IJPD The Indonesian Journal of Planning and Development

P-ISSN: 2087-9733 E-ISSN: 2442-983X

Journal Homepage: http://ejournal2.undip.ac.id/index.php/ijpd

Volume 5 No 2, October 2020, 66-77
http://dx.doi.org/10.14710/ijpd.5.2.66-77

OPEN ACCESS

Community Resilience to Climate Change in Agricultural Sector
(Case Study of Sentolo Subdistrict)

Submitted: 9 October 2019
Accepted: 7 October 2020
Available Online: 31 October 2020

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Abstract

Climate change has become a global issue over last decades. Its impact affects to various aspects of human life. Uncertainty of dry and wet seasons present a consequence to and create losses on agriculture sector. Therefore, resilience to climate change is necessary for farmers. This research aims to identify exposure, sensitivity, and adaptive capacity within the framework of community resilience to climate change in agricultural sector. Parameters used in this research include rainfall variability representing system exposure, landuse and topography representing sensitivity, and farmer's knowledge and behavior representing adaptive capacity. Secondary data used in this research are daily rainfall data, land use and topographic maps, while primary data obtained by interview using purposive sampling method to measure adaptive capacity of farmers community. We employ trend, spatial, and descriptive analysis. The results show that Sentolo Subdistrict has a relatively high exposure to extreme events both in wet and dry seasons that occurred 5 times in 12 years. However, this high exposure did not affect agriculture sector on Sentolo significantly, both in terms of damages and losses to farmers. It indicates that the sensitivity to climate change in this area is low, while farmers' community in Sentolo has a high level of adaptive capacity. They have sufficient level of knowledge to climate change, better adjustment to technology and well-managed assets. This interplay shows that the agricultural community in the study area has a relatively high resilience to climate change.

Keywords: agriculture; climate change; resilience

1. Introduction

The effect of human activities towards their environment in term of Green House Gases (GHG) emission has increased over the recent decades and trigger climatic change (IPCC, 2014). This phenomenon has enormous impacts towards Indonesian population and their economic sectors, including agriculture and business (Naylor, Battisti, Vimont, & Falcon, 2007). Climate change affects on climate variability, for example in terms of changes on rainfall and its intensity, anomalies of the wet or dry season, increasing temperatures, and higher frequencies of floods and droughts (Leichenko, 2011; Turral, Burke, & Faurès, 2011).

In the agriculture sector, the above changes will significantly affect farming season and its pattern, type of crops, and increasing risk of crop failures due to floods and droughts. In the statistical term, climate change could affect the higher variance of observed climate parameters (e.g. rainfall, temperature, and humidity) far away from their mean values. This condition leads to increasing extreme weather events and a higher uncertainty of the future climate condition (Christoff, 2016; Rhodes, 2016).

Considering that the agriculture sector is strongly dependent to climate condition, the increasing uncertainty of climate conditions has been proved to produce higher losses to local farmers (Nelson et al.,

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How to Cite:
Nucifera, F., Riasasi, Widiyana., Sekaranom, A.B., & Nurjani, E. (2020). Community resilience to climate change in agricultural sector (case study of Sentolo Subdistrict). *The Indonesian Journal of Planning and Development*, *5*(2), 66-77. doi:10.14710/ijpd.5.2.66-77.

2009). In Indonesian context, agriculture is often considered as a traditional sector with a relatively low technological exposure. As a result, agricultural sector may have a low coping capacity towards higher climate variability. For an example, an old practised methodological wisdom of traditional farmers known as *pranonto-mongso* to determine the beginning of rainy season is no longer relevant. The method has been observed to become less effective in the present (Retnowati, Anantasari, Marfai, & Dittmann, 2014; Yamauchi, Sumaryanto, & Dewina, 2010).

Resilience is dynamic and always changing depends on spatial and temporal scale. Factors of communication, risk, awareness, and preparedness influence resilience measurement, particularly in social resilience. Social resilience is strengthened through development and implementation of disaster plans, willingness to purchase for insurance, and sharing information in recovery process (Cutter et al., 2008). Resilience capacity has main drivers of livelihood strategies, level of education, and access to services (Alam, Alam, Mushtaq, & Filho, 2018).

Farmer's households, the most affected rural communities, have been performing alteration in their agriculture management in response to climate change (Khanal, Wilson, Hoang, & Lee, 2018). Moreover, farmers commenced autonomous adaptive practices such as changing crop varieties, adjusting sowing schedule, crop diversification and using intensive fertilization (Putri & Suryanto, 2012; Trinh, Rañola Jr, Camacho, & Simelton, 2018; World Bank, 2010). Farmer's adaptation strategies vary in each region depending on its physical landscape, socioeconomic, and institutional condition (Below et al., 2012; Deressa, Hassan, Ringler, Alemu, & Yesuf, 2009; Khanal et al., 2018; Tompkins & Adger, 2004). Nevertheless, climate change adaptation practices that applied in several developing countries including Indonesia are still limited (Dang, Li, Bruwer, & Nuberg, 2014; Fedele et al., 2016).

