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The Development of Bio-Industrial Agricultural Model on Dry Land

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Abstract

Bio-industrial agriculture is a farming system oriented towards biological and natural resources maximum utilization as sustainable biomass, energy, and mineral. Vegetable and horticulture-based bio-industrial agriculture is a sustainable system consisted of farming, livestock, sewage treatment, agricultural product processing, and marketing sub-systems. The main objective of this study was to analyze the impact of the bio-industrial agricultural model development on the value-added agriculture. This study was conducted on dry land in Antapan Village, Baturiti District, Tabanan, Bali. Questionnaires and interview sessions were applied to collect the study data. Data analysis was done by descriptive analysis, a ratio of R/C, and multiple linear regression analysis. Findings revealed that bio-industrial agriculture contibuted to higher value-added agriculture. Vegetable and horticulture-based bio-industrial agriculture provided alternative system for the development of processed organic agricultural products that finally adds more product's value and increase farmer income.

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INTRODUCTION

The concept of bio-industrial agriculture emphasizes the notion of the farming cycle as a protection mechanism of the natural environment. It should deliver positive impacts to all parties involved on the upstream, on-farm, and off-farm activities (farmers, ranchers, planters), both at household, regional and national scales with highly competitive products. Barat and Barat (2016) had identified factors influencing bio-industrial-based agriculture adoption among the farmers. They elaborated that interpersonal communication media, such as lecture, dialogue, or discussion, and results from demonstration contributed to farmer's will in adopting particular innovations. Manalu (2020), Seminar *et al.* (2020), and Daging (2009), also recognized similar factors that affected the adoption of bio-industrial-based agriculture. They identified communication strategy through dialogue, information competence, and the level of trustworthiness of reliable information sources provided a significant role in influencing innovation adoption.

Antapan Village was located approximately 30 km on the north side of Tabanan City. The rainfall intensity in this area was tended to decrease to under the normal standard of intensity, reaching an average of 2.078 mm. This fact signifies that water scarcity issues would influence the farming activities in this area. Furthermore, Septiadi and Mundiyah (2020), also found that climate issues highly opposed the growth of agricultural businesses on dry land. In addition, the high cost of cropping tools in this area also threatened the farming activity.

Antapan Village is a famous center of cattle fattening business. Cattle require to be provided with sustain and proper type of feed to ensure the weight gain (Suhendrata *et al.*, 2018. Manalu, 2020. Subekti, 2009). The quality of feeding practices in Antapan Village was relatively poor. Fortifying type of feed was rarely given to the cattle. This practice led to low cattle productivity. The average of weight gained for a cow was only ranged from 280 grams/day to 330 grams/day (Pertanian, 2019, Suhendrata *et al.*, 2018)

Climate changes provoke hindrances in managing the agricultural business. A lot of agriculture potential could not be well managed due to these climate issues. Departing from these issues, a strategy to increase farmer income was developed in 2015. A study by Deressa, Hassan and Ringler (2011) found that farmer population in Ethiopia was quite responsive toward a bio-industrial-based agricultural activity model introduced. Calicioglu *et al.* (2019) also stated that the bio-industrial-based agricultural activity model maintained the national food stability and income. In line with these findings, Dahono *et al.* (2020) also explained the benefits of the bio-industrial-based agricultural activity model. This model was producing higher agricultural production volume in comparison with the existing model. Barat and Barat (2016) stated that the bio-industrial-based agricultural model provided an alternative method to improve farmer income and

refinement of agricultural land quality. Sudjatmiko *et al.* (2021) also added the effect of bio-industrial-based agricultural activity on the farming business. It created more solid organizational structures and improved income among the farmers.

The development of a bio-industrial-based agricultural activity on the dry land in Antapan Village involved horticultural and vegetable commodities that integrated with cattle breeding. Scientific evidence and analysis of the advantageous effect of this model on the farmer income and value-added on the processed farming products and input is still limited. Hence, this study aimed to analyze: (1) effect of the development of bio-industrial-based agricultural model on the value-added on the agricultural activity and (2) factors influencing the value-added on the agricultural activity.

RESEARCH METHOD

This study was conducted in Antapan Village, Baturiti District, Tabanan Regency. A purposive sampling technique was employed to select Antapan Village as the study location with the consideration of its land area that fulfilled the requirement of bio-industrial-based agricultural activity on the dry land. The study population was 45 farmers who carried bio-industrial-based agricultural activity during the planting season in 2018/2019. All farmers were recruited as eligible study participants according to the census. A survey technique guided by a questionnaire employed to collect the study data.

