Investigation of C-Organic Content, Nitrogen, Phosphorus, Potassium Nutrients, pH Soil and C/N Ratio of Tidal Rice Fields in Sidomulyo Village, Anggana District, Kutai Kertanegara Regency, East Kalimantan

Suria Darma*, Syamad Ramayana, Sadaruddin and Bambang Suprianto

Laboratory of Agronomy, [2]Department of Agroecotechnology, Faculty of Agriculture, Mulawarman University, Jl. Tanah Grogot Building C10 Campus of Gunung Kelua Samarinda 75119
**Corresponding author. Email: suriadarmaidris@gmail.com*

ABSTRACT
The purpose of this study was to investigate the content of organic C, Nitrogen, Phosphorus, Potassium nutrients, pH soil and C/N ratio in tidal paddy fields in Sidomulyo Village, Anggana District, Kutai Kertanegara Regency, East Kalimantan; use for productivity sustainability conservation; and identify the current fertility condition of the land and for sustainable management actions. The research was carried out by taking 50 soil samples from 10 determined tidal fields, each 5 samples per field, made into 1 kg of soil in a composite manner, so that 10 soil samples were obtained. Soil samples were taken using a soil drill with a depth of ±30 cm. The composite sample was analyzed at the Laboratory of Soil Science, Faculty of Agriculture, Mulawarman University. The results of laboratory analysis provide information that: pH soil parameter, all samples showed very acidic with an average acidity number of 4.28 (lowest 2.13, highest 3.88), two categories of C-organic content parameters identified, namely the moderate category of 4 samples, (ie: 2.13 %, 2.71%, 2.91%, and 2.93%); and high category, totaling 6 samples (ie: 3.23%, 3.27%, 3.30%, 3.36%, 3.45%, and 3.88%); Total Nitrogen content parameters were also identified in the medium category, totalling 7 samples (0.27%, 0.35%, 0.38%, 0.39%, 0.48%, 0.48% and 0.48%); high category, totaling 3 samples (0.31%, 0.34%, 0.58%); parameter of C/N ratio, all 10 samples showed low category; Parameter of Phosphorus available shows variation, in the low category there is 1 sample (ie 6.73 ppm), the medium category is 1 sample (10.18 ppm), the high category, there are 2 samples (ie 14.27 ppm and 14.82 ppm), very high category, as many as 6 samples (18.36 ppm, 23.27 ppm, 17.64 ppm, 32.36 ppm, 17.45 ppm, and 15.64 ppm), Parameter of Potassium available, all samples show a very high category.

Keywords: *Investigation, C-organic, C/N ratio, pH soil, Tidal rice field.*

1. INTRODUCTION

The area of tidal swamp land in Indonesia is around 20.12 million ha, consisting of 2.07 million ha of potential land, 6.72 million ha of acid sulfate land, 10.89 million ha of peatland and 0.44 million ha of saline land. Tidal swamp land that may be used as agricultural land is around 8,535,708 ha. Of this area, about 2,833,814 ha have been reclaimed and 5,701,894 ha have not been reclaimed. The area of tidal swamp land that has been converted into rice fields until 2011 is only around 407,594 ha [1]. Tidal swamp lands are distributed in Indonesia in island of Sumatra, Kalimantan, Sulawesi, and Papua, and are estimated to cover an area of 20.13 million ha [2]. The standard area of tidal rice fields in Indonesia is around 657,000 ha. Based on the island, the area and distribution of tidal paddy fields in three major islandsare: Sumatra 324 231 ha, Kalimantan 331,072 ha, and Sulawesi 1,584 ha [3], East Kalimantan 7.527 ha [4] tidal rice fields in Indonesia have an increasingly important and strategic role for agricultural development, especially supporting national food security. This is due to the potential and productivity of the land and its management technology is already available. The area of tidal swamp land that has the potential to be used as agricultural land, especially rice plants, is still widely

available. Various obstacles faced in rice farming in tidal swamp land include: (1) low land fertility, (2) infrastructure that is still not functioning optimally, (3) farmers' education level is still low, (4) harvest index is still very low planting a year, and (5) the high attack of plant-disturbing organisms.

