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Effect of Soil Damage on Carrying Capacity of Biomass Production: An Lessons from Tanjung Selor District – Tanjung Redeb, Indonesia

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6

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Abstract Currently, land use is considered intensive for various purposes that affect the soil as the main series of land and the environment. The other side of the soil in Kalimantan is naturally formed from material that is poor in nutrients so it is not fertile and acidic. This study attempted to evaluate the status of soil damage to the carrying capacity for biomass production in Tanjung Selor District (Bulungan Regency, North Kalimantan Province). The overlay analysis of land slope, rainfall, soil type and land cover in the form of a map produces indicative areas of low, medium and high damage. High damage indicative areas were selected for verification, observation and soil sampling to obtain soil damage parameter data, carried out in March 2020. Analysis of the relative frequency score of the damaged parameters to determine the status of soil damage and carrying capacity. The results of the study based on 10 soil damage parameters obtained a score of 6 with the status of lightly damaged soil damage, the main factor being soil acidity (R.I-a) with a high carrying capacity of 1,684 ha. The acidity factor with a pH of <4.5 (very acidic) has the most effect, 80% is damaged, but is relatively easy to repair. Efforts to improve cultivated plants that are stressed by soil acidity by using soil amendments to raise the pH above the minimum range that is more suitable to increase biomass production and carrying capacity, namely agricultural lime and compost followed by N, P and K fertilization as needed.

Keywords land use, soil damage status, biomass production, carrying capacity

1. Introduction

Land use for various activities and purposes is increasing and even intensive, so that it affects the quantity and quality of the land component, namely the lithosphere. Lithosphere is part of the outer shell of the earth consisting of rocks and soil that supports life on it, among others, to produce biomass. As a component of land and the environment, the use of land that is more diverse and wider without considering the carrying capacity can cause soil damage which reduces the production of plant biomass on it.

4 Environmental carrying capacity is defined as the harmonization of the environment to meet the needs of living things, especially humans [1].

Soils in Kalimantan are formed from repetitive, nutrient-poor residual parent material such as sandstone. Nutrients that come out are not replaced or replaced but the amount and type are not balanced and for a long time, so that the quality of the soil is reduced or damaged which reduces its carrying capacity for biomass production [2-3]. Another factor is the high rainfall and lasts most of the year with a long period of time and this indicates that alkaline metal nutrient loads are leached to the lower layers and some are carried away by groundwater into water bodies with the consequence that the soil is relatively poor in nutrients and acidic.

1 As for the motivation and objectivity of the study to understand the status of soil damage to the carrying capacity for biomass production in Tanjung Selor District. To the author's knowledge, this study is one of the first to employ a different approach and technique than the others. A study that relates soil damage to carrying capacity based on indicative soil damage parameters. Production of green plant biomass in the form of fruit, tubers, leaves, shoots, stems, skins, flowers, oil as the main food chain on land and life support material. High biomass production can be achieved if the soil of the growing medium is good, otherwise if the soil is damaged. This may be of interest to stakeholders, particularly policy makers.

2. Materials and Methods

2.1. List of Equipments

Operationally, the main research equipment or item consists of soil samples and thematic maps. The maps in question are the 2012–2032 Bulungan Regency Spatial Plan [4], soil type maps [5], Indonesian topographic maps 1918-42 and 1918-44 [6], Digital Elevation Model (DEM) maps [7], rainfall [8] and land cover map [9] classification refers to Indonesian National Standard (SNI): 7145-1:2014 [10]. The whole is digitally based for easy overlapping

operations. Soil samples were taken at locations with high indicative soil damage potential referring to the result of overlapping thematic maps. Field activities are equipped with GPS, soil drill, double ring, clinometer, plastic bag and machete. Laboratory equipment and chemicals for soil testing. The soil samples analyzed in the laboratory included physical characteristics (fraction composition, bulk density, and total pores), chemical characteristics (pH, DHL, and Redox), and soil biology (bacteria and fungi) at the Soil Laboratory at the Faculty of Agriculture – Universitas Mulawarman.

2.2. Indicators

The concentration of areas that become effective work areas are cultivation areas [4] which so far have become prospects for expansion of biomass production, such as horticultural cultivation areas, agricultural and plantation areas, limited production forest areas, and permanent production forest areas. Meanwhile, other areas (protected areas and other cultivation areas such as settlements, fisheries, etc.) are not included in the effective areas [11-14].