The effect of the bio-industrial agricultural model was investigated through the ratio of R/C, where R and C was the total revenue and the total cost, respectively. A multiple linear regression analysis was applied to analyze factors influencing the value-added on the agricultural activity. The independent variables involved were X1 land, X2 seed, X3 fertilizer, and X4 worker. The value-added on the agricultural activity (value-added agriculture) was the dependent variable (Y). The formulation between the independent and dependent variable was elaborated as YA= f(X1, X2, X3, X4).

RESULT AND DISCUSSION

Effect of bio-industrial based agricultural model on the value-added agriculture

Some popular agriculture commodities in Antapan Village were cayenne pepper, red pepper, and vegetables such as mustard, green vegetables, tomato, carrot, cucumber, and celery. These commodities were distributed to various market lines as fresh vegetables. Farmer's major source of income originated from this activity. In this study, we explored and analyzed the dominant agricultural activities selected by the farmer that had turned into their highest source of income. According to Sudjatmiko *et al.* (2021), Syakir (2015), Putra, Efendi and Brata (2018), bio-industrial farming had a great prospect in improving farmer income. In the area 0.05 to 0.10 ha of the agricultural land, a small-scale farming had developed by the farmers. Table 1 shows the analysis of agricultural activity and value-added agriculture in Antapan Village.

Cayenne pepper bio-industrial-based agricultural activity had reduced the utilization of chemical pesticides and chemical fertilizers during the cultivation periods. It implicated on the improvement of the application of the cow manure compost that had been processed through the fermentation system. These findings were parallel with studies by Seminar *et al.* (2020), Suhendrata *et al.* (2018), Budiari, assestment and agriculture, (2018), and Karman, Suparwoto and Hutapea, (2020) that found beneficial effects of organic fertilizer on agricultural production. The highest expenditure cost of cayenne pepper on the production facility area was spent on the fermented manure fertilizer. It had reached IDR 2,133,333/ha. This cost classified into value-added agriculture and appended to the farmer income. But in the agricultural business, it was calculated as a part of the cost element.

Value-added agriculture referred to the manufacturing or production of the processed agricultural products, such as vegetable juice, berry juice, pineapple juice, and *serikaya* juice. The cayenne paper farmer income was reaching IDR 19,000,000/ha/planting season. The agriculture efficiency of cayenne pepper agricultural activity shows in Table 1. The R/C of the cayenne pepper was 3,478. This value indicated that the expenditure of IDR 1,000,000 would be returned by IDR 3,478,000. The R/C of cayenne pepper farming in Antapan Village, Tabanan, was greater than the value of R/C of corn farming (1.92), according to a study conducted by Rusdiana and Hapsari, (2020) in Gowa, South Sulawesi.

Table 1 Agricultural activity and value-added agriculture hectare per year on bio-industrial-based agricultural on the dry land in Antapan Village for the year 2019

No	Description	Revenue (IDR)	Cost (IDR)	R/C
A	Agricultural Activity			
1	Cayenne Pepper	26,666,667	7,666,667	3.478
2	Red Pepper	162,000,000	42,715,000	2.192
3	Mustard Green	25,781,250	12,781,250	2.017
4	Spinach	50,000,000	13,561,333	3.687
B	Value-added Agriculture			
1	Organic Vegetable Juice	6,750,000	2,888,250	2.949
2	Spinach Chip	7,225,000	2,384,250	3.030

Source: processed primary data, 2019

The main framework of the present study was different from the previous study conducted by Barat and Barat (2016) in West Java.-They investigated the bio-industrial-based agriculture activity on the rice commodity. Their finding showed that bio-industrial-based agricultural activity was an alternative method of organic farming development. No processed rice product had discussed in this study. Dahono *et al.* (2020), examined bio-industrial-based agricultural activity on palm oil commodities in Riau Province. They converted all production factors into

other products. However, there was no utilization of palm oil commodity recorded in the study.

Factors influencing the value-added agriculture on the bio-industrial-based agricultural activity model in Antapan Village

Factors influencing the value-added agriculture on the bio-industrial-based agricultural activity model (Y) was classified into the land area of cultivation (X1), utilized seed total (X2), utilized organic fertilizer total (X3), and utilized worker total (X4). The result of the F_{count} was 43.602 that revealed a statistical difference score at the significance level of 1%. The determination coefficient (R-squared) was 0.813. This result indicated that 81.13% of the value-added agriculture on the model had been explained by the model. The other unstudied variables will explain the 18.87% of the value-added agriculture.

