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Status of N, P, K, C-Organic and pH Nutrient in Paddy Fields in South Bolaang Mongondow Regency, Indonesia

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Abstract

Rice is the main food crop in Indonesia because rice is a staple food. Therefore, rice production must be increased significantly to meet the needs of the growing population. To increase rice production, in addition to superior varieties, irrigation, pest, and disease control, the nutrient fertility status of rice fields is also very important. Nutrient content in the soil that is below the critical limit is a limiting factor for plant growth and yield. Therefore, the nutrient status of rice fields at the farmer level needs to be identified to improve soil fertility. Bolaang Mongondow Regency is the largest rice-producing district in North Sulawesi Province. In Lolak District, Sangtombolang District, and Dumoga District, many large rice fields are the largest rice producers in North Sulawesi Province, which supply rice to Manado. The status of pH, C-organic, N, P, and K is important to know because it affects the growth and yield of rice. This study aims to study the nutrient status of rice fields in Bolaang Mongondow Regency. This study used a survey method and soil sampling was analyzed for pH, C-organic, N, P, and K at the Palm Plant Standard Instrument Testing Laboratory of Manado. Soil samples were taken from rice fields owned by farmers in Lolak District, Sangtombolang District, and Dumoga District. The results showed that the nutrient status of rice fields in South Bolaang Mongondow Regency varied in each village. Nitrogen nutrient status ranged from 0.01–0.19%, Phosphorus between 87–307 ppm, and Potassium between 0.2–0.5%. In addition, the soil pH was classified as acidic, and the C-organic content was classified as low. Increasing the use of organic fertilizers, agricultural lime to increase pH, application of N, P, and K fertilizers based on soil conditions, and implementing crop rotation to increase soil fertility and productivity.

Keywords: *Paddy Fields; Nutrient Status; Production*

Introduction

Soil fertility status is largely determined by natural factors such as parent material, climate, and soil age as well as socio-economic conditions such as whether or not fertilization is given to rice fields (Balitbangtan, 2021). Assessment of soil fertility status provides the basis for site-specific fertilization recommendations for optimal crop yields (Harahap et al., 2019). Productivity is the ability of the land to produce crop yields. According to Kusuma et al., (2023), unproductive land and less than optimal processing will produce agricultural yields that are not by expectations. Intensively cultivated rice production experiences a production decline, where the increase in additional inputs is not followed by an increase in production (Al-Jabri, 2013).

Rice farmers in Bolaang Mongondow Regency still cultivate rice fields conventionally so the use of chemical fertilizers to increase rice production continues to be carried out every planting season. Continuous use of chemical fertilizers can cause the role of chemical fertilizers to be ineffective. The use of chemical fertilizers without being followed by the provision of organic matter to the soil will hurt the physical, chemical, and biological fertility of the soil. Organic matter in the soil has a multifunctional role and is also an integral part of all soil-forming components. From the aspect of soil chemical fertility, organic matter functions as a provider of nutrients derived from weathering, decomposition, and mineralization of elements contained in organic matter (Sumarno et al., 2016; Sumarno et al., 2017). Organic matter has an important role in improving soil texture and structure, increasing fertility, and maintaining overall soil health (Nangaro et al., 2021; Tuas et al., 2022).

The suboptimal use of production technology that supports sustainable agriculture and the decreasing fertile land resources due to the continuous use of inorganic fertilizers have failed to achieve sustainable rice production. Good land management must be implemented to increase rice yields including water management, increasing soil fertility through soil improvement, preventing pests and diseases, crop rotation, managing soil organic matter, and fertilizing according to soil characteristics and plant needs. Land management actions such as continuous fertilization without soil fertility information can increase high macronutrients in the form of N, P, and K reduce nutrient deficiencies for soil and plant needs, and can indicate an imbalance that can cause land productivity to decrease. Information on N, P, and K condition maps, among others, can be used as a basis for determining effective fertilization recommendations for lowland rice (Taaka, 2014).

