

Evaluation Of Soil Nutrition Content Of Phosphore (P) And Organic-C In Thre Locations Of Intensive Rice Field In Balige District

Ulil Amri^{1*}, Fitra Syawal Harahap², Novilda Elizabeth Mustamu³, Luthfi Fadillah Zamzami⁴

^{1,2,3,4} Agroecotechnological Studies program, Faculty of Science and Technology, Universitas Labuhanbatu, Indonesia

*Corresponding Author:

Email: ulilamri@gmail.com

Abstract.

Evaluation of nutrient availability needs to be carried out to determine the ability of the soil to provide nutrients for plant growth, in this case the evaluation of the nutrient content of paddy fields in three locations in the Balige area, namely Huta Namora, Huta Bulu Mejan and Baruara. This is needed as information for the management of paddy fields on the provision of fertilizers in the future, both inorganic fertilizers and organic fertilizers. The purpose of this study was to evaluate the availability of soil nutrients such as organic C, total P, available P and soil pH after rice harvest. This research is a descriptive study by comparing data from the three research locations. In its implementation, 9 sample points of observation were chosen representing the location of each area. Every 3 sample points were mixed into one point of soil samples from the three research locations showing relatively the same results so that in one location there were 3 points of soil samples which were considered as replication 1, 2 and 3 replications. Thus, there were 9 soil samples for the three research locations. Based on the results of laboratory analysis shows that the nutrient content is relatively the same, namely for organic C content with low to moderate criteria, P-total nutrient content is on average between 6.55-7.52 (%) (low to moderate), for P is available between 27,241 – 28,909 with very low criteria. The pH parameter for paddy fields is relatively the same as the neutral criterion. This information becomes quite expensive information for the management of paddy fields in the future. The suggestion is to reduce the use of inorganic fertilizers and switch to the use of biological fertilizers and organic fertilizers.

Keywords: *Phosphoruss fertilizer, Rice field and Nutrients.*

I. INTRODUCTION

Paddy fields are land used for growing rice which is flooded either continuously throughout the year or in rotation with secondary crops. Paddy land is not a taxonomic term but a general term like agricultural land, plantation land, forest land and so on. All types of land can become rice fields if there is enough water. Lowland rice can be found in a wider variety of climates compared to other types of plants, so that the properties of paddy fields vary greatly according to the nature of the soil they come from [1]. According to [2], plots of agricultural land bordered by bunds (galengan), namely channels to hold or channel water which are usually planted with lowland rice, regardless of the source or status of the land, are called wetland. Rice fields are divided into: (a) Irrigated rice fields, rice fields whose water source comes from an irrigation system with tapping structures and the network is managed by government agencies and the community [3]. (b) Non-irrigated rice fields include tidal rice fields (irrigation depends on rivers which are influenced by sea tides), rain-fed rice fields (irrigation depends on rainwater), polder rice fields (located on either side of the river), and other rice fields [4]. The level of productivity of rice fields depends on the availability of nutrients in the soil. There are two factors that determine the availability of nutrients, namely innate factors and dynamic factors [5]. Innate factors in the form of soil parent material that influence soil order. Dynamic factors are factors that can change, namely fertilization, irrigation, soil processing and return of plant litter [6].

The element phosphorus (P) is an essential element for plants because it is a limiting factor that influences plant growth and production. In rice plants, the P element plays a role in encouraging root growth and development, triggering flowering and fruit ripening, especially in low climate conditions, encouraging the formation of more clumps/tills which enable faster recovery and adaptation when rice plants experience stress, and supports the formation of better grain and have better nutritional content in relation to P levels in the grain [7]. The important role of the P element means that this element must always be available when planting rice [8]. This is related to the ability to form clumps/saplings so that they can support production. Phosphorus (P) fertilization on land. Composition of Phosphorus Content in Rice Plants (*Oryza Sativa* L.) 127 rice fields is often carried out intensively, but often without paying attention to the P nutrient status of

the soil. This fertilization is carried out every planting season, thereby causing P deposits in the soil which can actually be used as a source of P nutrients for rice plants [9]. Based on the background above, research regarding the evaluation of the availability of P nutrients in intensive rice fields in the three Balige Districts is very important considering that there is no recent data regarding the availability of P nutrients in intensive rice fields in these areas. The data obtained can be used as a reference in managing soil fertility on intensive rice fields for the cultivation of lowland rice plants to make it profitable and sustainable.

