IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 09 Issue 07, July 2022
ISSN (Online) 2348 – 7968 | Impact Factor – 6.72
www.ijiset.com

Physical Analysis and Ecological Function Sago Baruk Plant (Arenga Microcarpha Becc) For the Conservation of Land and Water

Prof. Dr. Marianus, M.Si

Department of Physics Education, Faculty of Mathematics and Natural Sciences, Manado State University

Corresponding author phone: +62-81356697219, E-mail: marianus@unima.ac.id

ABSTRACT

The baruk sago plant (Arenga microcarpha) is an endemic and carbohydrate-producing plant that is used as a staple food for the people of Sangihe Islands Regency for generations. This plant is also known to the local community as a plant that is very beneficial for the preservation of the environment (soil and water). The study aimed to analyze the physical parameters (Microclimate, Infiltration, Water storage capacity and physical properties of soil) around Baruk sago plants in different seasons and different heights of places. The research was conducted in Gunung Village, Tabukan Tengah District, Sangihe Regency in April to August 2021. This village stretches from the beach to the top of the hill with a height of ± 500 meters above sea level. Land use is mixed gardens, coconut, cloves, nutmeg and sago Baruk. The tools or materials used are; ring for ground sampel, soil tester, GPS, Clinometer, a set of Infiltro meters, Four in one and Stopwatch. The methods used are survey methods and data analysis techniques are descriptive analysis, t test, F test (ANOVA). The results showed that the parameters of the physical condition of the soil, namely the class of texture of squidgy and clay, medium to high porosity, slow to rapid permeability, medium to high macro nutrient retention, Soil moisture around (near clumps) of baruk sago is higher than outside the clump in different seasons. The temperature of the soil near the clump is lower than the temperature of the soil outside the clump, Infiltration indicates higher at the point near the clump in different seasons and the water holding capacity to store water is high. Baruk sago plants can be recommended as soil and water conservation plants.

Keywords: Physical Analysis, Ecological Function, Conservation, Sago Baruk.

Introduction

Sago baruk plants that stretched out in one ecosystem, are biological natural resources (Biotic). The plant is a source of food and income for the people of Sangihe Island (People's Agricultural Service, 1980), and this plant has a high enough potential to protect / preserve the land and water. This, among others, can be seen on the surface of the land around the sago plant and the soil is still better (compared to land overgrown with other vegetation), as well as the source of springs around the sago plant baruk the presence of water is relatively more stable in the dry season. In addition, the plant is not affected by climate change (Climate Change) because the plant has a deep root and the width of its distribution as far as the title. This rooting system is what causes this plant to continue to produce even if the dry season is long, even the surrounding plants remain green.

According to (Jeff and M. Holly Hill 2009), all greenery can absorb carbon dioxide from the atmosphere. The absorption of carbon dioxide can take place through the leaves in the process of photosynthesis accumulated in biomass, through the stems and roots of plants. Thus baruk sago plants can play a role in mitigating climate change and if these plants are developed or conserved will ensure food security in the area. According to Lay,et al;1998, the beneficial factors that drive the development of baruk sago plants, are: (1) can grow on slope 45-60, (2) erosion prevention, (3) environmentally friendly, (4) Groundwater control, (5)supports a stable social agroforestry system.

Sago baruk is a type of sago that grows on dry land found on Sangihe Island. This sago can grow at a height of 0-500 m above sea level, has a stem diameter between 20-25 cm and plant height (ripe) between 6 -16 m (Harsanto, 1992). The name sago baruk is a name that has been known in Sangihe islands and Talaud islands since hereditary from the ancestors of the Sangihe people. By Denium (2001) the plant includes the Palma family and the genus Metroxylon, because it contains starch on its stems but the difference with true metroxylon is that baruk sago can grow well on dry land forming rumpun. But because the structure of the flower bears a resemblance to the palm plant, sago baruk is classified in the genus Arenga (Anonymous, 2005).

Sago baruk plant is a type of perennial that grows to form clumps with rooting that has a fairly high porosity. Sago plants with a new rooting system can grip the soil layer so that the sewage of the soil layer can be suppressed and the surface flow can be reduced. Sago baruk has a leaf length between 2-4 meters and the number of leaf chicks between 42-75 (Barri et al,2001). Sago baruk plants have the privilege of being able to grow and multiply on even steep land (600-700) (Harsanto, 1992). Sago baruk plants according to their ownership include privately owned natural resources (Maryunani and Sutikno, 2006).

The plant is only found on Sangihe Island (endemic plants) that need to be maintained or conserved. In Law No. 32 of 2009 Chapter 1 Article 18 explained that Conservation of natural resources is the management of natural resources to ensure their wise use and continuity of availability while maintaining and improving the quality of value and diversity.

Some of the facts that sago baruk plants are developed as soil and water conservation plants are:

1. **Economic Value**

Sago baruk plants are the main food source of 88.33% of sangihe island's population (Anonymous, 1980). According to Noli et al (2001) the production of sago baruk / rod 20-30 kg / per stem. The utilization of sago flour in addition to direct foodstuffs, is also an ingredient for the manufacture of various types of cakes, noodles etc. (Rostiwati, 1988 and Rekha, et al 2012), in addition, sago flour has the potential to be used as a raw material for making biodegradable plastics known as biodegradable plastic (Suraini, et al 2002) and sago flour can be processed into ethanol (Yusuf Samad, 2002). Sago plant stems that are quite hard are used by the community as construction materials (reinforcement for concrete walls) and have the potential to be developed into furniture. Sago waste grounds can be used as animal feed and are very potential for mushroom cultivation. When the pulp turns into soil, it is used as fertilizer.

2. **The ability to hold and channel rainwater through its distribution**

The ability of sago baruk plant to channel rainwater, among others, can be seen from the springs that appear in the area around sago plants that can last a long time in the long dry season; low surface erosion around land overgrown with sago. Baruk sago plants in addition to being used as a source of carbohydrates for food such as swamp sago plants (Tek, et al,2008), can also be used as reforestation plants (Amrisal; 1991). This is supported by the ability to multiply from the plant relatively quickly, namely every month saplings can increase on average 5-6 saplings per clump (Maliangkay, M, Djafar;2002). Thus the baruk sago plant has the power to close the soil fast enough so as to reduce the danger of erosion.

3. **Utilization of polyculture crops**

In fact, land overgrown with sago baruk plants is very well used for planting season crops (chili, tomatoes, rice, corn, sweet potatoes etc.). In the dry season, seasonal crops grown around sago baruk plants are more resistant than those grown on vacant land (observations and interviews, 2021).