Method

The research was conducted in Bolaang Mongondow Regency, Indonesia (Lolak District (East Buntalo), Sangtombolang District (Ayong), and Dumoga District (Dumoga) and the Palm Plant Instrument Standard Testing Laboratory of Manado. The research lasted for 4 months from May to September 2024. Soil sampling was carried out to determine the nutrient status of rice fields in Bolaang Mongondow Regency. The data taken in this study were pH, C-organic, N, P, and K by taking soil samples from farmers' rice fields.

Results and Discussion

The soil fertility status of rice fields in South Bolaang Mongondow Regency is presented in Tables 1 and 2. The soil pH is included in the very acidic and acidic criteria. Soil acidity can be an important indicator of soil fertility status because it can describe the nutrient status in the soil which can affect plant growth and also the effectiveness of the solubility of other nutrients available to plants (Harahap et al., 2021). Low soil pH causes decreased nutrient availability and inhibited organic matter decomposition, causing decreased soil fertility levels. Soil pH is a soil reaction that indicates soil acidity or alkalinity. Soil pH plays an important role in determining how easily nutrients are absorbed by plants. In acidic soil, phosphate will react with Al and Fe to form Fe-P and Al-P compounds which are difficult to dissolve. Nutrients can generally be absorbed well by plants at neutral soil pH (Virzelina et al., 2019).

Table 1. Content of pH and C-Organic

Village	pH H2O	pH KCl	C-Organic (%)
Ayong	5,42	4,53	1,89
Dumoga Timur	5,86	4,96	1,69
Buntalo Timur	5,34	4,62	1,41

Note: Palm Plant Instrument Standard Testing Center Testing Laboratory, 2024 (International Organization of Standardization 17025 Accreditation)

The organic C content is 1.41–1.89% with low criteria (Criteria for assessing the chemical properties of soil by BPT Bogor in 2005). Very low to low organic C content is an indicator of the limiting factor for soil fertility. The absence of organic fertilizer use in rice fields at the research location is the main factor in the low organic C content of the soil. This rice field is cultivated intensively (twice a year) and only uses inorganic fertilizers to increase soil fertility.

Table 2, it can be explained that the N content of rice fields is relatively low. This happens because the chemical bond properties of Nitrogen are easily changed shape and easily lost due to being washed away by water. Farmers fertilize using inorganic urea fertilizer in the early growth phase, then followed by one month after transplanting. The fertilizer dose depends on the farmer's finances. Inorganic compounds in this case Nitrogen are easily washed away, and can even evaporate into the atmosphere (Razali dan Hanum, 2017). Nitrogen is very easily lost or dissolved either due to evaporation into the atmosphere or being washed away by drainage water. One of the factors that limits the growth of rice plants in rice fields is nitrogen. Plants lacking N elements will affect plant growth because N elements play a role in the photosynthesis process, which has an impact on decreasing rice production. According to Agustine et al., (2020), NH4 + absorption takes place best in neutral media and will decrease as the pH decreases.

Table 2. Nitrogen, Phosphorus, Potassium Content

Village	N (%)	P (ppm)	K (%)
Ayong	0,19	203	0,60
Dumoga Timur	0,03	307	0,21
Buntalo Timur	0,01	87	0,15

Note: Palm Plant Instrument Standard Testing Center Testing Laboratory, 2024 (International Organization of Standardization 17025 Accreditation)

Phosphorus elements in the research area are very high, Phosphorus elements play a role in encouraging root growth and development, triggering flowering and fruit ripening, encouraging more formation of rice clumps/tillers. Phosphorus absorbed by plants in the form of inorganic ions quickly changes into organic P compounds in the plant body (Rosmarkam & Yuwono, 2002). Phosphorus is an essential nutrient that is important for plants and its presence cannot be replaced by other nutrients. Phosphorus (P) nutrients in rice plants can encourage the formation of grain, so that it can support maximum production and have better nutritional content in relation to the P content in seeds, so that the need for Phosphorus for plants is relatively large.

