Study on liability and farm handling of high value agricultural commodities in Aceh

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Abstract. Agricultural sector has a potential for improving the economy of Aceh because it plays major role in the commodities livelihood. Some of the agricultural commodities such as patchouli, melon, chili, corn, and soybeans have high economic value. However, growing that plants have high uncertainty for farmers especially in term of risk in financial, production and market. This study aimed to identify the sources of risks and study the impact on farm management. The research was conducted in 75 villages in 5 districts of Aceh Province that were determined using systematic sampling. As many as 275 farmers had been selected as response to risks of some aspects in production, marketing and financing were assessed and compared with potential benefit of farmers. The results indicated that potential benefit is always associated with the risk. The greater the on-farm risk is the bigger its potential benefits. Intensive farming system will reduce the risk, but it increases the cost. This research has been successfully ranking the risk of farming as the following plant: patchouli, chilies, corn, and soybeans.

1. Introduction
Agricultural sector has good potential in improving the economy of Aceh because as a source of livelihood. Potential commodity farm management as a basic livelihood aims to make a profit. Therefore, farmers will work on these commodities intensively [1] Farmers tend to choose commodity that produces the most income to obtain a large profit. On the other hand, farmers also consider production costs [2].

Melon farm management is considered has high value. In fact, the cost of melons farm management is much higher than corn and soybeans. However, farmers also consider easily marketed commodity at high prices. However, there is a possibility of failure which can cause huge losses for agricultural business actors. The most threatening risks in agricultural is natural factors, such as climate, weather, markets, and sources of financing [3]. Climate and weather factors are controlled by intensifying the use of farm management technology. Market conditions are difficult to control by farmers. The level of risk faced by this farm management can be analyzed using risk assessment which is interpreted at the level of risk and compared with the potential benefits. The risks in farm management are production risk, market risk, financial risk.
Risk identification is to judge, classify and appraisal risk nature process for the potential risk, namely identification of potential possible loss. Although the management main body's information is not enough, it is sufficiently to assign a probability value for each alternative plan's result and infers the probability distribution of some event or the action result presents
according to the existing information. Production risk comes from the unpredictable nature of the weather and uncertainty about the performance of crops or livestock, e.g., through the incidence of pests and diseases, or from many other unpredictable factors. Prices of farm outputs and sometimes also of inputs, may not be known at the time that a farmer must make decisions about how much of which inputs to use or what and how much of various products to produce. Increasingly, farmers almost the world over are being exposed to unpredictable competitive markets for inputs and outputs, so that price or market risk is often significant and may increase over time. [4]

Corn is a staple crop with very low risk thus attractive for farmers to be cultivated [5]. Farmers in 12 regencies of Aceh Province cultivate corn as a staple crop after harvesting rice in paddy fields and also in plantation areas. Corn are considered have the lowest risk, so farmers who have limited capital also cultivate this crop.

Melon is an exclusive crop that is only cultivated by farmers who have sufficient capital or have business partners with financial contributions. In 2019, melon was cultivated by 123 farmers in Pidie and North Aceh regencies. Therefore, in melon farm management, in addition to production risk, financing risk is also very important to analyze.

2. Research Method
This research was conducted in 5 regencies, 15 districts, and 75 villages throughout Aceh. The determination of regency as sample is based on the number of farmers who cultivate these five commodities. The determination of districts as sample is based on the production center of each district. The sample of farmers used in this study were patchouli, melon, chili, corn and soybean farmers. The samples were determined by systematic sampling in 75 study sites. The number of farmers is set proportionately based on the population. The sample is determined as 10 percent of the total population in each sample village.

Table 1. Location and sample.

| Kabupaten | District | Sample Village | Farmers Sampling Per Commodity |
|-----------|----------|----------------|-------------------------------|
| Aceh Besar| 3        | 15             | 5 Chili 10 Patchouli 10 Corn 5 Soybean |
| Pidie     | 3        | 15             | 15 Chili 20 Melon 10 Corn 5 Soybean  |
| Aceh Utara| 3        | 15             | 5 Chili 9 Melon 10 Corn 5 Soybean |
| Aceh Selatan| 3    | 15             | 10 Chili 26 Patchouli 60 Corn 10 Soybean |
| Aceh Tengah*| 3    | 15             | 21 Chili 30 Corn 9 Soybean |

Data collection was carried out by field observations and interviews using a questionnaire. The analysis method is measure farm management risk from some aspects such as production, market and financing using Risk Assessment (RA) and comparing the amount of risk with the benefits. Risk source data is collected from farmers with a probability of occurrence frequency. This risk is then multiplied by the impact. Risk is the ratio between failure and the number of activities as: \( r_i = \frac{g_i}{a} \); and impact is the amount of loss from failure \( C_{fi} = fg_{fi} \times IC_{f} \). The amount of risk, \( R_i \), is \( r_i \times C_{fi} \). Farm management profits is the difference between total revenue and total costs \( \pi_i = TR_i - TC_i \); and \( TC_i = FC_i + VC_i \); \( TR_i = P_i \times Q_i \); then the amount of production costs will determine the profit of farm management. The impact of losses from
risk is formulated by the amount of loss due to the probability of failure of the farm $i^{th}$ of the many times done by farmers.

