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DIVERSITY OF PALU LOCAL SHALLOT PRODUCTION IN VARIOUS LAND SUITABILITY CLASSES IN PALU VALLEY, CENTRAL SULAWESI PROVINCE, INDONESIA

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Abstract

The purpose of this study was to determine the land index and land suitability class of shallot plants, describe the climate and soil requirements for shallots, and the relationship between the land index and shallot production. This research was conducted at the shallots crop locations in the Palu Valley from June to September 2019 using a survey method. The results obtained indicate the location of shallots farming in the Palu Valley involving several villages, namely Maku, Salowe, Kayumalue, Guntarano and Oloboju having a land index about 37.78, 38.63, 54.03, 42.59 and 26.42, respectively, were considered marginally appropriate (S3) except Kayumalue village was quite appropriate (S2) with a moderate limiting factor. Analysis of farmers' net income ranged from IDR 72, 862, 500 - 101, 137, 500 with an R/C ratio ranged from 1.87 - 2.84. For the Oloboju Village, the lowest net profit was IDR 72, 862, 500 with an R/C ratio of 1.87 and the highest net profit in the Kayumalue village was IDR 101, 137, 500 with an R/C ratio of 2.84.

Key words: land suitability class, land index, shallot, production, income.

Introduction

Soil is a natural three-dimensional body where activities of all living things, including the growth of plants. The ground has a unique characteristic that affects the growth of commercialized crops. Soil classification and land evaluation is a way to determine the suitability of the land to develop a plantation (Soltani *et al.,* 2013).

The land has several properties consisting of physical, chemical and biological properties. With these various characteristics, fertility in different soil types also varies, depends on the features. Therefore we need an understanding of those soil characteristics so that it can be used according to its potential (Ferdinan *et al.,* 2013; Recatalá Boix & Zinck, 2008; Ritung *et al.,* 2011).

The conversion of productive agricultural land into a non-agricultural area has been going on and difficult to avoid as a result of the rapid pace of development accompanied by climate change (Oh *et al.,* 2011). To support the self-sufficiency of fried onions, it needs to expand plantations in potential areas, but are generally constrained by low land quality and inadequate infrastructure (Adinigsih *et al.,* 1994; Doi and Ranamukhaarachchi, 2009). The efforts made to maintain the production of Palu fried onions are to improve the quality of intensification, extensification, diversification, and rehabilitation of agricultural land.

Agricultural business is not only influenced by irrigation but also by the level of land fertility. Low fertility requires high input, so farming costs are being more expensive. Characteristics and quality of soil are essential in agricultural development (Li *et al.,* 2013). The Palu Valley has a flat topography with an adequate river network for irrigation channels, which is a downstream area of the Palu Sub-watershed. The purpose of this research is to study the soil characteristics and land quality in the Palu Valley, as well as to evaluate land suitability for the development of Palu's local shallot crops.

Materials and Methods

This research was conducted in Palu Valley, Central Sulawesi Province, which took place from June to September 2019. Observation of soil characteristics in the field was carried out by the survey method in several locations of local onion planting centers of Palu. Soil

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sampling at a depth of 0-30 cm was done by using a hand drill. Soil samples taken from the field were air-dried and then analyzed. The parameters observed including soil's texture, pH, N-total, P_2O_5, K_2O, cation exchange capacity, and electrical conductivity. The soil analysis method used for each parameter in the Laboratory referred to the technique used by the Soil Research Institute (Eviati & Sulaeman, 2009). Evaluation of land suitability was carried out through the Storie Index Method by grading or valuation between land characteristics data from the field and the Laboratory with land suitability criteria for Palu local shallots.

Results and Discussion

Climate Index Value of Shallot Crop Research Area

Rainfall data, both in number and distribution, are often used to estimate the potential availability of water for agriculture. The average annual rainfall in the coverage area of the BMKG (Meteorology, Climatology and Geophysical Agency) of Mutiara Palu station was 2,163 mm, and the average annual rainfall was 28.02ºC. According to Oldeman classification method (rainy season/wet months = average rainfall >200 mm months-1; dry season/dry months = average rainfall < 100mm months-1) (Kartasapoetra, 2008). The climate in the coverage area of the Palu Valley rainfall station was included/classified as type agro-climate C and there were six consecutive wet months, namely January-February-March-April, June-July and four consecutive dry months, namely August-September-October-November. The data shows that in the coverage area of the BMKG of Mutiara Palu station was classified as a dry climate type. Such climatic conditions do not support the development of local shallots.

Table 1: Value, Index of Land Suitability Class of Shallot Crop Research Area in Palu Valley.

