Livelihood Vulnerability due to Climate Change: Differences in Smallholder Farmers in Rural and Semi-urban Areas

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Abstract. Smallholder farmers as contributors to national food production have been burdened by various problems on their shoulders including low incomes. However, they also have to deal with global pressures such as climate change. Climate change presents direct impact and significant risks to agricultural sector such as higher average temperature changes, frequent extreme climate events, and increased weather variability. This is certainly a danger to farmers' livelihoods because it causes the livelihoods of smallholder farmers to be more vulnerable. This study aims to determine the differences in the vulnerability of smallholder farmers' livelihoods in rural and semi-urban areas of Bandung Regency as a result of climate change. This study employed qualitative research methods with primary and secondary data sources. The primary data collected through observations and in-depth interviews with smallholder farmers from Laksana Village and Sekarwangi Village as well as secondary data derived from literature studies. The results show that farmers from rural areas are observed to be more vulnerable due to their inability to access various technologies and innovations in the face of climate change. However, they tend to have a fairly good adaptability by utilizing local knowledge and optimally using livelihood capital, whereas semi-urban farmers tend to adapt by using knowledge they got from local government and diversifying their income by working outside the agricultural sector. Based on the results, it can be concluded that differences in vulnerability of farmers are triggered due to availability of resources and capital, disaster management strategies, as well as access to knowledge and benefits from local governments.

Keywords: Climate Change; Livelihood Vulnerability; Smallholder Farmers

RUSET 2022, August 10-11, Bogor, Indonesia

DOI 10.4108/eai.10-8-2022.2338976

1 Introduction

Small farmers as contributors to national food production have been burdened by various problems on their shoulders including low income. However, they also have to face global pressures such as climate change. IPCC defines climate change as a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. In effect, climate change can have a direct impact on increasing the frequency and intensity of extreme weather events, increasing temperatures and sea levels, and changing rainfall patterns. In this regard, climate change also poses a significant risk of threatening crop production systems thereby threatening the livelihoods and food security of the billions of people who depend on agriculture (Nuraisah & Kusumo, 2019).

Agriculture is the sector most vulnerable to climate change due to its high dependence on climate and weather. Climate change affects agriculture such as through higher average temperature changes, frequent extreme climatic events, and increased weather variability that have an impact on plant growth, development and yield. Based on data collected by BPS, agriculture is a very vital sector in Indonesia's development because more than 80% of the population are informal workers in the agricultural sector. Climate change is a threat to people who make a living as farmers as well as a threat to a country's food security. Indications of climate change include the increase in air temperature, drought due to the long dry season, floods, and shifting of the rainy season.

In recent years, the shift in the rainy season has caused a shift in the planting and harvesting seasons for food commodities. Meanwhile, floods and droughts cause crop failure, crop failure, and even cause *puso* (Ruminta, 2016). The phenomenon of climate change turns out to be very closely related and affects the vulnerability of a farming household related to access to livelihood sources, especially in the agricultural sector. Furthermore, considering that food production also determines the price of food products at the producer level, it can also be said that the impact will also be felt on the welfare of farmers in general and farmers' income in particular. In other words, the vulnerability of the community does not only cover the fulfillment of food needs but more broadly also includes their livelihoods (Widada et al., 2014).

Previous research conducted by Ruminta (2016) showed that due to the diversity of climate patterns, agricultural systems, social, economic, political and environmental conditions, the hazards, vulnerabilities, and risks of climate change will differ from one place to another. This attracts researchers to examine the differences in the vulnerability of smallholder farmers' livelihoods in rural and semi-urban areas of Bandung Regency due to climate change. Vulnerability is the level of ability of an individual or group of people, communities in anticipating, tackling, maintaining survival and saving themselves from the impacts caused by natural hazards (Ruminta, 2016). Vulnerability is always changing along with changes in socio-economic conditions and environmental conditions in the vicinity. Bandung Regency is part of the Bandung metropolitan development area which is a hinterland and buffer area of Bandung City and one of the regencies that has good food security, but the development of Bandung City activities has forced a shift in economic activity to Bandung Regency (Dzikrillah et al., 2017).