4. Low cost of planting and caring for plants

Sago plants are plants that are very resistant to weather changes. In the long dry season where other plants are already difficult to grow, sago plants can still grow and produce. Sago baruk plants can develop naturally forming saplings between 4 to 6 saplings / month (personal communication with sago farmers, 2021).

In practice, farmers do not do special care other than just clean it when they want to cut down sago trees from the clump. The advantages of sago baruk plants such as their economic value, their ability to hold and channel water into the soil and their ability to grow on even steep dry land, are very reliable potential for the use of sago plants as soil and water conservation plants (Macedru, et al,2011). To find out how far sago baruk plants can be developed as a conservation farming business, it is necessary to first research the rate of infiltration around sago baruk plants in various land conditions. Infiltration is the process of entering water into the soil through the soil surface and vertically down. According to Seyhan (1977) infiltration is water that infiltrates the earth's surface (if the surface is permeable) due to the influence of gravitational forces and capillaries. Water that infiltrates the permeable layer is then collected in the cavities in the soil to form groundwater. The infiltration process also includes the conversion of water into empty spaces in the soil and the movement of groundwater in unsaturated soil. This infiltration water is then used by plants, evaporates from the soil, appears as a lower runoff (sub surface run off) and deep flow (base flow) and continues in joined by groundwater (ground water). If the infiltration capacity of the soil is large enough, then some of the infiltrated water tends to be large and the part of the surface flow is small, depending on the nature of the rain (amount, intensity and duration) occurs. The smaller the runoff, the better the effect on soil sustainability because the threat of soil erosion becomes smaller.

Vegetation growth requires a certain level of soil moisture. Therefore, it can be said that soil moisture at a certain level can determine land use. Drought events that occur in an area also have more to do with how much moisture levels are in the soil than the number of rain events that fall in the place. But according to Asdak (1995), that it is also necessary to know that high humidity levels can cause problems. In summary it can be said that at some level soil moisture is very important to support human life, but at soil humidity levels that are too high or too low can cause problems for humans. Factors that affect soil moisture include: soil surface temperature, wind speed, rainfall and light intensity.

The effect of temperature on plants is very large, especially on growth so that there are plants have a height at a certain temperature. On soils with good air circulation will stimulate the occurrence of rapid decomposition and form humus called mull, and will allow for life various soil fauna. Humus also serves in changing the structure of the soil, and changing the soil. So if the surface temperature of the soil becomes hot, then the process of forming humus will be slow due to lack of water by evaporation.

Furthermore, Kumar (1979) asserted that vegetation cover is a very large factor in the influence on increasing soil infiltration capacity. The presence of vegetation will reduce the compaction of the soil by rainwater. The vegetation invites the presence and proliferation of certain small animals or microorganisms that form pores in the soil, helping weather organic material so as to form cavities in the soil so as to produce and thicken the permeable layer (Ruslan et al 2009). The factors mentioned above, it can be concluded that efforts to maintain and wherever possible increase the infiltration capacity of the land, among others, are by increasing the porosity of the soil. High soil porosity will allow a high infiltration rate thus surface flow can be reduced, so that the adverse effects of surface flows such as floods, surface erosion can be reduced (Hasrullah, 2009).

According to Andrew (2006) Vegetation plays a role in soil and water preservation, vegetated areas are expected to have a better function in regulating water systems compared to areas that do not vegetate on the grounds of:

1. The area that vegetated theoretically the land will have better physical properties so that it has a greater infiltration capacity.
2. The nature of woody vegetation rooting will be tighter and deeper through the soil horizon which allows for greater water retention.
3. The header system is tighter and consists of several layers so that the mechanical influence of rainwater blows does not directly hit the ground level.
4. Seresh in vegetated areas causes water at ground level to get more infiltration opportunities. This is supported by the research results of Purwanto and Ngaloken (1995).

For this purpose, it is necessary to analyze the physical condition of the environment, infiltrate and calculate the water holding capacity around the Baruk sago. Data obtained from the results of these measurements can be used to evaluate the possibility that baruk sago plants can be used as environmental preservation plants (soil and water conservation).

Materials and Methods

The research was conducted in Gunung Village, Central Tabukan District, Dati II Regency sangihe Islands in April to August 2021. This village stretches from the beach to the top of the hill with a height of ±600 meters above sea level. Mountainous topographical shape, with a slope of 8-40%.

The main material used is plantation land in Gunung Kab Sangihe Village. Supporting materials and tools include Topographic map of Tahuna, Map of height contours, Map of land use. The tools used are: Altimeter (measuring place height), Abney level (measuring slope of slope), GPS / Global Positioning System (Determining the coordinates of the measurement location), Four in one, Stop watch and ring to take soil samples, a set of Infiltrometers, Soil tester (measuring pH and soil moisture).

This research was classified in an observational study in the mixed garden land of Gunung Village, Sangihe Islands Regency. This research examines descriptive or analytical (Singarimbun and Effendi, 1989). The data collection method in this study uses the survey method, which is the acquisition of data is carried out by direct measurement in the field (primary data). The technique of determining observation points is carried out by purposive sampling.

Research Procedures

The procedure for the implementation of observations is carried out as follows:

1. Identification and measurement of land condition data according to established criteria to obtain observation units as planned. Measurement of slope variations is carried out directly in the field. Measurement and classification of soil characteristics is carried out in laboratories and fields. Measurement of the depth of the rooting, infiltration, microclimate and height of the place is carried out directly in the field, Measurement of the height of the place is carried out directly in the field.
2. Prepare the observation device as a single observation unit, observation format and data tabulation.
3. Field preparation, is to prepare observation locations, among others, to determine clumps for observation of formation patterns, observation positions etc.
4. Carry out observations simultaneously on observation units with a variable classification of field conditions.

Data Analysis

1. The method used is a survey with direct measurements in the field.
2. Data analysis Techniques: Descriptive; t Test , F Test (ANOVA).

IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 09 Issue 07, July 2022
ISSN (Online) 2348 – 7968 | Impact Factor – 6.72
www.ijiset.com

Research Operational Framework

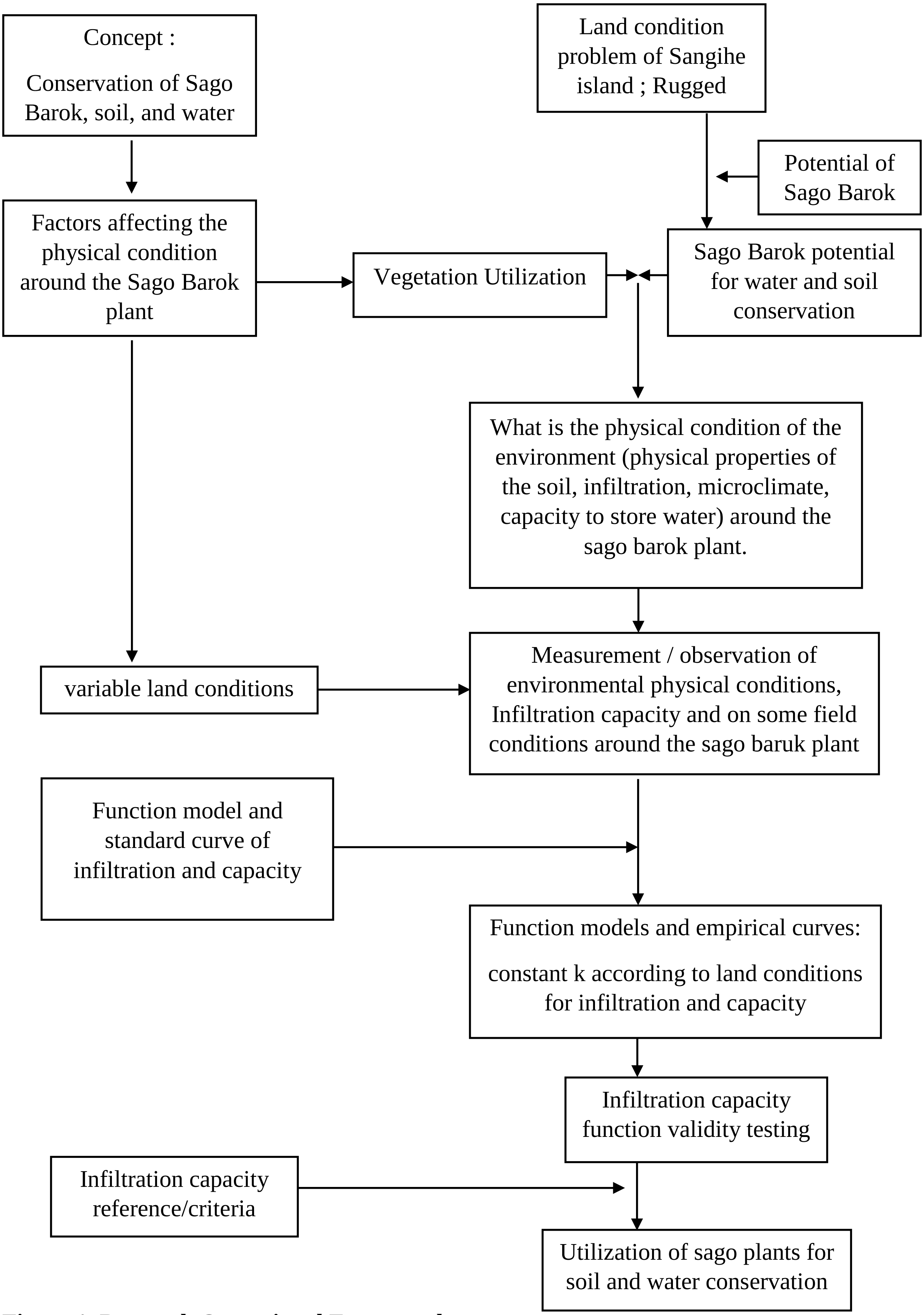

Figure 1. Research Operational Framework

Results and Discussion

The physical condition of the environment around the observed baruk sago plant is a microclimate. The analytical tools used on the physical conditions of the environment around the baruk sago plant are (1) descriptive statistics, (2) t tests, and (3) ANOVA tests.

Microclimate Data Analysis Results

In the microclimate data, it is divided into two seasons, namely rain and drought. There are ten variables observed in the microclimate data, namely air humidity near clumps, humidity of the air outside the clumps, air temperature near the clumps, soil moisture near the clumps, soil moisture outside the clumps, soil temperature near clumps, soil temperature outside the clump, wind speed, and intensity of irradiation. The following is presented a comparison of variable values per season:

Table 1. Microclimate Comparison between Seasons

Variable	Rainy Season	Dry Season
AH near clump(%)	85.13 a	79.58 a
AH outside the clump (%)	78.20 b	76.50 a
T near clump (^{0}C)	24.05 a	26.03 a
T outside clump (^{0}C)	26.01 a	27.91 b
SM near clumps (%)	68.14 a	68.01 a
SM outside the clump (%)	54.33 b	48.18a
ST near clump (^{0}C)	25.47 a	25.47 a
ST outside the clump (^{0}C)	25.26 a	25.37 a
Wind speed (m/s)	0.55 a	1.36 b
Intense Irradiation (lux)	3408 a	3575 a

Information :
-AH: Air Humidity, T: Temperature, SM: Soil Moisture, ST: Soil Temperature
-**N**umbers followed by the same letter on the same line do not differ markedly on p = 0.05

From Table 1 above, it can be explained as follows:

1. Variable humidity of the air near the clumps: the average humidity of the air near the clumps in the rainy season is 84.13%, and 84.58% in the dry season. From the results of different tests using t-test obtained Sig t amounted to 0.741. Because the Sig t value > 0.05 indicates

no difference in air humidity near the clumps in both seasons. This means that both the rainy season and the dry season, the humidity of the air near the clumps is the same.

2. Variable humidity of the outer air of the clump: the average humidity of the outer air of the clump in the rainy season is 81.20%, and 76.50% in the dry season. From the results of different tests using t-test obtained Sig t amounted to 0.001. Because the Sig t value < 0.05 indicates a significant difference in the humidity of the outer air clumps in both seasons. It can be seen from the average value of the humidity of the outer air clumps in the rainy season is higher than the dry season.
3. Variable air temperature near clumps: the average air temperature near clumps in the rainy season is 26.05°C, and 26.03°C in the dry season. From the results of different tests using t-test obtained Sig t amounting to 0.947. Because the sig t value > 0.05 indicates no difference in air temperature near the clumps in both seasons. This means that both the rainy season and the dry season, the air temperature near the clump is the same.
4. Variable air temperature outside the clump: the average air temperature outside the clump in the rainy season is 26.01°C, and 26.91°C in the dry season. From the results of different tests using t-test obtained Sig t amounted to 0.010. Because the Sig t value < 0.05 indicates a significant difference in the temperature of the outer air of the clump in both seasons. It can be seen from the average value of the air temperature outside the clumps in the dry season is higher than the rainy season.
5. Variable soil moisture near clumps: the average soil moisture near clumps in the rainy season is 68.14%, and 68.01% in the dry season. From the results of different tests using t-test obtained Sig t amounted to 0.936. Because the sig t value > 0.05 indicates no visible difference in soil moisture near the clumps in both seasons. This means that both the rainy season and the dry season, the soil moisture near the clumps is the same.
6. Variable soil moisture outside the clump: the average soil moisture outside the clump in the rainy season is 52.33%, and 48.18% in the dry season. From the results of different tests using t-test obtained Sig t amounted to 0.017. Because the sig t value < 0.05 indicates a significant difference in soil moisture outside the clump in both seasons. It can be seen from the average value of soil moisture outside the clumps in the rainy season is higher than the dry season.
7. Variable soil temperature near clumps: the average temperature of the soil near the clump in the rainy season is 25.47C, and 25.47C in the dry season. From the results of different tests using t-test obtained Sig t amounted to 1,000. Because the sig t value > 0.05 indicates that there is no visible difference in soil temperature near the clumps in both seasons. This means

that both the rainy season and the dry season, the temperature of the soil near the clump is the same.

