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Nutrient Characteristics of Purun Tikus (*Eleocharis dulcis* (BURM.F) TRIN. Ex HENCH) as a Foundational Material for Eco-friendly Handicrafts Supporting Sustainable Ecotourism

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Abstract. Purun tikus (*Eleocharis dulcis*) is an aquatic plant found in the swamp waters of Palam Village, Cempaka Sub-district, Banjarbaru City, South Kalimantan. The utilisation of purun tikus can play a significant role in bioecology and the development of eco-friendly ecotourism, while also fostering local economic empowerment. This study aimed to assess the nutrients of purun tikus by measuring water quality parameters such as temperature, clarity, depth, Total Suspended Solids (TSS), pH levels, Nitrogen (N), Phosphate (PO_4), Potassium (K), Magnesium (Mg). The research employed a quantitative approach with direct field measurements at three different stations, while water quality testing was conducted in the laboratory. The results of the water quality analysis for purun tikus revealed temperature levels ranging from 30.4-32.5°C, clarity between 65-73 cm, depth also between 65-73 cm, TSS between 1-4 mg/l, pH levels from 3.13-5.66, Nitrogen (N) levels between 4.9-14.06 mg/l, Phosphate (PO4) levels ranging from 0.04-0.08 mg/l, Potassium (K) levels between 3.58-17.73 mg/l, and Magnesium (Mg) levels ranging from 0.26-8.96 mg/l. The conditions of the swamp waters indicate that purun tikus thrives well, even highly fertile, in the Palam Village region. The study suggests that cultivating purun tikus through nursery practices and seeding methods could facilitate its propagation and conservation, benefiting both environmental and economic bioecological objectives and supporting sustainable ecotourism development.

1. Introduction

Purun tikus (*Eleocharis dulcis*) is an aquatic plant that thrives around Palam. It is notable for its ability to grow only in swamp waters with low pH levels, ranging from 3 to 5 [1-2, 31]. This plant is limited to habitats with acidic soil conditions and flourishes only in areas with specific water characteristics. While purun tikus can survive in freshwater with a pH between 6 and 7, its growth is significantly slower under these conditions [2-3]. In Banjarbaru, acidic soils are prevalent in Palam, where purun tikus dominates the vegetation of the acidic swamplands, and can even be considered a weed commonly found in acid sulfate soils. Due to its resilience to high acidity, with a pH range of 2.5 to 3.5, purun tikus can serve as a bioindicator of acidic waters [4-5]. Its growth pattern is unique compared to other aquatic plants, and it is a key species for acidic soils, thriving and reproducing only in specific environments.

Nutrients are essential substances required by plants for their growth, and they play a crucial role in the survival of aquatic plants like purun tikus [3]. For normal growth and to complete their life cycle, plants need at least 16 chemical elements. Among these, carbon, hydrogen, and oxygen are non-mineral elements obtained from air and water [6]. The remaining 13 elements must be absorbed from the soil in mineral form or added as fertilizers. Nitrogen (N), phosphorus (P), and potassium (K) are primary or macronutrients needed in large amounts, while calcium (Ca), magnesium (Mg), and sulfur (S) are secondary elements required in smaller quantities [7-8]. Purun tikus, like other aquatic plants, requires these nutrients to support its growth and development throughout its life cycle. In its natural acidic soil habitats, the necessary nutrients are consistently available. Research on the nutrient requirements of purun tikus in these aquatic environments is important to ensure its continued survival and availability in nature.

The use of purun tikus aquatic plants as a material for weaving, where the process of transforming raw purun tikus into handicraft items such as mats, bags, hats, and other products, is carried out by the people of Palam. This has led to an increased harvesting of purun tikus from its natural habitat without efforts to reproduce or cultivate the plant. As the demand for purun tikus-based handicrafts grows, so does the extraction of the plant from its environment. Handicraft products made from purun tikus are environmentally friendly, as they can be

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sustainably produced without harming the ecosystem. The development of purun tikus-based handicrafts using local resources can help preserve the environment and promote sustainable ecotourism [9-10, 33]. Collecting research data on the nutrients of purun tikus is crucial for its conservation, ensuring the plant's population remains stable as part of the aquatic ecosystem in wetlands. This effort supports the sustainable use of local natural and community resources in Palam, protecting the environment while promoting sustainable ecosystems and ecotourism.