II. METHODS

This research has been carried out in the Balige area, namely Huta Namora, Huta Bulu Mejan and Baruara. Analysis of the nutrient content of the soil was carried out in the Soil Chemistry Laboratory, Faculty of Agriculture, Syiah Kuala University and the Soil and Plant Laboratory, Faculty of Agriculture, Unsyiah, from October to December 2023. Soil samples were taken randomly at the three locations. The tools used in this research are GPS (global positioning system), hoes, shovels, plastic, label paper, rubber, markers, soil and several tools used in the laboratory, namely scales, ovens, shakers, measuring cups, test tubes, film bottles, dropper pipette, and pH meter. The materials used in this research were rice field soil samples and a number of other chemicals for laboratory analysis. This research uses a descriptive method, namely by conducting surveys and taking soil samples based on land position, namely in post-harvest rice fields. This research consisted of several stages, namely initial preparation in the form of taking samples of rice fields in several locations in Balige District, namely Huta Namora, Huta Bulu Mejan and Baruara.

Next, the soil samples are dried, pounded and sieved, then the sieved soil samples are taken to the laboratory for analysis. Soil samples were taken at a depth of 0-20 cm from the ground surface at three different locations. Determine the location for taking soil samples in 3 locations with three repetitions each, each repetition there are three points, so there are 9 soil samples, the determination of the points is carried out using purposive sampling, so that the soil samples taken are truly representative. 1 kg of each soil sample was taken and put into a plastic bag and then coded. The location of the coordinates of the soil sampling point, location in longitude and latitude, is recorded using a GPS (global positioning system) device. Next, the samples were air-dried before analyzing the nutrient content of the soil in the laboratory. This was done as a basis for determining the level of nutrient availability in rice fields in Balige District. Soil samples taken in the field before being analyzed in the laboratory were air-dried for 1 week. Then the soil was finely ground and sieved using a 0.5 mm sieve. The parameters of soil chemical properties observed in the soil chemistry laboratory are pH, P-total, and C-organic. Data obtained from the results of laboratory analysis of each soil sample in the rice fields were compared with soil samples in the rice fields at each sampling location, so that the nutrient content of the soil at the three research locations was known and could describe the availability of nutrients in the rice fields.

III. RESULTS AND DISCUSSION

The results of sample analysis from the three locations where rice field samples were taken after harvest from the three locations, namely Huta Namora, Huta Bulu Mejan and Baruara, can be seen in Table 2 below. The results of soil pH measurements on intensive rice fields in three different locations were highest in Huta Namora with an average value (7.47) classified as neutral criteria, on rice fields. The lowest was in Huta Bulu Mejan with an average value of (7.32) classified as neutral criteria, while the rice fields in Baruara had an average value of (7.37) classified as neutral criteria (Table 2). In general, the soil pH in the three locations sampled in the research is in the neutral category. The neutral pH of the soil in the rice fields in Huta Bulu Mejan, Baruara and Huta Namora is because the research location of the rice fields has a rice field irrigation system so that flooding is carried out continuously. Continuous flooding can increase the soil pH towards neutral. According to [10] the pH in flooded rice fields decreases to a minimum in the first few days, then a few weeks later it will rise again to neutral (6.6-7.5) in the rice field soil solution. Therefore, flooding of acidic soil can increase the soil pH. Flooded soil will increase the soil pH, this is due to the Fe reduction reaction occurring to Fe^{2+} yang makes OH^- free, and H^+ consumed. Meanwhile, soil pH decreases in alkaline

soil (alkaline) when the soil is flooded due to the accumulation of CO₂ where the decomposition of organic material from microorganisms can produce CO₂ yang when it reacts with water will produce H₂CO₃ and then oxidized to H ions⁺ and HCO₃⁻.