Several studies have been conducted to capture resilience and adaptation strategies to climate change in Indonesia. Saptyuningsih, Diswandi, & Jaung (2019) stated that social capital affects farmer's behaviour to climate change adaptation. Farmers with higher social capital tend to be more adaptive to climate change impacts. Natural resource management also become imperative to support community resilience as ecosystem services in reducing climate-related disaster vulnerabilities (Fedele et al., 2016). Farmers have already recognized about the risk of climate change, but the awareness of adaptation remained low (Putri & Suryanto, 2012). These previous studies focused on social and economic aspect whereas physical landscape aspect still have insufficient discussion.

To fill in this knowledge gap, this research aims to identify exposure, sensitivity, and adaptive capacity within the framework of community resilience to climate change in agricultural sector. We analysed both physical and social aspect regarding to climate change. Parameters used in this research were rainfall variability as an exposure, landuse and topography as sensitivity, and farmer's knowledge and behaviour as adaptive capacity. Interaction between three parameters build community resilience to climate change especially in agricultural sector.

2. Research Method

Resilience is defined as the capability of a system to survive and recover from shocks which is described by a degree of exposure, sensitivity, and adaptive capacity (Füssel, 2007). Human and environment will be less vulnerable and high resilience, if they are less exposed, less sensitive, and better adaptation (Finan, Austin, & McGuire, 2002; Smit, Burton, Klein, & Street, 1999). Major steps in this research includes: (a) an exposure identification over rainfall variability analysis; (b) sensitivity identification through landuse and topography analysis; and (c) an adaptive capacity identification through socioeconomic analysis. This data, data source and methods used in this research are summarized in Table 1.

Table 1: Summary of Data, Data Sources and Methods

Data	Source	Methods
Daily rainfall data 2008-2018	IMERG Precipitation Data from NASA (https://giovanni.gsfc.nasa.gov/giovanni/)	Extreme rainfall analysis, trend analysis
Land use map 2016	Geospatial Information Agency (BIG)	Spatial analysis
Digital Elevation Model	SRTM imagery	Topographical analysis
Adaptive capacity	Interview	Descriptive analysis
Climate-related disaster	Mass media	Descriptive analysis
Agriculture productivity	Bureau of Statistics	Descriptive analysis

Exposure to climate change is a degree in which systems are exposed to major climatic variations (Füssel and Klein, 2006). Extreme rainfall events tend to give an impact on crop productivity and cause declining food production (Lobell, Schlenker, & Costa-Roberts, 2011; Olesen et al., 2007). Extreme rainfall analysis was used to determine exposure of research area to climate change. Indicators of rainfall extreme events is described in Table 2. Trend analysis was carried out to determine tendency of extreme rainfall events using Mann-Kendal test method.

Sensitivity to climate change is described as a level in which a system is affected by climate change either adversely or beneficially (Füssel and Klein, 2006). Land use types especially agriculture receive different impacts on climate change. For example, drought has a negative impact on cropland and a positive impact on grassland and marginal land (Mu, Sleeter, Abatzoglou, & Antle, 2017). For the assessment of sensitivity to climate change, we used topographical condition and historical events analysis. By identifying the topographical characteristic and agricultural land use of the area and climate change's effect on agricultural from history events data, the level of sensitivity could be determined.

Table 2: Indicator of Rainfall Extreme Events

Indicator	Description
R100mm	The number of rain day with rainfall larger than or equal to 100 mm
R99p	The number of rain day with rainfall larger than or equal to 99th percentile of data series
Precipitation total (PRCTOT)	Total rainfall amount in rainy days
Consecutive dry days (CDD)	Maximum length of dry spell which is less than 1 mm rainfall

Source: Supari, Sudibyakto, Ettema, & Aldrian (2012); Tank, Zwiers, & Zhang (2009)

Adaptive capacity to climate change is described as the ability to cope with climatic hazard (Füssel, 2007). Assessment of adaptive capacity was conducted by interviews to the farmers using a purposive sampling method. This research focused on farmers who join farmer group to represent their condition and effort to cope with climate change. Association of farmer group is available in each village to coordinate farmer groups in a lower level. Application of purposive sampling method intended to take respondents from the coordinator and members of the association of each village. It was assumed that association of farmer group has the same policy and regulation with the farmer group in a lower level. The sample combination of coordinator and members of the community association could represent the farmer community conditions in Sentolo Subdistrict. Questionnaire covers information on building adaptive capacity, which used approach of five key domains across a range of disciplines, namely: (1) assets in times of need; (2) flexibility to change strategies; (3) ability to organize and act collectively; (4) learning to recognize and respond to change; and (5) agency to determine whether to change or not (Adger, 2003; Brown & Westaway, 2011; Cinner et al., 2018; Pelling & High, 2005). Table 3 shows several parameters used in the assessment of the adaptive capacity.