Tidal rice fields are a type of rice field located around river mouths and swamps close to the coast. This type of rice field is one of three types of rice fields, namely rainfed rice fields, irrigated rice fields, and lebak rice fields.

Sidomulyo Village, Anggana District, Kutai Kertanegara Regency in East Kalimantan, is the original village of the 1983 Transmigration Program Placement, has an area of 186 ha of tidal rice fields, which is influenced by the ebb and flow of the Mahakam River, often called the Suspension Bridge River (Source: Information farmers) which is exactly adjacent to the expanse of rice fields. High tide occurs 2 times a month, each high tide, 75-100 cm into the rice fields (occurs during a full moon), and 30 cm (when it is not a full moon). The productivity of this tidal paddy field is around 3.5 $Mg.ha^{-1}$ (direct interviews with farmers). Sidomulyo Village, is one of the rice barns in Kutai Kertanegara Regency.

Paying attention to the role of tidal rice fields in Sidomulyo Village in the contribution of rice production and food security for Kutai Kertanegara Regency and East Kalimantan Province; the sustainability of the productivity of the paddy fields; as well as the current fertility conditions of the land for sustainable management actions, it is necessary to investigate the content of C-organic, Nitrogen, Phosphorus and Potassium nutrients, pH soil and C/N rasio of tidal paddy fields in Sidomulyo Village, Anggana District, Kutai Kertanegara Regency, East Kalimantan Province

2. MATERIALS AND METHODS

2.1 Time and place

2.1.1 Research time

The research was carried out from March to May 2021, starting from preparation, sampling, sample preparation and chemical analysis at the Soil Science Laboratory, Agriculture Faculty of Mulawarman University.

2.1.2. Research Place

The field research was carried out in Sidomulyo Village, Anggana District, Kutai Kertanegara Regency. The study area includes a stretch of tidal rice fields as shown below (Figure 1.) The figures in the figure show that they are the sampling points, taking into account the distance of the rice fields from the riverbank (Far, medium and near)

2.2. Materials

Soil footage from 10 tidal rice fields in Sidomulyo Village, Anggana District, Kutai Kertanegara Regency. Soil drill, plastic clip, GPS, Camera, stationery, sample container

2.3. Procedures

The research implementation includes the following activities:

Taking 50 soil samples from 10 specified tidal field, five samples of each specified tidal field, using a soil drill with a depth of ±30 cm

Five (5) soil samples from each tidal paddy field were collected separately,

Each of the five soil samples was mixed and stirred evenly, 1 kg was taken compositely and put in a plastic clip, The composites of each soil sample were brought to the Laboratory of Soil Science, Faculty of Agriculture, Mulawarman University, to carry out soil chemical analysis procedures.

Limited soil chemical treatment and analysis – content of C-organic, Nitrogen, Phosphorus and Potassium nutrients, pH soil and C/N ratio by the Laboratory of Soil Science, Faculty of Agriculture, Mulawarman University The test procedures and methods used for the analyse Chemical parameters are presented in Table 1

2.4. Data analysis

The results of the chemical analysis were limited to samples of tidal rice fields from Sidomulyo village, Anggana District, Kutai Kertanegara Regency, East Kalimantan as follows

3. RESULTS AND DISCUSSION

3.1. Results

Based on the results of the limited soil chemical analysis of 10 soil samples of 10 tidal paddy fields in Sidomulyo Village (Table 2), it is known that: the pH soil parameter of all samples is very acidic with an average acidity avarage level of 4.28 (lowest 2.13,

Table 1. Testing Parameters and Methods used (Procedure by Soil Science Laboratory, Faculty of Agriculture, Mulawarman University)