8. Variable temperature of the outer soil of the clump: the average temperature of the outer soil of the clump in the rainy season is 25.26C, and 25.37C in the dry season. From the results of different tests using t-test obtained Sig t amounting to 0.211. Because the value of Sig t > 0.05 indicates that there is no difference in the temperature of the outer soil of the clump on both seasons. This means that both the rainy season and the dry season, the temperature of the outer soil of the clump is the same.
9. Variable wind speed: the average wind speed in the rainy season is 0.55 m/s, and 1.36 m/s in the dry season. From the results of different tests using t-test obtained Sig t amounted to 0.001. Because the value of Sig t < 0.05 indicates a significant difference in wind speed in both seasons. It can be seen from the average value of wind speed in the dry season is higher than the rainy season.
10. Variable irradiation intensity: the average intensity > of irradiation in the rainy season is 3408 lux, and 3575 lux in the dry season. indicates that there is no difference in the intensity of irradiation in both seasons. This means that both the rainy season and the dry season, the intensity of irradiation is the same. From the results above, there is a difference in the humidity of the air outside the clump, the temperature of the outer air of the clump, soil moisture outside the clump, and significant wind speed between the rainy season and the dry season. The rainy season has the characteristics of higher outdoor air humidity, lower outer air temperature of the clump, higher soil moisture outside the clump, and lower wind speed. While the rainy season has the characteristics of lower outer air humidity, higher outer air temperature of the clump, lower soil moisture outside the clump, and higher wind speed.

Results of Analysis in the Rainy Season

The research location is divided into three positions. First, the upper position with a height of 508 m above sea level. Second, the middle position with a height of 330 m above sea level. Third, the lower position with a height of 44 m above sea level. There are ten variables observed in the microclimate data, namely air humidity near clumps, humidity of the air outside the clumps, air temperature near the clumps, soil moisture near the clumps, soil moisture outside the clumps, soil temperature near clumps, soil temperature outside the clump, wind speed, and intensity of irradiation. The following is presented a comparison of variable values of each position in the rainy season:

Table 2. Microclimate Comparison between Positions In The Rainy Season

Variable	Position		
	508 m dpl	330 m dpl	44 m dpl
AH near clump(%)	85.81 b	85.81 b	80.75 a
AH outside the clump (%)	82.69 b	83.00 b	77.91 a
T near clump (^{0}C)	26.05 a	26.05 a	26.05 a
T outside clump (^{0}C)	26.01 a	26.01 a	26.01 a
SM near clumps (%)	67.75 a	67.75 a	68.92 a
SM outside the clump (%)	52.83 a	52.83a	51.33 a
ST near clump (^{0}C)	25.47 a	25.47 a	25.47 a
ST outside the clump (^{0}C)	25.26 a	25.26 a	25.26 a
Wind speed (m/s)	0.57 a	0.54 a	0.54 a
Intense Irradiation (lux)	3405 a	3405 a	3415 a

Information :
-AH: Air Humidity, T: Temperature, SM: Soil Moisture, ST: Soil Temperature
-**N**umbers followed by the same letter on the same line do not differ markedly on p = 0.05

From Table 2 above, it can be explained as follows:

1. Variable air humidity near the clump, judging from the average, the upper and middle positions have almost the same air humidity value near the clump, but the lower position has air humidity near the lower clump. From the results of the ANOVA it can be seen that the Sig F amounted to 0.045 < 0.05, so it can be concluded that there is a difference in air humidity near the clumps in all three positions. This indicates that in the rainy season, the humidity of the air near the clumps at the bottom position is lower than the upper and middle positions.
2. Variable humidity of the air outside the clump, judging from the average, the upper and middle positions have almost the same value of air humidity outside the clump, but the lower position has lower humidity of the outer air clump. From the results of the ANOVA it can be seen that sig F of 0.065 < 0.10 (error rate 10%), so it can be concluded that there is a difference in the humidity of the air outside the clump in all three positions. This indicates that in the rainy season, the humidity of the air outside the clump at the bottom position is lower than the upper and middle positions.
3. Variable air temperature in clumps, judging from the average, both the upper, middle and lower positions have air temperature values in almost the same clump. From the results of the ANOVA it can be seen that the Sig F is 1,000 > 0.05, so it can be concluded that there is no

difference in air temperature in the clumps in all three positions. This indicates that in the rainy season, in all three positions of altitude, the air temperature in the clump tends to be almost the same.

4. Variable air temperature outside the clump, judging from the average, both the upper, middle and lower positions have almost the same outer air temperature value. From the results of the ANOVA it can be seen that sig F amounted to 1,000 > 0.05, so it can be concluded that there is no difference in the temperature of the outer air of the clump at all three positions. This indicates that in the rainy season, in all three positions of altitude, the air temperature outside the clump tends to be almost the same.
5. Variable soil moisture in clumps, judging from the average, the upper and middle positions have almost the same value of soil moisture in clumps, but the soil moisture in clumps in the lower position is slightly higher. From the results of the ANOVA it can be seen that sig F amounted to 0.834 > 0.05, so it can be concluded that there is no difference in soil moisture in clumps in all three positions. This indicates that in the rainy season, in all three positions of altitude, the soil moisture in the clumps tends to be almost the same.
6. Variable soil moisture outside the clump, judging from the average, the upper and middle positions have almost the same value of soil moisture outside the clump, but the moisture of the outer soil clump at the bottom position is slightly lower. From the results of the ANOVA, it can be seen that sig F amounted to 0.834 > 0.05, so it can be concluded that there is no difference in soil moisture outside the clump at all three positions. This indicates that in the rainy season, in all three positions of altitude, the moisture of the outer soil of the clump tends to be almost the same.
7. Variable soil temperature in clumps, judging from the average, both upper, middle and lower positions have almost the same soil temperature value in clumps. From the results of the ANOVA it can be seen that the Sig F is 1,000 > 0.05, so it can be concluded that there is no difference in soil temperature in clumps in all three positions. This indicates that in the rainy season, in all three positions of altitude, the temperature of the soil in the clump tends to be almost the same.
8. Variable soil temperature outside the clump, judging from the average, both the upper, middle and lower positions have almost the same outer soil temperature value. From the results of the ANOVA it can be seen that sig F amounted to 1,000 > 0.05, so it can be concluded that there is no visible difference in the temperature of the outer soil of the clump in all three positions. This indicates that in the rainy season, in all three positions of altitude, the temperature of the outer soil of the clump tends to be almost the same.

