

Land characterization of local glutinous rice production

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Land characterization of local glutinous rice production

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Abstract. Pulu mandoti is the local glutinous rice from Enrekang Regency with the advantage of distinctive odor and taste, which is not possessed by similar rice. The research aimed to of knowing the character of the local glutinous rice producing area of Enrekang (pulu mandoti). The research was conducted using a structured survey method. Data collection was conducted by observation in the field, analysis in the laboratory, documentation, and interviews of farmers. Soil sampling were conducted by purposive sampling where the determination of the wetland planted with glutinous rice can be determined through the making of a transect lines using a topographic map. The results showed that the best producers of pulu mandoti were in the Piawan Village, Kendenan Subdistrict with an average temperature of 21-25°C, an average rainfall of \pm 1,083 mm/yr, the elevation of 800masl and the slope of 10%. The texture of silt loam, silt clay loam, clay loam and sandy loam. Soil depth >98cm with pH of 5.5 - 6.4, CEC 16-25 cmol/kg, C-organic >2%, low salinity <0.25 dS/m and base saturation >35%. This research has a low of N- total content >0.2%, high of P-available 17 ppm, low of K₂O <0.3 cmol/kg with average yield 440 kg/ha.

1. Introduction

Enrekang Regency is one of the areas dominated by the agricultural sector, where most of the population is related in agriculture. In some areas, especially in the Baraka district, Enrekang Regency, there are still farmers who grow local sticky rice. The local sticky rice in the people named it Pulu Mandoti. Pulu Mandoti is one of the assets of the nation's wealth, especially the wealth typical for the people of Enrekang Regency. Pulu Mandoti is local rice that can only grow well in Enrekang Regency, Baraka District, Salukanan Subdistrict, and Kendenan Subdistrict. One of the advantages of Pulu Mandoti is its distinctive odor and different taste from other glutinous rice, which makes this type of rice was favored by many local and national consumers. Besides, this type of rice is not carelessly grown elsewhere. That is why this type of rice has a higher economic value compared to other types of rice in the Enrekang Regency [1].

According to the Enrekang Regency community information, Pulu Mandoti rice can only grow at a certain height, so that was called Pulu Mandoti rice. If planted elsewhere, it still can grow, but the odor and taste will not be the same as the original place. A good producer of Pulu Mandoti has a different odor and taste in each planting place, but the odor and taste still have the typical Pulu Mandoti. Pulu Mandoti



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can only be harvested once a year with a plant age of six months or once planted in a planting period. This rice has a different character and quality from similar products, and it is caused due to the influence of natural or geographical factors, so Pulu Mandoti rice has a potential geographical indication [1].

The nature of the soil plays a role in determining the ability and suitability of land. The diversity of land properties will determine the type of commodity that can be cultivated and the level of productivity, this is because every kind of agricultural commodity requires specific land characteristics requirements to be able to grow and produce optimally [2].

2. Methods

Observations, profile descriptions, and soil sampling were carried out in Baraka District, Enrekang Regency, South Sulawesi Province. Soil analysis was conducted in the Soil Chemistry laboratory, Department of Soil Science, Faculty of Agriculture, Universitas Hasanuddin. The working map was used for observation is based on a topographic map of Baraka District with a scale of 1: 115,000, so that it will form a straight line (Transect Method). The observation points were made in two (2) transect lines according to elevation as representative of the study location. Each transect line passes through two (2) observation points. Data on local rice production was obtained from interviews with 28 farmers.

Determination of observation points in the field using a purposive sampling method that based on the presence or absence of paddy planted with Enrekang Local Glutinous Rice (Pulu Mandoti). Preliminary survey results showed that several subdistricts planted Pulu Mandoti that is Salukanan Subdistrict and Kendenan Subdistrict. The results of interviews with several farmers in several subdistricts who planted local rice mentioned that there were differences in taste, odor, and production of rice products in various places, even though they came from the same seed at the beginning of this local rice cultivation. For this reason, several observation points were chosen from various altitudes with varying rice yields (taste, odor, and productivity)

3. Results and discussion

3.1. Climate characteristics

Climate is very influential in the growth and production of a plant. Climate characteristics needed in land characteristics, land evaluation to soil formation. Based on rainfall data in the year 2008-2017 rainfall in the range of $\pm 1,083$ mm / year with rainfall intensity per month, which ± 12 -200 mm/month with a total of five dry months and five wet months. On data obtained from the 2018 Weather Princeton research, sites have temperatures ranging from 20°C-26°C. Baraka District with an altitude of 600 masl has a maximum temperature of 26°C, and a minimum of 22°C. An elevation of 800masl, has a maximum temperature of 25°C and a minimum of 21°C. An altitude of 1,000masl has a maximum temperature of 24°C and a minimum of 20°C. The average air humidity in the year 2008-2017 in the range of 29 - 59% band an average wind speed in the range of 3.7 - 6.9 km/hour (table1).

