining without accompanied by the reclamation and rehabilitation of the land. After the mining of soil for the brick industry leaves a lower subsoil who different chemical, physical and biological properties with top soil. Subsoil has soil properties of lower quality than topsoil.

The mining process was losses of top soil to leads deterioration of soil resources both quantity and quality of soil. The apparent physical phenomenon at the scene is the thin layer of soil, so the ability of the soil is unstable (Hidayat et.al., 2009). According Rahayu (2011), Mining causes thin soil solum and effective depth of soil to be shallow. The thinnest soil solum and the shallowest effective depths are found in mined fields of >20 cm deep and mined each year. Post mining occurs decrease soil fertility and rice productivity 50-60% if not accompanied by improvement effort. Changes in solum due to intensive mining make the soil properties lead to sandy texture, single grained structure, fast permeability, high penetration resistance and aggregate stability not stable. Restoration of soil functions with pasca mining land reclamation techniques for the brick industry especially in returning the amount of carbon and soil nutrients is essential for agriculture. Amelioration with biochar made from raw coconut shell and organic material is an alternative to the return of good soil carbon in the soil

Methode

The research of brick and reclamation techniques was carried out at Potorono Village, Banguntapan District, Bantul Regency, Indonesia. The coordinates Potorono village was located at 49º45 "-50º46" and 24º32"- 26º48". Altitude of place 65-80 above sea level, rainfall 2.233 mm per year, and lowland topography. The study was conducted in 2 stages. The first stage was to examine pasca-mining soil while the second phase was conducted pasca-mining land reclamation research. The research was used survey technique and descriptive method. namely by observing directly the condition of mining areas at various depths of land acquisition and take direct example of wetland. The first phase of post-mining research. Field observations show varying depth of mining material covering 100, 200 and 300 cm. At each depth of the mining results, soil analysis of soil physical and chemical properties is carried out. The second phase of mine land reclamation testing is generally applied to Inceptisol soil with complete randomized design (CRD). Reclamation materials for the treatment using lignin-rich materials and materials that are easily obtained and often used by local farmers, namely Bagasse, Cow Manure Waste and Biochar Coconut. Each treatment with a dosage of 0 tons hectares, 10 tons per hectare, 15 tons per hectare, and 20 tons per hectare and observed at 0 month, 1 month, 2 months and 3 months and repeated three times, general total to obtain 36 pots in research. The reclaimed material was mixed in the soil to obtain the decomposition process with soil minerals. The result of decomposition soil was analyzed carbon and cation exchange capacity (CEC) of soil was carried out in Soil Laboratory of Faculty of Agriculture University pembangunan nasional "Veteran" Yogyakarta, and Land Research Center Yogyakarta Indonesia.

Ressult and Disscusion

The main composition of the soil was composed of four materials among others: mineral materials, organic materials, water and air. The composite materials of the soil are each different for each soil or every layer of soil. The best of top soil for dryland was growed plant generally contains 45% of mineral materials, 5% organic matter, total air and water components 50% consisting of approximately 25% each. The soil was one of outher media for growth of plants in nature. The various types of plants can be cultivated on the ground. Plants absorb water, air, various nutrients available and the compounds available in the soil so that the top soil fertility is the most important thing in the system of cultivation of plants. The soil fertility was include three aspects of physical fertility, chemical and biological soil.

Interaction of these three aspects of fertility was determinant of the growth of plants to growth. The damage was caused by mining may cause deterioration of physical, chemical and biological soil quality. In the Potorono village, there are mining products for the brick industry. Soil mining in the manufacture of brick industry continuously without considering the loss of land at a certain depth, will cause land damage caused by the activity of miners so as to cause food production, especially paddy soil production in paddy fields to decline. Losing top soil will affect the availability of soil nutrients that source as a supporter of soil fertility and the establishment of plants. In the upper in top soil there are Carbon content which is the main source of soil organic matter. Soil organic matter was an indicator of soil fertility level. The higher carbon content greater than 2% indicates better soil fertility. The insufficiency of soil nutrients is caused by the mining process by taking soil in the soil surface causing the physical, chemical and biological properties of the soil to decrease the quality. Bigger soil mining the larger the soil removal process (Figure 1) resulted in low soil C-organic content of <1% (Table 1).

