Adoption of good agriculture practice for export-oriented snake fruit farming

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Abstract. Snake fruit is one of the major agricultural export commodities in Indonesia. One of the efforts to improve the quality of snake fruit production and quality is through the adoption of Good Agriculture Practice (GAP) for export-oriented of snake fruit farming. This paper aims to analyse the level of adoption of GAP and factors related to the level of application of the GAP for export-oriented snake fruit farming. The level of application of the GAP was analysed using a 3-point Likert Scale, while the factors correlated to the level of application of the GAP were analysed using Spearman Rank correlation. The results showed that the level of application of the GAP for export-oriented snake fruit farming was in moderate category. Moreover, land area and capital were significantly strong and positive correlated to the level of application of GAP export-oriented snake fruit farming.

1. Introduction
Snake fruit is one of the strategic horticultural commodities in Indonesia. Apart from consuming the fruit, snake fruit is also used for various purposes, even for medical treatment in the reason of its chemical content [1]. The Ministry of Agriculture of the Republic of Indonesia has designated snake fruit as one of the major horticultural commodities along with other commodities such as bananas, durian, oranges, mangoes, mangosteen, rhizomes, chilies, shallots, potatoes, and ornamental plants [2]. Indonesian snake fruit production in 2018 was recorded at 896.504 tons [3].

Moreover, snake fruit is also an agricultural commodity that has high economic potential to be developed [4]. One of the developments of snake fruit commodities is by encouraging it to become an export commodity in order to increase purchasing value of its products. Besides, it is hoped that the quality will also increase and in the end, it will excite farmers to develop it.

One of the efforts to increase market access for snake fruit, especially for the export market is the application of Good Agricultural Practices (GAP). Good Agricultural Practices itself is a strategy that helps farmers increase productivity, quality and farming income levels in an effort to expand market share, optimize resources, increase farm value and strengthen skills in farming [5]. The application of Good Agricultural Practices for snake fruit in Indonesia refers to the Regulation of the Minister of Agriculture No.61 2006 regarding Guidelines of Good Agriculture Practice for Fruit which was later revised by Regulation of the Minister of Agriculture of the Republic of Indonesia No.48 2009 concerning Guidelines for Good Agriculture Practices for Fruit and Vegetables. There are several variables in the GAP guidelines, including land management, seedlings, planting, fertilization, irrigation, pest control, harvest and post-harvest [6].

The adoption of principles in Good Agriculture Practice is expected to increase production standards [7], product quality [8], product safety [9] and sustainability of snake fruit farming. Especially with
regard to the export market, where one of the factors that sometimes hinders trade is not tariff barriers but technical barriers in the form of quality requirements, food safety [10], sanitary and phytosanitary [11].

The implementation of Good Agricultural Practices (GAP) by snake fruit farmers in Indonesia has begun in various regions, as well as snake fruit farmers in Magelang Regency, Indonesia, especially snake fruit farmers who are export-oriented [12] [13]. Magelang Regency is one of the production centers for snake fruit in Central Java Province [14] with production in 2018 recorded at 6,885 tons, which the majority (81% or 5,570 tons) came from Srumbung District [15].

Snake fruit is one of the export commodities in Magelang Regency with the main destinations to China and Singapore [16]. The export value of snake fruit and agropolitan commodities in Magelang Regency in 2018 was 1.34 million US $. This value decreased slightly from 1.35 million US $ in 2017. Meanwhile, from the production side in the same period it also decreased from 7.306 tons in 2017 to 6,885 tons in 2018 [17].

The decline in the value of exports and production, even though it is small, needs to be considered, given that the export market is a promising. There are various factors that may be the determinant of the decline in exports and production of snake fruit. On the other hand, snake fruit farmers in Magelang whose products are exported have implemented Good Agricultural Practices (GAP) in farming. Theoretically, the adoption of Good Agricultural Practices (GAP) could increase quality of snake fruit products and meet the export quality standards.

Based on the above formulation, it is necessary to examine the extent of the adoption of Good Agricultural Practices (GAP) in snake fruit farming by farmers in Magelang Regency. It is hoped that this study could provide an insight regarding the extent to which farmers have applied the principles of Good Agricultural Practices (GAP) in snake fruit farming which could support the improvement in quality of production and export-oriented snake fruit farming.