Discussion

Organic matter in the soil is one indicator of soil fertility. The use of organic matter can increase soil fertility through changes in the physical, chemical and biological properties of the soil. Organic matter plays an important role in increasing soil fertility. The function of providing organic matter such as organic fertilizer can provide macronutrients (N, P, K, Ca, Mg, and S) and micronutrients such as Zn, Cu, Mo, Co, B, Mn, and Fe even in small amounts.

Increased production and productivity are inseparable from the way farmers manage their land so that differences in land management can affect different levels of productivity. The return of nutrients transported during the rice harvest is very important through the provision of organic and inorganic (chemical) fertilizers. Astinungrum, (2005) stated that excessive use of chemical fertilizers can cause residues from the Nitrogen fertilizer carrier substance left in the soil, which will reduce the quality and quantity of the harvest. The return of Nitrogen elements to rice field soil by burying the remaining rice straw after harvest is buried so that it rots and can decompose in the soil so that there is an addition of Nitrogen elements. Management of farmers' rice field soil such as water regulation, provision of fertilizers (organic or inorganic), maintenance and determination of planting patterns affect different levels of productivity (Sirappa & Wahid, 2012).

After harvest, rice straw is usually burned by farmers on the rice fields. According to Husnain, (2010), the percentage of Potassium nutrient loss during straw burning is 36-47%. The main functions of Potassium include helping root development, helping the protein formation process, increasing plant resistance to disease and stimulating seed filling. The nutrient status of Potassium in this experiment was low. The causes of high and low potassium in the soil are influenced by the parent material, soil pH, and soil CEC. Zhang et al., (2021) reported that returning straw to rice fields as compost can increase the availability of K elements needed for plant growth and increase the supply capacity of soil K elements and potassium balance.

Conclusion

The nutrient status of rice fields in South Bolaang Mongondow Regency varies from village to village. Nitrogen nutrient status is between 0.01–0.19%. Phosphorus 87–307 ppm. Potassium 0.2–0.5%. Soil pH is acidic, low organic C content. Increasing rice productivity is determined by the availability of nutrients, so it is necessary to add organic materials to improve the nutrient status of the land.

References

Agustine, L., Widiatmoko, T., & Begananda. (2020). Identification of N Nutrient Status In Paddy Field At Area Irrigation Kedunglimus Arca, Left Areal In Sub-Ditrict Kembaran Banyumas. *Jurnal AGROSCRIPT*, *2*(1), 10–20.

Al-Jabri, M. (2013). Teknologi Uji Tanah Untuk Penyusunan Rekomendasi Pemupukan Berimbang Tanaman Padi Sawah. *Pengembang Inovasi Pertanian*, *6*(1), 11–22.

Astinungrum, M. (2005). *Manajemen Persampahan, Majalah Ilmiah Dinamika*. Universitas Tidar Magelang.

Balitbangtan. (2021). *Rekomendasi Pemupukan N, P, dan K Pada Padi Sawah Spesifik Lokasi* (Kementerian Pertanian (ed.)). Kementerian Pertanian.

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*(1), 37. https://doi.org/10.20961/agsjpa.v23i1.48479.

Harahap, F. S., Walida, H., & Fadillah, W. (2019). Evaluasi Status Kesuburan N P K Tanah Sawah Tadah Hujan Di Kecamatan Beringin Kabupaten Deli Serdang. *Jurnal Agroplasma*, *5*(1), 30–34. https://doi.org/10.36987/agr.v5i1.177.

Husnain. (2010). *Kehilangan Unsur Hara akibat Pembakaran Jerami Padi dan Potensi Pencemaran Lingkungan* (Balai Penelitian Tanah (ed.)). Balai Penelitian Tanah.