Table 3: Adaptive Capacity Domain and Parameter

Domain	Parameter
Assets	**Knowledge**: understanding of climate change and the impact
Flexibility	**Technology**: access to technology; adjustment to technology
Organization	**Financial**: livelihood strategies; agricultural insurance
Learning	
Agency	

3. Result and Discussion

3.1 Characteristics of Sentolo Subdistrict

This study was conducted in Sentolo Subdistrict, Yogyakarta Province-Indonesia (Figure 1a). In detail, this area has 8 villages within the total area of about 5.265 hectares (Central Bureau of Statistics Kulon Progo Regency, 2018). This area is bordered by Nanggulan Sub-district in the north, while in the east, it is bordered by Progo River, Sedayu and Moyudan Sub-districts. In the south, the area is bordered by Lendah Sub-district, while in the west it is bordered by two sub-districts, namely Pengasih and Panjatan Sub-districts (see Figure 1c). Based on its surface condition, about 45% of the Sentolo area consist of flat topography, while about 35% of the area consist of hilly topography (see Figure 1b). The rest (about 20%) are mountainous area.

3.2 Agriculture Condition in Sentolo Subdistrict

Sentolo Subdistrict consists of 8 villages which are Demangrejo, Srikayangan, Tuksono, Salamrejo, Sukoreno, Kaliagung, Sentolo and Banguncipto. As an agricultural center, Sentolo subdistrict has several agricultural commodities. Agricultural commodities for include rice, corn, secondary crops, cassava, soybeans, peanuts and green beans (Central Bureau of Statistics Kulon Progo Regency, 2018). Productivity from these commodities was describe in the Figure 2. Cassava was the highest productivity while green bean was the lowest.

3.3 Exposure

3.3.1 Rainfall

Having a tropical region, Sentolo Subdistrict is portrayed by abundant rainfall throughout a year. Extreme rainfall analysis in this research was presented by wet and dry extremes. The indicators used in wet extreme analysis include R100mm and R99p, while dry extreme analysis used CDD (consecutive dry days) as an indicator. Annual rainfall in Sentolo Subdistrict in 2008-2019 tends to decrease with Z value of -1,03. Nevertheless, the result is not statistically significant.

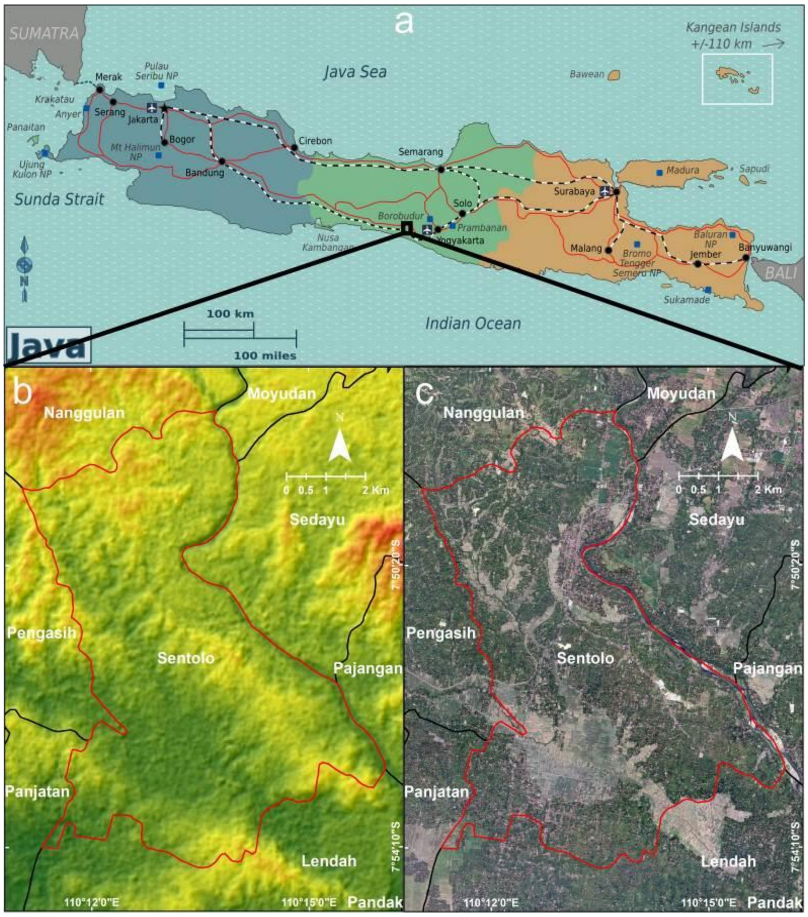
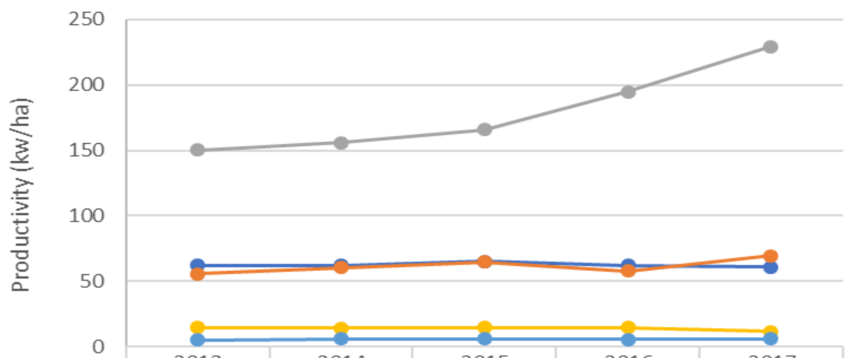