Table 1. Climate characteristics of the study area

Location	Elevation (masl)	Temperature		Humidity		Average wind speed	
		T.max (°C)	T.min (°C)	RH Max (%)	RH Min (%)	Max (km/hour)	Min (Km/hour)
Matarin	600	26	22	59	29	6.9	3.7
Tantido	800	25	21	59	29	6.9	3.7
Piawan	800	25	21	59	29	6.9	3.7
Salongge	1,000	24	20	59	29	6.9	3.7

3.2. Soil physical characteristics

The results of soil physical analysis in Profile 1 to Profile 4 were presented in table 2. Depth of soil or solum indicates the young age of a soil. Based on the analysis in the field, each profile has different soil depths. In the profile 1, the depth of the soil reaches 112 cm, profile 2 the depth of the soil reaches 122cm, profile 3 the depth of the soil reaches 98cm, and profile 4 the depth of the soil reaches 74cm. From these results the deepest soil in the profile 2 with the location in the Salukanan subdistrict

Variation in soil color can be described as a clue about soil properties. Organic matter content, drainage, and aeration conditions are soil properties related to soil color. Based on the results obtained in the field, soil colors range from dark to light colors. According to Hakim et al. [3], the dark color of the soil is generally caused by the content of decomposed organic matter. Organic matter in the soil will produce a dark gray, dark brown color unless there is an influence of minerals such as an iron oxide or accumulation of salts so that modification often occurs from the color obtained.

Based on the results of laboratory analysis, the percentage of texture is sand ranging between 18-73%, silt ranging from 3 - 58% and clay ranging from 17-30% so that the soil texture classification is clay, sandy clay, clayey loam, sandy clay loam, and clay dusty clay. According to Hanafiah [4], soils dominated by sand will have a lot of macro (large) pores (called more porous), soils dominated by silt will have many medium pores (somewhat permeable). In contrast, those dominated by clay will have micropores (small) or not porous. In moist conditions, the soil is divided into loose consistency (easy to process) to the firm (rather difficult to hoe). In wet conditions determined easily attached to fingers (attached or not attached)

3.3. Soil chemistry characteristics

The results of soil chemistry analysis in the profile 1 to profile four are presented in table 3. The acidity (pH) of the soil greatly influences the status of nutrient availability for plants. At neutral pH (6-7), nutrient availability is optimal in terms of quantity and equilibrium of nutrients in the soil solution. Based on laboratory results showed that the average pH value of H₂O ranges from 5.2 - 6.5 which is acidic to slightly acidic and the average pH value of KCl ranges from 3.7 - 5.5 which is very acidic to acidic

The average C-organic value ranges from 0.4 to 2.1%, where the organic content is classified as very low to low. The presence of C-organic variations causes differences in the type and amount of vegetation that grows on the soil. CEC values range from 13-23 cmol/kg of land, which can be said to be low to moderate cation exchangeability. In soils with relatively low CEC values, the process of absorption of nutrients by colloidal soils does not take place relatively. As a result, these nutrients will be easily washed away and lost with the movement of water in the soil so that nutrients are not available to plants. The value of CEC is very diverse and depends on the nature and characteristics of the land itself [5].

Land that is dominated by base cations such as Ca, Mg, K, and Na can increase soil fertility because base cation is a nutrient needed by plants [6]. Based on the results of the analysis of soil samples in the laboratory showed that Ca values ranging from 4-10 cmol/ kg are categorized as low to moderate. Mg ranged from 0.5 to 5 cmol/kg, which are classified as low to high. K ranges from 0.1 to 0.45 cmol/kg, which are classified as low to moderate. Na is in the range of 0.1 - 0.4 cmol/kg, which are classified as low. Base saturation value ranges from 33-84% which are classified as low to high

