Productivity and profitability of peanut at various land suitability in North Lombok Regency of Nusa Tenggara Barat Province

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Abstract

Peanuts (*Arachis hypogaea* L.) are the second main commodity in the annual cropping pattern in lowland and dryland in North Lombok District of NTB Province. However, peanut productivity is still low, and it varies across regions, which might be due to the traditional crop management of farmers and the difference in land suitability classes. Effects of crop varieties and land suitability on the peanut productivity have not been evaluated in the Region. Thus, this study aimed to evaluate the productivity and profitability of peanut varieties at various land classification in KLU NTB. The experiment was arranged in a Split Plot Design consisting of three classes of land suitability as main plot and six peanut varieties as sub-plot with three replications. The results showed that the land suitability classes have a significant effect on the agronomic variables of peanut varieties, including plant height, number of branches, number of pods and productivity. The highest peanut yield was obtained at suitable land class (S1), followed by moderately suitable land class (S2) and marginally suitable land class (S3) at 2.37 ton.ha^{-1}, 2.08 ton.ha^{-1} and 1.71 ton.ha^{-1}, respectively. Likewise, the R/C ratio follows a similar pattern to productivity in various land suitability classes. The highest yield (above 2 ton.ha^{-1}) in each land suitability class was produced by Kelinci variety, followed by Tuban, Bima and Talam varieties. Those varieties have potential prospective to be developed in North Lombok Regency.

INTRODUCTION

Peanuts (*Arachis hypogaea* L.) are the second most important national commodity after soybeans, as a source of protein and fat of 25 % to 32 % and 42 % to 52 %, respectively (Akhtar et al., 2014; Arya et al., 2016; Toomer, 2018; Adeboye et al., 2018; Syed et al., 2020). National demand for peanuts is still quite high, and it has not been fulfilled from domestic production. Based on Food and Agriculture Organization (2013) data from 2008–2012, Indonesia became the world's number two importer country for about 129.74 thousand ton, and the latest data from Tridge.com show that in 2020, Indonesia was in the third rank as a peanut importer after China and Netherland, which is valued $285.2M. Indonesia experienced peanut deficit for 122.84 thousand ton and 120.32 thousand ton in 2015 and 2016, respectively (Pusat Data dan Sistem Informasi Pertanian, 2015), and 243.42 thousand ton in 2018 (Pusat Data dan Sistem Informasi Pertanian, 2018).

Various efforts were made to increase peanut production, such as expansion of planting areas and improvement of cultivation technology using superior varieties adaptive to specific biophysical and agro-climate conditions (Faronika et al., 2013). North Lombok Regency (KLU) is one of the regions that has the second largest peanut development area in NTB with a harvest area of 7,542 ha and has the main crop in the annual cropping pattern both in lowland and dryland. However, the productivity is still low, and it varies between regions, ranging from 1.75 ton.ha^{-1}

to 2.11 ton.ha^{-1} (Badan Pusat Statistik Kabupaten Lombok Utara, 2017), which is below the potential yield of peanut varieties, ranging from 2.5 ton.ha^{-1} to 3.5 ton.ha^{-1} (Nazam et al., 2015). Improving peanut production can be obtained through technological improvements, such as using high yield potential varieties. Varieties are one of the factors that affect the productivity of peanuts (Munsaka, 2013; Katundu et al., 2014; Trustinah, 2015; Irmansyah et al., 2017; Siringo et al., 2018; Rahman et al., 2019).

