Mount Sinabung Eruption Impact on Local Economy and Smallholder Farming in KaroRegency, North Sumatra

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Abstract. Indonesia is a disaster prone country. One of the geo physical disaster is the prolonged of Mount Sinabung Eruption in Karo Regency, North Sumatra. This area is famous for horticultural (vegetable and fruit) producer in the region. The eruption has displaced people, destroyed infrastructure and livelihood. This research aims: (i) to investigate the magnitude of the economic losses, (ii) to find out impact on agricultural production and (iii) to investigate the adaptation pattern undertaken by farmers. The results of research showed that (i) the extent of losses on the regional level is bigger than the annual local government budget, whereas the feasibility of farm business deteriorated significantly, (iii) the disaster has jeopardized village self help organization, worsened access to farm credit as well as caused labour shortage in agriculture. Based on empirical finding, recommendation for the rehabilitation and mitigation is proposed.

1. Introduction

After 400 years of quiescence, Mount Sinabung roars back to life in 2010 with its activity up to alert level *warning* (level IV). The eruption has been ongoing until today (December 2017) which has lead to the displacement of 12,000 people. Karo Regency at the foot of Mount Sinabung is famous as a fruit and vegetable production area. Fifty nine percent (59%) of the damage and losses caused by the disaster is borne by the agricultural sector, especially the horticultural subsector. This research aims to (i) investigate the extent of losses due to the Sinabung volcano disaster, (ii) to analyze the losses on the level of farm business, (iii) to investigate the condition of supporting factors after eruption and (iv) to investigate the adaptation pattern undertaken by farmers in response to the risk of farming disruption due to volcanic ash rain. The empirical findings of this research will be used to propose measures that can be taken by the local government and the Regional Disaster Management Agency (BPBD) to assist farmers through appropriate recovery programs (rehabilitation) and to plan the development of agricultural sector as part of volcanic disaster mitigation program in the long-term (reconstruction phase).

2. The Magnitude of Damages and Losses

The eruption of Mount Sinabung has displaced 12,000 people (3,000 households) and 2,670 HHs have to be permanently relocated to new settlements. As of September 2017, only 370 HHs were successfully relocated to new settlements that have just been constructed. In the second phase, 1,683 households were relocated, but since the land for village development was not available, only 1,350 households were processed under an independent relocation scheme in which the victim's family have to find a new settlement location on their own with funds provided by the Regional

Disaster Management Agency. In addition, there are 648 families to be processed in the third phase of the relocation plan.

As stated by numerous studies [1]-[4], natural disasters in developing countries will directly affect agriculture and food security, as the greater the contributions of agricultural sector to Gross Domestic Product (GDP) and so long as it provides employment,the higher the level of losses that this sector experiences. Similar thing is found in Karo Regency, where the contribution of agriculture sector to Regional GDP and to employment was 61 % and 67% as the disaster struck [5].The agricultural sector bears almost 2/3 of the total losses, followed by the housing sector (28%). Considering that the household and farming are run under a farm household system, the losses in agriculture and housing sector are basically borne by one single family.

In line with experienced in New Zealand [6], that horticultural crops are most vulnerable against volcanic ash, the assessment conducted by the Regional Disaster Management Agency in 2015 [7] found out that in agricultural sector, the biggest loss was experienced by horticultural subsector (88.57% of total monetary value), especially vegetable crops where the heavy damage attacked 3,550.55 ha of plant with the main commodities affected include Chilli (47.91 %), Tomato (18.33%) and Potato (11.63%). The damage of fruit plants on 1,512.87 ha includes oranges (77.82%). Staple crops suffered damage of 1,221.91 ha with heavily damaged crops of dry land rice (62.80%) and maize (20.58%). Plantations are also affected by the exposure of volcanic ash but most of the plants have only mild/moderate damage that allows them to recover. The crop area damaged include 2,474.67 ha with main commodities of coffee (67.97%) and cocoa (23.57%).

The value of losses due to Sinabung volcano disaster will be more noticeable, if compared to the financial condition of Regional Government of Karo Regency. Total value of losses estimated by the Regional Disaster Management Agency[7]amounts to IDR 1.35 trillion and the value of agricultural losses amounts to IDR 1.06 trillion. Whereas the cost required for the rehabilitation and reconstruction amounts to IDR 3.6 trillion (especially agricultural sector spends Rp 1.21 trillion). In 2016, the Regional Budget Revenues and Expenditures of Karo Regency amounts to IDR 1.53 trillion [5].

As such, the cost needed for the recovery of agricultural sector due to eruption of Mount Sinabung nearly absorbed all regional expenditure within a year (80%). This underlines the view of UNDP[8], that disaster is an impediment to development in which limited budget that should be allocated for development purposes is otherwise spent on emergency responses and reconstructing damaged or lost facilities and infrastructure.

