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Study of the Productivity of Oil Palm Plants (*Elaeis guineensis* Jacq.) on Different Topographies

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ABSTRACT

The productivity of oil palm plants is influenced by several factors, including the environment (soil and climate), genetics (type or variety of oil palm) and agronomic techniques that are able to support the growth of oil palm to achieve optimal production. The objective of this research was to study the effect of topography on the oil palm productivity. Purposive sampling was carried out through direct observation in the field at three different topographies, namely, flat-to-undulating, hilly, and hilly without terraces. Each topography consisted of 2 blocks with 30 samples each. The total number of samples was 180 trees of Dy×P Dumpy variety with the same planting years, namely 2006. The results showed that oil palm plants did not show significant differences in term agronomic characteristic. The productivity of oil palm plants planted in flat to undulating topography was 21.23 ton/ha, higher than those of hilly topography (17.09 ton/ha) and those of hilly without terraces (14.62 ton/ha). Agronomic characters that were positively correlated with bunch weight were plant height, stem diameter, and number of bunches (in flat-to-undulating lands); all agronomic characters in hilly land; and plant height and number of fronds in hilly land without terraces.

1. INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.) is a plantation commodity that has an important role for economic development in Indonesia compared to other commodities such as coconut, peanuts and soybeans, because it is able to produce vegetable oil with the highest efficiency per unit area (Fitriana *et al*., 2022). In addition to being a source of foreign exchange for the country, oil palm can also improve the standard of living of farmers and create jobs that can improve the welfare of the Indonesian people. This is supported by the large area of oil palm plantations, which is 14,996,010 ha as of 2020 (Direktorat Jenderal Perkebunan, 2019) and makes Indonesia the largest exporter of palm oil (crude palm oil/CPO) in the world with an average export value of almost 34 million tons per year.

The part of the oil palm plant that has high economic value is FFB or Fresh Fruit Bunches. FFB that has been processed in a palm oil mill will produce the main products in the form of crude palm oil (CPO) and palm kernel oil (PKO). To obtain maximum production, oil palm cultivation must be supported by good environmental conditions. Increased production is basically the result of direct interaction between internal factors (genetics) and external factors (environment). Environmental factors affect the growth and development of oil palm plants and production levels (Adrianus *et al*., 2018).

According to Hasibuan *et al*. (2018), climate conditions, soil, and regional shape are the main environmental factors that affect the success of oil palm development, in addition to other factors such as planting materials (genetics) and technical culture treatments given. Topography is one of the environmental factors that affects the level of erosion related to the availability of nutrients. Siringoringo *et al*. (2023) reported that topography of the land significantly affect the soil water content where lands with slopes of 0-3% reveals higher soil water content than that of land with slopes >30%. Visano (2020) states that the diverse topography of oil palm plantations contributes to the diversity of oil palm productivity. On flat land, oil palm plant productivity is generally better than on hilly or sloping land, this is because the possibility of loss of fertilizer and nutrients caused by erosion is very small (Dewa *et al*., 2016). Meanwhile, on land with sloping or hilly topography, there is the potential for nutrient loss caused by surface flow and soil erosion in units of time (days, seasons or every rain) which can occur quickly (Mustikasari *et al*., 2018). On land with sloping or hilly topography, it is necessary to create continuous terraces or individual terraces which can reduce the risk of erosion while preserving the soil so that it can store water well. In addition, topography also affects the physiological functions of plant metabolism such as photosynthesis, respiration and anatomical shape and morphological structure. Therefore, topographical conditions significantly impact oil palm productivity.

Based on the explanation above, this study was conducted to identify the agronomic characteristics of oil palm plants planted in areas with different topography, compare plant productivity and analyze the correlation of plant height, plant diameter and number of fronds to bunch weight.

2. METHODS

2.1. Research Location

The research was conducted through field survey to collect data and observe indicator, followed by data processing to prepare final report (Figure 1). The implementation of this research began with a field survey to determine the sample location. Sampling was carried out using purposive sampling through direct observation in the field to obtain primary and secondary data. The whole study was executed at the PT. Perkebunan Nusantara I (PTPN I), Kebun Pulau Tiga located in Tamiang Hulu District, Aceh Tamiang Regency, Aceh Province, Indonesia (Figure 2). The Kebun Pulau Tiga Palm Oil Mill manages an area of 5,556.16 ha, of which 5,087.86 ha is used as a palm oil plantation area with elevation ranging from 500 to >1,000 meter above sea level. The plantation is divided into 8 divisions called Afdeling, namely Afdeling 1 with an oil palm plantation area of 973.30 ha, Afdeling 2 (665.30 ha), Afdeling 2 (665.30 ha), Afdeling 3 (638.00 ha), Afdeling 4 (710.00 ha), Afdeling 5 (554.30 ha), Afdeling 6 (441.80 ha), Afdeling 7 (503.00 ha), and Afdeling 8 (440.20 ha).