Figure 1. (a) Location of Sentolo Subdisdrict; (b) Topographical Map of Sentolo;
(c) Sentolo from Satellite Imagery



	2013	2014	2015	2016	2017
Rice	62,1	62,19	65,11	62,18	60,71
Corn	55,72	60,13	64,58	57,89	69,46
Cassava	150,28	155,97	165,71	194,63	229,35
Soybean	14,34	13,87	14,52	14,57	11,48
Green bean	5,44	5,86	5,82	5,47	5,91

Figure 2. Productivity of Some Commodities in Sentolo Subdistrict
(Source: Central Bureau of Statistics Kulon Progo Regency, 2018)

For 12 years period, the highest rainfall occurred in 2010 which is valued 3.565 mm. Based on extreme value classification, high rainfall extreme values occurred in 2010 and 2016 (Figure 3). In 2010, the frequency of extreme daily rainfall was the highest, specifically 9 times of rainfall which was valued more than 100 mm per day in one year (Figure 4).

High rainfall in 2010 was triggered by a strong La Nina event which increased trace wind so that raise rainfall intensity in Indonesia (Bureau of Meteorology, 2019; Nucifera, Riasasi, & Permatasari, 2019). La

Nina event in 2010 had significant impacts on various aspects including agriculture (Vargas et al., 2017). Sentolo Subdistrict experienced crop failure of corn, chillies and shallot covering 262 Hectares area inundated due to flood (Government of Kulon Progo Regency, 2010). La Nina hit again in 2016 but with a smaller intensity compared to 2010 event (Bureau of Meteorology, 2019). Several number of paddy fields were inundated by flood because of this La Nina event (Sekarini, 2016).