2.3. Indicative Land Damage

The requirements for measuring indicative damage are based on 4 parameters that are weighted based on their strong influence on soil damage, i.e. slope (%) and rainfall (mm.th⁻¹) weight 3, soil type (*Ordo*) and land cover weight 2, total weight 10 [15-17]. Each vital parameter is rated according to its potential damage. The ratings for each parameter are: Slope 1 (1-8%), 2 (9-15%), 3 (16-25%), 4 (26-40%), and 5 (>40%). rainfall 5 (> 4000), 4 (3000-4000), 3 (2000-3000), 2 (1000-2000), and 1 (<1000). Soil 1 (*Vertisols Aquic moisture regime*), 2 (*Oxisols*), 3 (*Mollisols, Ultisols*), 4 (*Inceptisols, Entisols, Histosols*), and 5 (*Andisols, Spodosols*). Land cover related to crop coefficient includes 1–Natural forest, rice fields, pure fertile along-alang; 2–Mixed gardens, shrubs, meadows; 3–Production forests, cultivation; 4–Perennials; and 5–Open land [18]. This land cover will be equivalent to the land cover of SNI: 7645-1:2014 found at the activity site [10]. Each weight multiplied by the rating yields a specific

score [19-23].

2.4. Map Overlay

The next step is the treatment of overlapping operations with ArcGis version 10.2 on slope maps, rainfall maps, soil types maps and land cover maps [24-25]. Sudaryatno [26], Hernando & Romana [27], and Roesch *et al.* [28] popularized the most important parts obtaining total scores (smallest 10) and (largest 50). The entire map area is only in the effective working area. It should be noted that the total score is classified according to the assumption of indicative soil damage potential into 5 classes (*Table 1*). These results provide a spatial sign of potential soil damage as a guide for field verification.

Table 1. Indicative soil damage potential

| Group | Score |
|-----------|----------|
| Very low | <15 |
| Low | ≤15 – 24 |
| Moderate | <25 – 34 |
| High | ≤35 – 44 |
| Very high | ≤45 – 50 |

Source: adopted from Siahaan [29].

2.5. Field Verification

Furthermore, field verification only focuses on locations of high indicative soil damage potential to prove the truth of the potential damage [30]. When in the field, the independent system soil observations at 10 representative sites of the dimensions of solum thickness, surface rock, degree of water release, and taking soil samples at a depth of 0–20 cm for laboratory review [31-33].

2.6. Categorization of Land Damage Status

Finally, compile the status of soil damage using the relative frequency scoring method with the provisions of the comparison of the number of soil samples based on the parameters of the laboratory analysis results classified as damaged (%) to all soil samples.

Table 2. Relative frequency ground damage score

| Frequency (%) | Score | Measures | Carrying capacity |
|---------------|-------|----------------------|-------------------|
| 0 – 11 | 0 | Not damaged | Very high |
| 1 – 25 | 1 | Slightly damaged | High |
| 26 – 50 | 2 | Medium | Moderate |
| 51 – 75 | 3 | Heavily damaged | Low |
| 76 – 100 | 4 | Very heavily damaged | Very low |

Source: Darma *et al.* [34].

Other parameters observed directly in the field were classified as damaged (%) against all observations of the same parameters in the field (see *Table 2*). The types of

parameters and their assessments refer to *Table 4*, the parameters are declared damaged if they are outside the threshold. The maximum accumulated score is 40 if all or

10 parameters (Table 4) are damaged, then divided into 5 classes (Table 3).

Table 3. Relationship of accumulated score to soil damage status

| Symbol | Accumulated score | Damage status | Carrying capacity |
|--------|-------------------|----------------------|-------------------|
| N | 0 | Not damaged | Very high |
| R.I | 1 – 14 | Slightly damaged | High |
| R.II | 15 – 24 | Medium | Moderate |
| R.III | 25 – 34 | Heavily damaged | Low |
| R.IV | 35 – 40 | Very heavily damaged | Very low |

Source: compilation from Syahidah [35].

Table 4. Dry land soil damage criteria

| Parameters | Symbol | Levels |
|---|--------|--|
| Solum thickness | s | <20 cm |
| Surface rock | b | > 40% |
| Composition of colloidal clay and sand fraction | 1 | <18% clay colloid or >80% tick quartz sand |
| Filling weight | d | > 1.4 g.cm ⁻³ |
| Total porosity | 1 | <30% or >70% |
| Degree of water pass | p | <0.7 cm.hr ⁻¹ or >8 cm.hour ⁻¹ |
| pH (H ₂ O) --> 1:2.5 | a | <4.5 or >8.5 |
| Electrical conductivity/DHL | e | > 4.0 mS.cm ⁻¹ |
| Redox | r | <200 mV |
| Number of microbes | m | <10 ² cfu.g ⁻¹ soil |

Source: Qurrahman et al. [36] dan Sumarno et al. [37].

Each parameter that has been scored is then added up, from that number the soil damage status (dry land) is categorized as represented by Table 3.

Table 4 interprets the criteria for dry land soil damage referring to 10 parameters and each with a threshold. Each

field observation sample and the observed soil sample have 10 parameters, the results are compared to determine the parameter that is damaged if the value is outside the threshold.

total score between 20–42 which indicates that the potential for soil damage is indicative of low, medium, to high (see Table 5).