2. Method

2.1. Study Area

Purun tikus aquatic plants are found in Palam Village, Cempaka Subdistrict, Banjarbaru City, South Kalimantan. Water quality sampling was conducted at three stations, chosen to represent the various conditions of the waters where purun tikus grows. Station 1 represents swamp waters near local rice fields. Station 2 is an area of former diamond mining that has been converted into a water tourism site by the community. Station 3 is a pond created from an old diamond mine, where there is no ongoing community activity. Water sampling at each station was conducted from morning to noon, with samples collected in bottles and transported to the laboratory for analysis. The water quality sampling locations, which are overgrown with purun tikus, are shown in Figure 1 and the observation stations for purun tikus are detailed in Table 1.

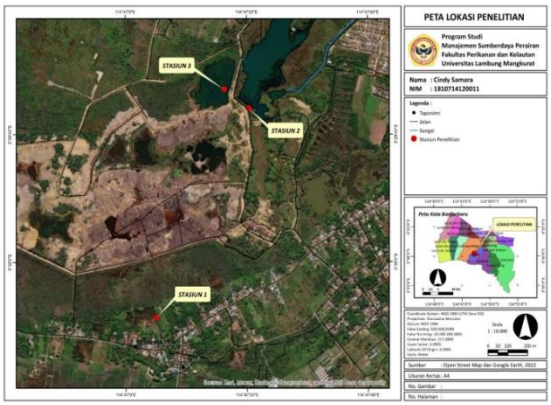


Figure 1. Location of the purun tikus samples

Table 1. Determination of Observation Stations of Purun Tikus

Stasiun	Latitude (N/S)	Longitude (E)	Description
1	3°5024041"S	114°7847519"E	The swampy waters in Kampung Purun are located near residential areas in Palam Village
2	3°4933133"S	114°7890039"E	Seran Lake Tourism is a large, deep waterbody formed from a former diamond excavation site. Both the local community and city government are involved in managing the area as an ecotourism destination, utilizing the water for various sustainable activities.
	3°4924800"S	114°7878686"E	A former diamond mining excavation site, left undisturbed without any community activities, allowing it to return to its natural state

2.2. Water Quality Analysis

Water quality measurements include physical parameters such as temperature, clarity, depth, and total suspended solids (TSS). Chemical parameters assessed are pH, nitrogen (N), phosphate (PO4), potassium (K), and magnesium (Mg). Water quality samples from each observation station were collected in April 2025, and the water quality analyses were carried out in the laboratory. pH meter for analyzing water acidity, a thermometer for measuring water temperature (AS218 pH meter smart sensor certificate calibration tester AS-218), a Secchi disk for determining water transparency and depth (Seccidisk 20 cm mini water transparency and depth tester), and a Global Positioning System (GPS-garmin GPS 60) device for recording sampling coordinates. The distances between stations ranged from 560 to 2,405 meters. In situ analysis of physical and chemical was carried out at the Water Quality and Hydro-Bioecology Laboratory of the Faculty of Fisheries and Marine Science at Lambung Mangkurat University, as well as at the Banjarbaru Industrial Research and Standardization Center (Baristand Industri) Laboratory.

2.3. Analysis Data

Data processing comes from direct measurements of water quality overgrown with rat purun aquatic plants and data from laboratory water quality measurements. Data were collected and analysed using descriptive and inference statistical methods. Descriptive statistics explain sample data without making broader conclusions. Inference statistics use sample data to make conclusions and predictions. The results of water quality measurements of rat purun were tested to test the difference in water quality results between observation stations using one-way Anova test.

3. Results and Discussion

The potential of purun tikus (*Eleocharis dulcis*) aquatic plants was assessed at three stations in Palam Village, Cempaka District, Banjarbaru City. This assessment included measurements of water quality both physical parameters and water chemistry as well as morphological observations of the purun tikus plants.

3.1. Water Quality

The results of water quality measurements, including temperature, clarity, depth, total suspended solids (TSS), pH, nitrogen (N), phosphate (PO4), potassium (K), and magnesium (Mg) in areas overgrown with purun tikus, are detailed in Table 2.

Table 2. Water Quality Purun Tikus (*Eleocharis dulcis*)

No.	Parameter	Units	Station			Ranges	References
			1	2	3		
Physical							
1	Temperature	^{o}C	30.4	32.2	32.5	30.4 – 32.5	30 – 35 [12]
2	Transparency	cm	65	73	73	65 – 73	0.5 – 50 [11]
3	Depth	cm	65	73	73	65 – 73	0.8 m [9]
Chemical							
4	TSS	mg/l	4	3	1	1 – 4	26 – 75 [16]
5	pH	-	5.66	3.86	3.13	3.13 – 5.66	6.9 – 7.3 [12] 2.5 – 3.5 [20]
6	Nitrogen (N)	mg/l	11.25	4.92	14.06	4.90 – 14.06	3.36 % [20]
7	Phosphate (PO4)	mg/l	0.05	0.04	0.08	0.04 – 0.08	0.43 % [20]
8	Potassium (K)	mg/l	3.58	17.73	3.88	3.58 – 17.73	2.02 % [20]