9. Variable wind speed, judging from the average, the middle and lower positions have almost the same wind speed value, but the wind speed in the upper position is slightly higher. From the results of the ANOVA, it can be seen that the Sig F of 0.859 > 0.05, so it can be concluded that there is no difference. Wind speed in all three positions. This indicates that in the rainy season, in all three positions of altitude, wind speeds tend to be almost the same.
10. The irradiation intensity variable, judging from the average, the upper and middle positions have almost the same irradiation intensity value, but the irradiation intensity at the bottom is slightly higher. From the results of the ANOVA, it can be seen that sig F of 1,000 > 0.05, so it can be concluded that there is no difference in the intensity of irradiation in all three positions. This indicates that in the rainy season, in all three positions of altitude, the intensity of irradiation tends to be almost the same.

It can be concluded that in the rainy season: air humidity near the highest clumps at the upper position (508 m above sea level) and the middle (330 m above sea level). The humidity of the outer air of the clump is highest in the middle position, and the lowest is at the bottom position. As for the other eight variables, it did not show a significant difference between the three positions.

Results of Data Analysis of the physical condition of the soil

Soil samples are taken at two depths, namely 0-20 cm and a depth of 100-250 cm. The six variables observed in the physical condition of the soil are the percentage of sand, the percentage of dust, the percentage of clay, permeability, weight of the contents, and porosity, presented in Table 3.

Table 3. Comparison of Soil Samples between Depths

Variable	Depth 0-20 cm	Depth 100-250 cm
Sand Percentage	41.40 b	4.54 a
Dust Percentage	39.02 b	36.17 a
Clay Percentage	19.73 a	59.30 b
Permeability (cm/hour)	57.57 b	15.69 a
Fill Weight (g/cm3)	1.18 a	1.29 b
Porosity (%)	55.32 b	50.25 a

Information:
Numbers followed by the same letter on the same line do not differ markedly on p = 0.05

From Table 3 above, the following conclusions can be drawn:

1. For sand percentage variables: the average percentage of sand at a depth of 0-20 cm is 41.40%, and the average percentage of sand there is a depth of 100-250 cm is 4.54%. From the results of different tests using t-test obtained Sig t amounted to 0.001. Because sig t values < 0.05 indicate a significant difference in the percentage of sand in both types of depth. It can be seen from the average value of the percentage of sand at a depth of 0-20 cm higher than the depth of 100-250 cm.
2. For variable dust percentage: the average percentage of dust at a depth of 0-20 cm is 39.02%, and the average percentage of dust at a depth of 100-250 cm is 36.17%. From the results of different tests using t-test obtained Sig t amounted to 0.001. Because sig t values < 0.05 indicate a significant difference in dust percentage in both types of depth. It can be seen from the average value of the percentage of dust at a depth of 0-20 cm higher than the depth of 100-250 cm.
3. For clay percentage variables: the average clay percentage at a depth of 0-20 cm is 19.73%, and the average clay percentage at a depth of 100-250 cm is 59.30%. From the results of different tests using t-test obtained Sig t amounted to 0.001. Because the sig t value < 0.05 indicates a significant difference in clay percentages in both depth types. It can be seen from the average value of the clay percentage at a depth of 100-250 cm higher than the depth of 0-20 cm.
4. For permeability variables: the average permeability at a depth of 0-20 cm is 57.57 cm /h, and the average permeability at a depth of 100-250 cm is 15.69 cm / h. From the results of different tests using t-test obtained Sig t amounted to 0.001. Because a Sig t value of < 0.05 indicates a significant difference in permeability in both types of depth. It can be seen from the average value of permeability at a depth of 0-20 cm higher than the depth of 100-250 cm.
5. For the content weight variable: the average weight of the contents at a depth of 0-20 cm is 1.18 grams / cm3, and the average load weight at a depth of 100-250 cm is 1.29 grams / cm3. From the results of different tests using t-test obtained Sig t amounted to 0.001. Because the sig t value < 0.05 indicates a significant difference in fill weight in both depth types. It can be seen from the average value of the weight of the contents at a depth of 100-250 cm higher than the depth of 0-20 cm.
6. For pority variables: the average pority at a depth of 0-20 cm is 55.32%, and the average pority at a depth of 100-250 cm is 50.25%. From the results of different tests using t-test obtained Sig t amounted to 0.001. Because the sig t value < 0.05 indicates a significant

difference in pority in both types of depth. It can be seen from the average value of pority at a depth of 0-20 cm higher than the depth of 100-250 cm.

From the results above, there is a significant difference in the six variables between the depths. 0-20 cm and a depth of 100-250 cm. A depth of 0-20 cm has the characteristics of high permeability, high load weight, and high porosity. However, a depth of 100-250 cm has the characteristics of low permeability, high load weight, and low pority. This condition can be explained that in addition to the process of soil formation from volcanic tuff rock bedrock that forms latosol soil (clay and clay), also due to the process of flowing (infiltration) of water into the soil, around sago plants because of the type / pattern of rooting so that the soil is porous (Marianus, 2012).

Infiltration Data Analysis Results And Infiltration Capacity

The model of infiltration capacity equations and infiltration constants around sago baruk plants in various land conditions is obtained from measurement data and calculation of infiltration rates. The form of infiltration capacity equation as a time function of the model developed by Horton is:

f_t = fc+(fo – fc) e – kt where:

f_t = infiltration capacity at time t,

f_c = infiltration capacity price when reaching a constant price

f_o = initial infiltration capacity price (when t=0)

k = constants that vary according to soil conditions and factors that determine infiltration

t = time (Seyhan, 1977; Kumar 1979)

e = 2.71828 (natural logarithmic principal number)

Obtained infiltration equation is as follows:

Infiltration Equation near the clump of the rainy season:

$Ft = 0.01+5.80\ e^{-0.563}\ t$

The equation of infiltration outside the clumps of the rainy season:

$Ft = 0.01+1.78\ e^{-0.1.87}\ t$

Infiltration equation near the clumps of the dry season:

$$Ft = 2.43+129.45\ e^{-0.351}\ t$$

Equation of Infiltration outside the clump of the dry season:

$$Ft = 1.34+11.06\ e^{-\ 11,06t}$$

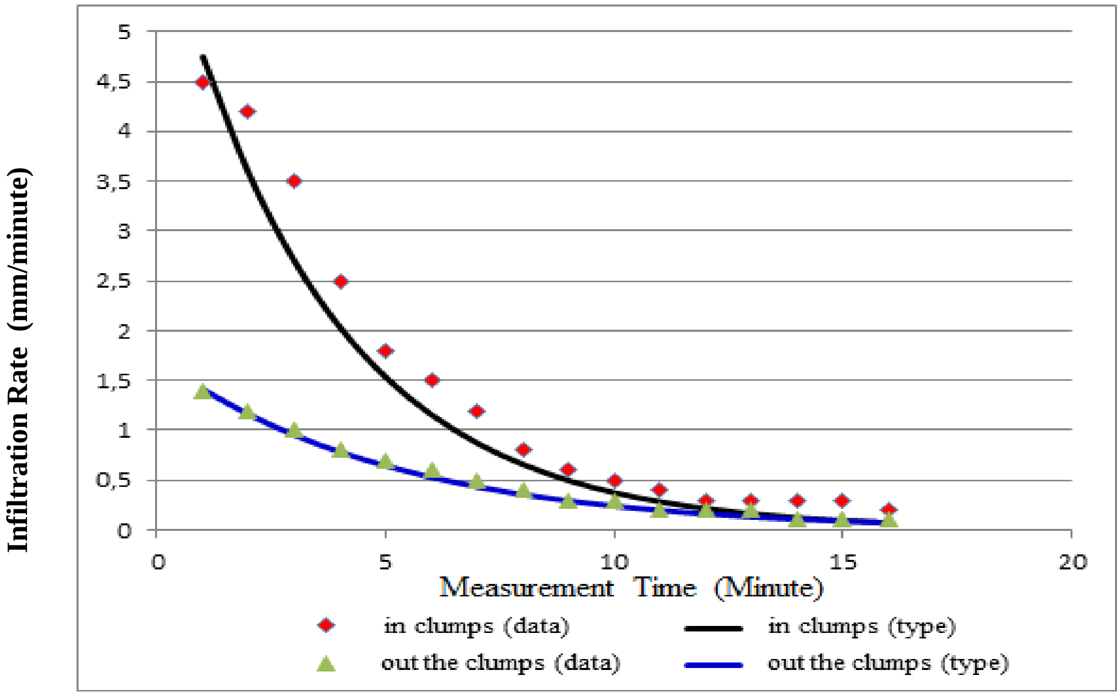

Figure 2. Infiltration capacity curve in rainy season

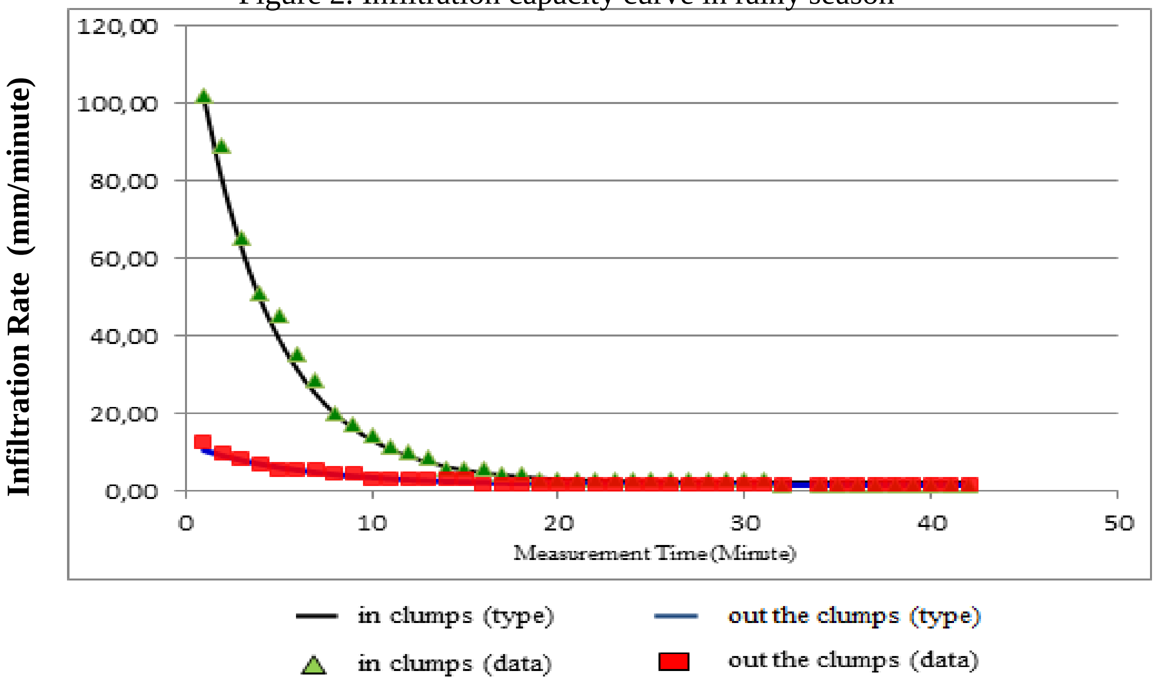

Figure 3. Infiltration capacity curve in dry season

Next is presented a comparison of the initial infiltration rate, the final infiltration rate, the average infiltration rate, and the infiltration constant in both seasons (dry and rainy), and the three altitude positions (above, 508 m above sea level, middle, 330 m above sea level, and below 44 m above sea level), in conditions near and outside the clump. The analytical tools used in observing the physical condition of the environment around the baruk sago plant are (1) descriptive statistics, (2) t tests, and (3) ANOVA tests.

In the data of the measurement results and calculation of the infiltration rate, capacity and infiltration constants, divided into two seasons, namely drought, and rain. There are four variables observed in the measurement data and its calculations, namely the initial infiltration rate (fo), the final infiltration rate (fc), the average infiltration rate (f), and the infiltration constant (k) in both conditions (near the <0.5 m clump, and the outer clump of 2.5 m.

