

Farmers' Adaptation to Climate Change in Wonogiri, Indonesia

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Climate change has serious consequences, especially for developing countries, which depend strongly on natural resources for food, water and shelter (FAO 2010). The effects of each manifestation of climate change can bring opportunities to some communities and problems to others. Different societies respond to the consequences of climate change according to different patterns of adaptability. Different forms of local adaptation offer examples of how societies innovate in coping with threat, and the interactions between ecosystems and humans become key issues to identify and develop (Takeuchi 2012; Irham 2012).

There is a strong relation between adaptation, resilience and sustainability. Resilience is the ability to persist and adapt in order to achieve sustainability. But resilience and sustainability need preemptive action on emerging risks, to avoid vulnerability and to provide ecological integrity (Hahn et al. 2009). Enhancing resilience means increasing communities' adaptability while reducing vulnerability, risk and uncertainty. Acceleration of economic development has a strong relation with the increase of such problems.

Many studies have examined the impact of climate change on biological production, water availability, temperature and other factors. But few studies have examined how traditional societies understand climate change and how they are coping with the consequences (Olsson 2003; Takeuchi 2012). This study will contribute to understanding how climate change is defined from different perspectives by examining farmers' experiences of climate change in relation to their farming activities. The objectives of this study were (1) to understand farmers' perceptions of climate change in the upland area, (2) to see how the farmers adapt to cope with climate change. The study was conducted in Wonogiri, in an upland and lowland area.

Keywords: adaptation, climate change, farmers, Wonogiri Central Java



Climate change is predicted to have a serious impact on the environment, economy, and social (Fosu-Mensah, et al, 2010). Especially in Indonesia, which is known as an agricultural country. The agricultural sector is closely associated with particular natural climatic conditions. Given the fundamental role of agriculture in the realization of human welfare, special attention needs to be related to the potential impacts of climate change.

The climate change become important issue since 1990 decade. Intergovernmental Panel on Climate Change or IPCC state that climate change has occur and has wide impact on several case, not only in Indonesia but also include other countries in this world. Nowadays, climate change threat water resources, natural ecosystem, agriculture, food security, energy availability, and also public health. As a country which lays on equator line, climate become important determinant on food production in Indonesia.

Studies conducted Maddison (2007) in collaboration with the World Bank in several African countries show that the majority of agricultural actors perceive the climate gets hotter, the rain is getting difficult to predict, and the duration of the rainy season is getting shorter. In many cases, the activity of farmers through the cultivation method is applied also contributed to the increase in greenhouse gases, and in turn affect climate change.

Adaptation is one of the policy options to reduce the negative impacts of climate change (Adger et al., 2003). Adaptation to climate change refers to adjustment in natural or human systems in response to climatic stimuli from the actual or expected climate change effects are likely to significantly harm or benefit (IPCC, 2001). Given the importance of climate change adaptation in the phenomenon that is happening, it is

necessary to research on the perception of farmers towards climate change adaptation strategies that do form, as well as the factors that influence the adaptation strategy.

Effect of climate change on the agricultural sector are multidimensional, starting from resources, agricultural infrastructure and agricultural production systems, to security and food self-sufficiency aspect, as well as the welfare of farmers and communities.

The effects are divided into two indicators, namely the vulnerability and impact. Literally, vulnerability to climate change is a condition that reduces the ability of (human, plant, and animal) to adapt and / or run a physiological or biological functions such as development, growth, production and reproduction optimum (reasonable) stress due to climate change. While the impact of climate change is a disorder or condition of any loss or profits, whether physical or social and economic stresses caused by climate change (Deptan, 2011).

From the description above it can be seen that climate change has an impact on the agricultural sector and the impact on farmers, thus the problem can be formulated as follows:

1. How does farmers perception on climate change?
2. How farmers adaptation strategies with climate change?

This study will contribute to understanding how climate change is defined from different perspectives by examining farmers' experiences of climate change in relation to their farming activities. The objectives of this study were (1) to understand farmers' perceptions of climate change in the upland area, (2) to see how the farmers adapt to cope with climate change. The study was conducted in Wonogiri, in an upland area. The number of samples available is 43 respondents with purposive random sampling.

Research conducted by R. Hasan and C. Nhemachena (2008) on the perception of farmers on climate change showed that of the 8208 respondents said that 50% of respondents feel the temperature getting warmer / hot, and another 50% felt the water precipitation decreases. 33% expressed confidence that the rainy season has changed, and 16% said more frequent droughts.