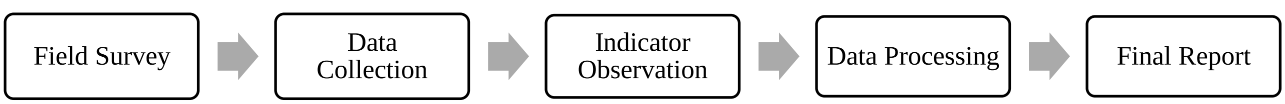

Figure 1. Block diagram of research flow

2.2. Primary and Secondary Data

Data collection for this current study was conducted in Afdeling 2. Based on topography, plantation area involved in Afdeling 2 was classified into three class, namely flat to undulating, hilly, and hilly without terrace. Primary data were obtained by direct observation of total sample of 180 oil palm trees existed in 3 different topography. Each topography class was taken from 2 blocks with 10 tree samples per block. For flat to undulating, agronomic characters of oil palm trees were collected from Block 145 and 153, for hilly terrain were Block 126 and 133, and for hilly without terrace were collected from Block 122 and 132. All oil palm trees were of the Dy×P Dumpy variety planted at the same years, namely 2006. The Dumpy variety is a cross between Dura Dumpy and Psifera SP540 descendants. This variety has several superior characteristics, especially its slow growth rate, making it easy to care for and harvest, and it has a long economic life of up to 30 years. Furthermore, this variety produces a high average bunch weight and has a relatively large stem, making it suitable for planting in tidal areas to reduce the risk of lodging. The Dumpy variety was released in 1984 based on the Decree of the Minister of Agriculture No. 384/Kpts/TO.204/4/1984 (Silitonga *et al*., 2020). The advantage of this variety was presented in Table 1.