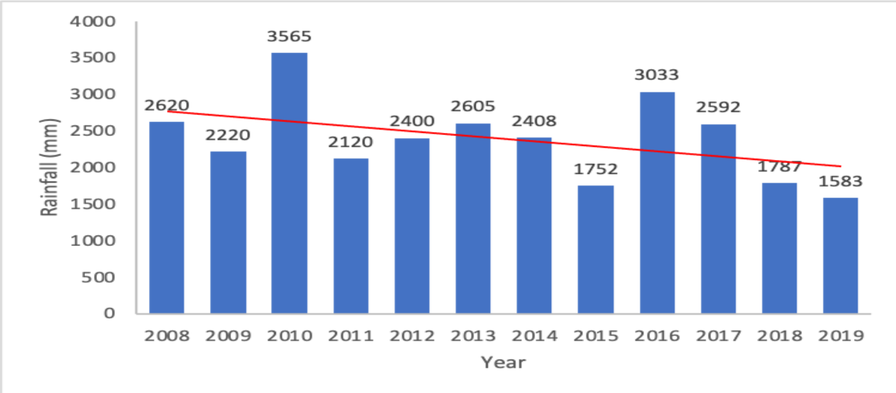


Figure 3. Annual Rainfall in Sentolo Subdistrict 2008-2019

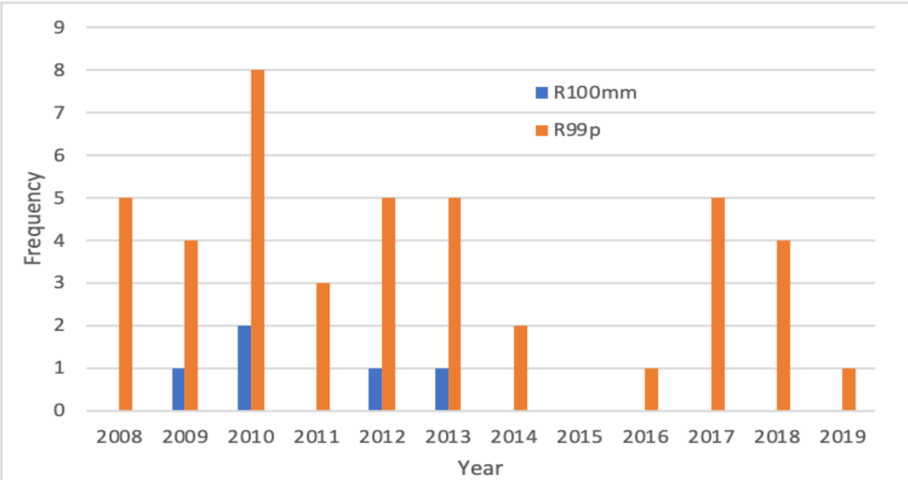


Figure 4. Wet Extreme for Daily Rainfall in 2008-2019

Based on extreme value classification, dry extreme events occurred in 2015, 2018 and 2019 which has the lowest rainfall for 12 years (Figure 3). Dry extreme events were indicated by the long average of consecutive dry days (CDD) per months (Figure 5). Longer consecutive dry days reduce soil moisture then lead to drought condition. El Nino caused dry extreme events in 2015, 2018 and 2019. A strong El Nino event in 2015 resulted in widespread drought in Indonesia and Australia (Bureau of Meteorology, 2016; Athoillah, Sibarani, & Doloksaribu, 2017). People in the Sentolo Subdistrict struggled for clean water especially in Tuksono Village (Hary, 2015). However, water needs for agriculture in Sentolo District was fulfilled using irrigation water from Kalibawang (Kartika, 2015).

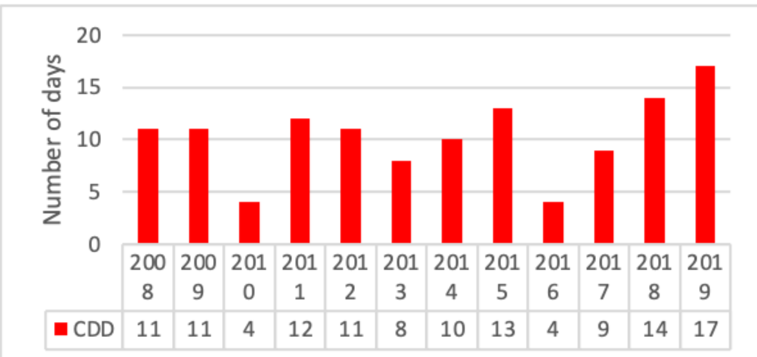


Figure 5. Average of Consecutive Dry Days (CDD) per Month in 2008-2019

Generally, Sentolo Subdistrict has high exposure to extreme weather events. Extreme weather events are generated by atmosphere dynamics in global, regional, and local scale (Gernowo, Kusworo, & Arifin, 2013). Regional atmosphere dynamics such as ENSO and tropical cyclones triggered extreme weather events in Sentolo Subdistrict. The geographic location of Sentolo Subdistrict which is close to the ocean causes the impact of atmosphere dynamics more severe.

3.4 Sensitivity to Climate Change

Sensitivity describes the impact that occurs in a system due to climate change, both positive and negative. Sensitivity of agricultural sector to climate change is determined by several factors including agricultural landuse type and topographic condition (Ogwang, Chen, Li, & Gao, 2014; Rojas, Li, & Cumani, 2014). Exposure to climate change gives different impacts for each agricultural landuse type. Agricultural landuse in Sentolo Subdistrict consists of paddy field, reeds, cultivated crops, cropland, and bushes. Landuse map of Sentolo 2016 is presented on Figure 6.