3. Results and Discussion

3.1. Score each Parameter

After reviewing the slope class, there were scores of 3 (1-8%), 6 (9-15%), 9 (16-25%), 12 (26-40%), rainfall scores 9 (2000-3000). Soil type with a score of 6 (*Ultisols* and *Alfisols*), and 8 (*Inceptisols* and *Entisols*). Land cover from SNI: 7645-1:2014 [10] found 10 equalized classes, where a score of 2 (natural forest, rice fields, pure fertile reeds) was equal to swamp scrub, dry land forest, secondary mangrove forest, secondary swamp forest, and ponds. Then, a score of 4 (mixed gardens, shrubs, grasslands) is equal to plantations, a score of 6 (production forest, cultivation), is equal to dryland agriculture, shrubs/shrubs, a score of 8 (seasonal crops) is equal to dryland annual crops, and a score of 10 for open ground.

3.2. Exploration with Overlays

The effective work area in Tanjung Selor Regency supports the designation of a cultivation area with an area of 39,800 ha. The results of the overlay of the slope map, rainfall map, soil type map, and land cover map obtained a

Table 5. Findings on soil damage are indicative

| Potential damage | Area (ha) |
|------------------|-----------|
| Low | 7,735 |
| Moderate | 30,381 |
| High | 1,684 |
| Total | 39,800 |

Source: elaboration of Authors.

High indicative soil damage potential is designated as a location for field verification for evaluation and proof of the actual land damage status. The verification point was chosen with consideration of the ease of accessibility and representativeness of the location.

3.3. Overview Attributes

The results of the verification which focused on high indicative damage areas were carried out in early March 2020, observations were made of 10 locations as representatives, it was found that the soil solum depth for all sample points was >60 cm, slopes 15%–40%, there was a small part of slopes >40%, but only to the extent of

inclusion. Interestingly, there are surface rocks with a size of about 2 mm–7.5 cm, but the determination is between 2 mm–1 cm, thus it is classified as gravel. Gravel on the surface and cross section of the soil, to a depth of >40cm with a general distribution of <10%, but two locations \pm 45%. Soil permeability is between 0.55–10.40cm.hour⁻¹. At each observation location, soil samples were taken for laboratory analysis.

3.4. Soil Damage Assessment

2 Table 6 summarizes the field verification study and the results of soil analysis in the laboratory. The soil damage parameters are outside the threshold and the parameters are within the threshold. The data collected refers to observations and selection in the field, laboratory studies and analysis of soil damage status, it is concluded that the accumulated score is 6.

Table 6. Soil damage assessment based on relative frequency score

| Parameters (symbol) | Components | | Soil observations and samples | | | |
|----------------------------------|------------------|--------------------------|-------------------------------|-----------------------|-----------------------|-----------------------|
| | Value | Unit | I | II | III | IV |
| Solum thickness(s) | < 20 | cm | >90 | 60–90 | 60–90 | >90 |
| Surface rock (b) | > 40 | % | <10 | 45* | <10 | <10 |
| Composition of sand fraction (f) | < 18 | % clay | 36.7 | 40.3 | 12.57* | 42.26 |
| | > 80 | % sand | 48.7 | 30.8 | 73.3 | 16.86 |
| Filling weight (d) | >1.4 | g.cm ⁻³ | 1.30 | 1.42* | 1.32 | 1.34 |
| Total porosity (v) | < 30; >70 | % | 47 | 43 | 53.12 | 42.3 |
| Degree of water release (p) | < 0.7; >8 | cm.hour ⁻¹ | 0.71 | 0.55* | 7.15 | 1.02 |
| pH (H ₂ O) --> 1:2.5 | < 4.5; >8.5 | - | 4.4* | 4.3* | 4.10* | 4.2* |
| Electrical conductivity (e) | > 4 | mS.cm ⁻¹ | 1.87 | 1.34 | 2.26 | 1.97 |
| Redox(r) | < 200 | mV | 247 | 200 | 235 | 241 |
| Number of microbes (m) | <10 ² | cfu.g ⁻¹ soil | 2.2 x 10 ⁴ | 1.9 x 10 ⁴ | 2.1 x 10 ⁴ | 2.1 x 10 ⁴ |

Table 6. Continued.....