In this risk assessment, several dominant threats were identified by giving the following categories: 1 = insignificant, 2 = minor, 3 = moderate, 4 = major, and 5 = catastrophic. Meanwhile, the categories for the level of occurrence probability are a = never, b = almost never, c = seldom, d = often and e = always. The results are then described in a farm management risk map.

3. Results and discussion

Performance of the 5 potential commodities in this research description is measured by planting area, production, production costs, revenue, and profits from farm management. The results on 56 chili farmers showed that the average planting area was 0.35 hectares per farmer; 34 soybean farmers with an average planting area of 0.75 hectares; 29 Melon farmers with an average planting area of 0.2 hectares; 36 patchouli farmers with an average planting area of 0.6 hectares; and 120 corn farmers with an average planting area of 1.25 hectares.

The highest production costs were found for chili farm management, followed by melon and patchouli. Likewise, the highest revenue and profit of farm management was found in chili, followed by melon and patchouli, as shown in Figure 1 below.

![Figure 1. Cost, revenue, and profit of 5 potential commodities.](image)

The figure show that the greater the production cost, the greater potential revenue and farm profits. Therefore, from the perspective of revenue, profit and farm management investment criteria, the decision can be described in Table 2 below.
Table 2. Feasibility criteria and farm management priorities.

| Commodities | C/R  | RoI  | Decision  |
|--------------|------|------|-----------|
| Chili        | 4.67 | 3.67 | Priority 1st |
| Soybean      | 1.25 | 0.25 | Priority 4th |
| Melon        | 4.23 | 3.23 | Priority 2nd |
| Patchouli    | 3.19 | 2.19 | Priority 3rd |
| Corn         | 1.88 | 0.88 | Priority 5th |

In terms of farm management feasibility criteria, chili is the first choice, melons and patchouli are the second and third choices. Soybean is the last choice because has the lowest revenue and profit from.

Farm management risk is measured from the frequency of farm management failure committed by all farmers for each commodity. The results showed that the most failures were chili farm management, where out of 114 times the cultivation frequency failed 32 times. The farms that experienced the least failures were soybeans and corn, as shown in Table below.

| No. | Commodities | Farmer | Farm management Freq. | Success Freq. | Failure Freq. |
|-----|-------------|--------|-----------------------|---------------|---------------|
| 1   | Chili       | 56     | 114                   | 82            | 32            |
| 2   | Soybean     | 34     | 56                    | 54            | 2             |
| 3   | Melon       | 29     | 59                    | 43            | 16            |
| 4   | Patchouli   | 36     | 64                    | 51            | 13            |
| 5   | Corn        | 120    | 228                   | 226           | 2             |

Farm failure that causes total loss and the impact is the ratio between the losses and profits from farm management. Based on the failure frequency, all losses from each commodity are calculated. Risk type 1 is obtained from the amount of opportunity multiplied by the impact of the loss. Risk type 2 is the potential yield to be obtained if the farm management is fully success. Risk type 2 is calculated from the difference between the expected profit and the real profit obtained from each farm. The results of this study indicate that the greatest impact of farm management failure type 1 is on chili. However, the greatest impact of risk failure in type 2 was in melon, as shown in Table 4.
### Table 4. Risk type 1 and 2 by commodity.

| No. | Commodities | Failure Freq. | Total Loss IDR | Total Profit IDR | Risk 1st | Risk 2nd |
|-----|--------------|---------------|----------------|------------------|---------|---------|
| 1   | Chili        | 32            | 287,616,000    | 2,706,984,000    | 39,0    | 10,6    |
| 2   | Soybean      | 2             | 12,975,000     | 87,075,000       | 3,70    | 14,9    |
| 3   | Melon        | 16            | 75,648,000     | 244,352,000      | 37,21   | 31,0    |
| 4   | Patchouli    | 13            | 146,562,000    | 1,261,026,000    | 25,49   | 11,6    |
| 4   | Corn         | 2             | 44,888,553     | 2,380,062,500    | 0,88    | 1,9     |

The risk type 1 of corn farm management is the smallest, because corn rarely fail. Therefore, the potential loss for 114 plantings is very small. Corn is cultivated by 120 farmers covering an area of 285 hectares has generated a profit of Rp. 2,380,062,500. The total loss in farm management failure is Rp. 44,888,553. Meanwhile, for chili, the total profit obtained by 56 farmers was Rp. 2,706,984,000 with a total loss of Rp. 287,616,000.