Here is a comparison of variable values per season:

Table 4. Comparison of Infiltration Rates between Seasons

Variable	Dry Season	Rainy Season
fo near clump (mm/min)	130.68 b	6.21 a
fo outside the clump (mm/min)	12.30 b	1.73 a
fc near clump (mm/min)	2.23 b	0.01 a
fc outside the clump (mm/min)	1.24 b	0.01 a
f near the clump (mm/min)	102.90 b	51.19 a
f outside the clump (mm/min)	11.97 b	6.44 a
K near clumps	0.251 b	0.463 a
K outside clump	0.166 a	0.197 b

Information:
- fo: Initial infiltration rate, fc: final infiltration rate, f: average infiltration rate, K: infiltration constant
- **N**umbers followed by the same letter on the same line do not differ markedly on p = 0.05

From Table 4 above, it can be explained as follows:

There is a significant difference in four variables between the dry season and the rainy season. In the dry season, the rate of early, late, and overall infiltration is faster than the rainy season. However, in the rainy season, the infiltration constant is higher than the dry season. The above results can be further explained that the four variables are significant in the dry season and rainy season, because the infiltration process is strongly influenced by the condition of the soil texture and seasons. Also because of the formation of new sago that causes the presence of cavities that can increase the infiltration value. This is in line with the results of previous research (Marianus, 2004) said that the infiltration capacity near clumps is higher than infiltration outside clumps in both seasons. This means that the sago baruk plant has the potential as a soil and water conservation plant.

In the next section is presented a comparison of the position of the height of the location (top, middle, and bottom) for each depth (0-20 cm and 100-250 cm).

Results of Analysis in the Dry Season

The research location is divided into three positions. First, the upper position with a height of 508 m above sea level. Second, the middle position with a height of 330 m above sea level. Third, the lower position with a height of 44 m above sea level. There are four variables observed in the measurement data and its calculations, namely the initial infiltration rate (fo), the final infiltration rate (fc), the average infiltration rate (f), and the infiltration constant (k) in both conditions (near the <0.5 m clump, and outside the clump 2.5 m. Here is presented a comparison of the variable values of each position in the dry season:

Table 5. Comparison of Infiltration Rates between Positions In the Dry Season

Variable	Positions		
	508 m asl	330 m asl	44 m asl
fo near clump (mm/min)	130.51a	130.52 a	131.02 b
fo outside the clump (mm/min)	12.27 a	12.36 a	12.26 a
fc near clump (mm/min)	2.20 a	2.24 b	2.24 b
fc outside the clump (mm/min)	1.24 a	1.24 a	1.24 a
f near the clump (mm/min)	102.57 a	103.49 a	102.63 a
f outside the clump (mm/min)	11.96 a	11.91 a	12.03 a
K near clump	0.245 a	0.245 a	0.264 b
K outside clump	0.168b	0.165ab	0.164a

Information:
- fo: Initial infiltration rate, fc: final infiltration rate, f: average infiltration rate, K: infiltration constant
- **N**umbers followed by the same letter on the same line do not differ markedly on p = 0.05

From Table 5. above, it can be explained as follows:

In the dry season, there is a difference in the rate of initial infiltration, the final infiltration rate, and significant infiltration consensus between the three positions. The upper position with a height of 508 m above sea level has the characteristics of a slow initial infiltration rate, a slow final infiltration rate, and a lower infiltration constant. The middle position with a height of 330 m above sea level has the characteristics of a fast initial infiltration rate, a fast final infiltration rate, and a low infiltration constituency. The lower position with a height of 44 m above sea level has the characteristics of a fast initial infiltration rate, a fast final infiltration rate, and a high infiltration constant.

Results of Analysis in the Rainy Season

The research location is divided into three positions. First, the upper position with a height of 508 m above sea level. Second, the middle position with a height of 330 m above sea level. Third, the lower position with a height of 44 m above sea level. There are 8 (eight) variables observed in the infiltration data: the initial infiltration rate near/outside the clump, the near/outer average infiltration rate of the clump and the infiltration constant near/outside the clump. The following is presented a comparison of variable values of each position in the rainy season:

Table 6. Comparison of Infiltration Rates between Positions In The Rainy Season

Variable	Positions		
	508 m asl	330 m asl	44 m asl
fo near clump (mm/min)	6.15 b	6.13 a	6.35 c
fo outside the clump (mm/min)	1.74 c	1.71 a	1.73 b
fc near clump (mm/min)	0.0100 c	0.0042 a	0.0043 b
fc outside the clump (mm/min)	0.0077 a	0.0080 a	0.0077 a
f near the clump (mm/min)	55.21 c	49.54 b	48.83 a
f outside the clump (mm/min)	7.08 c	6.72 b	5.52 a
K near clump	0.2827 a	0.2832 b	0.8233 c
K outside clump	0.1975 c	0.1970 b	0.1963 a

Information:
- fo: Initial infiltration rate, fc: final infiltration rate, f: average infiltration rate, K: infiltration constant
- Numbers followed by the same letter on the same line do not differ markedly on $p = 0.05$

From Table 6 above, it can be explained as follows:

In the rainy season, there are significant differences in the rate of initial infiltration, the rate of final infiltration, the overall infiltration rate and the significant infiltration consensus between the three positions. The upper position with a height of 508 m above sea level has the characteristics of a medium initial infiltration rate (near the clump), a fast final infiltration rate (outside the clump), a fast final infiltration rate (near the clump), a fast overall infiltration rate (near and outside the clump), a low infiltration constituency (near the clump), and a high infiltration (outside the clump). The middle position with a height of 330 meters above sea level has the characteristics of the slow initial infiltration rate (near and outside the clump), the slow final infiltration rate (near the clump), the overall infiltration rate (near and outside the clump) which is moderate, the infiltration constituency (near and outside the clump) which is being. The lower position with a height of 44 m above sea level has the characteristics of a fast initial infiltration rate (near the clump), a medium final infiltration rate (outside the clump), a moderate final infiltration rate (near the clump), a slow rate of infiltration (near and outside the clump), a high infiltration constituency (near the clump), and a low infiltration constituency (outside the clump), This is in line with the results of previous research (Marianus, 2004,Marianus and Silangen,2020).

Results of Data Analysis of Water Storage Capacity Around Baruk Sago Plants

To determine the capacity to store water in a land, it takes data on soil texture and data on the root zone (depth) of vegetation that grows above the surface of the soil. Water Holding Capacity (WHC) is a variable that depends on the depth of the root and the class of soil texture. The results are shown in Table 7.

Table 7. Results of the calculation of water storage capacity

Position/Location	Root Depth	Soil Texture Class	Water Availability	WHC Value Results
508 m asl	0 – 20 cm	Clay	250 mm/ m	50 mm
508 m asl	100 cm	Clay	300 mm/ m	300 mm
508 m asl	250 cm	Clay	300 mm/ m	750 mm
330 m asl	0 – 20 cm	Clay	250 mm/ m	50 mm
330 m asl	100 cm	Clay	300 mm/ m	300 mm
330 m asl	250 cm	Clay	300 mm/ m	750 mm
44 m asl	0 – 20 cm	Clay	250 mm/ m	50 mm
44 m asl	100 cm	Clay	300 mm/ m	300 mm
44 m asl	250 cm	Clay	300 mm/ m	750 mm

Source: Research Result

Table 8. Results of WHC Value Comparison Analysis at each position

	WHC Average	Sig F	Conclusion
508 m asl	366.67	1.000	Non-Significant
330 m asl	366.67		
44 m asl	366.67		

Source: Research result

From Table 8 Above it can be seen that at the top, middle and bottom positions, the WHC value is exactly the same, which is 366.67 mm. From the test results showed a Sig F value of 1,000 > 0.05 (error rate of 5%) so it can be concluded that there is no significant difference in WHC value between the three positions. That is, both the lower, middle and upper positions, will give a WHC value that tends to be almost the same.