2. Material and Methods

Descriptive method was used in this research. The descriptive method aims to describe systematic, factual, and accurate problems regarding the facts and characteristics of the population in a particular area [18]. With the descriptive method, it can be seen the level of adoption of Good Agricultural Practices (GAP) and the factors that are related to the level of adoption of Good Agricultural Practices (GAP) in snake fruit farming in Magelang Regency.

Research location in Srumbung District, Magelang Regency was determined using a purposive method, in the reason that Srumbung District was the highest snake fruit production region in Magelang Regency [15]. Moreover, snake fruit farmers in Srumbung District has implemented Good Agricultural Practices (GAP) for export-oriented snake fruit farming [12] [13].

The population of this research is the snake fruit farmers derived from 3 farmer groups who have collaborated with snake fruit exporters, totaling 722 farmers from Ngudi Cukup, Ngudi Mulya and Madu Rejo Farmer Groups. Respondents was selected using simple random sampling method with a total sample size of 70 farmers.

The level of adoption of Good Agricultural Practices (GAP) in snake fruit farming was analyzed using a 3-point Likert Scale [19]. The score was counted as 1 if the farmer has never applied of GAP which indicates that the level of adoption is low. While the score is 2 if the farmer applies GAP, however, they are not suitable and indicates as moderate. And the score is 3 if the farmer has applied according to GAP and the level of adoption category is high. There are 13 indicators of GAP for export-oriented snake fruit farming, which include land preparation, seed preparation, planting, plant stitching, plant thinning, fertilization, irrigation, trimming fronds, pests control, pollination, fruit thinning, harvest and post-harvest. The level of GAP adoption is determined by subtracting the maximum score from the minimum score then dividing by 3 which is the range of each category level, with the formula:

\[
\text{interval} = \frac{\text{maximum score} - \text{minimum score}}{\text{number of categories}}
\]
### Table 1. Range Score Adoption Category

| Score | Range Score | Category |
|-------|-------------|----------|
| 13 - 39 | 13.0 – 21.6 | Low |
| | 21.7 – 30.3 | Moderate |
| | 30.4 – 39.0 | High |

Source: [20]

The relationship between the factors that influence the level of adoption of Good Agricultural Practices (GAP) in snake fruit farming was analyzed using Spearman Rank Correlation. The variables examined in this study were age, farming experience, education level, land area, and capital. The strength of correlation was categorized based on the value of the coefficient, as listed in Table 2.

### Table 2. Coefficient of Correlation and Relationship Strength

| Coefficient of Correlation | Relationship Strength |
|---------------------------|-----------------------|
| >0.90                     | Near Perfect          |
| 0.70 – 0.89               | Very Strong           |
| 0.50 – 0.69               | Strong                |
| 0.30 – 0.49               | Moderate              |
| 0.10 – 0.29               | Weak                  |
| 0.10 – 0.09               | Very Weak             |
| 0.00                      | No Correlation        |

Source: [21]

### 3. Results and Discussion

#### 3.1 Farmer’s Profile.

A total of 70 farmers from Srumbung District, Magelang Regency were selected as respondents of this study. Table 3 demonstrated the profiles of export-oriented snake fruit farmers in this study. There are 6 variables that describe the socio-demographics of the respondents including age, gender, education, experience, land area and capital.

The majority of snake fruit farmers who were respondents in this study were men between age of 41-60 years with high school education level and farming experience between 21-30 years. As seen from the use of production factors for Snake fruit farming, the majority of farmers has an area of land between 500 to 3,999 m² with farming capital between 1 million to 6 million rupiah.

The profile of snake fruit farmers is in line with the results of the Indonesian agricultural census where the majority of farmers in Indonesia (75.9%) are male with an average age above 45 years [22]. It is interesting to note the average age of farmers, considering that age is an important variable in farmer decision making, especially regarding new production methods that may be risky [23].