| Soil observations and samples | | | | | | Σ damaged | Relative frequency of damaged soil (%) | Score |
|-------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------|--|----------|
| V | VI | VII | VIII | IX | X | | | |
| >90 | >90 | >90 | >90 | >90 | 60–90 | 0 | 0/10 x 100 = 0 | 0 |
| >10 | <10 | <10 | <10 | <10 | 45* | 2 | 2/10 x 100 = 20 | 1 |
| 29.9 | 23.1 | 32 | 61.2 | 53.7 | 17.2* | 2 | 2/10 x 100 = 20 | 1 |
| 52.8 | 55.9 | 45.26 | 39 | 46.3 | 72.9 | 0 | 0/10 x 100 = 0 | 0 |
| 1.28 | 1.22 | 1.28 | 1.28 | 1.3 | 1.26 | 1 | 1/10 x 100 = 10 | 0 |
| 56.41 | 52.57 | 53.66 | 50.08 | 40.43 | 56.32 | 0 | 0/10 x 100 = 0 | 0 |
| 3.06 | 10.40 | 3.36 | 6.32 | 4.99 | 7.64 | 1 | 1/10 x 100 = 10 | 0 |
| 4.30* | 5.84 | 4.81 | 4.13* | 4.42* | 4.33* | 8 | 8/10 x 100 = 80 | 4 |
| 3.35 | 4.05* | 3.05 | 2.83 | 3.47 | 1.95 | 1 | 0/10 x 100 = 10 | 0 |
| 213 | 225 | 231 | 275 | 232 | 284 | 0 | 0/10 x 100 = 0 | 0 |
| 1.8 x 10 ⁴ | 1.7 x 10 ⁴ | 2.2 x 10 ⁴ | 1.8 x 10 ⁴ | 2.2 x 10 ⁴ | 1.9 x 10 ⁴ | 0 | 0/10 x 100 = 0 | 0 |
| Accumulated score | | | | | | | | 6 |

Source: elaboration of Authors. Remark: *) Beyond critical threshold

Table 6 also explains the accumulated score of soil damage status, which is lightly damaged (R.I) or high carrying capacity with an area of 5,604 ha, originally indicated with high damage potential. The factors causing the soil damage status that affect the status of the soil consist of three main classifications, namely surface rock, clay fraction composition (f), and pH or soil acidity. From this aspect, the pH factor is the largest (80%) outside the threshold, the surface rocks, and the composition of the clay fraction is only 20%. But, the density and degree of water release are only 10% or one point of observation. The dominant soil acidity is below the threshold (<4.5) with a very acidic status.

The main soil group (*Ordo*) in the overall study area that is dominant is *Ultisols* or *Podsolik* with an area of 29,329 ha or 73.70% in the effective area [38-39]. Soil acidity of *Ultisols* in Kalimantan with a pH of 4.22-4.77 is classified as very acidic [40-42]. The damage status of lightly damaged soil which was originally indicated as having high damage potential can give the same picture that the indication of low and moderate damage is the main factor is pH, especially those found in the same soil type (*Ultisols*) so that it is classified as lightly damaged.

The status of soil damage with the main limiting pH is very acidic (R.I-a), but the soil still functions well as a natural medium for natural vegetation to grow. Yet, land

use for cultivation that produces biomass must be regulated, maintained and maintained¹² so that biomass production remains good [43]. So, over a long period of time, the existing vegetation has adapted to the soil conditions where

it grows [44]. This vegetation can produce biomass in the form of stems, leaves, flowers, fruits, tubers, sap, bark, roots and oils that support animal life and human dependence in the vicinity.

Table 7. Variety of cultivated plants and their tolerance to minimum soil pH

| Plant type | Minimum pH |
|----------------------------|--|
| <i>Foods:</i> | |
| - Local/upland rice fields | 4 ¹⁾ – <5 ³⁾ |
| - Cassava | 4 ¹⁾ – <4.8 ³⁾ |
| - Sweet potatoes | 4 ¹⁾ – <4.8 ³⁾ |
| - Corn | 4 ¹⁾ – <5 ³⁾ |
| - Taro | 4 ¹⁾ – <5 ³⁾ |
| <i>Plantations:</i> | |
| - Coconut | 4 ¹⁾ – <4.8 ³⁾ |
| - Palm oil | 3.5 ²⁾ – <4.2 ³⁾ |
| - Rubber | 3.5 ²⁾ – <4 ³⁾ |
| - Cocoa | 4 ¹⁾ – <5.5 ³⁾ |
| - Robusta coffee | 4 ¹⁾ – <5.3 ³⁾ |
| <i>Vegetables:</i> | |
| - Beans | 4 ¹⁾ – <5 ³⁾ |
| - Eggplant | 4 ¹⁾ – <4.8 ³⁾ |
| - Cucumber | 4 ¹⁾ – <4.8 ³⁾ |
| - Chilli | 4 ¹⁾ – <5 ³⁾ |
| - Petai | 4 ¹⁾ – <5 ³⁾ |
| <i>Fruits:</i> | |
| - Durian | 4 ¹⁾ – <5 ³⁾ |
| - Banana | 4 ¹⁾ – <5.2 ³⁾ |
| - Papaya | 4 ¹⁾ – <5.5 ³⁾ |
| - Cempedak/Nangka | 4 ¹⁾ – <4.5 ³⁾ |
| - Rambutan | 4 ¹⁾ – <4.5 ³⁾ |

Notes: ¹⁾ Rounding off the lowest soil pH at the activity site, ²⁾ Observations of the authors at several locations in North Kalimantan, and ³⁾ adopted from Ritung *et al.* [45].