Table 2. Analysis of soil physical

Profil (cm)	%Sand	%Silt	%Clay	Class of soil texture	Consistency				
1	0 – 14	38	38	25	Loam	Firm	Moist	⁷ 5 YR 4/3	⁴ Reddish Brown
	14 – 35	43	33	23	Loam	Firm	Moist	7.5 YR 3/2	Dark Brown
	35 – 67	53	24	23	Sandy clay loam	Firm	Moist	5 YR 3/2	Dark Reddish Brown
	67 – 80	47	32	21	Loam	Very Firm	Moist	5 YR 3/2	Dark Reddish Brown
	80 – 93	41	34	24	Loam	Very firm	Wet	5 YR 3/2	Dark Reddish Brown
	93 – 112	49	30	21	Loam	Very firm	Wet	2.5 YR 3/1	Dark Reddish Gray
2	0 – 27	29	42	29	Clay loam	Loose	Moist	7.5 YR 4/6	Strong Brown
	27 – 42	41	35	23	Loam	Loose	Moist	10 YR 3/6	Dark Yellowish
	42 – 72	72	11	17	Sandy loam	Loose	Moist	10 YR 4/4	Dark Yellowish Brown
	72 – 88	26	43	30	Clay loam	Firm	Moist	7.5 YR 4/6	Strong Brown
	88 – 122	22	50	28	Clay loam	Firm	Moist	5 YR ¾	Dark Reddish Brown
3	0 – 23	18	58	24	Silt loam	Firm	Moist	10 YR 5/4	Yellowish Brown
	23 – 52	18	52	29	Silty clay loam	Firm	Moist	10 YR 5/6	Yellowish Brown
	52 – 70	23	49	28	Clay loam	Firm	Moist	10 YR 6/6	Brownish Yellow
	70 – 95	54	28	18	Sandy loam	Loose	Moist	10 YR 5/7	Yellowish Brown
4	0 – 18	36	42	22	Loam	Friable	Moist	2.5 YR 6/8	Olive Yellow
	18 – 33	73	3	24	Sandy clay loam	Friable	Moist	10 YR 4/6	Dark Yellowish Brown
	33 – 58	52	29	19	Loam	Loose	Moist	10 YR 5/6	Yellowish Brown
	58 – 74	46	36	18	Loam	Loose	Moist	10 YR 5/8	Yellowish Brown

Table 3. The results of the analysis of soil chemical

	Profile (cm)	pH H ₂ O	pH KCl	%C	%N	P (ppm)	K Cmol/kg	CEC Cmol/kg	%Base Saturation
1	0 - 14	5.34	3.70	1.96	0.20	20.82	0.22	22.53	34
	14 - 35	6.05	4.73	1.72	0.11	15.44	0.36	19.64	48
	35 - 67	5.70	5.50	1.56	0.08	14.15	0.42	18.94	52
	67 - 80	6.52	5.21	1.64	0.08	13.53	0.33	17.55	55
	80 - 93	6.25	5.17	0.48	0.03	13.53	0.25	15.15	67
	93 - 112	6.09	4.63	0.46	0.03	13.13	0.09	13.16	84
2	0 - 27	5.79	5.25	2.07	0.11	17.89	0.45	19.34	57
	27 - 42	6.21	5.12	1.98	0.11	15.92	0.36	18.94	54
	42 - 72	6.09	5.02	1.96	0.08	14.96	0.38	18.34	76
	72 - 88	5.96	4.72	1.40	0.06	14.49	0.22	17.55	39
	88 - 122	6.02	5.35	1.00	0.03	13.47	0.11	13.06	56
3	0 - 23	5.46	3.76	2.06	0.20	17.82	0.28	16.95	47
	23 - 52	6.27	5.48	2.03	0.14	17.01	0.32	18.15	33
	52 - 70	6.02	5.47	1.90	0.08	16.32	0.29	16.15	50
	70 - 95	6.39	5.20	0.96	0.08	14.62	0.11	25.52	33
4	0 - 18	6.50	5.26	1.88	0.11	16.46	0.38	20.34	33
	18 - 33	6.12	4.77	0.93	0.08	16.46	0.25	12.36	65
	33 - 58	5.78	4.32	0.44	0.08	15.03	0.22	17.15	41
	58 - 74	5.74	4.27	0.45	0.06	14.08	0.21	14.36	46