9	Magnesium (Mg)	mg/l	0.26	4.54	8.96	0.26 – 8.96	0.42 % [1]

Water quality assessments that reflect the nutrient conditions in the aquatic environment, along with the presence of purun tikus as an emergent aquatic plant at all three observation stations, show that Station 3 provides the most favorable conditions for the species to grow and flourish in Palam, resulting in its high density at that site. Statistical analysis revealed a significant variation in the density of Purun Tikus among the stations ($p = 0.009$). Station 3 recorded the highest density, with an average value of 44.31, which was further confirmed by the pairwise comparison test showing that Station 3 ($p = 0.009$) was significantly higher than the other stations. These notable differences are strongly linked to the distinct water quality conditions and habitat characteristics present at each station.

3.1.1. Temperature

Temperature is a key physical factor in water quality because it influences the growth of aquatic species, including purun tikus (*Eleocharis dulcis)* plants [3]. Changes in water temperature can affect the amount of dissolved oxygen and the rate of chemical reactions [11]. Higher temperatures accelerate chemical reactions and impact the number of concurrent chemical processes in plant and animal tissues, affecting the entire aquatic ecosystem [11]. Purun tikus thrives within a temperature range of 30-35°C, with soil moisture levels between 98-100% [12]. Temperatures rising to around 50°C can reduce growth enzymes, and temperatures reaching 55°C can cause cell damage and plant death. Conversely, lower temperatures can lead to the loss of vital water from plant cells, causing denaturation and eventual death [13]. The temperature measurements at the observation stations, ranging from 30.4 to 32.5°C, indicate an optimal temperature range for purun tikus growth in the swamp waters of Palam.

3.1.2. Transparency

Water transparency is a physical parameter crucial for photosynthesis in aquatic ecosystems. High transparency allows sunlight to penetrate deeper into the water. Measurements of water transparency should be taken during daylight hours and under relatively clear weather conditions [11,14]. Water transparency reflects how well light can penetrate through the water and is influenced by sunlight penetration [15]. It also provides an indirect measure of turbidity and the concentration of suspended solids, which are affected by the number of particles in the water [16]. For purun tikus, water transparency at different ages varies: approximately 0.5 cm at age 0, 20 cm at around 8 years, and over 50 cm at more than 15 years [11]. Measurements of water transparency around the swamp areas with purun tikus ranged from 65 to 73 cm, indicating excellent conditions for the plant's growth, as the green stems of purun tikus are visible to significant depths.

3.1.3. Depth.

The depth of a body of water influences the penetration of light and nutrients. As depth increases, temperature, dissolved oxygen, and sunlight intensity decrease, eventually reaching levels where only the metabolic needs of organisms can be met by the remaining light energy. Each water body has a different depth of compensation, primarily due to varying water clarity. Clearer waters allow for deeper light penetration, resulting in a greater depth of compensation, whereas waters with high levels of dissolved or suspended particles have shallower compensation depths [11]. Purun tikus can thrive in swampy areas with water depths of up to 0.8 meters [9]. The depth measurements in the study ranged from 63 to 75 cm, which is suitable for the growth and development of purun tikus.

3.1.4. Total Suspended Solid (TSS)

Total Suspended Solids (TSS) refer to solid particles in water, including sand, mud, clay, and living components such as phytoplankton, zooplankton, bacteria, and fungi, as well as non-living components like detritus and inorganic particles [13,16]. These solids are typically difficult to settle out of the water through conventional gravity methods. Clay is a common colloidal suspended solid in surface waters. TSS often originates from stormwater runoff and soil erosion, leading to water turbidity that can be aesthetically unpleasing. TSS includes smaller and lighter particles, such as clay, organic materials, and microorganisms. Purun tikus plants are effective in reducing TSS levels: 75 mg/l in the first week, 51 mg/l in the second week, and 26 mg/l in the third week in an installation pond [16]. In the study, TSS measurements ranged from 1 to 4 mg/l, indicating low TSS

levels in the swamplands where purun tikus grows, supporting its healthy development in the swamp waters of Palam Village, Cempaka Subdistrict, Banjarbaru.

