Characteristics of coastal sediment from three different sites and their potential as the ameliorant of peat soil in West Kalimantan

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Abstract. It is well-known that there are some problems faced in cultivating peat-land as an agricultural land. The main problems are related to both its low soil acidity and its high cation exchange capacity. Previous studies showed that coastal sediment has shown its potential to overcome these constraints. This experiment is design to invent new potential coastal sediment resource after the closeness of Pantai Kijing areas as the coastal sediment source, and to study some of important basic chemical properties of coastal sediment collected from new sites. The samples were collected from 10 selected sites in District of Sambas, and analyzed in the Laboratory of Soil Chemistry and Soil Fertility of Faculty of Agriculture, Tanjungpura University. For other two districts we used secondary data from previous studies. It was found that (1) District of Sambas could be the most next potential coastal sediment source after the closeness the area of Pantai Kijing, (2) High pH and BS values of coastal sediment from District of Sambas are two important properties needed to improve poor soil properties in West Kalimantan, and (3) high base element content could be further resource in improving properties of upland degrade soil in West Kalimantan. It is highly recommended to do more further basic experiments in order to optimize this new coastal sediment function as soil ameliorant.

1. Introduction
Recently in West Kalimantan, researchs on using coastal sediment as soil ameliorant are likely to increase from basic to applied research. Researchers started their research from identifying the characters of coastal sediment and studying their effect in increasing some chemical soil properties. However, most of their researchs are still limited in the laboratory scale and they still use coastal sediment from only one site resource. Due to closeness of that potential site resource for a commercial industry center, there is a need to explore more another potential resources for coastal sediments that might be able to be further study objects and developments.
West Kalimantan has a great potency of its coastal line that widespread from the north in the District of Sambas up to the south in the District of Ketapang. This coastal line is believed to have a great potency of coastal sediment. However, this great potency need more basic studies especially on its chemical properties that might be able to be used in improving poor soil properties such as in peat soil, and in upland degraded soils. This basic study is still needed to be more developed to answer some crucial issues both in developing sustainable agriculture in peatland and upland degraded soils. Recently, peatland in West Kalimantan has become a crucial land resource to develop high economic vegetable crops.

Based on above critical issues, we design this basic experiment. Its main objectives are (1) to explore the site that has great potential amount of coastal sediment, (2) to study the basic chemical properties of coastal sediment from that different potential sites, (3) to study the effect of coastal sediment as ameliorant in improving peat soil characteristics in West Kalimantan.

2. Materials and Methods

2.1. Materials
For this experiment we used a basic West Kalimantan topographical map to invent and point out the potential sites that are likely to store a great amount of coastal sediment (Fig.1). For this experiment we approved 10 potential sites in District of Sambas. For other two district sites, District of Mempawah and District of Kubu Raya, we use previous data from 1 sites in District of Mempawah (Suswati, et.al, 2015), and 5 sites in District of Kubu Raya (Arief, et.al, 2018). From the total of 10 potential sites in District of Sambas, coastal sediment samples are collected and analyzed for its basic chemical properties (Table 1).

There are several chemical and non-chemical materials needed to do analytical works such as HCl 25%, (NH₄)Mo₇O₂₄·4H₂O, Ascorbic Acid, K(SbO)C₄H₄O₆·0.5H₂O, PO₄ (Titrisol), Ammonium Acetate 1M, Ethanol, HCl 4N, NaCl 10%, Boric Acid, NaOH, H₂SO₄ 4N, Aquadest, (NH₄)₂SO₄, NaOCl 5%. (need further check)

2.2. Methods
Coastal sediment samples, originated from District of Sambas, were collected from the following sites: Sungai Nyirih, Sebangkau, Pemangkat Kota, Matang Suri, Dungun Laut, Sentebang, Sungai Bakau, Sarang Burung Kolam, Sungai Nilam, and Sarang Burung Danau. Each sample was replicated 3 times. All analytical procedures for all the samples were done after Page, et.al, (1982). All laboratory works were done in the Laboratory of Soil Chemistry and Soil Fertility of Faculty of Agriculture, Tanjungpura University. All data are described and presented using graphic and tables.

3. Results & Discussion

3.1. The pH of Coastal Sediment
This research found that the pH value of coastal sediment from three district different sites is likely different. The pH of coastal sediment from Sambas and Mempawah District is about similar but its average value is a little bit higher than that of Kubu Raya District (Table 1). The characteristics of coastal sediment are likely much affected by the characteristics of its origin sites. Coastal sediments of Sambas and of Mempawah are believed coming from dominant substances having similar characteristics, while characteristic of coastal sediment of Kubu Raya District are believed to be more affected by substances from peatland in its surrounding areas (Arief et.al. 2018).
3.2. Cation Exchange Capacity (CEC)