Table 2 Factors influencing the value-added agriculture in bio-industrial agricultural activity model in Antapan Village for the year 2019

Variable	Coefficient	Prob (t-statistic)
Constanta	0.938	0.001
Land Area of Cultivation X_1	0.163	0.098 (1.692)
Utilized Seed Total X_2	0.306	0.001 (3.513)***
Utilized Organic Fertilizer Total X_3	0.176	0.001 (3.854)***
Utilized Worker Total X_4	0.187	0.008 (2.769)***
R-squared		
0.813		
Adjusted R-squared		
0.795		
F-statistic		
43.602		
Prob (F-statistic)		
0.000		

Note : Numbers written in brackets were the t-count
*** = significantly different at the level of significance of 1 %

The value added on the bio-industrial-based agricultural activity business was influenced by the land, seed, organic fertilizer, and worker utilization. Studies by (Pratama, Soetriono and Aji, 2019, Hasnun, Made and Alimuddin, 2015, Nabilah, Baga and Tinaprilla, 2017), also identified several factors affected the bio-industrial-based agricultural activity: raw material availability, selling price, processed raw material, and selling price output. The land area of cultivation (X1) did not affect the value-added agriculture with the probability value (t-statistic) of

0.098, t-statistic <0.0500. This result signified that the land area of cultivation did not significantly affect the value-added agriculture at the significance level of 5% (0.0500). This situation might be happened due to the high percentage of land utilization did not align with the high agricultural volume production (Suhendrata et al., 2018). High agricultural volume production is usually associated with the fertility rate of the soil and pest attack intensity. The majority of farmers were planted agricultural commodities that could be processed into some foods in a small area of crops monoculturally, such as organic vegetable juice and spinach chip. We also observed various types of vegetables and horticultural plants in a crop of cultivation land.

Utilized seed total (X2) was significantly affected the value-added agriculture with probability value (t-statistic) of 0.001, t-statistic <0.01. This result yielded that the utilized seed total affected the value-added on the agricultural activity at the significance level of 1 % (0.0100). This situation might be occurred due to higher seed utilization produced a higher volume of the agricultural commodity. Higher volume commodity was linked with higher value-added from the processed commodity (Budhisatyarini, no date). In this study, the organic vegetable juice and spinach chip contributed more value to the agricultural commodity. Therefore, a higher seed utilization was associated with a higher value-added on the farming business.

Utilized organic fertilizer total (X3) was significantly affected the value-added agriculture. The probability value (t-statistic) was 0.001, <0.0100. This result indicated that the organic fertilizer utilization was significantly influenced the value-added on the agricultural activity at the significance level of 1% (0.0100). Adequate utilization of organic fertilizer tended to produce higher agriculture productivity (Septiadi and Mundiyah, 2020). This situation led to significant improvement in the production of processed agricultural commodities and value-added agriculture.

The worker utilization (X4) was significantly affected the value-added on the agricultural activity. The value of the probability (t-statistic) was 0.008, <0.0100. This result indicated that the worker utilization was significantly affected the value-added on the agricultural activity at the significance level of 1 % (0.0100). This result signified that a higher number of workers produced a higher value-added agriculture. This situation also explained higher farming production volume would be required a higher number of the worker. Finding also showed that the development of a bio-industrial-based agricultural activity model had provided a broader chance of employment and increase farmer income (Sudjatmiko *et al.*, 2021, Seminar *et al.*, 2020). It would be employed and recruited female workers (90%) in the tofu-making process. These findings showed that the bio-industrial-based agricultural model required to be sustainably implemented.

CONCLUSION

The bio-industrial model of agriculture had delivered beneficial impacts on the increase of the farmer income from the value-added agriculture on the processed vegetable and horticultural commodity. An example of the processed product produced was the organic vegetable juice. The factors influencing value-

added agriculture on the agricultural business were the utilization of seed, organic fertilizer, and workers.

RECOMMENDATION

This study only discussed the bio-industrial agricultural system on the farming and agricultural product processing sub-systems. Future studies required exploring other sub-systems, such as the livestock, sewage, and marketing sub-systems.

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