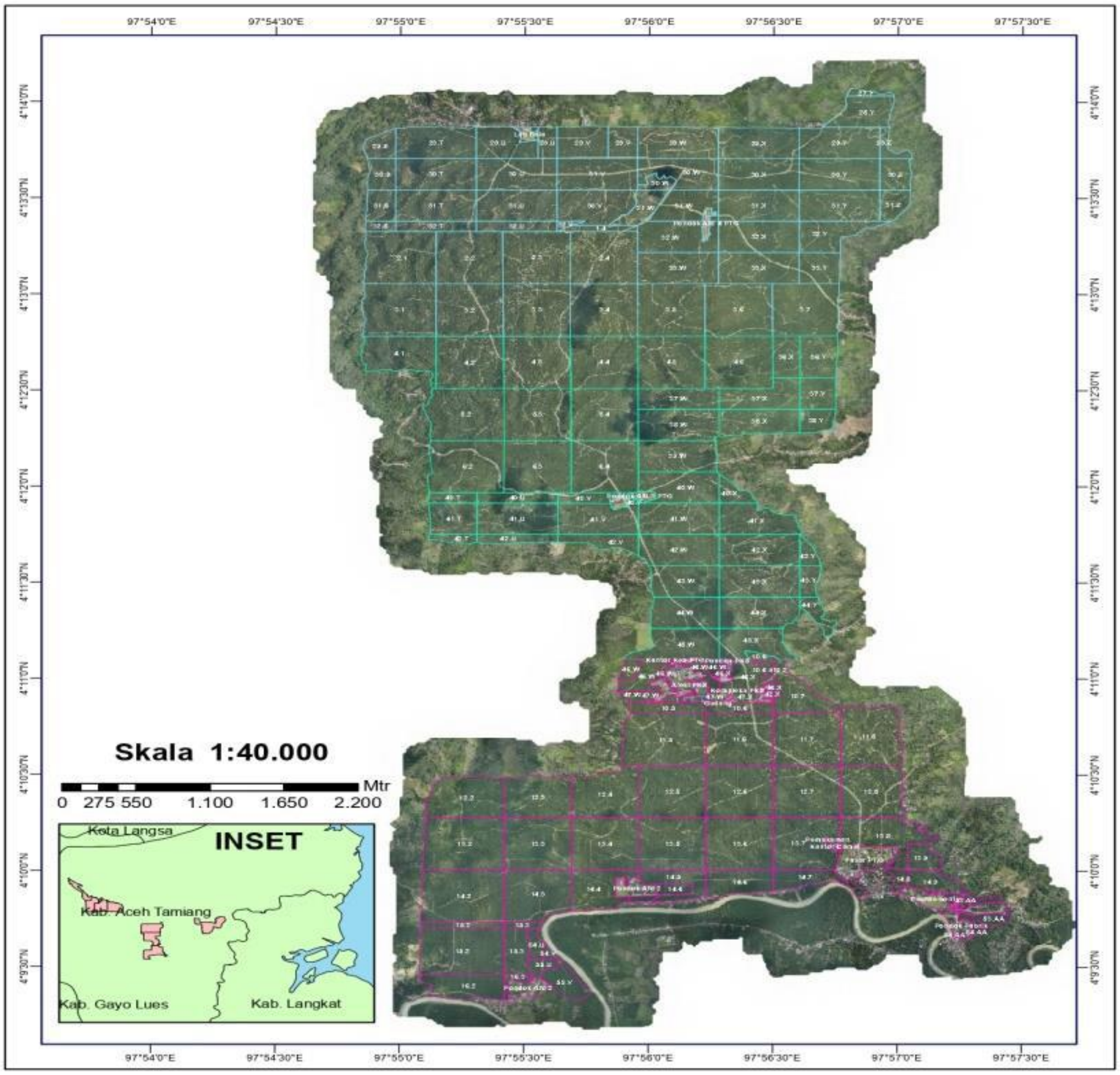

Figure 2. Field map of Kebun Pulau Tiga Oil Palm Plantation of the PTPN I, Sei Serba Area, Aceh Tamiang Regency

Table 1. Characteristics of the Dy×P Dumpy oil palm variety (Silitonga *et al*., 2020)

Character	Unit	Value
Average number of bunches per tree	bunch/year	8
Average weight of bunch	kg/bunch	25
Annual production potential for fresh fruit bunch (FFB)	ton/ha/year	32
Rendemen CPO (CPO yield)	% FFB	26
Annual production potential for CPO	ton/ha/year	7.5
Annual production potential for PKO	ton/ha/year	0.9
Annual production potential for CPO + PKO	ton/ha/year	8.4
Iodine value	--	54.1
Beta Carotene content	ppm	354
Vertical plant growth	cm/year	40-55
Frond length	m	6.2
Plant density	tree/ha	130
Harvest age	month	28-30
Adaptation on marginal land	--	Able to adapt to peat and tidal lands

Secondary data were obtained from the department office in the form of oil palm productivity documents for the last 5 years (2018–2022), rainfall data for the last 5 years (2018–2022), and maintenance data for the last 5 years (dose recommendations, fertilization realization, fertilization methods and fertilization times) 2018–2022.

2.3. Agronomic Characteristics

Agronomic characteristics were observed directly in the field on each sample tree. The plant characters included: (1) Plant height (measured by a harvester using "egrek" from the base of the stem to the end of the plant); (2) Trunk diameter (measured the circumference of the oil palm trunk using a meter tape at a height of 0.5 m from the ground); (3) Number of fronds (counted from the topmost crown to the bottom frond); (4) Number of bunches (all bunches on the oil palm tree where the loose fruit is observable); (5) Bunch weight of the harvested FFB (fresh fruit bunch).

2.3. Data Analysis

Analysis of variance (ANOVA) was performed to answer if the differences in oil palm production was significantly caused by topography. The analysis was followed by LSD (least square difference) test to determine the differences. Simple regression analysis was also performed to find relation of oil palm production with the agronomic characters in each topography class. In addition, the collected data was analyzed to obtain a correlation plant agronomic characteristics against bunch weight. Correlation test was calculated using Pearson formula:

$$r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}} \tag{1}$$

where x_i and y_i are pair data points, $\bar{x}$ is the mean of the x-values, and $\bar{y}$ is the mean of the y-values. Pearson's correlation coefficient (r) is a measure of the linear relationship between two variables. The values of r are between −1 and 1 wich is interpreted as in Table 2.