In addition, land characteristics also affect peanuts productivity (Didagbe et al., 2015). Different land characteristics may result in difference in productivity between regions or even between lands. Peanuts grow well and yield optimally in areas with land characteristics suitable with their growing require-ments (Feronika et al., 2013). Peanuts may produce high yield in loose soil with good drainage, and high soil organic matter content (Jain et al., 2018). Due to a change in the function of suitable land for peanut cultivation in KLU, farmers use dry land that is mostly not suitable for peanut production. There-fore, using high yielding peanut varieties, which are adaptive to varied environmental conditions is very important to increase peanut production in KLU. This study aimed to evaluate the productivity and profitability of peanut varieties at various land classification in KLU NTB

MATERIALS AND METHODS

In KLU, peanut land suitability class was determined by land evaluation for agricultural commodities (Nazam et al., 2014). The method of land suitability classification was explained in detail by BBSDLP (2011). Briefly, the land suitability for agricultural commodities were divided into four classes that were: 1) S1 land suitability class (very suitable), which means that the land has no or little limiting factor for peanut cultivation; 2) S2 (moderately suitable), which means that the land has a moderate level of limitation factors to be used for crop cultivation such as nutrients limitation; 3) S3 (marginally suitable), which means that the land has a heavy limiting factor for its use, and 4) N (not suitable), which means that land is not possible to be used for peanut cultivation. The growth requirements of peanut at various classes of land suitability are presented in Table 1.

The results of land evaluation conducted by Nazam et al. (2014) showed that S1 land classes

were mostly found in the districts of Pemenang and Tanjung. Meanwhile, the S2 and S3 classes were mostly found in sub-districts of Bayan, Kayangan and Gangga. Land distribution and suitability of S1, S2 and S3 classes for peanuts in each sub-district in KLU are presented in Table 2. The site of S3 was surrounded by trees that may affect the sun radiation. The results of land suitability analysis were used to determine experimental sites (Figure 1).

The main limiting factors for land suitability classes are erosion (er) and rooting media (rc). The erosion limiting factor was determined by the slope level of the land in which erosion hazard is classified as light (low) to moderate at the slope of 3 % to 15 %. The limiting factor for root media was determined by soil texture, percentage of coarse material, and effective soil depth (Balai Besar Sumberdaya Lahan Pertanian, 2011). The characteristics of rooting media suitable for peanuts are slightly smooth to moderate in soil texture with coarse material of less than 15 % and effective depth of soil that is more than 75 cm.

The experiment was arranged using Split Plot Design with land suitability class as main plot consisting of three classes (S1, S2 and S3) and peanut varieties as sub-plot consisting of 6 varieties (Bima, Hypoma 2, Talam 1, Tuban, Kelinci and Kepundung), which were replicated three times. Superior varieties seeds with breeder seed (BS) seed classes were used except for Kelinci and Kepundung varieties, which were obtained from the local provider. The seeds were sown on the land without tillage, which was previously cleared from straw and grasslands using herbicide. This planting method has long been carried out in North Lombok to reduce erosion and land-use costs, as well as to maximize income. Cultivation management followed integrated planting manage-ment (PTT) of peanut by Purnomo et al (2016).

The observed variables were plant height, number of branches, number of pods per hill and yield. Financial analysis was obtained from farming input and output data that have been recorded, including land preparation costs, planting cost, price of seeds, fertilizers, pest and diseases control costs, and harvest cost. Data were analyzed with analysis of variance (ANOVA) using Genstat.

RESULTS AND DISCUSSION

Evaluation of land suitability for peanut in North

Table 1. Peanut growth requirements at various classes of land suitability in KLU (Ritung et al., 2011)