Conclusions and Suggestions

Conclusion

Based on the results of calculations and analysis that have been done in this study, the following conclusions can be drawn:

1. Parameters of soil physical condition are grades of texture of squirmed clays and clay, medium to high porosity, slow to rapid permeability, moderate to high macro nutrient retention and microclimate conditions can be used to estimate the optimal conditions of the environment in which Baruk sago plants grow.
2. The soil moisture around (near the clumps) of sago baruk is higher than outside the clump in different seasons, The temperature of the soil near the clump is lower than the temperature of the soil outside the clump.
3. Land infiltration capacity near baruk sago clumps is higher than outside the clump in different seasons.
4. The water Holding capacity is relatively high, so that baruk sago plants can be used as soil and water conservation plants.

Suggestions

Based on the conclusions of the above research, some suggestions can be submitted as follows:

1. For the development of baruk sago plants in other locations it is necessary to pay attention to physical conditions, soil chemistry and microclimate.
2. Recommendations for the Sangihe Regency Regional Government to develop /preserve Baruk sago plants in order to availability of local food sources and maintain environmental preservation (Land and Water).

References

1. Andrew, G. 2006. The Human Impact on The Natural Environment. Blakwell Publishing Australia, p.25-27. Anonymous. 1980. Beberapa Penelitian Sagu baruk di Pulau Sangihe Besar, Kabupaten Sangihe Talaud.
2. Dinas Pertanian Rakyat Propinsi Dati I SULUT.Bulletin Palma. 26:21-22.
3. Anonymous. 2005. Budidaya Dan Manfaat Sagu Batuk. Bulletin Palma. Pusat Penelitian dan Pengembangan Perkebunan Bogor.29:73-74.
4. Anonymous. 2009. Undang-Undang no. 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup. Sekretariat Negara RI.39 pp.
5. Asdak, 1995. Hidrologi Dan Pengelolaan Daerah Aliran Sungai. Gadjah Mada University Press. p.95-100.
6. Barri, N dan D. Allorerung. 2001. Survey Keragaman Tanaman Dan Ekosistem Habitat Sagu Baruk Di Kabupaten Sangihe Talaud. Laporan Akhir. Kegiatan Penelitian Balai Penelitian Tanaman Kelapa Dan Palma Lain.115pp.
7. Denium dan Noli, B. 2001. Survey Keragaman Tanaman dan Ekosistem Habitat Sagu di Kabupaten Kepulauan Sangihe Talaud. Laporan Akhir Kegiatan Penelitian Balai Penelitian Kelapa dan Palma Lain, 28:43.
8. Harsanto, B. 1992. Budidaya dan Pengolahan Sagu, Kanisius Yogyakarta. Bulletin Sagu.43:1-15
9. Jeff And Hill, H. 2009. Agriculture, Climate Change and Carbon Sequestration. ATTRA Publication*.15-01-2010.*
10. Kumar, S. 1979. Water Resources and Hydrology. Khanna Publishers, Nai Sarak. New Delhi.
11. Lay. A, D. Allorerung, Amrizal, M.Djafar. 1998. Pengolahan Sagu Berkelanjutan, Hasil-hasil Penelitian Kelapa dan Palma Lain, Balitka, Bulletin, 29: 73-75.
12. Macedru, K. 2011. Sago Palm Awareness for White Water Rafters, Fiji Nature Conservation Trust**Error! Hyperlink reference not valid.**
13. Mahmud, Z. dan Amrisal. 1991. Palma Sebagai Bahan Pangan, Pakan Dan Konservasi. Bulletin Balitka.14:112-114.
14. Maliangkay, R. dan M. Djafar. 2002. Teknik Pemindahan Anakan Sagu Baruk. Bulletin Palma .28:43.
15. Marianus. 2004. Pengukuran Infiltrasi di Sekitar Tanaman Sagu Baruk (*Arenga microcarpha* Becc*)* untuk Pelestarian Lingkungan. Jurnal Lem Lit UNSRAT,10(2) 20-24.

16. Marianus. 2012. Sago Baruk Palm (Arenga microcarpha Becc) As A Superior Local Food Source and Soil Conservation Plant at Sangihe Island Regency. Agrivita Journal of agricultural Science.
17. Marianus dan Silangen.2022. The Analysis Of Ecological Functions Of Sago baruk (Arenga Microcarpha Becc) Plants For Sustainable Use. International Journal of Conservation Science, ISSN: 2067-533X. Volume 11, Issue 3, September, 2020.

18 Maryunani dan Sutikno. 2006. Ekonomi Sumber daya Alam. Badan Penerbit Fakultas Ekonomi .Universitas Brawijaya Malang. p.30-32.

19. Purwanto, I dan Ngaloken.1995. Pengaruh Berbagai Jenis Vegetasi Terhadap kapasitas Infiltrasi Tanah Di Cijambu, Sumedang Jawa Barat. Bulletin Penelitian Hutan , 573: 13-16.

20. Rostiwati, T. 1988. Teknik Penaaman Sagu, Pusat Penelitian dan pengembangan Hutan Bogor. Bulletin Palma. 235:13-18.

21. Samad, Y. 2002. Meningkatkan Produksi Industri Kecil Sagu melalui Penerapan Teknolongi Ekstraksi Semi Mekanis. Jurnal Sains Dan Teknologi BPPT.

22. Seyhan, E. 1977. Fundamental of Hydroligy, Diterjemahkan Oleh Sentot Subagyo, 1993. Dasar-dasar Hidrologi, Gajah Mada University Press, Yogyakarta. p.125-130.

23. Singarimbun, M. dan Effendi, S. 1989. Metode Penelitian Survei, Edisi Revisi. LP3ES, Jakarta. p-45-50.

24 .Suraini A. Asis. 2002. Sago Starch and Its Utilisation, Journal of Bioscience and Bioengineering University Putra Malaysia, 43400 Serdang Selangor Malaysia, 1389-1723 (02) 80190-6. 29-05-2012.

25 T.A. Chew, A. H. bin Isa; Mohd. G. bin Mohayidin. 2008. Sago (Metroxylon sagu Rottboll) The Fogothen Palm, Journal of Sustainable Agriculture 14 (4):5