Furthermore, regarding the education level, majority of farmers has graduated from high schools. With a relatively good educational background, it is expected that the level of adoption of new technology or business techniques will be easier [24] since better of literacy levels. This is supported by farming experience which was over 20 years. Farming experience tends to support the adoption process of new farming practices [25].

The further characteristics are land area and capital. Majority of farmers (68.6%) acquire relatively narrow of land between 500-3,999 square meters. The wider the land used by farmers, the more likely that farmers adopt Good Agricultural Practices (GAP) since they expected of better results [26]. While the variable of capital, this study showed that farmer’s capital ability was between 1 million and 6 million rupiah. The higher the farmer’s capital may make farmers more likely to adopt technology [27].
Table 3. Snake-fruit Farmer’s Profile

| No | Variable                        | Range     | Respondent |
|----|---------------------------------|-----------|------------|
|    |                                 |           | Number %   |
| 1  | Age                             | 31 - 40   | 6 8,6      |
|    |                                 | 41 - 50   | 24 34,3    |
|    |                                 | 51 - 60   | 25 35,7    |
|    |                                 | >60       | 15 21,4    |
| 2  | Gender                          | Male      | 46 65,7    |
|    |                                 | Female    | 24 34,3    |
| 3  | Education                       | Elementary School | 24 34,3 |
|    |                                 | Junior High School | 15 21,4 |
|    |                                 | Senior High School | 28 40    |
|    |                                 | Graduate  | 3 4,3      |
| 4  | Farming Experience (Year)       | ≤ 10      | 10 14,3    |
|    |                                 | 11 - 20   | 19 27,1    |
|    |                                 | 21 - 30   | 28 40      |
|    |                                 | > 30      | 13 18,6    |
| 5  | Land Area (m²)                  | 500 - 3.999 | 48 68,6   |
|    |                                 | 4.000 - 7.999 | 14 20   |
|    |                                 | 8.000 - 10.000 | 5 7,1   |
|    |                                 | > 10.000  | 3 4,3      |
| 6  | Capital (IDR)                   | 1.000.000 - 6.000.000 | 36 51,4 |
|    |                                 | 7.000.000 - 12.000.000 | 23 32,9 |
|    |                                 | 13.000.000 - 18.000.000 | 8 11,4 |
|    |                                 | 19.000.000 - 25.000.000 | 3 4,3 |

Source: Primary data, calculated by the authors (2019)

3.2 Level of GAP Application of Export-oriented Snake fruit Farming.

The level of application of Good Agriculture Practices for export-oriented Snake fruit farming is analysed using several indicators as stated in the Regulation of the Minister of Agriculture of the Republic of Indonesia No.48 2009 regarding The Guidelines of Good Agriculture Practices for Fruit and Vegetables (GAP). There are several variables in the GAP guidelines which cover the scope of land, use of seeds/seedlings, planting, fertilization, irrigation, pest control, harvest, and post-harvest.

Table 4 shows that the overall total score of the GAP application of snake fruit farming in Srumbung District is 23.87 from 13 indicators. Based on these results it can be concluded that the level of adoption of GAP is in moderate category. In general, snake-fruit farmers have applied farming techniques according to the GAP. However, in several indicators, farmers have not fully implemented optimally according to the GAP recommendations.

Trimming fronds and harvesting activities are indicators that show the highest score among other GAP variables. This demonstrates that farmers pay more attention to and follow the instructions in the Good Agriculture Practices guidelines for trimming fronds and harvesting activities. Harvesting activities, especially for small farmers with relatively narrow land area, are important activities [28], for this reason, the adoption of GAP in harvesting activities will certainly be very much considered and adopted by farmers.
On the other hand, the indicator of fertilizer application, irrigation, pest control and post-harvest activities shows a low level of adoption. The low level of adoption of variable pest control by farmers is likely due to the low of knowledge of farmers regarding pests and diseases of plants they cultivate [29]. Similarly, the low level of adoption of good fertilizers, it is possibly due to the low access to fertilizer itself which could be caused by the costs required to purchase it [30]. As mentioned before, the majority of farmers' capital capacity is in the lowest range between 1 million to 6 million rupiah. In addition, the low level of fertilizer use may also be related to land area, farmers with large areas of land tend to increase their use of fertilizers in farming [31].