Table 2. Interpretation of Pearson correlation coefficient (r)

***r* positive**	**Interpretation**	***r* positive**	**Interpretation**
$r = 1$	Perfect positive linear correlation	$0 > r \geq -0.4$	Weak negative linear correlation
$1 > r \geq 0.8$	Strong positive linear correlation	$-0.4 > r \geq -0.8$	Moderate negative linear correlation
$0.8 > r \geq 0.4$	Moderate positive linear correlation	$-0.8 > r > -1$	Strong negative linear correlation
$0.4 > r > 0$	Weak positive linear correlation	$r = -1$	Perfect negative linear correlation
$r = 0$	No correlation		

3. RESULTS AND DISCUSSION

3.1. Description of Research Location

Pulau Tiga Plantation is one of the agribusiness units of PTPN I which has a HGU of 5,556.16 ha, where 5,087.86 ha are used for oil palm plantation. It is divided into 8 Afdelings whose area is located in Tamiang Hulu District, Aceh Tamiang Regency, Aceh Province, Indonesia with an altitude of 10–125 meters above sea level. The Pulau Tiga Plantation Working Area is divided into 2 (two) areas, namely Area I comprissed of Afdeling I to IV; and Area II constituted of Afdeling V to VIII.

3.2. Rainfall

Rainfall is an important factor that determines the success of oil palm plantations. Rainfall required by oil palm plants is around 1500–3000 mm/year with the number of rainy days no more than 180 days per year. Rainfall in division II of Kebun Pulau Tiga for the last 5 years, namely from 2018–2022, can be seen in Table 2. It can be seen that the rainfall in the II division of Kebun Pulau Tiga from 2018 to 2022 is 4,327 mm/year with an average of 361 mm/month. From the table data above for the last 5 years, the average wet month is 10.4 months, while the dry month is 1 month. So based on the climate type classification according to Schmidt–Ferguson for the last 5 years from 2018 to 2022, the climate type is extreme wet (tropical rainforest) with a Q-value of 9.6%.

Table 3. Rainfall data of Afdeling II, Pulau Tiga Plantation (2018–2022)

Month	2018		2019		2020		2021		2022		Average	
	CH (mm)	HH (days)	CH (mm)	HH (days)	CH (mm)	HH (days)	CH (mm)	HH (days)	CH (mm)	HH (days)	CH (mm)	HH (days)
January	277	13	46	7	19	5	422	20	400	15	233	12
February	37	4	65	5	119	8	154	4	513	13	178	7
March	73	4	39	4	28	5	164	13	401	16	141	8
April	90	9	186	8	390	15	436	18	465	15	313	13
May	161	12	412	20	618	26	440	17	569	19	440	19
June	159	11	272	16	552	17	273	12	595	15	370	14
July	179	12	339	10	369	15	367	19	361	15	323	14
August	135	11	140	7	229	10	592	19	441	18	307	13
September	418	15	312	13	574	21	313	17	728	21	469	17
October	435	18	359	18	364	18	465	16	1046	27	534	19
November	196	13	580	19	622	24	611	21	883	26	578	21
December	125	12	303	16	536	18	452	19	784	26	440	18
Total	2285	134	3053	143	4420	182	4689	195	7186	226	4327	176
Average	190	11	254	12	368	15	391	16	599	19	361	15
Wet Months	9		9		10		12		12		10.4	
Dry Months	1		2		2		0		0		1	
					Q-value (%)						9.6	
					Climate type:				Extremely wet (Tropical Rainforest)			

Notes: CH = Rainfall (mm), HH = Rainy day; *Q*-value (%) $= \left(\frac{\text{Average Dry Months}}{\text{Average Wet Months}}\right) \times 100\%$

3.3. Fertilization

Fertilization is an activity of caring for oil palm plants that aims to optimize plant growth and productivity, reduce competition for nutrients with weeds and resistance to pests and plant diseases. This is in accordance with Farrasati (2018), namely fertilization is an effort to add essential nutrients from outside, either in chemical or organic form which aims to optimize plant growth and development. In implementing fertilization, it must be in accordance with plant needs and fertilization recommendations from the company's research team. Unbalanced, inefficient and continuous fertilization will result in decreased soil fertility and cause sick soil, decreased production to wasteful costs because sick soil cannot absorb nutrients from the fertilizer applied properly (Lubis *et al*., 2023). The fertilization method carried out at the research location in a flat area was spread evenly on the main plate with a distance of 1.50–2.50 m from the base of the stem, while for hilly and hilly areas without terraces it was done by pocketing (immersed) that aim to prevent fertilizer from being washed away due to erosion.