No.	Tes Parameters	Method used
1.	pH H2O	pH H2O is determined using a pH meter with a soil to solvent ratio of 1: 12 Available
2.	C-organik	C-organic was determined using wet digestion and using potassium bichromate according to the Walkley and Black method
3.	N Total	N total was determined by the Kjehldahl method
4	C/N Rasio	Determined by directly dividing the Organic C number by the Total N number
5.	Available of P2O5	Total phosphate (mg/100g) was determined using 25% HCl extraction, while available phosphate (in ppm) was determined using Bray extraction
6.	Available of K2O	Total potassium was determined using the extraction of 25% HCl, while available potassium (in ppm) was determined using Bray extraction.

highest 3.88), parameter C-organic was identified in two categories, namely the medium category with 4 samples (ie: 2.13%, 2.71%, 2.91%, and 2.93%); and high category, totaling 6 samples (ie: 3.23%, 3.27%, 3.30%, 3.36%, 3.45%, and 3.88%); parameter of the Nitrogen content of total samples was also identified in the medium category, totaling 7 samples (0.27%, 0.35%, 0.38%, 0.39%, 0.48%, 0.48% and 0.48%); high category, totaling 3 samples (0.31%, 0.34%, 0.58%); parameter C/N Ratio, all of 10 samples showing the Low category; Available of Phosphorus parameters show variation, 1 sample Low category (ie 6.73 ppm), 1 sample medium category (10.18 ppm), high category, 2 samples (ie 14.27 ppm and 14.82 ppm), very high category, 6 samples (18.36 ppm, 23.27 ppm, 17.64 ppm, 32.36 ppm, 17.45 ppm, and 15.64 ppm), available of Potassium parameters, all samples show a very high category.

3.2. Discussion

3.2.1. pH Soil

The pH soil values in the tidal paddy field soil samples studied showed numbers in the acid category, 2 samples; very acidic 8 samples. In tidal paddy fields and paddy fields in general, acidity is caused by the decomposition process of organic matter and all oxidation reactions in the soil that produce hydrogen ions [6]. Serain that there is a possibility of acidity in the land of tidal rice fields due to organic matter carried by high tide water in the form of sediment that accumulates in the soil of the rice fields. The conveyed how to reduce acid soil by (1) liming, (2) intensive application of organic materials, (3) intensive application of phosphate fertilizers, (4) regulation of planting system and, (5) provision of microbial decomposers [7]. Management of acidity in tidal paddy fields in Sidomuryo Village, Anggana District, Kutai Regency Kertanegara can be carried out by by lime which contains the micronutrient Mg, namely Dolomite $CaMg(CO_3)_2$ lime gradually, paying attention to soil reactions, Intensive provision of organic matter and provision of decomposing microorganisms.

3.2.2. C-Organic

The C organic content of 10 samples of tidal paddy fields showed a moderate category of 4 samples, and a high category of 6 samples. Paying attention to the number of C organic content in 6 samples, there is no number that exceeds 0.4% which is the middle number in the high category (0.3% – 0.5%), basically the figures are closer to the maximum number of the medium category (0.2% – 0.3%).

Soil organic matter is all types of organic compounds found in soil, including the fraction of light organic matter, microbial biomass, organic matter in water, and organic matter that is dry or humus [8]. C-Organic content is an element that determines the level of soil fertility. Soil organic matter is all types of organic compounds found in soil, including litter, light organic matter fractions, microbial biomass, organic matter dissolved in water.

The agricultural practice carried out by farmers by bringing the land with them and not returning the harvested forest to the fields has led to a decrease in the deposit of organic matter on the soil. The C-Organic content is only based on the rest of the rice stalks and roots in the soil, after harvest.