Land characteristics	Land suitability classes		
	S1	S2	S3
Temperature (tc)			
Average Temperature (°C)	25 - 27	20 - 25	18 - 20
		27 - 30	30 - 34
Water availability (wa)			
Rain fall (mm) during	400 - 1.100	1.100 - 1.600	1.600 -1.900
the growth of peanut		300 - 400	200 - 300
Humidity (%)	50 - 80	> 80	> 80
		< 50	< 50
Oxygen availability (oa)			
Drainage	good-moderate	quite fast, quite hampered	hampered
Root Media (rc)			
Texture	slightly smooth, moderate	slightly rough, smooth	very smooth
Rough material (%)	< 15	15 - 35	35 - 55
Solum depth (cm)	> 75	50 - 75	25 - 50
Peat:			
Thickness (cm)	< 50	50 - 100	100 - 150
Maturity	sapric+	sapric, hemic	hemic,
Nutrient Retention (nr)			
Clay CEC (cmol)	> 16	5-16	< 5
Saturation Base (%)	> 35	20-35	< 20
pH H_2O	6.0 – 7.0	5.0 – 6.0	< 5.0
		7.0 – 7.5	> 7.5
Organic C (%)	> 1.2	0.8 – 1.2	< 0.8
Nutrient availability (na)			
N total (%)	moderate	low	very low
P_2O_5 (mg/100 gr)	high	moderate	low - very low
K_2O (mg/100 gr)	high	moderate	low - very low
Toxicity (xc)			
Salinity (dS/m)	< 4	4 - 6	6 - 8
Sodicity (xn)			
Alkalinity/ESP (%)	< 10	10 - 15	15 - 20
Sulfidic risk (xs)			
Sulfidic depth (cm)	> 100	75 - 100	40 - 75
Erosion hazard (eh)			
Slope (%)	< 3	3 - 8	8 - 15
Erosion hazard		very light	light - moderate
Flood hazard (he)			
Flood	-	-	25
Duration (days)	-	-	< 7
Land disclosure (lap)			
Surface rock (%)	< 5	5 - 15	15 - 40
Disclosure rock (%)	< 5	5 - 15	15 - 25

Table 2. Land use, distribution and suitability of S1, S2 and S3 classes for peanuts in each sub-district in KLU (Nazam et al, 2014).

| Land suitability classes	Potential land at each sub-district					Total	
	Pemenang	Tanjung	Gangga	Kayangan	Bayan	(ha)	(%)
Very suitable land (S1)	1,714	1,807	458	0	745	4,724	15.20
Moderately suitable land (S2)	378	715	853	2,843	10,578	15,367	49.44
Marginally suitable land (S3)	491	86	2,739	3,392	4,284	10,992	35.36
Total (ha)	2,583	2,608	4,050	6,235	15,607	31,083	100.00
Current land use for peanut	310	562	858	2,306	3,506	7,542	24.26
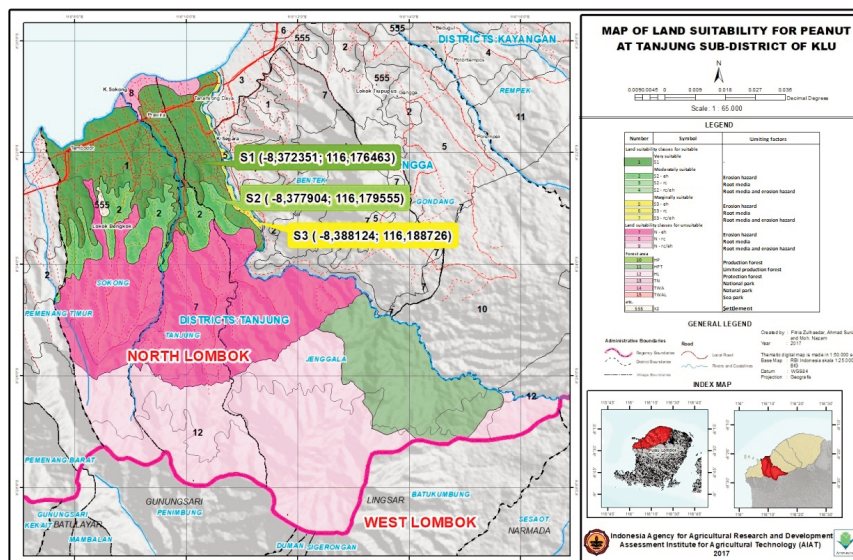
Figure 1. Map of peanut land suitability and experimental site of S1, S2 and S3 in North Lombok District

Lombok District is shown in Figure 1. In general, suitable land (S1) is mostly (0.7 ha) distributed in Pemenang and Tanjung Subdistricts, while the land of S2 (0.3 ha) and (0.5 ha) S3 classes are found in Bayan, Kayangan and Gangga Subdistrict.