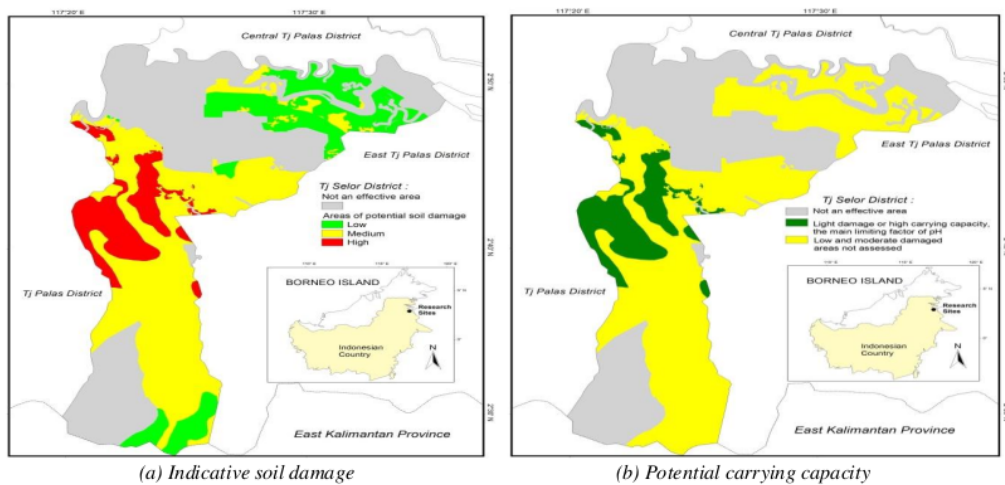


Figure 1. Map of study stage

Source: elaboration of Authors.

The variety of vegetation needed by humans, such as food-producing plants, horticulture, secondary crops,

vegetables, and plantation crops, most of which are not native plants. This is caused by cultivation activities that allow the process of adaptation to their environment. Although growing, these plants require certain requirements to provide good results to the greatest. Observing *Table 7*, plant varieties can produce and grow well in the least soil pH interval, although not optimally [46-47]. Parameters of very acidic soil damage have an explicit impact on the carrying capacity of production yields for a case study of several cultivated plants. Soil pH factors, which are very acidic (<4.5) with dominant (80%) in the study area, must be considered for the suitability of the variety of plants that will be and have been developed (see *Figure 1*).

The act of providing soil amendments to increase soil pH, including within a range that is more suitable for the type of plant and compost [48-51]. In terms of soil amendments, agricultural lime is very suitable for reducing soil acidity or increasing soil pH in encouraging better alignment of plant guidance ranges (above the minimum). Compost is also applicable to increase soil fertility (physical, chemical, and biological) and maintain soil pH stability. Also to soil improvement, extra fertilizer containing N, P and K elements is also good and important to give to plants to increase nutrient availability so that optimal biomass production implies increasing carrying capacity [52]. Very acidic soils are followed by very low to low macronutrient deficiencies [53-55].

4. Conclusions

This study attempted to examine the relationship between soil damage and the carrying capacity of biomass production in Tanjung Selor District (Bulungan Regency, North Kalimantan Province). Initial analysis of the 4 main parameters of the output indicated high soil damage as a reference for field verification. However, further analysis shows that the soil damage status is lightly damaged (R.I-a) with the main limiting factor being very acidic soil acidity. Thus, the carrying capacity of the soil for biomass production is still high. For cultivated plants, it is necessary to provide soil amendments (captan and compost) to reduce the main limiting effect to increase production capacity massively. Additionally, N, P and K fertilizers need to be given to increase soil fertility so that biomass production and carrying capacity are optimal.

Theoretical contributions and practical implications are developed to assist practitioners and researchers in considering the carrying capacity of biomass production and soil degradation. The limitations and directions of future studies are discussed for a more exclusive generalization of these findings and new research flows in the field.