Rice stalks contains double nutrients in the form of macro and micro nutrients. In general, the Nitrogen, Phosphorus, Potassium nutrients are 0.4%, 0.2% and

0.7%, respectively, while the Si and C content is quite high at 7.9% and 40% [7].

optimum nutrient supply process in the soil solution, one of the reasons is the low content of soil organic matter

Table 2. The Results of Chemical Analysis of Tidal Rice Fields Soil Samples in Sidomulyo

No	Kode		pH	C organik	N Total	C/N Rasio	P_2O	K_2O_5	Coordinate point
	Sampel	Lab		%			Available (ppm)		
1.	ANG I SP 1	6945	4.10 (VA)	3.45 (H)	0.38 (M)	9.19 (L)	14.27 (H)	54.38 (VH)	S 00° 32′ 18.0″ – E 117° 16′ 27.3″
2.	ANG I SP 2	6946	4.54 (A)	2.93 (M)	0.39 (M)	7.57 (L)	10.18 (M)	52.50 (VH)	S 00° 32′ 18.3″ – E 117° 16′ 25.8″
3.	ANG I SP 3	6947	4.35 (VA)	2.71 (M)	0.27 (M)	9.89 (L)	17,45 (VH)	25.00 (VH)	S 00° 32′ 18.2″ – E 117° 16′ 24.5″
4.	ANG I SP 4	6948	4.37 (VA)	2.91 (M)	0.31 (H)	9.27 (L)	15.64 (VH)	105.00 (VH)	S 00° 32' 7.06″ – E 117° 16' 31. 68″
5.	ANG I SP 5	6949	4.14 (VA)	3.23 (H)	0.34 (H)	9.45 (L)	6.73 (L)	35.63 (VH)	S 00° 32' 7.54" – E 117° 16' 40.52"
6.	ANG II SP 2	6951	4.17 (VA)	3.30 (H)	0.48 (M)	6.82 (L)	18.36 (VH)	54.58 (VH)	S 00° 32′ 9.8″ – E 117° 16′ 54.6″
7.	ANG II SP 3	6952	4.25 (VA)	2.13 (M)	0.35 (M)	6.06 (L)	23.27 (VH)	47.43 (VH)	S 00° 32′ 17.9″ – E 117° 16′ 54.9″
8.	ANG II SP 4	6953	4.28 (VA)	3.36 (H)	0.48 (M)	7.05 (L)	17.64 (VH)	45.42 (VH)	S 00° 32′ 23.0″ – E 117° 16′ 58.0″
9.	ANG II SP 5	6954	4.80 (A)	3.27 ₩(H)	0.48 (M)	6.86 (L)	32.36 (VH)	45.00 (VH)	S 00° 32′ 23.0″ – E 117° 17′ 02.7″
10.	ANG II SP 1	6950	3.86 (VA)	3.88 (H)	0.58 (H)	6.66 (L)	14.82 (H)	52.08 (VH)	S 00° 32' 18.62" – E 117° 17' 2.83"

Description: VA: Very acidic, A: Acidic; M: Moderate; H: Height; L: Low; VH: Very High. Determination of status

With the abundance of harvested forest at harvest time, spreading straw to the fields is a good way to increase C-Organic deposits that function to maintain and increase soil fertility by improving pH numbers, increasing the amount of organic matter, increasing CEC numbers, adding macro and micro nutrients and microorganism on soil.

3.2.3. Nitrogen Total

Based on the results of chemical analysis, the total Nitrogen content was also identified in the medium category, totalling 7 samples (0.27%, 0.35%, 0.38%, 0.39%, 0.48%, 0.48% and 0.48%); high category, totalling 3 samples (0.31%, 0.34%, 0.58%). Plants absorb Nitrogen nutrients in the form of NO_3^- and NH_4^+, so the presence of Nitrogen in the soil solution must be maintained [10].

Low absorption of fertilizer nutrients. including Nitrogen, by plants is mostly caused by the failure of the [11]. In integrated nutrient management, the use of organic and inorganic fertilizers as a source of nutrients is a requirement that must be met, although quantitatively the nutrient content of organic fertilizers is low.

Paying attention to the Total Nitrogen content of the tidal paddy soil samples studied, dominant in the medium category, it is necessary to increase the return of harvested material to the land, in order to process the increase in the organic matter content of the land, and at a later stage, will increase the efficiency of fertilizing inorganic fertilizers.