Statistical analysis of agronomic variables for peanut varieties at various land suitability classes is presented in Table 3. In general, effect of land suitability on agronomic variables of peanut varieties significantly varied. Furthermore, performance of peanut varieties in various land suitability also varied. Agronomic variables of peanut were also influenced by interaction effect of land suitability and peanut varieties.

Plant height was influenced by land suitability classes and varieties. The highest plant height of peanut was found at S3 land suitability class, followed by S2 and S1 for 60.4 cm, 54.9 cm and 49.8 cm, respectively. This was probably due to the etiolation occurred during the growth process, as land for planting peanut at S3 land suitability was shaded by plant trees. Meanwhile, Tuban variety showed the highest plant height in all land suitability classes, followed by Bima, Kelinci, Tuban, Talam and Kepundung varieties. The plant height in this study was higher than that in the description of the variety issued by Balai Penelitian Tanaman Aneka Kacang dan Umbi (2016). According to the description, the plant height of Bima, Hypoma 2, Tuban, and Talam is 56.8 cm, 35.5 cm, 45-60 cm, and 42 cm, respectively (Balai Penelitian Tanaman Aneka Kacang dan Umbi, 2016). The differences in agronomic variables

including plant height, number of branches, and number of pods between varieties indicate the existence of genetic factors from each variety. This was in line with the results of study by Hayati et al. (2012), mentioning that the varieties affected plant height, number of branches per plant, number of pods per plant, and weight of 100 dry seeds. Rabo and Ahmed (2013) proved that zero tillage practices improved agronomical performance of peanut, such as plant height, number of branches, weight per 100 seeds, and yield.

Land suitability significantly affected number of branches of peanut varieties. The highest number of branches was found at S2 land suitability class, followed by S1 and S3 land suitability classes. Furthermore, there was significant difference in number of branches between peanut varieties. The highest number of branches was observed in Kepundung variety, followed by Bima, Kelinci, Hypoma 1, Talam and Tuban varieties. The number of branches was merely determined by genetic factor of peanut variety.

Number of pods per hill is shown in Table 3. In general, the land suitability class significantly affected the number of pods per plants. The highest number pods per hill was found at S2 land suitability class. Number of pods per hill was also influenced by peanut varieties. The highest number of pods was produced by Kepundung variety (39.04), while the lowest one was produced by Bima variety (21.28), respectively. The interaction factor of land suitability and peanut varieties also influenced the number

Table 3. Statistical analysis of agronomic parameters of peanut at various land suitability classes in Tanjung Sub district of KLU

Land suitability	Varieties	Plant height (cm)	Branches	Pods per hill	Yield (ton.ha^{-1})
	Bima	46.89 b	10.06 bc	22.17 ab	2.65 h
	Hypoma 2	46.39 b	9.78 b	27.28 c	2.03 e
S1	Talam 1	48.33 c	9.94 bc	29.89 c	2.43 g
	Tuban	54.39 g	10.61 de	30.67 cd	2.55 gh
	Kelinci	53.00 e	11.67 f	34.33 de	2.83 i
	Kepundung	49.17 d	11.33 f	41.78 f	1.73 cd
Average		49.80	10.57	31.02	2.37
	Bima	61.44 i	12.56 g	21.33 ab	2.19 ef
	Hypoma 2	52.32 e	11.03 ef	25.25 bc	1.66 bc
S2	Talam1	52.17 e	10.23 c	35.67 e	2.11 ef
	Tuban	62.12 i	10.13 c	34.00 de	2.50 gh
	Kelinci	58.00 h	10.67 f	33.33 de	2.50 gh
	Kepundung	43.50 a	11.00 ef	40.78 f	1.50 ab
Average		54.90	10.94	31.73	2.08
	Bima	67.22 k	10.67 de	20.33 a	1.85 d
	Hypoma 2	53.56 f	10.22 c	22.56 ab	1.34 a
S3	Talam1	57.78 h	10.89 e	28.89 c	1.62 bc
	Tuban	68.67 l	9.22 a	25.78 bc	1.73 cd
	Kelinci	63.00 j	10.33 cd	24.33 abc	2.24 f
	Kepundung	52.44 e	11.67 f	34.56 de	1.46 a
Average		60.40	10.50	26.08	1.71
Main plot (L)		**	*	**	*
Subplot (V)		**	**	***	**
L x V		***	***	**	***