References

- [1] R.M. Subekti., D.S.A. Suroso. Ecological footprint and ecosystem services models: A comparative analysis of environmental carrying capacity calculation approach in Indonesia, Paper presented in the 1st ITB Centennial and 4th Plano Cosmo International Conference 3–5 April 2018, Bandung, Indonesia, IOP Conference Series: Earth and Environmental Science, 158: 012026, 2018.
- [2] S. Darma. Land Suitability of Rice Fields in Bumi Rapak Village and Selangkau Village East Kutai Regency, *Jurnal Ilmu Tanah Dan Lingkungan*, Vol. 24, No. 1, 32-38, 2022.
- [3] F. Fahrumsyah., M. Mulyadi., A. Sarjono., S. Darma. Peningkatan efisiensi pemupukan fosfor pada ultisol dengan menggunakan abu terbang batubara (Increasing the efficiency of phosphorus fertilization on ultisols using coal fly ash), *Jurnal Tanah dan Sumber Daya Alam*. Vol. 8, No. 1, 189-202, 2020.
- [4] Regional Development Planning Agency of Bulungan Regency. Peta administrasi Kabupaten Bulungan. Rencana Tata Ruang Wilayah 2021-2041 (Map of Bulungan Regency administration. Regional Spatial Plan 2021-2041), 2021. Online available from <https://tataruang.atrbpn.go.id/protaru/upload/RtrwT52/Perda%20RTRW%20Kab%20Bulungan%202021-2041.pdf>.
- [5] Center for Research and Development of Agricultural Land Resources of Indonesia. Peta tanah semi detail (Semi-detailed land map), 2016. Online available from <https://bbsdlp.litbang.pertanian.go.id>.
- [6] Geospatial Information Agency of Indonesia. Peta Rupa Bumi Indonesia: Lembar 1918-42 dan Lembar 1918-44 (Indonesian Geographical Map: Sheet 1918-42 and Sheet 1918-44), 2019a. Online available from <https://tanahair.indonesia.go.id>.
- [7] Geospatial Information Agency of Indonesia. Peta Digital Elevation Model (DEM) Nasional (National Digital Elevation Model (DEM) Map), 2019b. Online available from <https://tanahair.indonesia.go.id>.
- [8] Central Bureau Statistics of Bulungan Regency. Bulungan in figures 2021, BPS: Tanjung Selor, 2022.
- [9] Ministry of Environment and Forestry of Indonesia. Peta penutupan lahan (Land cover map), 2017. Online available from <https://geoportal.menlhk.go.id/webgis/index.php/en/feature/download>.
- [10] National Standardization Agency. Standar Nasional Indonesia (SNI) No. 7645-1:2014 (Indonesian National Standard (SNI) No. 7645-1:2014), Land Cover Classification, 2014. Online available from <https://www.bsn.go.id>.
- [11] N.E. Benti., G.S. Gurmesa., T. Argaw., A.B. Aneseyee., S. Gunta., G.B. Kassahun., G.S. Aga., A.A. Asfaw. The current status, challenges and prospects of using biomass energy in Ethiopia, *Biotechnol Biofuels*, Vol. 14, No. 1, 209, 2021.
- [12] H. Masturi., A. Hasanawi., A. Hasanawi. Sinergi dalam pertanian Indonesia untuk mitigasi dan adaptasi perubahan iklim (Synergy in Indonesian agriculture for climate change mitigation and adaptation), *Jurnal Inovasi Penelitian*, Vol. 1, No. 10, 2085-2094, 2021.
- [13] P.W. Gallagher. Energy production with biomass: What are the prospects?, *Choices: The Magazine of Food, Farms and Resource Use*, Vol. 21, No. 1, 21-25, 2006.