Table 4 shows fertilization carried out at the research location from 2018–2022, there are 2 types of fertilizers, namely dolomite and compound fertilizers (NPK 15.8.23 + 1 TE). Dolomite and compound fertilization are carried out every year with doses recommended by Indonesian Oil Palm Research Institute (IOPRI), Medan. However for 2018 and 2020 semester 2 there was no realization of dolomite or compound fertilization.

Table 4. Types and doses of fertilizer for oil palm plants (2018–2022) in Pulau Tiga Plantation of the PTPN I

Year	Topography	Application Semester	Fertilizer Type and Dose (kg/tree/year)	
			Dolomite	NPK 15.8.23 + 1 TE
2018	All	1	1.50	4.75
	All	2	0	0
2019	All	1	1.50	4.50
	All	2	1.25	2.50
2020	All	1	1.25	4.00
	All	2	0	0
2021	All	1	1.75	3.50
	All	2	1.00	2.50
2022	All	1	2.25	2.50
	All	2	2.25	2.50

3.4. Productivity of Oil Palm Plants

Oil palm plant productivity is the production of oil palm per unit area of land used. According to Sipriani *et al*. (2017), productivity has two dimensions, namely efficiency and effectiveness. Effectiveness leads to maximum work achievement through work achievement that is in accordance with targets, quality, quantity and time. While efficiency is a comparison of realization with the input used.

The elements in productivity in each block are the number of bunches/tree, kg/bunch, and ton/ha. Table 5 summarize the fluctuations in oil palm productivity at research locations located in different topography for the last 5 years (2018–2022). It shows that productivity of oil palm plants in different topography does not show significant differences. The highest productivity is in flat to undulating topography with an average number of bunches of 12.40 per tree, bunch weight of 13.91 kg/bunch, and bunch yield of 21.23 ton/ha. While the lowest productivity is in hilly topography without terraces with an average number of bunches of 10.68, kg/bunch 12.05 and ton/ha 14.62. This can be caused by intensive management of technical culture in the research area such that produce maximum yield, considering that management in hilly lands is more difficult than in flat undulating land. Our result is in accordance with Totok *et al*. (2024) reporting that hilly terrain without terraces of a commercial oil palm plantation in Riau consistently produce significantly lower yields. Over an 18-year period (2003–2021), hilly areas yielded 5.7 ton/ha less FFB compared to flat terrain, with the yield gap widening progressively over time. Similarly, Balasundram *et al*. (2006) reported that in the Sri Gunung Estate (South Sumatera), the highest yields recorded at the toeslope (flat) and the lowest at the summit (hilly) areas.

Table 5. Productivity of oil palm plants on different topographies in Afdeling II (2018–2022)

Year	Number of FFB (bunch/tree)			Weight of FFB (kg/bunch)			Yield of FFB (ton/ha)		
	F-U	H	HwT	F-U	H	HwT	F-U	H	HwT
2018	11.85	10.89	11.22	14.36	13.35	14.64	20.88	19.27	16.96
2019	13.51	11.99	11.22	13.98	13.22	7.16	23.01	20.97	20.41
2020	12.35	8.53	12.74	13.97	12.83	12.80	21.14	14.43	8.77
2021	13.14	9.86	10.34	13.86	13.34	12.94	22.36	17.35	15.28
2022	11.16	7.71	7.89	13.37	12.91	12.71	18.75	13.44	11.69
Average	12.40a	9.79b	10.68ab	13.91a	13.13a	12.05a	21.23a	17.09ab	14.62b

Note: The same notation (a) indicates no significant difference based on variance analysis at the 5% level.

The topography class shows significant difference for number of FFB ($p = 0.05$) and yield of FFB ($p = 0.026$), but not significant for weight of FFB ($p = 0.247$). Flat to undulating terrain produce significantly higher yield than those in hilly areas. This may occur due to run off and wash out from hilly areas which flow into the flat areas in the lower parts. The flat to undulating topography, however, may have poor drainage and flooding or inundation risk occurs when during high rainfall. Flooded land conditions will make the land reductive, so that the solubility of micro metal elements becomes high so that it has the potential to be toxic to plants and production is not optimal (Dewa *et al.*, 2016). While, in hilly topography, runoff and erosion occurs, washing out the fertile soil by water to a lower place and resulting in the loss of topsoil. If the loss of topsoil occurs continuously, it will result in decreased soil fertility and impact production.