Data in Table 2 showed that CEC of coastal sediment from all site were about similar. It is might be due to the clay type, content and its size were about similar as well. However, this type of information is not yet clarified. But, it had been explained that CEC value of the soil could be similar if the soil pH, humus, and clay content are about similar. The soil’s CEC value will change when these properties change (Miller and Donahue, 1990). The CEC values of all coastal sediment samples are in the range of 12-17 cmol(+)/kg(-1), it is still in the normal range of clay loam value. It shows that coastal sediment from all sample sites has about similar capacity in holding the cations.
3.3. Base Saturation (BS)
The data from this experiment showed that base saturation values are highest in coastal sediment samples of Sambas district. The average value is more than double of that value from samples of District of Mempawah. Previously, Mempawah coastal sediment is regarded as the best coastal sediment resource. Table 2 is clearly pointed out that two base element values namely Ca and Mg were much higher in samples from Sambas District, eventhough two other base element values K, and Na were about similar. Therefore, it is undoubtfully that base saturation values from samples of Sambas District is significantly higher than that from the other two district samples.

3.4. Electrical Conductivity (EC)
In this experiment we also collected the EC data. It is needed to answer the issue of salinization level within the ameliorant substances. It was found that EC data varies within the sites in each district. It was in the range of 5 to 13 and categorized as intermediate level. The negative effects that might be occurred when this coastal sediment is applied to the soil may not be severe, because it is believed to decrease when it mixed with soil in the cropping fields.

Table 1. Some Chemical Properties of Coastal Sediment samples from different sites in West Kalimantan.

| No | Origin of Sample | pH  | BS (%) | EC m$ | Ca        | Mg     | Na | K   | CEC   |
|----|------------------|-----|--------|-------|-----------|--------|----|-----|-------|
| 31 | Sungai Nyirih (Sambas) | 7,79 | 186,60 | 12,78 | 11,0 | 10,0 | 5,1 | 2,1 | 15,60 |
| 32 | Sebangkau (Sambas) | 7,18 | 193,50 | 5,74 | 11,2 | 9,8  | 4,1 | 2,6 | 14,30 |
| 33 | Pemangkat Kota (Sambas) | 7,64 | 169,42 | 6,72 | 8,5  | 9,4  | 3,8 | 2,4 | 14,26 |
| 34 | Matang Suri (Sambas) | 8,09 | 178,64 | 7,91 | 10,2 | 8,7  | 3,2 | 2,1 | 13,48 |
| 35 | Dungun Laut (Sambas) | 7,99 | 172,48 | 10,44 | 11,6 | 9,6  | 4,7 | 3,0 | 17,99 |
| 36 | Sentebang (Sambas) | 7,93 | 170,10 | 11,32 | 8,0  | 8,9  | 4,3 | 2,6 | 13,98 |
| 37 | Sungai Bakau (Sambas) | 7,99 | 195,09 | 9,24 | 10,1 | 9,2  | 4,3 | 2,6 | 13,43 |
| 38 | Sarang Burung Kolam (Sambas) | 8,00 | 179,18 | 6,60 | 9,9  | 8,7  | 2,9 | 1,9 | 13,03 |
| 39 | Sungai Nilam (Sambas) | 7,99 | 197,31 | 8,89 | 12,4 | 9,1  | 3,9 | 2,5 | 14,11 |
| 310 | Sarang Burung Danau (Sambas) | 7,78 | 191,56 | 10,23 | 8,6  | 8,2  | 5,6 | 3,4 | 13,50 |
| 11 | Pantai Kijing (Mempawah) | 7,77 | 87,32 | 8,89 | 4,0  | 1,7  | 3,4 | 2,1 | 12,78 |
| 21 | Muara Dabong 1 (Kubu Raya) | 5,50 | NA | NA | NA | NA | NA | NA |
| 22 | Muara Dabong 2 (Kubu Raya) | 5,67 | NA | NA | NA | NA | NA | NA |
| 23 | Muara Dabong 3 (Kubu Raya) | 5,5 | 112,10 | NA | 9,0  | 3,5  | 4,7 | 1,8 | 17,03 |
| 24 | Tanjung Radak (Kubu Raya) | 4,20 | 29,40 | NA | 2,1  | 1,2  | 0,3 | 0,1 | 12,63 |
| 25 | Muara Kubu (Kubu Raya) | 5,80 | NA | NA | NA | NA | NA | NA |

Note : NA=Not available.
3.5. Base Element Content of Ca, Mg, Na, and K.
Base element content of Ca, Mg, Na, K, in the samples District of Sambas are much higher than those samples of District of Kubu Raya and District of Mempawah. These data are in line with that of BS. These properties will be good to enrich base element content in peatsoil and upland degraded soil as these two type of soils are very poor in base element content (Aaaa, 20..)

4. Conclusion
From these preliminary experimental data and short above discussion it is concluded that (1) District of Sambas could be the most next potential coastal sediment source for further study and development, after the closeness the area of Pantai Kijing, (2) High pH, BS, and base elements values of coastal sediment from District of Sambas make it to be more valuable because these all properties are crucially needed to improve poor soil properties such as found in peat-soil and upland degraded soil, and (3) It is needed to do more further basic experiments, specifically in how these coastal sediment could be optimized as soil ameliorant in West Kalimantan.

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