- [14] A. Haryana. Biomass utilization as renewable energy for optimization of national energy mix, Bappenas Working Papers, Vol. 1, No. 1, 55-65, 2018.
- [15] V.S. Mahajan., P. Jarolim. How to interpret elevated cardiac troponin levels, *Circulation*, Vol. 124, No. 1, 2350-2354, 2011.
- [16] R.E. Schmieder. End organ damage in hypertension, *Deutsches Arzteblatt International*, Vol. 107, No. 49, 866-873, 2010.
- [17] M. Putra., M. Edwin. Analisis status kerusakan tanah pada lahan kering di Kampung Jawa Dusun Kobo Jaya, Sangatta (Analysis of soil damage status on dry land in Kampung Jawa Dusun Kobo Jaya, Sangatta), *Jurnal Pertanian Terpadu*, Vol. 6, No. 2, 109-120, 2018.
- [18] M. Hikmat., B. Barus., M. Ardiansyah., B. Mulyanto. Parameterisasi sifat biofisik lahan sawah dengan menggunakan citra radar resolusi tinggi: Studi Kasus di Kabupaten Indramayu - Jawa Barat (Parameterization of biophysical properties of paddy fields using high resolution radar imagery: A Case Study in Indramayu Regency - West Java), *Jurnal Tanah dan Iklim*, Vol. 43, No. 1, 1-12, 2019.
- [19] Y. Setiawan., K. Yoshino. Spatial modeling on land use change in regional scale of Java Island based-on biophysical characteristics, *Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan*, Vol. 10, No. 3, 511-523, 2020.
- [20] S. Pal., S. Ziaul. Detection of land use and land cover change and land surface temperature in English Bazar urban centre, *The Egyptian Journal of Remote Sensing and Space Science*, Vol. 20, No. 1, 125-145, 2017.
- [21] J.A. Verstegen., C. van der Laan., S.C. Dekker., A.P.C. Faaij., M.J. Santos. Recent and projected impacts of land use and land cover changes on carbon stocks and biodiversity in East Kalimantan, Indonesia, *Ecological Indicators*, Vol. 103, 563-575, 2019.
- [22] B. Drašković., A. Ponosov., N. Zhernakova., M. Gutalj., B. Miletić. Land cover types and changes in land use in Republic of Srpska (Bosnia and Herzegovina) over the period 2000-2018, *Journal of the Geographical Institute Jovan Cvijić SASA*, Vol. 70, No. 1, 81-88, 2020.
- [23] A. Huang., R. Shen., Y. Li., H. Han., W. Di., D.F.T. Hagan DFT. A methodology to generate integrated land cover data for land surface model by improving dempster-shafer theory, *Remote Sensing*, Vol. 14, No. 4, 972, 2022.
- [24] A. El Jazouli., A. Barakat., R. Khellouk. GIS-multicriteria evaluation using AHP for landslide susceptibility mapping in *Oum Er Rbia* high basin (Morocco), *Geoenviron Disasters*, Vol. 6, No. 1, 3, 2019.
- [25] S.P. Ozkan., C. Tarhan. Detection of flood hazard in urban areas using GIS: Izmir Cas, *Procedia Technology*, Vol. 22, 373-381, 2016.
- [26] S. Sudaryatno., S.R. El-Yasha., Z.N. Afifah. Thematic geovisualization of the data profile of Kaligesing, Purworejo, Central Java, *Forum Geografi*, Vol. 33, No. 2, 153-161, 2019.
- [27] D. Hernando., M.G. Romana. Development of a soil erosion classification system for cut and fill slopes, *Transportation Infrastructure Geotechnology*, Vol. 2, No. 4, 155-166, 2015.
- [28] A. Roesch., P. Weisskopf., H. Oberholzer., A. Valsangiacomo., T. Nemecek. An approach for describing the effects of grazing on soil quality in life-cycle assessment, *Sustainability*, Vol. 11, No. 18, 4870, 2019.
- [29] E. Siahaan., K. Susila., I. Bhayunagiri. Pemetaan potensi dan status kerusakan tanah lahan pertanian Kecamatan Buleleng, Kabupaten Buleleng (Mapping the potential and status of damage to agricultural land in Buleleng District, Buleleng Regency), *Jurnal Agroekoteknologi Tropika*, Vol. 9, No. 4, 258-267, 2020.
- [30] M. Mentis. Environmental rehabilitation of damaged land, *Forest Ecosystems*, Vol. 7, 19, 2020.
- [31] J. Phillips. The convenient fiction of steady-state soil thickness, *Geoderma*, Vol. 156, No. 3-4, 389-398, 2010.
- [32] F. Yu., B. Faybishenko., A. Hunt., B. Ghanbarian. A simple model of the variability of soil depths, *Water*, Vol. 9, No. 7, 460, 2017.
- [33] J.E. Schoonover, J.F. Crim. An introduction to soil concepts and the role of soils in watershed management, *Journal of Contemporary Water Research & Education*, Vol. 154, No. 1, 21-47, 2015.
- [34] S. Darma., W. Kustiawan., S. Sigithardwinarto., S. Sumaryono. Evaluation of land damage status for biomass production in Loakulu Subdistrict Kutai Kartanegara Regency of East Kalimantan Province Indonesia, *International Journal of Scientific & Technology Research*, Vol. 6, No. 7, 106-110, 2017.
- [35] K. Syahidah., S. Sumarno., S. Hartati. Pemetaan status kerusakan tanah lahan pertanian di Kecamatan Selo, Kabupaten Boyolali (Mapping the damage status of agricultural land in Selo District, Boyolali Regency), *Agrosains*, Vol. 18, No. 1, 6-11, 2016.
- [36] B.F.T. Qurrahman., A. Suriadikusumah., R. Haryanto. Evaluasi kriteria kerusakan tanah untuk produksi biomassa pada lahan kering di Kabupaten Subang (Evaluation of soil damage criteria for biomass production on dry land in Subang Regency), *Soilrens*, Vol. 4, No. 1, 1-5, 2016.
- [37] S. Sumarno., P. Purwanto., S. Rakhmawati. Kajian faktor penyebab kerusakan tanah dalam memproduksi biomassa di Kecamatan Padas Kabupaten Ngawi (Study of factors causing soil damage in producing biomass in Padas District, Ngawi Regency), *Agrotechnology Research Journal*, Vol. 2, No. 1, 35-40, 2018.
- [38] Soil Survey Staff. Keys to soil taxonomy, 12th Ed. USDA-Natural Resources Conservation Service, Washington, D.C, 2014.
- [39] S-H. Jien., S-P. Wu., Z-S. Chen., T-H. Chen., C-Y. Chiu. Characteristics and pedogenesis of podzolic forest soils along a toposequence near a subalpine lake in northern Taiwan, *Botanical Studies*, Vol. 51, No. 2, 223-236, 2010.
- [40] A.S. Dariah., N.L. Sutono., W. Nurida., H. Hartatik., E. Pratiwi. Pembenah tanah untuk meningkatkan produktivitas lahan pertanian (Soil repairers to increase agricultural land productivity), *Jurnal Sumberdaya Lahan*, Vol. 9, No. 2, 67-84, 2015.
- [41] S. Sudaryono S. Tingkat kesuburan tanah ultisol pada lahan pertambangan batubara Sangatta, Kalimantan Timur (Ultisol soil fertility rate in Sangatta coal mining area, East Kalimantan), *Jurnal Teknologi Lingkungan*, Vol. 10, No. 3,