Remarks: Number followed by the same letter on the same column means not significantly different between treatments based on ANOVA at α= 5 %. (*)= significant at α= 1%, (**)= significant at α= 5 % (***)= significant at = 10 %

of pods per hill. Based on the description of peanut varieties (Balai Penelitian Tanaman Aneka Kacang dan Umbi, 2016), the number of pods per hill of Bima, Hypoma 2, Talam, Tuban and Kelinci varieties are 14–20, 29.8, 27, 15–20 and 15, respectively. Thus, the number of pods of Kelinci, Tuban, Talam 1, and Bima varieties in this study was in equal to the description by Balai Penelitian Tanaman Aneka Kacang dan Umbi (2016). It indicates that those peanut varieties have good adaptability to environmental conditions, so that they have potential varieties to be developed.

Yield of peanut varieties at various land suitability is presented in Table 3. Yield of peanut showed various responses to the land suitability classes and varieties. Land suitability class had a significant effect on the productivity of peanut varieties. The highest yield of peanut was obtained at S1 land suitability class, followed by S2 and S3 for 2.4 ton.ha^{-1} (dry pods), 2.1 ton.ha^{-1} and 1.7 ton.ha^{-1}, respectively. It indicates that less suitable land may decrease productivity of peanut varieties. Yield of peanut was also significantly influenced by varieties. The yield was produced by Kelinci variety, followed by Tuban, Bima, Talam, Hypoma 1 and Kepundung highest. Meanwhile, the yield of Hypoma 2, Talam 1 and Tuban were below the potential yield (Balai Penelitian Tanaman Aneka Kacang dan Umbi, 2016). Productivity of Kelinci and Bima varieties were higher than the potential yield according to description of peanut varieties by Balai Penelitian Tanaman Aneka Kacang dan Umbi (2016). In this research, both environmental condition and

Table 4. Financial analysis of peanut cultivation at various land suitability classes in KLU

Items	Volume	Unit	Cost/unit (IDR)	Total cost (IDR)
(1)	(2)	(3)	(4)	(5)
A. Cost components				
1. Labor Cost				
Land clearance	100	are	7,000	700,000
Drainage	4	PD	50,000	200,000
Seed preparation	3,75	sack	100,000	375,000
Seed dabling	100	are	13,000	1,300,000
Weeding	100	are	12,000	1,200,000
Fertilization	11	PD	40,000	447,205
Maintenance	3	PD	40,000	120,000
Harvest:				
S1 Land	125	sack	20,000	2,500,000
S2 Land	113	sack	20,000	2,252,964
S3 Land	95	sack	20,000	1,897,233
Total 1 S1 Land				6,861,335
Total 1 S2 Land				6,614,300
Total 1 S3 Land				6,258,569
(1)	(2)	(3)	(4)	(5)
2. Input production				
Seed	287,50	kg	12,000	3,450,000
Fertilizer (NPK)	100	kg	3,000	300,000
Fertilizer Urea	50	kg	2,500	125,000
Compost	2,50	ton	120,000	300,000
Herbicide	2,50	L	60,000	150,000
Pesticide	250	cc	600	150,000
Organic fertilizer	250	cc	350	87,500
Total 2				4,562,500
Total cost (C) S1				11,423,835
Total cost (C) S2				11,176,800
Total cost (C) S3				10,821,069
B. Output (fresh pods)				
Land S1	5,060	kg	7,250	36,685,000
Land S2	4,560	kg	7,250	33,060,000
Land S3	3,840	kg	7,250	27,840,000
C. Revenue (R)				
Land S1				25,261,165
Land S2				21,883,200
Land S3				17,018,931
D. R/C Ratio				
Land S1				3.21
Land S2				2.96
Land S3				2.57