Table1. The result of analysis C-organic on the various of depht after brick mining activities (Herlambang & Purwono, 2016)

No	Village	Soil depht losses cm	C_org %	N-tot %	C/N	BV g/cm^3	Pourosity %	pH H_2O	% Texture		
									Silt	Clay	Sand
1	Nglaren	300	0.256	0.0985	4.7	1.4	40.64	7.26	13.80	0.40	85.90
2	Mertosanan Wetan	100	0.324	0.0499	12.5	1.3	33.68	7.29	25.00	7.40	67.60
3	Petet	200	0.257	0.0992	3.6	1.4	38.44	7.47	15.30	3.00	81.70
4	Prangwedanan	210	0.259	0.1921	2.1	1.4	39.33	7.37	12.80	1.00	86.20
5	Salakan	170	0.312	0.0958	4.2	1.5	37.91	7.28	10.00	4.70	85.30
6	Mintoragan, Kempol	120	0.2590	0.0488	9.4	1.2	44.34	7.23	31.70	7.60	60.80

Figure 1. The brick minning effect of top soil losses at Potorono village Indonesia

The pasca-mining soil was carbon organic content at various in the depths. The shows of the result was inversely proportional to the soil bulk density (Table 1). This indicates that more soil has high density in mine land resulting in low levels of soil C-organic, land damage or land degradation caused by the mining process was decreased in the soil quality becomes lower. The soil degradation can be interpreted as losses of productivity or actual or potential benefits due to natural or anthropic factors (Eswaran, 1999 cit. Khan et al., 2007). Degradation of agricultural land includes 3 (three) aspects, namely the physical aspect. chemistry and biology. Physical degradation consists of compaction, scaling, water imbalance, aeration obstruction, run off and erosion. The chemical degradation consists of acidification, nutrient depletion, leaching, nutrient imbalances and poisoning, salinization, and alcalinization. Whereas biological degradation was include the decrease of soil organic carbon, decrease of soil biodiversity and decrease of biomass carbon. (Directorate General of Land and Water Management, 2009). Especially for wet tropical soils there are three important processes that cause land degradation, namely: 1) physical degradation associated with the deterioration of soil structures that trigger movement, compaction, excessive flooding, and accelerated erosion, 2) chemical degradation associated with disruption of soil carbon and other elements, and 3) biological degradation associated with declining soil quality and quantity of soil organic matter, declining biotic activity and diversity of soil faunal species (Lal, 2000 cit. Andriani, 2011).

The brick industry can be re-established used to reclamation technology through biochar. The biochar was carbon capture system with pyrolysis burning with little or no oxygen at 450^{o}C. The soil reclamation wasan effort to utilize, repaired and improved quality of soil. The Biochar was charcoal with carbon black content derived from biomass, the biochar process through burned in limited oxygen conditions produces organic matter with 70-80% carbon concentration (Lehmann and Yoseph, 2009; Woolf et al. 2010). Utilization of biochar as a soil enhancer and energy source, which needs to be developed more widely to improve soil fertility by improving cation exchange capacity and nutrient retention resulting in increased land productivity (Katharina et al., 2013). Biochar application to the soil can increase C uptake and soil quality (Smith et al., 2010). The raw material of manufacture is a biomass residue which is rich in lignin tissue including wood pieces, biochar coconut shell, palm oil bunch, corn cob, rice husk or peanut shell, bark, timber remnants, and organic material derived from garbage and animal waste

The reclamation of land was carried out by biochar coconut applications dossage 15 tons per hectare in Incepstisol showed significantly different levels of 5% on C-organic content was increased in incubation two months, while the increase in cation exchange capacity (CEC) of soil showed an increased in third month incubation (Table 1 and 2). Increase in C-organic soil wa increased from 0.54 cmol(+) kg^{-1} to 0.78cmol(+) kg^{-1} about 44.44% at 15 tons per hectare. Addition of biochar coconut may be increased the availability of soil and posfor, total nitrogen and exchange capacity of cation (CEC) that ultimately increase yields as they can reduce the risk of nutrient leaching especially potassium and N-NH_4 (Bambang, 2012). To according Lehmann, 2007, all organic ingredients added to the soil significantly increase the range of soil functions including the retention of essential nutrients for plant growth. Biochar added in soil can be increased C-organic and cation exchange capacity (CEC) of the soil while composting can decrease soil organic C (Katharina et al., 2013). Biochar was more than effective in suppressing nutrient availability for plants than in other organic materials such as leaf litter, compost or manure.

The agricultural waste of coconut shell as matterial for biochar has a very high CN ratio about 122, C-organic total very high about upper 20%. the agricultural waste has high CN ratio with the system composed was less effective to produce C-organic in the soil, but it's potential to be used as charcoal for biochar system very capable of function as a soil enhancer (Nuridha et al., 2012). the C-organic on biochar can not subtitution of fertilizer so the addition of a certain amount of nitrogen and other nutrients was needed in increasing the yield of the plant. The biochar was very effective for the enrichment of carbon in the soil. According to Asai et al. (2009), the amount of biochar added has an effective on the yield of rice plant on the addition of 4 tons per hectare biochar, but dossage biochar feeding up to 8 or 16 tons per hectare yield is not significantly different from the control without the addition of biochar. On the paddy soil were planted in the dry season, indicating that the weight of wet grain increased significantly in biochar and organic waste of bagasse and cow manure compared to controls of >3.5 tons per hectare after 2 months incubation is better.