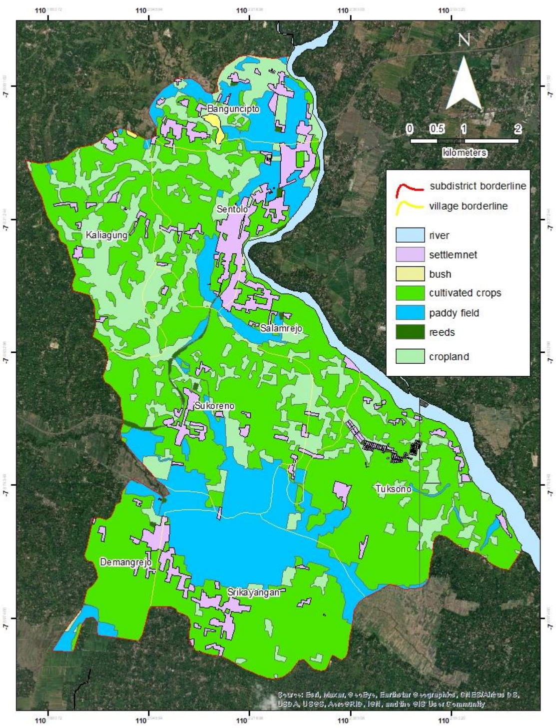


Figure 6. Land Use Map of Sentolo Subdistrict 2006
(Source: Geospatial Information Agency, 2006)

Most of landuse in Sentolo (70%) are cultivated land and crop land which are categorized as dry land agriculture. Dryland farming requires less water supply than wetland farming. It makes dry land more resistant to drought than wetland. However, dryland farming with corn, chilies and shallots were affected by floods during La Nina in 2010 (Government of Kulon Progo Regency, 2010). Declining cropland productivity, especially rice, also occurs when the rice fields are inundated because of increasing rainfall (Santikayasa, Amdan, Perdinan, & Sugiarto, 2018).

Most of paddy field (90%) in this area are irrigated. Irrigated paddy fields are not completely dependent on climatic and weather conditions. It makes irrigated paddy field has lower sensitivity to extreme weather events particularly dry extreme. Farmers have been doing irrigation as a response to reduce crop failure risk due to drought (Elsner et al., 2010). During El Nino 2015, irrigated paddy field in Sentolo were not affected by drought and did not experienced losses. But during prolonged El Nino 2018-2019, some of paddy field experienced crop failure. This is because the duration of El Nino is quite long, about 10 months so that irrigation is not able to supply all the water needs. The impact of El Nino on agriculture varies in various places due to various factors, including the use of agricultural technology, plant varieties, land physical conditions, and plant phase conditions (Iizumi et al., 2014). Annual crops planted in October-November in the Southern Hemisphere are less likely to be affected by El Nino because the 30-year El Nino pattern occurs in April-May-June (Rojas et al., 2014).

Most of Sentolo Subdistrict has an undulating topography with 2-8% slope (Figure 7). This has an impact on sensitivity to extreme rainfall and inundation. Flat topography with a slope of less than 2% is mostly paddy fields. The location of paddy fields in Sentolo Subdistrict is not directly adjacent to a large river so the risk of experiencing flooding and inundation is low. The sensitivity to extreme rainfall is lower than other sub-districts such as Lendah and Galur, which are mostly in flat topography and are in the estuary of the Progo River.

Sentolo Subdistrict generally has a low sensitivity to extreme weather events due to climate change. Agricultural technology such as irrigation has reduced risk of crop failure due to extreme events. The topography, which is mostly undulating and not close to the river, has a positive impact, so it tends to be low risk for flooding.

3.5 Adaptive Capacity to Climate Change

Resilience usually associates with adaptation, which adaptation to climate commonly is described as ability of adjustment to a system by following its characteristics and behaviour in order to cope with the change of climate (Brooks, 2003; Smit, Burton, Klein, & Wandel, 2000). Adaptive capacity appears as measured ability to deal with the effect of vulnerability of socio-economic and environmental system due to climate change. The greater the adaptive capacity of a system to given climate event, its vulnerability is getting lower (Swanson, Hiley, Venema, & Grosshans, 2009). Farmers' capacity to adapt on climate change shows sustainability of the agriculture. It describes how farmers to learn, respond, and act on unavoidable phenomenon with several adjustments. Assets, flexibility to change strategies, ability to organize and act, learning to recognize and respond to changes, and agency to determine to change or not are domains to build adaptive capacity (Adger, 2003; Brown & Westaway, 2011; Cinner et al., 2018; Pelling & High, 2005). Adapting to the main domains to build adaptive capacity, the research measured capacity of farmers in Sentolo subdistrict by domain of learning, assets, flexibility, and organizing that explained as follows.