This makes the areas in Bandung Regency characterized by being semi-urban areas that are quite developed with many development and improvement projects and some other areas still characterize rural areas. One of the areas that characterizes a semi-urban area is Sekarwangi Village, which is in the capital city of Bandung Regency, namely Soreang District and the area that characterizes a rural area is Laksana Village, which is in Ibun District and is directly adjacent to Garut Regency. The purpose of the study was to examine the differences in

the vulnerability of smallholder farmers' livelihoods in rural and semi-urban areas in the agricultural sector in Bandung Regency due to environmental changes, namely climate change. Another objective is to establish a knowledge base on the impact of climate change on agriculture in Bandung Regency. The results of the analysis from this study are also expected to be taken into consideration in the formulation of policies related to the socialization of the impacts of climate change on farmers and guidelines for local adaptation.

2 Methods

This research was conducted in Bandung Regency, West Java. The location of the research was taken using purposive sampling method, which was determined with the consideration that in these districts most of the population has a main job as farmers and are areas that are quite sensitive to climate change, so that it can represent research on farm households. The locations studied were rural areas and semi-urban areas. Determination of the location of the village is determined purposively, namely the sub-district located in the district capital and has the character of a semi-urban area and a rural area based on a map of the Bandung Regency area. The sample of semi-urban areas was selected from Sekarwangi Village, Soreang District and samples from rural areas were selected from Laksana Village, Ibun District.

The study was conducted from May to June 2022. This study used primary and secondary data. The primary data in this study were obtained by field surveys, in the form of interviews assisted by a list of questions with farmers and direct observations in the field. Secondary data obtained from several agencies. The criteria for farmers to be sampled are small farmers who have been carrying out food crop farming for more than 10 years. The data obtained were then analyzed using a descriptive method. Descriptive analysis was used to determine the knowledge of farmers on climate change, the perceived impact, and the adaptation strategies carried out.

3 Results and discussion

3.1 General Condition of Location and Characteristics of Farmers

Bandung Regency is located south of the equator at 107°22' east longitude to 108°50' east longitude and between 6°41' south latitude and 7°19' south latitude. Bandung Regency covers an area of 1,665.83 km² (166,583 Ha) or 4.7% of the area of West Java (37,173.97 km²) with most of it being used as an agricultural cultivation area, which is 53.22% of the total area of 176,238.67 Ha. The topography of Bandung Regency is flat, wavy, to hilly, most of the paddy fields are located on medium plains with an altitude of 500-750 m above sea level. The area of Bandung Regency has a tropical and wet climate (Ruminta, 2016). Throughout the year the district is only affected by two seasons, namely the rainy season and the dry season. The cropping pattern that is developing in the farming community of Bandung Regency currently refers to the cropping pattern that applies nationally with a pattern following the distribution of rainfall.

Sekarwangi is a small village and is the lowest point in Soreang District with an area of 666 meters above sea level. In the semi-urban area, namely Sekarwangi Village, the existing small farmers are dominated by sharecroppers who work on other people's land. Most of the cultivated land is owned by people outside the village. The area of land that is cultivated ranges from 1-3 hectares and usually in one land is cultivated by more than one person. In irrigating

their land, farmers rely on irrigation water. In contrast to Sekarwangi Village, the observed rural area is Laksana Village which has a height of 917 meters above sea level. In this village there are still many farmers who have their own land but with a narrower land area. The land owned by farmers ranges from less than 1 hectare per head of household. This is one of the causes of land fragmentation when land is inherited from parents to their children. The characteristics of the area in the highlands make the rice fields in this area apply a terracing system. Laksana is a typical rural-traditional agricultural village of West Java, where farming is on precipitation as the water-irrigation supply. The use of modern technology for farming is very limited.

3.2 Farmers' Knowledge of Climate Change

In general, farmers' understanding of climate change varies. Farmers always deal directly with the climate in their farming activities. In the span of 5-6 years, farmers in both regions feel that there is a change in the environment. Farmers in semi-urban areas tend to perceive climate change as global warming, whereas global warming itself is part of climate change. Meanwhile, farmers in rural areas stated that they knew about climate change, but they could not explain in detail about climate change itself. In general, they interpret climate change as a transition season or erratic weather changes. There are very few studies and understanding of climate change among farmers, even though farmers often face climate change in their lives.