3.4. Soil Mineralogy

Based on the results of the mineral analysis that using the XRD method showed that the soil were dominated minerals Quartz, Chlorite, and Calcite. Apart from primary minerals, there are secondary minerals such as Hematite, Bimessite, Kaolinite, Sodalite, Montmorillonite, Chabazite, Titanium Oxide Anatase, and Magnetite, but they are not dominant. A description of the types of minerals produced is shown in table 4

Table 4. The results of the mineral analysis using XRD

TP	Elevation	Horizon	Primer	Sekunder
1	600	A	Quartz	Hematite, Bimessite
		B	Chlorite, Calcite	Montmorillonite, Chabazite
2	800	A	Quartz	Hematite, Bimessite
		B	Quartz	Montmorillonite, Chabazite
3	800	A	Quartz	Kaolinite, Sodalite
		B	Quartz	Titanium oxide
4	1000	A	Quartz	Hematite, Titanium oxide
		B	Quartz	Montmorillonite
4	1000	A	Quartz	Sodalite, Kaolinite
		B	Chlorite	Titanium oxide
4	1000	A	Quartz	Kaolinite, Hematite
		B	Chlorite	Titanium oxide
4	1000	A	Quartz	Titanium oxide, Kaolinite
		B	Chlorite	Kaolinite, Titanium oxide
4	1000	A	Quartz	Magnetite
		B	Chlorite	Magnetite

3.5. Soil classification

Based on the analysis using soil taxonomy, soil types in profiles 1 to 4 are categorized into the Inceptisols Order

3.6. The correlation between the average productivity of Pulu Mandoti in each unit of observation

Growth and production of plants depend on the interaction of biological systems and the physical environment in which the plants grow and develop, the physical environment that influences plants, including the light, atmosphere, rooting environment, and temperature [7]. The difference in production obtained farmers in each location can be influenced by nutrient content in the soil, climate, location, and processing of farmers. Based on the results were obtained from farmers through interviews and questionnaires the average production of Pulu Mandoti from each research location is different, where at location 1 produces the lowest production among other research sites, at location 4 the production yields increase but produce a sense which is different, among all study sites, at locations 2 and 3 provides a quite high production, but the highest production is at location 4.

The results of the questionnaire showed that farmers did not use organic fertilizer (manure) and chemical fertilizers in excess. Due to excessive use of organic fertilizers and chemical fertilizers, it can cause rice stems and panicles to be reduced so that production results will be reduced. Besides, the use of organic fertilizer is not done because it will harm farmers because of the high price and requires a lot of organic fertilizer. Mandoti Pulu planting occurs only once in one planting period or planting once a year within six months from sowing to harvest. From the results of interviews, it was also found that some farmers sometimes did not plant Pulu Mandoti within one planting period.

Table 5. Average production of Pulu Mandoti

Profile	Coordinate	Average production
1	3° 23' 4.8" LS dan 119° 53' 10.8" BT	± 320 Kg/ha
2	3° 22' 28.7" LS dan 119° 53' 30.7" BT	± 500 Kg/ha
3	3° 23' 38.2" LS dan 119° 54' 16.9" BT	± 440 Kg/ha
4	3° 23' 13.8" LS dan 119° 55' 27.7" BT	± 640 Kg/ha

4. Conclusion

Climate characteristics of local glutinous rice development (Pulu Mandoti) include rainfall ± 1,083 mm / yr (five wet months and five dry months) with a maximum temperature of 24-26°C, minimum temperature 20-22°C, air humidity 29 - 59%, and wind speed 11 km/hr. Soil and terrain characteristics include soil drainage good - moderate, an altitude 600-1000 masl, the slope of 8-11% and depth of land 110 cm - 144 cm. The texture of clay, dusty clay, sandy clay. Chemical characteristics such as pH 5.3-6.52, CEC>12 cmol/kg, salinity <0.3 dS / m, base saturation 35-60%, and C-organic> 1%.

The best local sticky rice results in Pulu Mandoti were found in Kendenan Subdistrict, Piawan Village, which has the following specific land characteristics with an average temperature 21-25°C, average rainfall ± 1,083 mm/yr, an altitude of 800 masl and the slope of 10%. The texture of silt loam, Silt clay loam, clay loam, sandy loam. Soil depth> 98cm, pH 5.5-6.4, CEC 16-25 cmol/ kg, C-organic> 2, low salinity <0.25 dS / m, base saturation> 35%, contain N- total low> 0.2%, high P-available 17 ppm, and low K₂O <0.3.

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