3.1.5. pH.

pH measures the level of acidity or basicity of a solution, with values below 7 indicating acidity and values above 7 indicating basicity [11]. Changes in pH can significantly impact aquatic life [15]. For optimal iron absorption by plants, the ideal pH range is between 4.6 and 7.4 [17-18]. In South Kalimantan, the swamps, which are flooded year-round and have acidic peat soil with a pH of less than 7, are ideal for growing purun tikus [19]). While purun tikus prefers loamy or humus soils with a pH of 6.9 to 7.3, it can also thrive in more acidic soils with a pH ranging from 2.5 to 3.5 [5,12]. The pH measurements in areas overgrown with purun tikus ranged from 3.13 to 5.66, demonstrating that purun tikus can successfully grow and develop in the acidic pH conditions of the swamp waters in Palam Village, Cempaka Subdistrict, Banjarbaru.

3.1.6. Nitrogen (N)

Nitrogen and its compounds are present in the atmosphere and in terrestrial and aquatic environments. However, nitrogen cannot be used directly by living organisms and must first undergo fixation. In water, nitrogen is primarily found in organic forms such as proteins, amino acids, urea and inorganic forms such as ammonia (NH_3), ammonium (NH_4), nitrite (NO_2), nitrate (NO_3), and nitrogen gas (N_2). Nitrogen is essential as a protein component in plants [8]. In flooded conditions, ammonia is the predominant form of nitrogen. Plants absorb nitrogen mainly in the form of nitrate (NO_3) or ammonium (NH_4), which come from the decomposition of organic matter. Nitrate ions, being negatively charged, remain in the soil solution and are easily absorbed by plant roots [8]. Purun tikus contains 3.36% total nitrogen [20]. Eutrophic waters typically have a total nitrogen concentration of ≤ 1.9 mg/l [14]. Measurements of nitrogen (N) in areas overgrown with purun tikus ranged from 4.9 to 14.06 mg/l, indicating that the swamp waters in Palam Village, Cempaka Subdistrict, Banjarbaru, provide sufficient nitrogen to support the growth and development of purun tikus.

3.1.7. Phosphate (PO_4)

Phosphate (PO_4) represents the form of elemental phosphorus found in water. Phosphorus exists in two primary forms: organic phosphates, which are part of plants and animals, and inorganic phosphates, found in water and soil. While phosphorus is crucial for organisms, its natural availability is limited, and it significantly impacts water productivity [8]. In water, phosphorus is present as inorganic compounds like orthophosphates (e.g., Na_3PO_4, Na_2HPO_4) and polyphosphates (e.g., sodium hexametaphosphate, $Na_3(PO_3)_6$), as well as organic compounds in particulate form. Sources of phosphates include laundry detergents, animal waste, and dissolved fertilizers, which can contribute to nutrient enrichment and potentially lead to eutrophication [11]. Generally, natural waters have a total phosphorus content of less than 0.1 mg/l, although this can increase due to household, industrial, and agricultural waste [8]. Purun tikus plants contain 0.43% phosphorus [20]. Measurements of phosphate (PO_4) in areas with purun tikus ranged from 0.04 to 0.08 mg/l, indicating that the swamp waters in Palam Village, Cempaka Subdistrict, Banjarbaru, provide adequate phosphate levels to support the growth and development of purun tikus.

3.1.8. Potassium (K)

Potassium is the third major nutrient essential for plants, following nitrogen and phosphorus. It is absorbed by plants as K^+ ions and is highly mobile within plant cells, tissues, xylem, and phloem, with the majority found in the cytoplasm. Potassium plays a crucial role in photosynthesis, the transport of assimilates, enzyme activation, and mineral absorption, as well as enhancing plant resistance to diseases [8]. It is involved in activating enzymes, carbohydrate formation, and various physiological processes, including respiration. Potassium deficiency can lead to rapid aging and browning of leaves, as young leaves absorb potassium from older ones, which can inhibit growth [21]. Purun tikus plants contain 2.02% potassium [20]. Measurements of potassium (K) in waters overgrown with rat purun ranged from 0.04 to 0.08 mg/l, indicating that the swamp waters in Palam Village, Cempaka Subdistrict, Banjarbaru, provide sufficient potassium to support the growth and development of purun tikus.

3.1.9. *Magnesium (Mg)*

Magnesium (Mg) is a crucial secondary macronutrient required by both terrestrial and aquatic plants. It originates from the weathering of rocks containing minerals such as biotite, hornblende, serpentine, epsomite, and olivine. Plants absorb magnesium in the form of Mg^{2+} ions. Magnesium is a key component of chlorophyll, the pigment responsible for photosynthesis. It plays a vital role in chlorophyll formation, phosphate transport, and contributing to the green coloration of leaves. A deficiency in magnesium can lead to chlorosis, where leaves turn

yellow, starting from the tips and progressing to the base [3, 22, 29-30]. Purun tikus plants contain 0.42% magnesium [1]. Measurements of magnesium (Mg) in areas with purun tikus ranged from 0.26 to 8.86 mg/l, indicating that the swamp waters in Palam Village, Cempaka Subdistrict, Banjarbaru, have sufficient magnesium to support the growth and development of purun tikus.