Table 5. Financial analysis of peanut varieties at various land suitability classes based on the value of R/C ratio in KLU

Varieties	R/C Ratio at various land suitability classes		
	S1	S2	S3
Bima	3.42 d	3.02 c	2.56 cd
Hypoma 2	3.27 c	3.18 de	2.50 bc
Talam 1	2.97 b	2.78 b	2.58 de
Tuban	3.42 d	3.26 e	2.47 a
Kelinci	3.33 c	3.14 d	2.88 f
Kepundung	2.86 a	2.43 a	2.48 ab
Average	3.20	3.00	2.60

Remarks: Number followed by the same letter on the same column means not significantly different between treatments based on ANOVA at α= 5 %

genetic factors affected the yield. This finding is in line with the statement of Rahmianna, et al. (2012) and Irmansyah et al., (2017), reporting that differences in genetic structure caused diversity in plant performance. Overall, high yield (more than 2 ton.ha^{-1}) was produced by Kelinci, Bima, Tuban and Talam 1. Those varieties have a potential prospective to be developed in KLU. Local variety of Kepundung, which is commonly cultivated in this site, and Hypoma 2 showed low productivity.

Financial analysis of peanut cultivation is presented in Table 4. In general, the results of financial analysis showed that peanut farming was feasible for all land suitability classes of S1, S2 and S3, indicated by R/C ratios greater than 1. The cost spent for peanut cultivation in S1, S2 and S3 land classes was 11,423,835 IDR, 11,176,000 IDR, and 10,821,069 IDR per ha, respectively. The difference in cultivation costs was due to the differences in harvest costs for S1, S2 and S3 classes. The results of financial analysis showed that the highest R/C ratio was found at S1 land class, followed by S2, and the lowest was found at S3. The values of R/C ratio for S1, S2 and S3 were 3.2, 3.0 and 2.6, respectively. This result indicated that the cost of peanut cultivation was higher in less suitable land.

Financial feasibility of some peanut varieties productivity at various land suitability based on the value of R/C ratio is presented in Table 5. The results of analysis of variance showed that land suitability classes affected the feasibility of peanut farming. The results of LSD test at α= 5 % level indicated a significant difference in the level of feasibility of

peanut farming. All of R/C ratio values of all peanut varieties over land suitability classes were higher than 1, and the highest R/C ratio was found at Bima and Tuban varieties and those values decreased as the decreasing level of land suitability.

Peanut yield was the main parameter that determines peanut varieties to be adopted by farmers. Farmers would like to cultivate peanut if its performance had high yield compare to others varieties. All peanut varieties used in this experiment demonstrated high yield and financial benefit which can be potentially cultivated by farmers in the region. All of the R/C ratio values of all peanut varieties over land suitability classes were more than one. This indicated that all peanut varieties were feasible to be cultivated in those lands suitability. The highest R/C ratio was found at Bima and Tuban varieties and the values were decreased as the decreasing level of land suitability

CONCLUSIONS

Land suitability classes affected all agronomic components of peanut production, including plant height, number of branches, number of pods, and productivity. The highest yield of peanut was obtained in S1 land suitability class, followed by S2 and S3, indicating that decreasing level of land suitability may reduce yield of peanut varieties. The highest yield produced by Kelinci variety, however, it was not significantly different compared to Bima, Tuban and Talam 1 varieties, and those varieties have potential and prospect to be developed in North

Lombok District. Similar pattern of R/C ratio was found in land suitability classes. All of R/C ratio values of all peanut varieties over land suitability classes were higher than 1, and the highest R/C ratio was found in Bima and Tuban varieties, and those values decreased along with the decreasing level of land suitability.

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