Changes felt by farmers are changes in temperature and changes in rainfall. Both of these are felt by farmers because they also have an impact on pest attacks. The impact of changes in rainfall is significant on increasing pest attacks on plants. In addition, the increase in air temperature also affects the life cycle of the pest, high temperatures will accelerate its life cycle so that the regeneration cycle is very fast (Sarvina, 2019). Climate change causes changes in environmental conditions that have an impact on less than optimal plant growth and development. In less than optimum conditions, plant growth will be disrupted which in turn reduces production and yield quality. Each plant requires different climatic conditions to be able to produce optimally, so that climate change will have a different impact on each type of plant.

3.3 Impact of Climate Change on Farmers' Vulnerability

The implications of the beginning of the rainy season and the dry season in Bandung Regency are very decisive when starting the planting and harvesting seasons. Both small farmers in rural and semi-urban areas, in recent years feel that their knowledge and predictions of seasonal patterns are often wrong. This is caused by changes or shifts in the planting period, namely the average planting time becomes more advanced or backward from the usual time. In addition, both in rural and semi-urban areas, farmers feel that the intensity of the sun's rays is uncertain every year. This makes it difficult for farmers who are small farmers to dry rice. Small farmers in rural areas who still rely on traditional farming feel this affects the time they sell their agricultural products. Previously, if the sun was hot, farmers could dry for 2-3 days after harvesting, but due to the intensity of sunlight and erratic rainfall, farmers could dry for 5-7 days and this could be done up to 3-4 times. However, this is not a problem for small farmers in semi-urban areas because they already use grain dryers so they are less dependent on the sun.

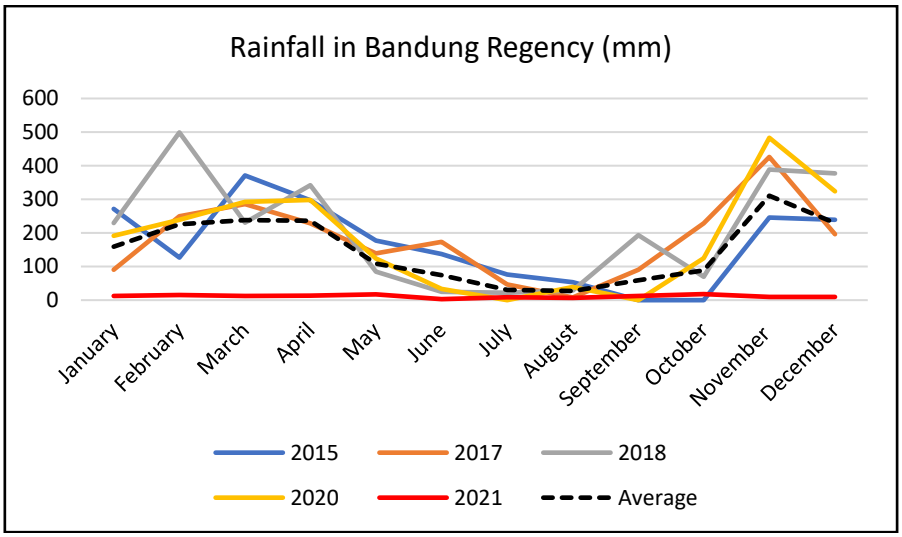

Figure 1. Rainfall in Bandung Regency

Identification of the impact of climate change on small farmers is carried out in three aspects, namely the impact on the physical aspect, the ecological aspect and the socio-economic aspect. Physical and ecological impacts were observed directly on the changing physical environment at the study site and asked the farmers about it. The ecological impact is felt by the threat of disaster. Rural areas tend to still have sufficient catchment areas, the threat of disaster comes from landslides when rainfall increases. Laksana Village, which is located in the Ibun District, has the characteristics of mountainous relief that rises and falls which makes the area prone to erosion. Erosion is an event of the movement of soil or part of the soil from one place to another by natural media, namely water. The occurrence of erosion is natural, but if this process goes too fast (accelerated erosion) then soil loss will occur faster than the formation itself (Salean & Andriansah, 2021).