Table 1. Results of measurements of Huta Bulu Mejan soil samples

Results of measurements of Huta Bulu Mejan soil samples				
m1	7.31 n	2.01 r	6.95 sr	28,403 st
m2	7.38 n	2,48 r	6,89 sr	29,609 st
m3	7.26 n	2.84 r	8.19 sr	29,714 st
Raverage	7.32 n	2.44 r	7.34 sr	28.909 st
Results of measurements of Imdrapuri soil samples				
I1	7.50 n	1.77 r	6.38 sr	29,392 st
I2	7.54 n	2.00 r	6.24 sr	27,413 st
I3	7.36 n	1.65 r	9.93 sr	24,919 st
Raverage	7.47 n	1.81 r	7.52 sr	27,241 st

Source: *Soil Chemistry Research Laboratory (2023)*

According to [11], the pH of rice field soil is determined by flooding. Flooding results in a change in pH towards neutral (6.6-7.5). In acid soil the increase in pH is caused by reduction of Fe³⁺ to Fe²⁺ yang is accompanied by the release of OH ions, while the decrease in alkaline soil pH is caused by the accumulation of CO₂ in the anaerobic decomposition process, then CO₂ yang reacts with water to form H₂CO₃ yang dissociates into H ions⁺ and HCO₃⁻. The highest measurement results for soil organic C content in paddy fields were in Baruara with an average value of (2.44%) classified as medium criteria, while the lowest in paddy fields was in Huta Bulu Mejan with an average value of (1.81%) classified as low criteria, while rice fields in Huta Namora have an average value (2.41%) classified as medium criteria (Table 1). The C-organic content was classified as moderate in rice fields in three different locations, namely Huta Namora, Baruara and Huta Bulu Mejan due to the addition of organic material originating from the remains of rice plant roots and the flooding process. Rice fields that are often flooded can generally preserve the organic material content. When flooded, the decomposition process of organic material is slow, whereas in rice fields that are rarely flooded, the decomposition process occurs quickly so that the organic material content decreases quickly. According to [12], the more frequently the soil is flooded by rice fields, the more likely it is to preserve organic material, because the decomposition of organic material in a reductive or flooded atmosphere is able to slow down and inhibit the process of decomposition of organic material. Soil organic C content in dry soil and paddy field soil generally has the same pattern, namely that the organic matter decreases with increasing soil depth.

This is caused by the decomposition process of organic material by microorganisms which only takes place in the top layer. According to [13], organic materials in lowland rice farming systems play an important role in improving the physical, chemical and biological properties of the soil. The important role of organic material in paddy soil is that it is able to store water so that it is available more, minimizes evaporation, helps the movement of plant roots, is able to provide macro and micro nutrients for plants, increases the capacity to hold cations (CEC) and anions (KTA) so that nutrients are not easily lost (leached) from the soil, neutralizes Al and Fe poisoning and as a medium Soil microorganisms grow, such as N-fixing organisms in the air, P solvents. Apart from that, the function of organic material, especially straw, has an important role in maintaining the level of potassium availability in paddy soil. According to [14], organic material has an important role in changing the chemical properties of soil through the decomposition process carried out by microbes which always stick to organic material. The decomposition process will release nutrient elements into the soil solution and also convert organic material into a simpler, colloidal form. This condition will increase the absorption capacity of the soil which is also related to the cation exchange capacity (CEC) of the soil due to increasing the surface area of soil particles. This makes the soil have better ability to store nutrient elements, reducing nitrogen evaporation and leaching of other cation nutrients. The results of measuring the P-total content of soil in intensive rice fields in three different locations, the highest was in Huta Bulu Mejan with an average value of 7.52 mg/100g, which is classified as very low criteria.