Table 4. Level of GAP Application

| No | GAP Indicator       | Application Level | Category |
|----|---------------------|-------------------|----------|
| 1  | Land preparation    | 2.09              | Moderate |
| 2  | Seed preparation    | 1.78              | Moderate |
| 3  | Planting           | 2.14              | Moderate |
| 4  | Plant stitching     | 1.66              | Moderate |
| 5  | Plant thinning      | 1.98              | Moderate |
| 6  | Fertilizer application | 1.62         | Low      |
| 7  | Irrigation          | 1.38              | Low      |
| 8  | Trimming fronds    | 2.51              | High     |
| 9  | Pest control        | 1.04              | Low      |
| 10 | Pollination         | 2.05              | Moderate |
| 11 | Fruit Thinning      | 1.74              | Moderate |
| 12 | Harvesting          | 2.49              | High     |
| 13 | Post-Harvest        | 1.40              | Low      |
|    | **Total score**     | **23.87**         | **Moderate** |

Source: Primary data, calculated by the authors (2019)

Table 4 showed that the low level of adoption of Good Agriculture Practices on post-harvest variables. It is important to note as one of the results of this research. This finding is contrast to the adoption of harvest technique which is showed on already high level. Post-harvest handling of agricultural products is important since it is associated with possible yield losses [32]. Good post-harvest handling is influenced by several variables, including access to training, capital size and farm scale. Commercial farm scales tend to adopt good post-harvest handling [33].

All in all, based on the 13 indicators of Good Agriculture Practices, the adoption of GAP export-oriented snake fruit farming shows a moderate level. This on the one hand shows that the majority of farmers have applied GAP of export-oriented principles, however, it needs to be improved, especially in the efforts to increase the export of snake fruit in the future.

Factors Related to GAP Adoption of Export-oriented Snake fruit Farming. It is important to note that there were several factors related to the level of adoption of Good Agriculture Practices of export-oriented snake fruit farming. This is because this factor could provide insight to identify variables that have a negative or positive relationship to the adoption of Good Agriculture Practices.

Table 5 shows that land area and capital ownership are statistically significant and have a positive correlation with the adoption of Good Agriculture Practices for export-oriented snake fruit farming. The variables of age, education and farming experience proved to be uncorrelated to the GAP adoption.

Variable of land area with a correlation coefficient of 0.580 (strong) is significantly correlated with the level of GAP adoption of snake fruit farming at a confidence level of 99%. Studies show that farmers with large areas of land are more likely to adopt new technologies [34] and new farming methods [35]. The adoption of new technology such as the application of GAP is considered to have the potential to
improve welfare and production [36]. Moreover, the more land the farmer owns, the greater the potential for improvement in the results so that the adoption rate will be higher.

### Table 5. Rank Spearman Correlation analysis of factors related to the GAP application

| No. | Variable     | Coefficient (rs) | Sig.  |
|-----|--------------|------------------|-------|
| 1.  | Age          | 0.113            | 0.351 |
| 2.  | Education    | 0.213            | 0.077 |
| 3.  | Experience   | 0.079            | 0.513 |
| 4.  | Land area    | 0.580            | 0.000*** |
| 5.  | Capital      | 0.482            | 0.000*** |

Note: Significant at ***1%, **5%, *10%

The capital variable shows a correlation coefficient value of 0.482 (moderate) and statistically significant correlated to the level of application of Good Agriculture Practices for export-oriented Snake fruit farming with a confidence level of 99%. The higher the availability of capital owned, the higher the level of GAP application of snake fruit farming. Adoption of new technology requires investment and capital support, generally there is an addition or upgrade of equipment needed to support the new technology [37]. Access to capital could encourage farmers to apply new technology [23] and enable farmers to meet their farming costs.

### 4. Conclusion

Based on the results and discussion, it can be concluded that the level of adoption of Good Agriculture Practices (GAP) in export-oriented snake-fruit farming in Magelang, Indonesia, is in the moderate level. Moreover, land area and capital were factors that significantly related to the level of adoption of GAP export-oriented snake-fruit farming.

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