Kusuma, G. A. I., Rosmawaty, R., & Yusria, W. O. (2023). Analisis Persepsi Petani terhadap Perubahan Penggunaan Lahan Perkebunan ke Lahan Padi Sawah di Kelurahan Atula Kecamatan Ladongi Kabupaten Kolaka Timur. *JIA (Jurnal Ilmiah Agribisnis) : Jurnal Agribisnis Dan Ilmu Sosial Ekonomi Pertanian*, *8*(3), 186–198. https://doi.org/10.37149/jia.v8i3.125.

Nangaro, R. A., Tamod, Z. E., & Titah, T. (2021). Analisis Kandungan Bahan Organik Tanah Di Kebun Tradisional Desa Sereh Kabupaten Kepulauan Talaud. *Cocos*, *1*(1), 1–17.

Razali, I. A dan Hanum, H. (2017). Identifikasi Status Hara dan Produksi Padi Pada Lahan Sawah Terasering dan Non Terasering di Kecamatan Onan Runggu Kabupaten Samosir. *Jurnal Agroekoteknologi*, *5*(2), 338–347. https://www.neliti.com/publications/110165/identifikasi-status-hara-dan-produksi-padi-pada-lahan-sawah-terasering-dan-non-t.

Rosmarkam, A., & Yuwono, N. W. (2002). *Ilmu Kesuburan Tanah*. Penerbit Kanisius.

Sirappa, M. P., & Wahid. (2012). Kajian Tiga Jenis Pupuk Organik Terhadap Pertumbuhan Dan Hasil Padi Rawa Di Desa Debowae, Kecamatan Waeapo, Kabupaten Buru. *Budidaya Pertanian*, *8*(2), 95–102.

Sumarno, Mahdalena, & Hamidah. (2016). Pengaruh Berbagai Media Tanam Dan Pemberian Mikro Organisme Lokal (MOL) Keong Mas Terhadap Pertumbuhan Dan Produksi Tanaman Bawang Tiwai (*Eleutherine americana*). *Journal Agrifarm*, *18*(2), 33–37. http://www.tjyybjb.ac.cn/CN/article/downloadArticleFile.do?attachType=PDF&id=9987.

Sumarno, S., Widjianto, H., & Kusuma W, R. (2017). Pemberian Pupuk Alam Terhadap Serapan Nitrogen dan Hasil Sawi di Alfisols. *Agrosains: Jurnal Penelitian Agronomi*, *19*(2), 33. https://doi.org/10.20961/agsjpa.v19i2.20910.

Taaka, O. . (2014). *Influence of Communication on Adoption of Agricultural Innovation: A Case of the System of Rice Intensification in Mwea Irrigation Scheme*. Thesis. University of Nairobi.

Tuas, M. A., Raharjo, K. T. P., & Kapitan, O. B. (2022). Identifikasi Sifat Kimia Tanah Entisol di Lahan Kering Desa Sekon Kecamatan Insana Kabupaten Timor Tengah Utara – NTT. *Jurnal BETA (Biosistem Dan Teknik Pertanian)*, *10*(2), 396. https://doi.org/10.24843/jbeta.2022.v10.i02.p22.

Virzelina, S., Tampubolon, G., & Nasution, H. (2019). Kajian Status Unsur Hara Cu Dan Zn Pada Lahan Padi Sawah Irigasi Semi Teknis : Studi Kasus di Desa Sri Agung Kecamatan Batang Asam Kabupaten Tanjung Jabung Barat. *Agroecotenia*, *2*(1), 11–26.

Zhang, Z., Liu, D., Wu, M., Xia, Y., Zhang, F., & Fan, X. (2021). Long-term Differences in K Balance Under Rice-wheat Cultivation Alter Potassium Supplying Ability of Soils. *Springer Nature*, 1–25. https://doi.org/10.21203/rs.3.rs-739403/v1.