Conclutions

1. The mine of topsoil was losses potensial soil for media agriculture, the deeper mining of soil will be properties of physical, chemical and biological damage and so poorly C-organic content under 2%.

2.Reclamation of land with biochar application can be significantly increase the C-organic on soil. The application biochar coconut was dossage 15 tons per hectare with incubation 2 months level increase C-organic 44.44%. The cation exchange capacity increased 39.5% after incubated for 3 months at a dossage 10 tons per hectare

3. The production of paddy soil in dry season yields was grain product upper 3 tons per hectare in application biochar coconut, bagase and cow manure after incubated for 3 months

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Table 2. The C-Organic content after treatment on the waste organic bagasse, biochar coconut and cow manure

Incubation (month)	Organic waste (Tons per hectare)											
	Bagasse				Biochar coconut				Cow manure			
	0	10	15	20	0	10	15	20	0	10	15	20
1	0.64 ab	0.64 ab	0.51 c	0.49 c	0.64 abcd	0.48 cd	0.45 d	0.61 abcd	0.64 abc	0.44 d	0.42 d	0.53 cd
2	0.54 bc	0.54 bc	0.56 bc	0.56 bc	0.54 bcd	0.58 abcd	0.78 a	0.70 ab	0.54 bcd	0.53 cd	0.57 bc	0.62 abc
3	0.70 a	0.63 ab	0.70 a	0.72 a	0.70 ab	0.69 ab	0.66 abc	0.64 abcd	0.70 a	0.65 ab	0.64 abc	0.73 a

Numbers in the same column followed by similar letters are not significantly different according to Duncan's Multiple range test (P>0.05).

Table 3. Cations exchange capasity (CEC) after treatment on the waste organic bagasse, biochar coconut and cow manure

Incubation (month)	Organic waste (Tons per hectare)											
	Bagasse				Biochar coconut				Cow manure			
	0	10	15	20	0	10	15	20	0	10	15	20
1	6.28 bc	4.40 c	4.81 c	6.64 abc	6.28 c	7.53 bc	5.74 c	8.26 bc	6.28 bc	5.14 c	4.68 c	7.70 ab
2	6.75 abc	7.42 abc	7.05 abc	4.72 c	6.75 c	5.90 c	6.35 c	7.44 bc	6.75 abc	8.29 ab	8.51 ab	7.56 ab
3	7.78 abc	10.43 ab	10.85 a	7.17 abc	7.78 bc	10.85 a	6.92 c	9.49 ab	7.78 ab	6.28 bc	8.61 a	8.40 ab

Numbers in the same column followed by similar letters are not significantly different according to Duncan's Multiple range test (P>0.05).

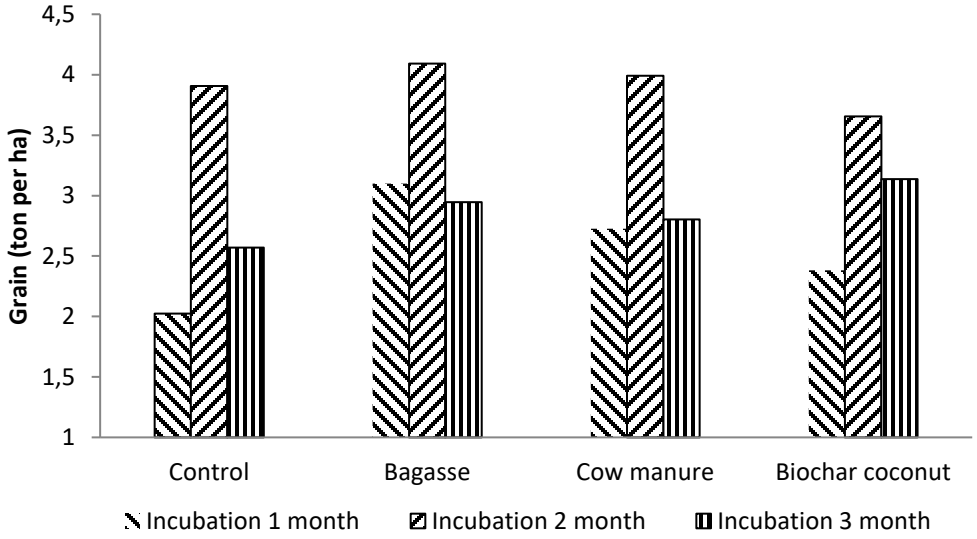

Figure 2. Paddy soil production after reclamation by biochar and organic fertylizer at Incepstisol