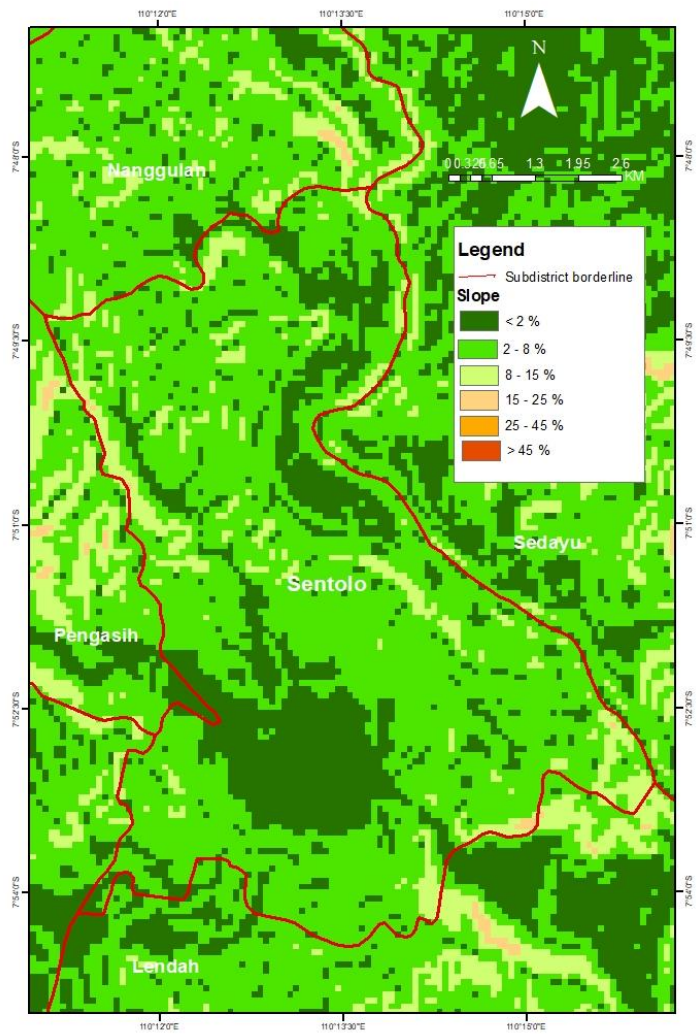


Figure 7. Slope Map of Sentolo Subdistrict

3.5.1 Knowledge on Climate Change

Knowledge or education associates to domain of learning that reflects capacity to generate, absorb, and process new information about change, particularly the climate (Adger, Arnell, & Tompkins, 2005; Cinner et al., 2018; Folke, Hahn, Olsson, & Norberg, 2005; Lutz, Muttarak, & Striessnig, 2014). Provision of access to farmers' knowledge on climate change is necessary to build adaptive capacity in agricultural communities. Measurement on knowledge level of the farmers classifies three categories which describes their understanding of the concept of climate change. Most of the respondents do not understand about the concept of climate change but they can mention characteristics of climate change, with percentage of 87.5%. As much as 12.5% of respondents do not understand about climate change, however, none of the respondents understand about the concept of climate change and its characteristics (Table 4). The result explicitly shows that the farmers do not understand about literally the concept of climate, nevertheless they have understood the changing weather patterns from day to day.

Learning to climate change adaptation requires networks, in terms of community of practice to share experiences of knowledge and ecological surprise through social organization (Cinner et al., 2018; Pahl-Wostl et al., 2007). In Sentolo, there are several farmers' groups that its function is as information sharing platform, without exception the climate change. The Office of Agriculture and Food Security in Kulon Progo Regency took part on the organization by delivering the information. Unfortunately, many Sentolo's farmers consider joining the organization was unnecessary, therefore the information was not delivered to most of the agriculture communities.

Table 4: Farmer's Knowledge about Climate Change

Parameters	Percent of respondents
Knowledge of climate change	
- Do not understand about climate change	12.5
- Do not understand about the concept of climate change but they can mention characteristics of climate change	87.5
- Understand about the concept of climate change and they can mention characteristics of climate change	0

3.5.2 Adjustment to Technology

Impact of climate change leads to severe damage and losses in agricultural sector so that farmers must manage this negative impact by improving adaptation strategies on their farming method (Arunrat, Wang, Pumijumnong, Sereenonchai, & Cai, 2017; Azadi, Yazdanpanah, Forouzan, & Mahmoudi, 2019; Füssel, 2007). The flexibility is necessary to get along to the change, which is the flexibility on building adaptive capacity emphasizes on capturing diversity of potential adaption strategies available (Cinner et al., 2018). In Vietnam, farmers' adaptation strategies include change farming calendar, switch crop varieties; intercropping, modify cultivation method and monitoring seasonal forecast, in terms of plantation (Trinh et al., 2018). Those strategies were branched out of domain of flexibility.

Technology has embodied into almost all human live aspect, included its utilization for agriculture. Technology for agriculture has been developed to facilitate agriculture sector, mostly since the climate has changed that led to changing of season for plantation. Utilization of technology is a strategy option to adapt to the change. Farmers' access to technology was used to assess the flexibility of adaptive capacity.

Government has prioritized adaptation strategies to climate change. It was stated in Strategic Planning of Department of Agriculture and Food Security Kulon Progo Regency 2017-2022. Government launched a program for protecting farmers from climate change impact, such as training to farmers to increase their capacity in dealing with climate change.