In contrast to Laksana Village, the threat of disasters in semi-urban areas tends to be flood disasters as a result of changes in rainfall and reduced water catchment areas as well as changes in land cover due to development. When rainfall increases, the threat of flooding also increases, especially inundation floods. During high rainfall, rainwater is not absorbed directly but inundated lower areas and this has an impact on several rice fields in Sekarwangi Village. Although different, the two threats have an impact not only on the land cultivated by farmers but also on the houses where farmers live. Socio-economic impacts arising from climate change identified from the understanding of farmers show that there are similarities between farmers in semi-urban and rural areas. Climate change causes a decrease in crop productivity, which is triggered by the difficulty of determining the season, increasing pest attacks, and erratic rainfall.

3.4 Risk of Crop Failure and Adaptation Strategies

As a result of erratic rainfall, farmers experience decreased production, delayed planting schedules, water shortages, and increased farming costs. Climate change can have a negative impact because it can cause a decrease in quality, an increase in pest attacks, crop failure and a decrease in income, so that it can cause a decrease in the level of farmers' welfare. When experiencing crop failure automatically farmers also experience a decrease in production. The increase and decrease in farm production will affect the income and profits received by

farmers, in other words it will affect the source of livelihood, especially for small farmer households. Climate change which results in decreased production forces farmers to carry out a certain adaptation strategy to maintain their livelihoods.

In rural areas, access to assistance and socialization related to agriculture is difficult and is one of the triggers for the lack of knowledge of farmers about climate change and its impact on agriculture. Small farmers in rural areas tend to use a trial-and-error system in dealing with climate change that causes changing planting times. At first one of the farmers would try to plant at the usual planting time, but the farmer did not succeed in harvesting. Then other farmers tried to change the early planting period later than usual and it turned out that by changing the beginning of the planting season the farmer managed to harvest, although the results were not as much as in the previous planting season. However, farmers tend to stay in the on-farm sector because it is still difficult for small farmers in rural areas to access or work in the non-farm sector.

In semi-urban areas, easy access to information, assistance, and innovation helps them adapt to climate change, especially high rainfall. Sekarwangi is located in an area prone to flooding when rainfall is high. The Bandung Regency Agriculture Office often provides socialization on the problems faced and also assistance such as fertilizers, seeds, and pesticides which have an impact on the stability of their farming although there has been no special socialization regarding climate change and its impact on agriculture. However, it is undeniable that the decline in production is quite pronounced so that low incomes from agricultural products encourage farmers to look for additional income alternatives to meet the needs of their families. One of the efforts made by small farmers in semi-urban areas is to undergo a double income pattern (undertake multiple employment strategies) and work in the non-farm sector such as being a laborer, taxi driver, and others.

4. Conclusion

In the agricultural sector, the concept of risk can be interpreted as a possibility that can cause losses represented by a decrease in food crop production. The danger of this decline in production can lead directly or indirectly to a decrease in the welfare of farmers and a decrease in food supply in an area. It can be concluded that climate change has a considerable impact on agriculture, especially for small farmers who run rice farming in both rural and semi-urban areas. In this case, if smallholder households manage to survive by controlling the negative impacts of climate variability, then they are considered to have livelihood security. In the long term, livelihood security is reflected in guaranteed income, food sufficiency, and welfare. From the foregoing, the degree to which climate change events affect agricultural systems depends on various factors. Due to the diversity of climate patterns, agricultural systems, social, economic, political and environmental conditions, the hazards, vulnerabilities, and risks of climate change in rural and semi-urban areas are different. The differences are triggered by the availability of resources and capital, disaster management strategies, and access to knowledge and benefits from local governments.

The issue of climate change is not a new thing. However, most farmers and rural communities are not aware of this condition. In these conditions, adaptation of farmers is needed. Thus adaptation to climate change is a strategy that is needed at all scales to ease efforts to mitigate the impacts of climate change that occur. A good understanding of how farmers perceive climate change is knowing the definition of climate change, its impacts, and appropriate adaptation measures to the impacts caused by climate change. A comprehensive

study of the impact of climate change on agriculture needs to be carried out to determine the right steps for the government and farmers. In addition, it is necessary to increase the understanding of agroecosystems by farmers so that they can better understand and respond to existing changes. Some indigenous knowledge that is based on the arrangement of the planting period also needs to be reviewed.

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