Table 5 shows that oil palm productivity on different topographies from 2018 to 2022 have increased every year. However, in 2020 and 2022, both on flat to undulating, hilly and hilly topographies without terraces experienced a decrease in yields from the previous year. This can be caused by the absence of fertilization in the 2nd semester of year 2018 and 2020, which reduced productivity. In addition to fertilizer factors, the decline in production in 2020 and 2022 can be caused by climate factors. Table 3 shows that rainfall in Afdeling II was the lowest in 2018 mm/year, but extremely high in 2022. Both conditions may disrupt the formation and development of female flowers into fruit. One technical culture management carried out at research locations with different topography is the application of fertilizer. As seen in Table 4 the types and doses of fertilizers applied to oil palm plants show that each year the block is fertilized according to the recommended dose from the research center (PPKS) after reviewing results of LSU (Leaf Sampling Unit). Although the fertilizer applied is the same type and dose of fertilizer for each topography, there is a possibility that fertilization will be less effective and not all nutrients can be absorbed optimally by plants.

Other technical culture implementations that must be developed on flat–undulating, hilly and hilly land without terraces are infrastructure or infrastructure maintenance, such as repairing harvest ladders, terraces and making transport routes on terraces as access for harvesters to bring production from the market to the TPH. With soil and water conservation activities such as terrace maintenance which aims to prevent land degradation, minimizing the loss of nutrients provided through fertilization can maintain the nutrients in the soil needed by oil palm plants to remain optimally available. In accordance to Sastrosayono (2003), the growth and productivity of oil palm plants are influenced by many factors, including varieties, climate, soil and cultivation management. The most important climate factors are rainfall, temperature, air, humidity, and solar radiation. High rainfall encourages flower formation, but can inhibit the pollination process because pollen is lost in the water flow. While low rainfall will inhibit the formation of leaves and flowers.

Fluctuations in the increase and decrease in oil palm productivity are also caused by the increasing age of the plants. Oil palm plants start producing at the age of 3 years in the field, then productivity increases rapidly until the age of 4–6 years. After that, productivity runs at a slow rate or decreases and productivity reaches its peak at the age of 20 years. This is in accordance with research by Tampubolon (2016), that the production will continue to increase as age increases and will reach maximum production at the age of 9–14 years, after which the production will decrease.

3.5. Agronomic Characteristics of Oil Palm Plants

In undulating land topography, there is the potential for soil damage due to erosion, such as a decrease in the organic matter content of the soil followed by a decrease in the content of nutrients and the availability of groundwater for plants. Planting in areas with steep topography allows erosion to occur which causes the topsoil to become thinner. This condition will result in a decrease in flower development and plant productivity (Hardjowigeno, 1993). The quality and quantity of oil palm production are influenced by several factors including climate factors, land topography, technical culture, and agronomic characteristics of plants.

Table 6 shows effect of topography class on the agronomic characteristics of oil palm planted in year 2006, including five characters: plant height, stem diameter, number of fronds, number of bunches, and average bunch weight. Topography class significantly influences number of fronds, number of bunches, and average bunch weight, but not significantly affects plant height and stem diameter. Oil palm production in term of bunch weight in flat topography is significantly higher than that of hilly terrains.

Danso (2018) found in Ghana that oil plant growth as well as plant production (in term of FFB weight) of oil palm in the lowlands are always higher than those in the highlands. Hilly areas are regarded as marginal lands for cultivating oil palm due to numerous agro-management challenges that arise from the initial planting stage, through the growth and maintenance phases, and continuing to the harvesting and transportation of fresh fruit bunches (Totok *et al*., 2024). The position on the slope significantly influenced (p<0.05) soil pH, electrical conductivity (EC), and the concentrations of calcium (Ca), magnesium (Mg), potassium (K), and nitrogen (N) (Abdalrahem *et al*., 2024). Further support was also reported by Yasin & Yulnafatmawita (2018) where the bottom areas (flat) of oil palm plantation in West Sumatera had better soil physicochemical properties than those of others slope positions (upper, middle, lower slope). Balasundram *et al*. (2006), however, reported different finding in South Sumatera where the sideslope and summit (hilly) of the Sungai Pelepah Plantation consistently produced higher yields compared to the toeslope (flat).

Table 6. Agronomic characteristics of oil palm plants on different topographies

Agronomic Characteristics	Flat to Undulating	Hilly	Hilly without Terrace	*p*-value	Significance
Plant height (cm)	733.23a	734.95a	713.92a	0.602	not significan
Stem diameter (cm)	292.13a	294.48a	296.65a	0.675	not significant
Number of fronds (unit)	44.15b	46.53a	46.35a	0.039	significant
Number of bunches (unit)*	4.32b	4.45b	5.25a	0.017	significant
Average bunch weight (kg)	16.04a	14.18b	13.77b	0.005	significant

* During field survey, zero number of bunch was observed in hilly topographies, namely 2 trees in hilly, and 1 tree in hilly without terrace. These records were removed during data analysis. Therefore, unbalanced ANOVA was conducted with different sample size, namely 60, 58, and 59 trees, respectively for flat to undulating, hilly, and hilly without terrace topographies.