3.2. Purun Tikus as a Raw Material for Weaving

The tropical aquatic environment offers substantial benefits due to its rich diversity of aquatic plants, including the abundance of purun tikus (*Eleocharis dulcis*) around the community in Palam Village, Cempaka District, Banjarbaru. The diverse range of aquatic plants, including purun tikus, is well-suited to its habitat [12]. In Palam Village, purun tikus thrives and has been utilized for crafting for many years. The local community has long practiced turning purun tikus into various handcrafted items such as mats, bags, and hats, a tradition passed down through generations [1]. Both long and short stems of purun tikus are collected from their natural habitat to meet the increasing demand for woven products. The use of purun tikus as a raw material in crafting not only provides economic and aesthetic value but also creates employment opportunities, particularly for housewives and young women involved in the craft industry. This utilization of purun tikus contributes to the local economy by generating income and leveraging the readily available resource in the Palam Village area [23-24]. In Palam Village, Cempaka Banjarbaru District, local residents have organized a group to market handicraft products made from purun tikus, setting up outlets right outside their homes [25-26]. This approach has boosted demand for purun tikus, leading to increased harvesting of the plant, both young and old, from its natural habitat to meet the needs of the craft industry [27]. Regional and other institutions support this local craft industry as a means to enhance community welfare. However, the rising demand for purun tikus has not been matched by efforts to cultivate it, risking the plant's sustainability. To ensure a steady supply and maintain environmental balance, it's essential to start cultivation efforts based on research findings about the plant's nutrient needs and optimal growth conditions. Cultivation will help preserve the unique wetland habitats of purun tikus while supporting both ecological sustainability and the local economy [9, 34].

3.3. Purun Tikus: Eco-Friendly Ecotourism

The use of purun tikus for woven crafts has been a long-standing tradition among local communities. Both local and external demand for purun tikus as a crafting material has led to increased harvesting from its natural habitat [28]. Research into the life cycle and nutrient content of purun tikus, particularly as an aquatic plant thriving in acidic waters, is essential. This research can help ensure that purun tikus, which has both aesthetic and commercial value, can be sustainably cultivated through simple propagation methods. Understanding the nutrient composition such as Nitrogen, Phosphorus, Potassium, and Magnesium can significantly influence the growth and quality of purun tikus. These nutrients play a crucial role in maintaining ecological balance within aquatic ecosystems. Sustaining purun tikus not only ensures a steady supply of materials for weaving but also supports local craftsmanship in Palam Village. The production of purun tikus based handicrafts contributes to sustainable ecotourism by promoting local industries and preserving the environment. Integrating crafts made from purun tikus stems with natural tourist destinations supports sustainability by emphasizing the preservation of aquatic and wetland ecosystems. Utilizing purun tikus stems for woven handicrafts is an eco-friendly practice that does not harm these ecosystems and can naturally regenerate [32]. Effective management of natural resources, including the responsible harvesting of purun tikus and the protection of its habitat, is crucial for sustainable resource use and is widely supported to ensure its continuity. Research on purun tikus, including nutrient analysis within its habitat, promotes sustainability and supports environmentally friendly ecotourism. This research aids in conserving aquatic and wetland environments while also benefiting local communities. The presence of purun tikus in Palam Village offers opportunities for innovative handicraft production, which can boost community income. This economic benefit, combined with the village's designation as an ecotourism destination by the Banjarbaru city government, enhances the village's role as an ecotourism hub. Palam Village’s ecotourism potential is illustrated in Figure 2.



Figure 2. Kampung purun palam village

4. Conclusion

The swamp waters of Palam Village provide water quality that contains the essential nutrients needed for the growth of Purun tikus. Key nutrients such as Nitrogen (N), Phosphate (PO_4), Potassium (K), and Magnesium (Mg), along with supporting factors like temperature, light intensity, water depth, TSS, and pH, enable Purun tikus to grow abundantly and even become the dominant vegetation in the area. In practical terms, these conditions support the potential for cultivating Purun tikus as part of community- based initiatives to propagate and preserve this species in acidic wetland ecosystems, thereby contributing to sustainable eco-tourism development.

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