At the regional level, in addition to the destruction of thousands of hectares of planted areas, the eruption of Mount Sinabung that spewed volcanic ash has lead to the decrease of total cropping area especially staple crops area (dry land rice, corn and sweet potato) and horticultural crops where chilli, carrots, tomatoes and cabbage as most popular commodities cultivated by farmers. Figure 1 shows the development of cultivation of staple crops and horticultural cropping area which shows continuous improvement since 2002 with peak total area in 2010.

Due to eruption, the area of cultivation decreases and fluctuates according to volcanic condition. The chronology of eruptions was documented as follows[9]: (i) 29 August to 7 September 2010, the eruption produced volcanic ash reaching as high as 1000 - 5000 meters, (ii) 2011 to the end of 2013, nearly three years with relatively quiet conditions (non-eruptive), (iii) 18 December 2013 - January 10, 2014, the eruption and cold lava floods occurred, and the biggest threat is lava flood with limited impact on mountain foot of which it has actually been relocated and (iv) eruption with volcanic ash roared back to life in August 2015. By associating volcanic activity with the total staple crops and horticultural harvested area, it is indicated that the eruption will cause schock in the form of decrease in total cultivation area with one year lag.

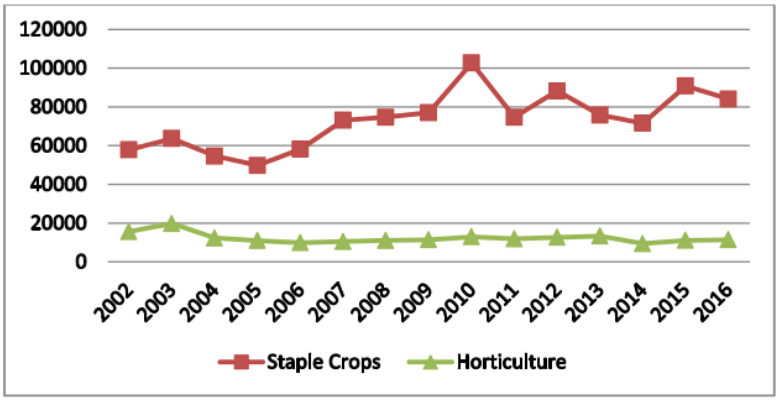

Figure 1. Development of Total Staple Crops and Horticultural Harvested Area, Karo Regency, 2002 - 2016 (in Ha)

3. Losses at the Level of Farm Family Business

In line with agricultural conditions at the regional level, there is a decrease in the total cultivation area at the farm business unit level. From interviews with 34 farmers in Simpang Empat District (one of the districts in the hazard zone II), it was revealed that there is a significant change in horticultural business. By comparing before and after situation of the eruption of Mount Sinabung (in 2009 vs. 2017), it was found that the total cropping area has decreased, productivity also decreased while on the other hand the production cost increased. The logical consequence of the changes of these three variables is the decrease in farm income.

The reduction in the cropping area and decrease in the production led to the decrease in the market supply, which eventually raised prices. However, the rise of the selling prices and thus the revenue, were far below the level of cost increase, thus the farm income experienced a substantial decrease. Two cost components that did not occur in a normal situation are technical actions to deal with volcanic ash and avoidance of the outbreak of certain pests after eruptions. To get rid of the ash covering plant leaves, farmers flushed them, which required pumping machine as well as its operational cost. Meanwhile, to prevent pest outbreak (especially against tomato crops), farmers set up nets surrounding the whole cropping area.

The financial damage caused by Mount Sinabung eruptions will be more conspicuous in the results of further farming analysis. While the business feasibility of carrot, cabbage, tomato and chilli farming was good before the eruptions (R/C ratio between 1.43 and 4.79), after the eruptions, only cabbage farming was economically feasible to be conducted (R/C ratio = 2.46), while tomato, carrot and chilli farming incurred loss with an R/C ratio < 1 (see Figure 2).

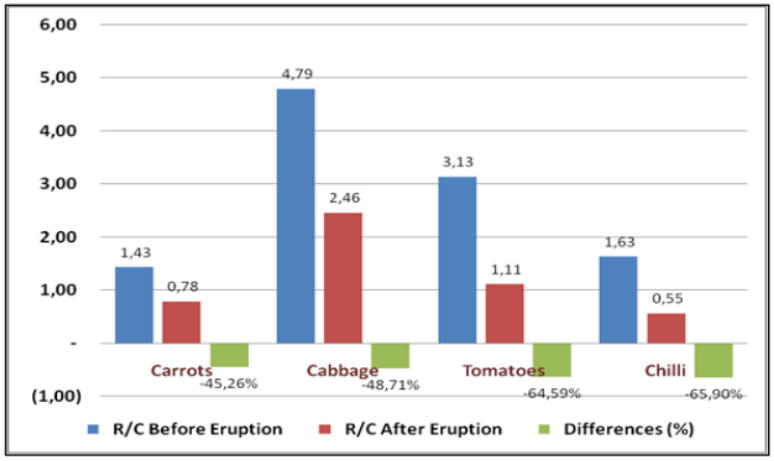

Figure 2. Feasibility of Horticulture Production Before and After Mt Sinabung Eruption (R/C ratio Comparison).