3.6. Correlation of Agronomic Characters

Figure 3 to 5 portrait relation of bunch weight with other agronomic characters for the three topography, namely flat to undulating, hilly, and hilly without terrace, respectively. All agronomic characters in each topography were subjected to correlation analysis against bunch weight. According to Sugiyono (2013), guideline for interpreting the correlation coefficient (r) is as follows: 0.00–0.199 (very low); 0.20–0.399 (low); 0.40–0.599 (moderate); 0.60–0.799 (strong); and 0.80–1.00 (very strong). Based on Figure 3–5, it can be surmised that correlation between average oil palm bunch weight and agronomic characteristics of oil palm plants across all topographical land classes is very weak. This is evident from the correlation coefficient r values, which are all less than 0.20, except for plant height at flat to undulating topography with $r = 0.324$ (weak relation).

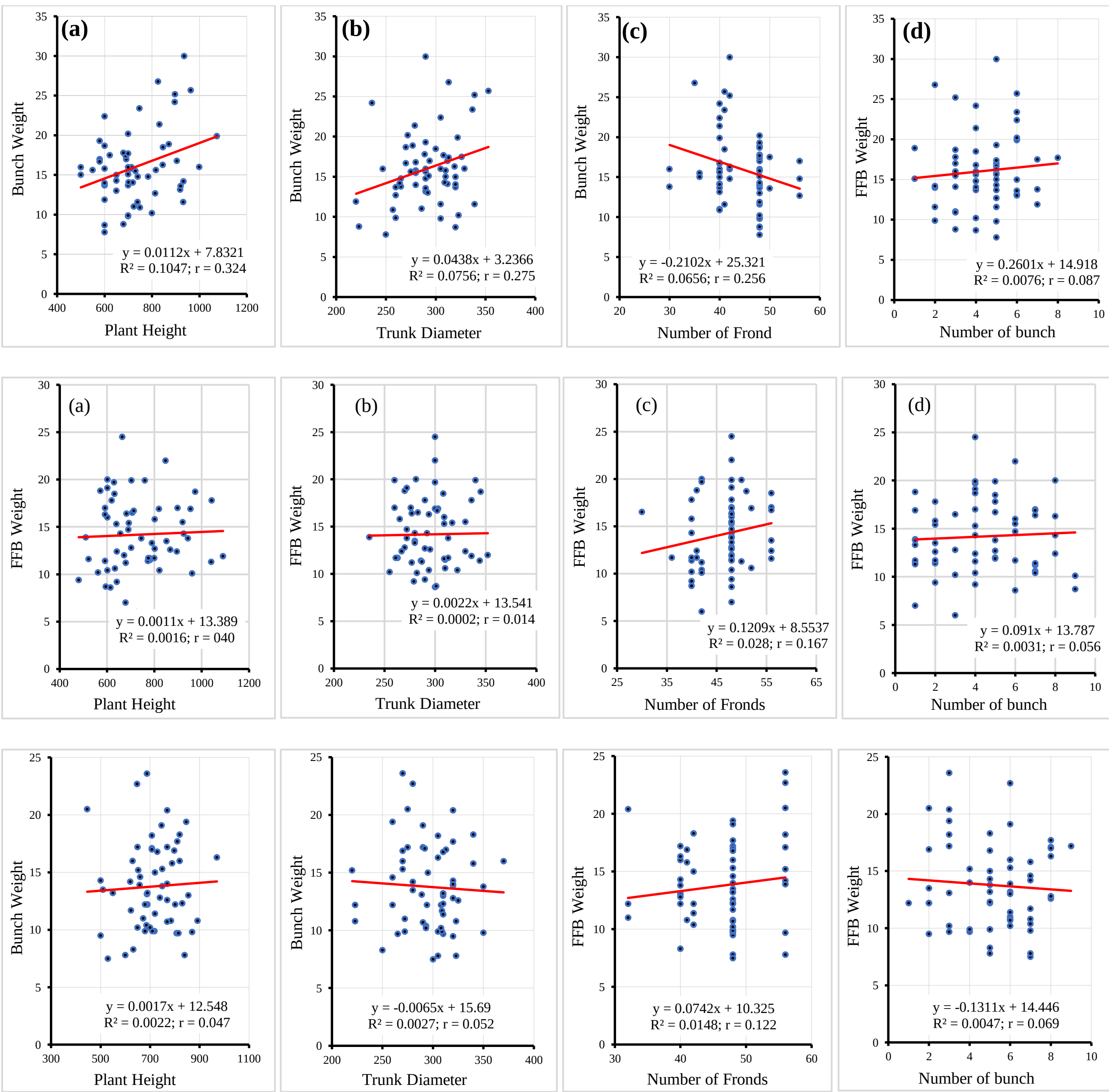

Figure 5. Relation of oil palm bunch weight with other agronomic characters at different topography [flat to undulating (top), hilly (middle), hilly without terrace (bottom)]: (a) Plant height, (b) Trunk diameter, (c) Number of fronds, and (d) Number of bunch.

Pearson correlation analysis was conducted to determine the relationship between agronomic characters of oil palm plants. The results of Pearson correlation analysis for agronomic characters were summarized in Table 7 for the three topography classes. On flat to undulating terrain, positive significant correlation was showed by bunch weight with plant height and stem diameter. The bunch weight, however, negatively correlated with number of fronds. This means that average bunch weight increase with the increase of plant height and stem diameter, but decrease with the increase of frond number. For hilly lands, stem diameter correlated positively with plant height and number of fronds. While in the topography of hilly without terrace, stem diameter correlated positively with the number of bunch. Absolute values of Pearson correlation coefficients in Table 7 are all less than 0.4. Therefore, according to criteria in Table 2, the inter-correlation among the agronomic characters are classified as weak.

Table 7. Pearson correlation coefficients of agronomic characters of oil palm plant for three topography classes

Variable	Bunch Weight (Y)	Plant Height (X1)	Stem Diameter (X2)	Number of Frond (X3)	Number of Bunch (X4)
Topography: Flat to Undulating (N = 60)					