Farm management risk is also described from the probability of failure from various sources of risk practiced by farmers. The risks of chili, melon, patchouli, soybean and corn comes from production, market and financing dimension. In the production dimension, the aspects of climate, weather, pests and cultivation practices contribute to cultivation risks. The results showed that the farm management risk of five potential agribusiness commodities was the largest from the production dimension, as shown in the following table.

### Table 5. Probability and sources of agribusiness risk.

| No. | Commodities | Prob. Of Production Dimension | Prob. Of Market Dimension | Prob. Of Financial Dimension | Total Probability |
|-----|--------------|-------------------------------|---------------------------|------------------------------|------------------|
| 1   | Chili        | 0,095                         | 0,122                     | 0,031                        | 0,248            |
| 2   | Soybean      | 0,044                         | 0,023                     | 0,026                        | 0,093            |
| 3   | Melon        | 0,128                         | 0,159                     | 0,053                        | 0,341            |
| 4   | Patchouli    | 0,078                         | 0,039                     | 0,069                        | 0,186            |
| 5   | Corn         | 0,006                         | 0,006                     | 0,002                        | 0,014            |

Production risk comes from climatic conditions, weather and pest attacks. For commodities with high risk such as patchouli, melons and chilies, the risk should be controlled with more adaptive technologies such as drip irrigation, use of soil mulch and environmentally friendly pesticides. High production risk will cause financial losses for the farm management of these five commodities. There are 3 sources of risk that exist in production risk. Scarcity of pesticides can cause death on farm due to exposed to disease. Lack of adequate equipment will affect the production of chili, melon and patchouli. Failure of watering control equipment will lead to reduction of potential productivity of chili and melon, even 12.8 percent of the melon death at a critical plant age. Critical plant age in chili and melon is just before fruiting. Another source of risk is irregular nutrients application. Fertilization requires five points, namely: the right type, the right amount/dose, the right method and the right time.
The risk type 2 comes from market mechanisms failure, namely the relationship between the amount of supply and market demand between planting and harvest time. Sometimes farmers plant when the price of this commodity is high. At harvest time, prices fall beyond farmers' expectations, even at the lowest price. Thus, the market risk is calculated from the market dimension, which is derived from the aspect of sales volume or the amount of sold and from the aspect of the selling price.

Financing risk is the risk received by farmers from the source and the amount of financing agreed between the farmer and the partner. In agribusiness, there are farmer financing partners in the form of in-kind production facilities contributions or capital participation. Usually farmers establish partnership with toke or shops. This partner is in the form of a production facility shop or buyers of agricultural products (toke). Specifically, for chili and melon farm management, there are 8 toke which provide capital to cultivate these two commodities. Investors usually provide assistance in purchasing production facilities, land processing costs, purchasing equipment such as sprayers, plastic mulch and water pumps [13, 14].

For chili and melon farm management, there are 8 threats related to risk, namely: pest control (A6), use of fertilizers (A5), decreased selling prices (B2), high rainfall (B4), increased production input costs (C2), increased marketing costs (C6), decreasing land quality (D1), and availability of new superior seeds (D2).

![Figure 2. Risk on chili and melon agribusiness in Aceh Province.](image)

In Figure 2, it can be seen that for chili and melon farm management, the most urgent thing for farmers is to control plant pests. The dominant pests in chili are aphids, fungi, and anthrax. Aphids and fungi can simultaneously invite anthracite on chili. Meanwhile, the dominant pests on melons were aphids and fruit rot bacteria. At the beginning of fertilization,
bacteria like melons. Thus, farmers must control this pest as early as possible. Comparative analysis of risks between commodities illustrates the significance of the commodity cultivated by farmers to the risks.

| Source of Variation | SS    | Df | MS    | F    | p-value  | F.critl |
|---------------------|-------|----|-------|------|----------|---------|
| Between Group       | 0.082 | 4  | 0.0205| 10.2 | 0.000002 | 2.41    |
| Within Group        | 0.341 | 270| 0.002005882 | 10.2 | 0.000002 | 2.41    |
| Total               | 0.423 | 274|       |      |          |         |

Farm management risk analysis is carried out by approaching the utilization of cultivation technology and market opportunities for the yield of each commodity. The amount of risk is sorted according to the level of cultivation technology, the marketing strategy, and the financing commitment. The table above shows very significant difference with $p$-value < $\alpha = 0.01$. This means that the risk of each commodity is very significant. This difference is due to differences in aspects of production, markets, and financing.

4. Conclusions

Commodities with the greatest production costs have the greatest opportunity, but also have the greatest risk. Agribusiness enterprises with the highest production costs per hectare are Chile, Melon and Patchouli, and the lowest production costs are Soybean and Corn. Commodity choice priority based on feasibility criteria is Chile, Melon and Patchouli, but based on the amount of risk, the priority commodities are soybean and corn. The highest risk sources for exclusive crops such as Chile and Melon are pest infestation and heavy rainfall. The highest losses in the case of crop failures is on Chilean and Melon

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