4. The Impact of Eruption on Farm Management

In running their farm businesses, farmers are relying on at least five factors that help support the success of their businesses[10]-[14], including (i) availability of production factors such as seeds, fertilizers and pesticides, (ii) availability of agricultural wage workers, (iii) availability of credit as a source of funding to finance production facilities and pay the workers, (iv) marketing guarantee for agricultural products and (v) the condition of social infrastructures (local institution) in agricultural sector such as self help organization and cooperative.

The results of interviews with farmers, with a scale of 0 to 100 discovered that the condition they face today is categorized as bad with a total score of 52.35. Likewise there are two factors that are still categorized in a good condition including the availability of production facilities and marketing of products, each with a value of 68.82 and 89.41. Distributors of production facilities and products wholesalers are located outside the village (in the Capital Regency), which is why they still exist despite the eruption. As for the other three factors, the condition is very bad after the disaster. Those poorest scores are the availability of credit for farm business (25.88), local social support system (34.71) and availability of wage workers (42.94).

5. Farmers Adaptation to the Volcano Disaster

In response to potential volcanic ash disrupting the crops, farmers react by maintaining existing farms and providing water pumps to water the plants on a daily basis in order to get rid of the ash that covers the leaves. However, in the long run, farmers reduce the total farm area in general.

The fluctuation depends mainly on the intensity of eruption of Mount Sinabung with a one-year lag. Similarly, in the short term (last four years), there has been changes in patterns of the cultivated commodity. Long duration production crops such as chilli, tomato and corn are consistently reduced and replaced by plants with shorter production cycle, such as carrots, beans and cabbage, which can be harvested less than three months (Figure 3).

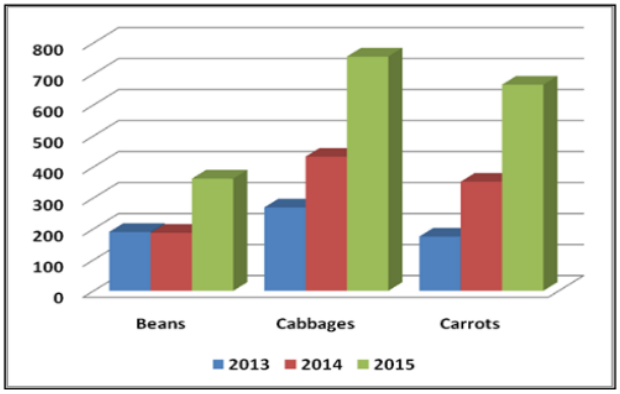

Figure 3. Development of Harvest Area of Horticultural Commodity with Shorter Production Cycle at Simpang Empat District, Karo Regency, 2013 – 2015 (in Ha).

6. Conclusions and recommendations

This study indicates that the eruption of Mount Sinabung has resulted in huge losses not only on the area directly exposed to volcanic ash (hazard zone I and II) but also on the whole area of Karo Regency as it deals with the damages and losses whose value is greater than the total regional expenditures in a year. Funds allocated from the Regional Budget Revenues and Expenditures for rehabilitation and construction should be used for other programs to improve community welfare.

At the farm level, the eruption of Mount Sinabung has weakened the feasibility of horticultural farming with a decrease of R/C value of 45 - 66% as compared to the period before the eruption. Some commodities such as chili and carrot are cultivated even in a loss condition with an R/C value <1.

In response to farming disturbance, farmers reduce the total cultivated area so that the trend of staple crops and horticultural cropping area significantly decrease, despite the fluctuation in which the area increases after the period of quiet volcanoes and the total area decreases after the eruption gets back alive within a year time lag.

To maintain the existing farms, farmers equip themselves with water pump machines to flush plants on a daily basis so that the leaves of the plants are free from volcanic ash. These efforts incur additional costs. Similarly, in the short term to reduce the risk of crop failure, there seems to be a clear pattern of adaptation in which farmers expand the harvest area of short-period-cultivation vegetable crops (harvestable before three months) such as beans, cabbage and carrot replacing chilli and tomato whose production period can reach 16 months.

Of the five factors supporting the farming, only two factors are still well functioning, namely the availability of production facilities and marketing of agricultural products, because business players in these two areas are located outside disaster-stricken area (the capital of regency). While other factors such as access to farming credit, availability of agricultural paid worker and local institution such as self-help organization are all in bad condition because the actors involved in them constitute the victims of volcano disaster.

Based on the findings of this research, it is recommended that in the rehabilitation phase, the Regional Government and Regional Disaster Management Agency (BPBD) to include pump machines and farm credit in the distribution package, but the provision of this assistance begins by forming community organization at the village level so that the provision of equipment is adjusted to the capacity of farm. In addition, village community organizations may help monitor the distribution and utilization of farm credits. For the long term, it is expected that government produce high technology and high value types of crops that can still produce well despite being exposed to volcanic ash, beside changing in agricultural technique. This type of specific commodity development effort can only be realized through experiments and collaborations with research institutes and universities.

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