Bunch Weight	**1**	**0.324***	**0.275***	**–0.256***	0.087
Plant Height		**1**	0.202	–0.098	–0.104
Trunk Diameter			**1**	–0.051	0.147
Number of Fronds				**1**	–0.032
Number of Bunches					**1**
Topography: Hilly (N = 58)					
Bunch Weight	**1**	0.044	–0.004	0.151	0.039
Plant Height		**1**	**0.270***	0.135	–0.183
Stem Diameter			**1**	**0.278***	0.183
Number of Fronds				**1**	0.049
Number of Bunches					**1**
Topography: Hilly without Terrace (N = 59)					
Bunch Weight	**1**	0.054	–0.050	0.115	–0.087
Plant Height		**1**	0.165	–0.250	0.253
Stem Diameter			**1**	–0.189	**0.323***
Number of Fronds				**1**	–0.072
Number of Bunches					**1**

*) Correlation is significant at the 0.05 level (2-tailed)

4. CONCLUSION

Based on production data for 5 years (2018-2022) of Afdeling II of the PT. Perkebunan Nusantara I (PTPN I), Kebun Pulau Tiga Tamiang Hulu (Aceh), land topography resulted in significant effect on the oil palm yield. Flat to undulating terrain produce significantly higher number of FFB (12.40 bunch/tree), average weight of FFB (13.91 kg/bunch), and yield of FFB (21.23 ton/ha) as compared to those of hilly and hilly without terrace lands. This current study also revealed that land topography in Afdeling II significantly influences the agronomic characters of oil palm plants of the Dy×P Dumpy variety planted in the 2006. Hilly terrains produce significantly higher number of bunch and number of fronds than that of flat to undulating topography. Significantly higher bunch weight, however, was resulted from the flat to undulating topography as compared to the hilly and hilly without terraces. Plant height and stem diameter are not significantly affected by topography class.

Inter-correlation among the agronomic characters were exist for different topography. In flat to undulating terrain, positive significant correlation was showed by bunch weight with plant height and stem diameter, but negatively correlated with number of fronds. For hilly lands, stem diameter correlated positively with plant height and number of fronds. While in the topography of hilly without terrace, stem diameter correlated positively with the number of bunch. Absolute values of Pearson correlation coefficients are all less than 0.4 meaning weak correlation. Based on the results, oil palm plantations must pay attention to land conditions and optimize good technical culture in order to achieve maximum productivity.

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