337-346, 2009.

- [42] S. Darma. Identifikasi status kerusakan tanah untuk produksi biomassa di Kecamatan Tanjung Palas Timur Kabupaten Bulungan Provinsi Kalimantan Utara (Identification of soil damage status for biomass production in Tanjung Palas Timur District, Bulungan Regency, North Kalimantan Province), *Ziraa'ah*, Vol. 42, No. 1, 8-16, 2017.
- [43] S. Darma., D. Lestari., D.C. Darma. The productivity of wineries – An empirical in Moldova, *Journal of Agriculture and Crops*, Vol. 8, No. 1, 50-58, 2022.
- [44] R. Rindyastuti., L. Hapsari. Adaptasi ekofisiologi terhadap iklim tropis kering: Studi anatomi daun sepuluh jenis tumbuhan berkayu (Ecophysiological adaptation to dry tropical climate: Study of leaf anatomy of ten woody plant species), *Jurnal Biologi Indonesia*, Vol. 13, No. 1, 1-14, 2017.
- [45] S. Ritung., K. Nugroho., M. Mulyani., E. Suryani. Petunjuk teknis evaluasi lahan untuk komoditas pertanian, Edisi Revisi (Technical guide for land evaluation for agricultural commodities, Revised Ed.), Balai Besar Penelitian dan Pengembangan Sumberdaya Lahan Pertanian, Bogor, 2011.
- [46] R. Gentili., R. Ambrosini., C. Montagnani., S. Caronni., S. Citterio. Effect of soil pH on the growth, reproductive investment and pollen allergenicity of *ambrosia artemisiifolia* L, *Frontiers in Plant Science*, Vol. 9, 1335, 2018.
- [47] P.S. Kidd., J. Proctor. Why plants grow poorly on very acid soils: are ecologists missing the obvious?, *Journal of Experimental Botany*, Vol. 52, No. 357, 791–799, 2001.
- [48] F.X. Narambuye., R.J. Haynes. Effect of organic amendments on soil pH and AI solubility and use of laboratory indices to predict their liming effect, *Soil Science*, Vol. 171, No. 10, 754-763, 2006.
- [49] N. Abdul Halim., R. Abdullah., S. Karsani., N. Osman., Q. Panhwar., C. Ishak. Influence of soil amendments on the growth and yield of rice in acidic soil, *Agronomy*, Vol. 8, No. 9, 165, 2018.
- [50] L.S. Rusli., R. Abdullah., J.S. Yaacob., N. Osman. Organic amendments effects on nutrient uptake, secondary metabolites, and antioxidant properties of *Melastoma malabathricum* L, *Plants*, Vol. 11, No. 2, 153, 2022.
- [51] M.J. Goss., A. Tubeileh., D. Goorahoo. A review of the use of organic amendments and the risk to human health, *Advances in Agronomy*, Vol. 120, 275–379, 2013.
- [52] Z. Tong., G. Quan., L. Wan., F. He., X. Li. The effect of fertilizers on biomass and biodiversity on a semi-arid grassland of Northern China, *Sustainability*, Vol. 11, No. 10, 2854, 2019.
- [53] S. Roques., S. Kendall., K. Smith., P. Newell Price., P. Berry. A review of the non-NPKS nutrient requirements of UK cereals and oilseed rape, *HGCA Research Review No. 78*, Kenilworth, 2013.
- [54] D. Soetrisnanto., M. Christwardana., H. Hadiyanto H. Application of phytoremediation for herbal medicine waste and its utilization for protein production, *Reaktor*, Vol. 14, No. 2, 129-134, 2012.
- [55] N.S. Yaacob., M.F. Ahmad., A. Sivam., E.F. Hashim., M.N. Maniyam., F. Sjahrir., N.F. Dzulkafli., W.M.I. Wan Mohd Zamri., K. Komatsu., V.S. Kuwahara, H. Abdullah. The effectiveness of soil extracts from selangor peat swamp and pristine forest soils on the growth of *green microalgae* sp. *Forests*, Vol. 13, No. 1, 79, 2022.

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