Ministry of Agriculture has launched an Integrated Farming Calender locally known as *Kalender Tanam Terpadu (KATAM*) in response to climate change impacts on agriculture. KATAM provides information about potential cropping patterns, planting times, potential planting areas and recommended adaptive technologies at subdistrict level throughout Indonesia. This system is operated based on climate forecast per season that can be integrated with fertilizer recommendation. Farmers in Sentolo subdistrict can access this technology by themselves or by guidance of facilitator from government.

The parameter to assess the domain of flexibility is willingness to accessing to technology of planting seasonal forecast. The result shows that 93.75% of farmers use the technology of planting seasonal forecast, even though it is only 6.25% of which are able to access the technology by themselves. Most of them need an assistance. Approximately 6.25% of respondents do not access it and uses traditional farming calendar. It is due to lack ability of the elder farmers to access the technology (Table 5). It indicates that Sentolo's farmers have high consideration to expect less risk of losses due to uncertainty climate change.

Table 5: Farmer's adjustment to technology

Parameters	Percent of respondents
Access to technology of weather forecast	
- Do not access weather forecast Access weather forecast by	6.25
another people assistance	87.5
- Access weather forecast by themselves	6.25
Adjust farming calendar	
- Use traditional farming calendar	6.25
- Adjust farming calendar based on weather forecast	93.75

3.5.3 Financial Security

Having assets is considered as having better adaptation to change because the assets, in forms of financial, technology, and service which could be accessed when the worst period came, such as crop failure, drought and flood (Brooks, Adger, & Kelly, 2005; Cinner et al., 2018; Fenichel et al., 2016). In adaptive capacity, ownership of building assets increased opportunities to access affordable capital, credit, and insurance (Barrett & Carter, 2001). Financial security also includes in the ownership of building assets. To assess the assets of Sentolo's farmers, it was used parameters of side occupation as agricultural farmers and ownership of agricultural insurance.

Table 6 indicates that almost of respondents (93.75%) have side occupation apart of as agricultural farmer. Most of them have livestock include cattle, goat and poultry. Side occupation is necessary to keep having alternative income in case the agricultural failure occurred. Agriculture is vulnerable sector exposed by climate change. Having alternative income is also effort to build adaptive capacity through domain of flexibility because it bridges reduce poverty (Krishna, 2006). The other product to adapt to climate change in financial sector is agricultural insurance. Agricultural insurance is a product that guarantees agricultural product in every season. Agricultural insurance protects against loss or damage to crops when shocks occur and it encourages greater investment in crops, which primarily provides great potential value to low-income farmers and their communities (Müller, Ramm, & Steinmann, 2014; Sandmark, Debar, & Tatin-Jaleran, 2013). In Indonesia, the insurance is managed by the State-owned enterprises of the Republic of Indonesia under the Ministry of Agriculture, named Paddy's Farming Insurance or *Asuransi Usaha Tani Padi* (AUTP). It indemnifies the loss of crops due to drought, flood, crop disease and pest. Nevertheless, none of the respondents have insurance for their crops. Since the concept of insurance is regularly prepaid before the shocks happen, they mostly assume it unnecessary and have not considered to have an insurance is a great investment yet.

Table 6: Farmer's Assets

Parameters	Percent of respondents
Livelihood strategies	
- Farmers as main livelihood	6.25
- Have other job beside farmers	93.75
Agricultural insurance	
- Do not have agricultural insurance	100
- Have agricultural insurance	0

Each parameter did not represent only one domain. In some cases, there might be more than one domain that associate, for example the adjustment to technology. It reflects the domain of learning and flexibility because by the technology, farmers are expected to generate, absorb, and process new information about climate change adaptation and management. Along with it, farmers are also expected to be more flexible to switch to available option to improve their capacity of adaptation.

Based on the assessment on adaptive capacity of Sentolo's farmers, they have high level. However, they more focus on present condition, which they would make effort to adjust. On the other side, in financial terms, their awareness of long-term investment has been not considered yet, even more, they have to pay for an invisible thing, such as insurance.

4. Conclusion

Exposure of rainfall variability to agricultural in Sentolo did not affect significant damage and loss. It indicates that sensitivity of climate change in the area is low. On building adaptive capacity, Sentolo's farmers have exposures that determine high capacity to adapt to climate change. Interaction among the results shows the agricultural community is high resilience to climate change. In addition to the socio-economic exposures, physical exposures of rainfall variability and topographical condition added variable to assess resilience, because they also change affected by climate change. It could be implemented in urban and regional development, which in assessment of community resilience needs to considerate the physical and socio-economic exposures.

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