3.2.4. C/N Rasio

In the C/N ratio parameter, all 10 samples showed the low category, which was an average of 7.90. A high C/N ratio indicates the presence of a relatively large amount of weathered soil material (eg cellulose, fat and wax), on the other hand, a smaller C/N ratio indicates that organic matter is more easily decomposed. The C/N ratio will

Table 3. Criteria for Assessment of Soil Chemical Properties for Agriculture of Best Conditions for Soil Fertility

No.	Chemical Properties of Soil		Very Low	Low	Moderate	High	Very High
1.	C (%)		< 1.0	1.0 – 1.9	2.0 – 2.9	3.0 – 5.0	> 5.0
2.	N (%)		< 0,10	0.10 – 0.20	0.21 - 0.50	0.51 – 0.75	> 7.5
3.	C/N Lasio		< 5	5 - 10	11 - 15	– 25	> 25
4.	Phosphorus Bray (ppm)		< 4	4 - 6	7 - 11	12 – 15	> 15
5.	Potassium		< 5	5 – 16	17 - 24	25 – 40	> 40
6.	pH H_2O	Very acidic	Acidic	Slighly acidic	neutral	Slightly alkaline	Alkaline
		< 4.5	4.5 – 5.5	5.6 -6.5	6.6 – 7.5	7.6 – 8.5	> 8.5

Sumber : Balittanah. 2009 [5]

affect the availability of nutrients, the C/N ratio is inversely proportional to the availability of nutrients, meaning that if the C/N ratio is high then the nutrient content is slightly available for plants, whereas if the C/N ratio is low then the availability of nutrients is high and plants can meet their needs. Soil C/N ratio ranges from 10-12. If the organic matter has a C/N ratio close to or equal to the soil C/N ratio, then the material can be used by plants [12].

Based on the information from the analysis of the C/N ratio parameter, which got an average number of 7.90, it is necessary to increase this number by applying organic fertilizer or organic matter, which in practice can be done by increasing the biomass of paddy weeds after harvest and returning the waste material. harvest to paddy fields

3.2.5. Available of Phosphorus

Parameter of Phosphorus available shows variation, there is 1 sample in the low category (ie 6.73 ppm), 1 sample medium category (10.18 ppm), high category, there are 2 samples (ie 14.27 ppm and 14.82 ppm), very high category, 6 samples (18.36 ppm, 23.27 ppm, 17.64 ppm, 32.36 ppm, 17.45 ppm, and 15.64 ppm). According to [13], Rice fields that have been cultivated for a long time as agricultural land and are managed intensively, the length of management can increase the levels of available Phosphorus, Ca and Mg in the soil because it is related to the process of decomposition and mineralization of organic matter and weathering of soil parent materials.

The condition of the available P content found in the tidal paddy soil samples in Sidomulyo Village, must be maintained through improving the cultivation practices that have been going on so far by balancing fertilization treatment not only with inorganic fertilizers, but also with organic fertilizers, so that fertilizer absorption efficiency is achieved. by plants increases.

3.2.6. Available of Potassium

The parameter of Potassium available indicates that all samples are in the very high category. Soil K content in agricultural land for food crops is quite diverse. However, generally paddy soils contain more Potassium than dry land [14]. This is closely related to the type of soil and the natural processes that determine the input and output of Potassium to and from the land. Rice fields generally have a flat topography and/or as a depositional area so that the parent soil material is alluvial which is relatively fertile. It is possible that the tidal water that enters the tidal paddy fields contributes to increasing the Potassium content, through the sediment that is carried, settled and left on the land, when the water recedes.

4. CONCLUSION

Based on the results of laboratory analysis on 10 samples/representatives of the expanse of tidal rice fields in Sidomulyo Village, Anggana District, Kutai Kertanegara Regency, East Kalimantan, it can be concluded as follows:

1. The potential for sustainable productivity of rice fields will decrease, if there is no immediate handling of soil acidity and the amount of C/N ratio

2. Current fertility conditions; shows the average number at: pH 4.28 (Very acidic), C-organic content 3.11% (High), Total of Nitrogen 0.40% (Moderate), C/N ratio 7.88 (Low), Phosphorus available 17.07 ppm (Very High) and Potassium available 49.20 ppm (Very High)

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