The lowest amount of P-total was found in Huta Namora rice fields with a value of The average value (6.55 mg/100g) is classified as very low criteria, while the rice fields in Baruara have an average value (7.34 mg/100g) which is also classified as very low criteria (Table 2). Based on the results of the analysis that has been carried out (Table 2), it shows that the amount of Ptotal available from the three locations is generally very low, this is probably due to maximum use by plants during the vegetative growth period and timely administration so that some The amount of P fertilizer given during the planting season can be maximally absorbed by rice plants, resulting in maximum rice production. Another possibility is the use of low doses of P fertilizer so that all the fertilizer applied is used by the plants so that nothing is left on the land, which causes the total P content in the paddy fields from the three locations to be very low. According to [15,] the availability of P in the soil is closely related to the acidity (pH) of the soil. In most soils, maximum P availability is found in the pH range between 6.0 – 7.0. P availability will decrease if the soil pH is lower than 6.0 or higher than 7.0. Based on the results of the analysis in Table 2, it shows that the average P-available content from the three research locations shows a very high P-available value. The high P-available content in the three paddy fields is probably due to the continuous use of Urea fertilizer so that more of the P fertilizer remains in the land. This continuous provision of fertilizer is also in accordance with the results of interviews with BPP who explained that fertilizer is often used at every planting season. The results of the evaluation of the nutrient content of intensive paddy field soil in three different locations, namely Huta Namora, Samahani and Sibreh, Balige District, were determined based on the criteria for assessing soil chemical properties (PPT, 1995) on four parameters, namely pH H₂O, P-total, P-available and C-organic.

Based on the criteria for soil fertility status, two classes of soil fertility status were obtained, namely medium fertility status in Huta Namora and Sibreh, while high fertility status was found in Samahani. Soil fertility status for medium criteria is limited by two limiting factors, namely the low value of soil organic C. Low organic C is found in (I2, H1, H2, and H3) that is Huta Namora and Sibreh (Table 2). Low organic C content at the research location due to the low level of soil organic matter due to the transportation of harvested crops such as straw, most of which is not returned to the soil and continuous flooding can inhibit the decomposition process resulting in low organic matter content. This shows that the nutrient content of intensive rice fields in Huta Namora and Sibreh is quite good when compared to intensive rice fields in Samahani. The intensive paddy land management system in Samahani is better because every planting season the paddy fields are regularly fertilized and harvest residues are returned so that the P levels available in the soil are higher. Management alternatives that need to be carried out to increase organic C content are the addition of organic material and regular balanced fertilization so that soil fertility can be well maintained and sustainable. Soil organic matter greatly determines the interaction between abiotic and biotic components in the soil ecosystem. [15] in his research stated that the content of organic matter in the form of organic C in the soil must be maintained at no less than two percent. This situation is necessary so that the organic matter content in the soil does not decrease over time due to the mineralization decomposition process. The addition of organic material during soil management is absolutely necessary every year.

IV. CONCLUSION

Based on the results of the research that has been carried out, conclusions can be drawn regarding the evaluation of the nutrient content of the three rice fields in three locations in the Balige area, namely in Huta Namora, Huta Bulu Mejan and Baruara, namely the remaining nutrient content in the rice fields from the three locations, namely Huta Namora, Huta Feathers of Mejan and Baruara are generally relatively the same, namely from low to high criteria. The nutrient content of C-organic is classified as low, P-total is classified as very low, P-available is classified as very high, and soil pH is generally neutral, namely an average value between 7.32-7.47. Based on the results of a study evaluating the nutrient content of rice fields in three intensive rice fields in Balige District, it is necessary to carry out balanced fertilization with a combination of inorganic and organic fertilizers in order to maintain soil fertility in a sustainable manner. Reduce chemical fertilizers and switch to the use of organic fertilizers. The land remains fertile and sustainable so that it can prevent soil and water pollution so that the environment is healthy and clean from chemicals.