Land Characteristic	Locations				
	Maku	Salowe	Kayu-malue	Gunt-arano	Olo-boju
Climate	74.64	74.64	74.64	74.64	74.64
Slope	96.25	96.25	95	96.25	77.19
Flood	100	100	100	100	100
Drainage	100	95	100	100	100
Texture	95	100	95	95	95
Cation exchange capacity	81.5	84,5	95	88.6	80
Base saturation	85	85	95	85	85
Organic-C	85	85	95	88.75	85
Electrical conductivity	99.8	99.7	99.2	99.6	99.8
$CaCO_3$	97.02	97.28	97.02	96.83	98.08
Exchangeable bases	100	100	100	100	100
Land index	37.78	38.63	54.03	42.59	26.42
Suitability class	S3	S3	S2	S3	S3

The value or grade of each climate and land characteristics was obtained by combining the climate and land characteristics of the study area with the requirements for growing onions based on limiting factors, from without limitation to very heavy limitation by each valuation from a maximum value of 100 to a minimum value of 0. Furthermore, the land and climate index was a multiplication of each characteristic or quality of land and climate that has been evaluated. The assessment criteria used to assess the suitability of climate and onion crop fields in the Palu Valley based on standards established by Sys *et al.,* (1993) (Sys *et al.,* 1993). Onion plants require rainfall of not less than 250 - 300 mm and optimal between 400 - 500mm during its growth, regardless of the rainfall requirements for each phase of its growth (Sys *et al.,* 1993).

Land Index Value of Shallot Crops Research Area's

Land index and land suitability level of onion plants in Palu Valley based on assessment criteria can be seen in table 1.

According to the requirements needed by onion plants as presented in table 1, the land in the study area was considered to be quite appropriate with the low limiting level (S2) in Kayumalue and according to marginal with a moderate limiting level (S3) in Maku, Salowe, Guntarano, and Oloboju. In the five research locations, namely Maku, Salowe, Kayumalue, Guntarano, and Oloboju, the limiting factor was the climate, especially rainfall.

This is due to the five onion farmings have a rainfall of 51-52 mm/month while onion plants require high rainfall during the growth phase of not less than 250-300 mm per growth cycle (Sys *et al.,* 1993). The optimum temperature for onions during growth ranges from 15-20 ºC with a maximum temperature of 24ºC; above 25ºC, the growth of will be obstructed (Sys *et al.,* 1993). This led to the suitability of land in Kayumalue considered as quite appropriate (S2), and Maku, Salowe, Guntarano, and Oloboju rated as marginally suitable (S3), causing

Table 2: Land Index and Local Shallot Production at 5 Locations in the Palu Valley.

No.	Villages	Land index	Production (ton/Ha)
1	Maku	37.78	5.48
2	Salowe	38.63	6.02
3	Kayumalue	54.03	8.20
4	Guntarano	42.59	7.59
5	Oloboju	26.42	5.42

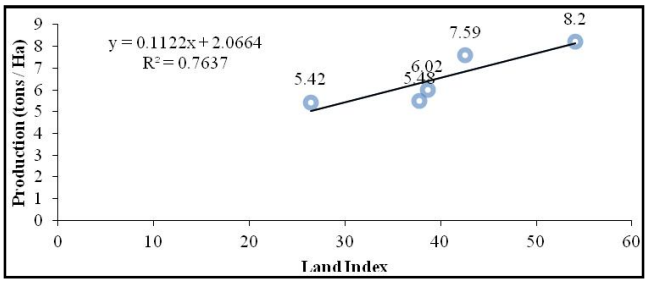

Fig. 1: The relationship between the land index and shallot production in several locations in the Palu Valley.

low onion production below the optimal production (17.57 ton/Ha). One effort to elevate the onion production in those location sites is by irrigation.

Relationship between Land Index and Shallot Production

Besides being determined by genetic factors, the growth and production of onions are also determined by environmental factors and crop cultivation. Climate and soil are important environmental factors in influencing the growth and production of shallots. Regression analysis results show a linear relationship between land index and production (Y = 0.1122 X + 2.0664) with a coefficient of determination R = 0.7637. This identified a close correlation between the land index and production. The high land index tends to produce high production, and vice versa. It is consistent with previous research on several plantation commodities such as sugar cane, coffee, tea, palm oil, and rubber (Lopulisa, 1996). Fig. 1 shows the relationship between the land index and onion production in several locations in the Palu Valley. Table 2 shows the land index and onion production in the five locations of shallots crops in Palu Valley.

In general, the research location areas were considered S2 (quite suitable) and S3 (marginal appropriate) to support the growth of onion. Drainage also medium and clay soil textures were limiting factors at Maku, Salowe, Kayumalue, Guntarano, and Oloboju. While onion plants require good drainage with the sandy loam soil texture (Sys *et al.,* 1993).

Various factors, including climate, influenced the low production of onion in several locations in the Palu Valley. Wherein it is known that onion plants require rather high rainfall throughout its growth, which is around 250-300 mm. While the location of onion plants in the Palu valley only reached 51-52 mm monthly.

Relationship between Optimal Production and Land Suitability Classes

The influence of climate and soil on onion crop production can be known through the relationship between the optimal production of onion plants. Table 5 shows the relationship between the optimum production of shallots and the suitability class.

Table 3 shows that the highest onion production was obtained at Kayumalue, Guntarano, Maku, Salowe and Oloboju were 8.20, 7.59, 6.03, 5.48 and 5.42 tons/Ha, the product obtained was considered to be quite appropriate (S2) in Kayumalue and marginally appropriate (S3) in

Table 3: Relationship between optimum production of shallots with suitability classes.