REFERENCES

- [1] Septyani, I. A. P., & Harahap, F. S. (2022). Pengaruh Co-Compost Biochar dalam Meningkatkan Ketersediaan Hara dan Pertumbuhan Tanaman Padi (*Oryza sativa*) di Tanah Sawah Intensif. *Jurnal Tanah dan Iklim*, 46(2), 133-144.
- [2] Harahap, F. S., Walida, H., Dalimunthe, B. A., Rauf, A., Sidabuke, S. H., & Hasibuan, R. (2020). The use of municipal solid waste composition in degraded waste soil effectiveness in aras kabu village, beringin subdistrict, deli serdang district. *Agrinula*, 3(1), 19-27.
- [3] Walida, H., Harahap, F. S., Dalimunthe, B. A., Hasibuan, R., Nasution, A. P., & Sidabuke, S. H. (2020). Pengaruh Pemberian Pupuk Urea Dan Pupuk Kandang Kambing Terhadap Beberapa Sifat Kimia Tanah Dan Hasil Tanaman Sawi Hijau. *Jurnal Tanah dan Sumberdaya Lahan*, 7(2), 283-289.
- [4] Walida, H., Harahap, F. S., Hasibuan, M., & Yanti, F. F. (2019). Isolasi dan identifikasi bakteri penghasil IAA dan pelarut fosfat dari rhizosfer tanaman kelapa sawit. *BIOLINK (Jurnal Biologi Lingkungan Industri Kesehatan)*, 6(1), 1-7.
- [5] Surya, E., Hanum, H., Hanum, C., Rauf, A., Hidayat, B., & Harahap, F. S. (2019). Effects of composting on growth and uptake of plant nutrients and soil chemical properties after composting with various comparison of POME. *International Journal of Environment, Agriculture and Biotechnology*, 5(6).
- [6] Harahap, F. S., Harahap, D. E., & Harahap, P. (2020). Land characteristics and land evaluation for development on other use area rice fertilizer plants in District Salak Regency Pakpak Bharat. *Ziraa'ah Majalah Ilmiah Pertanian*, 45(2), 195-204.
- [7] Harahap, F. S., Kurniawan, D., & Susanti, R. (2021). Pemetaan status pH tanah dan c-organik tanah sawah tadah hujan di Kecamatan Panai Tengah Kabupaten Labuhanbatu. *Agrosains: Jurnal Penelitian Agronomi*, 23, 37-42.
- [8] Agoesdy, R., Hanum, H., Rauf, A., & Harahap, F. S. (2019). Status hara fosfor dan kalium di lahan sawah di Kecamatan Tanjung Morawa Kabupaten Deli Serdang. *Jurnal Tanah dan Sumberdaya Lahan*, 6(2), 1387-1390.
- [9] Harahap, F. S., Walida, H., & Arman, I. (2021). *Dasar-dasar Agronomi Pertanian*. CV. Mitra Cendekia Media.
- [10] Harahap, F. S. H., Walida, H., Harahap, D. A., Oesman, R., & Fadhillah, W. (2019). Response of growth and production of corn (*Zea Mays L*) with liquid fertilizer in Labuhan Batu regency. *Jurnal Pertanian Tropik*, 6(3), 363-370.
- [11] Harahap, F. S., Rahmaniah, R., Sidabuke, S. H., & Zuhirsyan, M. (2021). Evaluasi kesesuaian lahan tanaman sorgum (*shorgum bicolor*) di kecamatan bilah barat, kabupaten labuhanbatu. *Jurnal Tanah dan Sumberdaya Lahan*, 8(1), 231-238.
- [12] Andriawan, F., Walida, H., Harahap, F. S., & Sepriani, Y. (2022). Analisis Kualitas Pupuk Kascing Dari Campuran Kotoran Ayam, Bonggol Pisang Dan Ampas Tahu. *Jurnal Pertanian Agros*, 24(2), 423-428.
- [13] Afsyah, S., Walida, H., Dorliana, K., Sepriani, Y., & Harahap, F. S. (2021). Analisis kualitas kascing dari campuran kotoran sapi, pelepah kelapa sawit dan limbah sayuran. *AGROVITAL: Jurnal Ilmu Pertanian*, 6(1), 10-12.
- [14] Harahap, F. S. (2018). Evaluasi status kesuburan NPK tanah sawah tadah hujan di Kecamatan Beringin Kabupaten Deli Serdang. *Jurnal Agroplasma*, 5(1), 30-34.
- [15] Siregar, A., Walida, H., Sitanggang, K. D., Harahap, F. S., & Triyanto, Y. (2021). Karakteristik sifat kimia tanah lahan gambut di perkebunan kencur Desa Sei Baru Kecamatan Panai Hilir Kabupaten Labuhanbatu. *Agrotechnology Res J*, 5(1), 56-62.