Production index	Optimal production index (ton/Ha)
>75	>12.30
50-75	8.20 - 12.30
25 – 50	4.10 - 8.20
12 – 25	2.05 - 4.10
<12	<2.05

Table 4: Economic Analysis Based on Land Suitability Classes at the level of Farmer/Ha.

	The used of shallot land				
Location	**Maku**	**Salowe**	**Kayumalue**	**Guntarano**	**Oloboju**
Land suitability classes	**S3**	**S3**	**S2**	**S3**	**S3**
I. Production cost (IDR)					
A. Workers	36,155,000	36,155,000	36,155,000	36,155,000	36,155,000
B. Production facilities	24,300,000	24,300,000	24,300,000	24,300,000	24,300,000
C. Others	11,255,000	11,255,000	11,255,000	11,255,000	11,255,000
II. Production Result (kg)	600,000	600,000	600,000	600,000	600,000
III. Production cost (IDR /kg)	5480	6020	8,200	7590	5420
IV. Production value	6,598	6,006	4,409	4,764	6,671
A. Price (IDR /kg)	12,500	12,500	12,500	12,500	12,500
B. gross profit (IDR /Ha)	68,500,000	75,250,000	102,500,000	94,875,000	67,750,000
V. Farmer's profit					
A. Net price (IDR/kg)	5,902	6,494	8,091	7,736	5,829
B. Net price (IDR/kg)	73,775,000	81,175,000	101,137,500	96,700,000	72,862,500
	1,89	2,08	2,84	2,62	1,87

Guntarano, Maku, Salowe and Oloboju. Besides, the land and climate at the onion crops observation site were considered quite appropriate (S2) at the Kayumalue with a land index of 54.03 and marginal appropriate (S3) at the Guntarano, Maku, Salowe, and Oloboju locations with a land index of 42.59, 38.83, 37.78 and 26.42.

At the site of onion planting, optimum production was obtained, ranging from 8.20-12.30 tons/Ha in Kayumalue with a net profit of around IDR 101,137,500. While the other four locations were below the optimum production where the production obtained ranged from 4.10-8.20 tons/Ha with a net profit of (IDR of 96,700,000; 81,175,000; 73,775,000 and 72,862,5000, respectively). This is due to the severe limiting factor to plant onions in the farming area is climatic factors, while no severe limiting factor found in the soil of the farming area. Onions are better cultivated in cold climates with rainfall of not less than 250-300 mm per growth cycle and an optimum temperature of 15-25ºC or a maximum temperature of 24ºC. The results obtained by the location of onion crops had an average rainfall of 51-52 mm/month with a temperature of 27.1ºC and including areas with a dry climate.

Analysis of Onion Economic Based on Land Suitability Classes at the level of Farmer/Ha

The result of economic analysis in table 4 shows the R/C ratio ranges from 1.87 to 2.84. This value is higher than one. Thus, the five locations in the Palu Valley were suitable for agricultural business even though the five rated S2 (quite suitable) and S3 (marginal appropriate) are shown in table 4.

At the location of onion planting in Palu Valley, it was assessed that S2 (quite suitable) and S3 (marginal appropriate) but the net income of farmers was higher in Kayumalue, which was IDR 101,137,500 compared to the others in the amount of IDR 73,775,000-96,700,000 per hectare but still feasible for onion business. The most severe limiting factors at these locations were drainage, texture, and soil acidity, so this location required greater input than others to be able to increase soil productivity.

In the onion fields of Palu Valley, the limiting factor was not only rainfall but also the texture and acidity of the soil. Specifically for Kayumalue, one severed limiting factor was the rainfall factor, but this location was still feasible for onion crops where the highest net income of farmers was obtained, compared to the others, *i.e.,* Kayumalue (IDR 101,137,500) was rated S2 (quite appropriate) and Guntarano, Maku, Salowe, and Oloboju (IDR of 96,700,000; 81,175,000; 73,775,000, Rp.72,862,5000, respectively) although rated S3 (marginal appropriate).

Conclusion

The soil in the Palu Valley, both physically and chemically, have very diverse characteristics, which can be limiting or supporting factor in the development of agricultural crops, particularly Palu's local shallots. Soil types in the Palu Valley are Alluvial and Kambisol. Each of these soil types has different characteristics for the development of Palu's local shallot plants.

According to the land suitability evaluation, land quality data, and land characteristics in the Palu Valley obtained an actual suitability class S2 (quite suitable) with a land index about 54.03 at the Kayumalue, and an actual suitability class S3 (marginal appropriate) with a land index of 42.59, 38.83, 37.78 and 26.42, at the Guntarano, Salowe, Maku, and Oloboju, respectively. Following the economic analysis at the Kayumalue location, it provided a net profit of IDR 101,137,500, while in other locations, such as Guntarano, Salowe, Maku, and Oloboju in a sequence were IDR of 96,700.00; 81.175.00; 73,77500; and 72,862,500.

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