Conceptual Framework

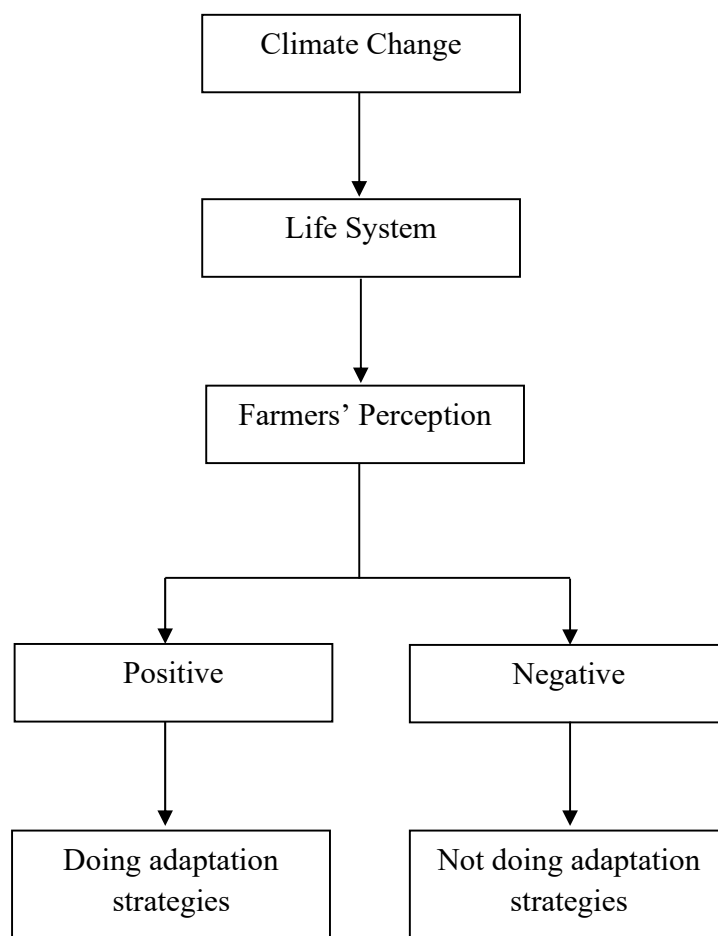


Figure 1. Conceptual Framework of Farmers Perception and Adaptation Strategies

The indicators which used to assess households' perception about climate change are:

- a. Generally air temperature change, rainfall fluctuations, as well as the shift of seasons;
- b. Changes in the state of agricultural land, other fluctuations farm production and pest explosion events, as well as the state of water resources, both on agricultural land and irrigation water for the household.

The observed indicators to determine the adaptation strategies of households are divided into two group, first, farm management, and second is food in household, which more detail as follows:

- a. Farm management includes the application of agriculture conservation, crop variety selection, application of multiple cropping or other cultivation techniques, and the starting time to planting;
- b. Household food stocks assessed on the availability of food and staple food diversification.

Result

Farmers' Perception on Climate Change

As the result from this research, it can be seen that only 9,30% farmers know about global warming and 20,93% know about climate change (Table 1). Farmers who know about global warming said that they heard it from television. For farmers who know about climate change, they heard the information from television (88,89%) and also from the village officer (11,11%). It is certainly a challenge for the government and relevant agencies to further promote issues related to global warming, climate change, its impacts, since farmers are affected because of their activities related to nature directly.

Table 1. Farmers' Knowledge about Global Warming and Climate Change

Kind of knowledge	Percentage (%)		Information Source
	Yes	No	
Global warming	9,30	90,70	
Information Source			

• Television	100
• Newspaper	0
• Village officer	0

Climate change	20,93	79,07
Information Source		
• Television		88,89
• Newspaper		0
• Village officer		11,11

Source: Analysis of Primary Data, 2013

The study on farmers' perceptions of the current climate change condition shows that 83,72% respondents agreed that today's temperature warmed over a period of 10-20 years. They also stated that erratic rainfall, as well as an erratic season cause farmers had trouble determining starting time to plant (Table 2). This also makes declining or fluctuation of farmers' crop production and pest explosion (plant pests). Several farmers have crop failure, an average of one time, within a period of 10-20 years.

Table 2. Farmers' Perception about Climate Condition during 20 years

Perception about:	Yes (%)	No (%)
Temperatures warmed	83,72	16,28
Erratic rainfall	93,02	6,98
Erratic season so time to start planting is difficult to determine	83,72	16,28

Source: Analysis of Primary Data, 2013

Judging from the changes in agricultural land and water sources, as many as 53.49% of respondents stated that droughts more frequently, more agricultural land dry (Table 3). Respondents stated that it makes agricultural land becomes more difficult to process. The water requirement for agricultural land most respondents sourced from springs, both in the rainy season. Nevertheless, there are also respondents who take water from wells,

rivers, or reservoirs. More than 60% of respondents stated that the volume of water to agricultural land tends to change over a period of 10-20 years, which in the rainy season the water tend to be excessive, while in the dry season tends to be less.

Table 3. Farmer Perceptions about the Current Condition of Agricultural Land

Perception about:	Yes (%)	Information	No (%)
Crop production decreases or more volatile	69,77		30,23
Crop failure	62,79		37,21
Explosion of plant pests are increasing			
Flood more often	13,95		86,05
Increasingly frequent droughts	53,49		46,51
Agricultural land becomes drier	60,47		39,53
Agricultural land more difficult to process	60,47		39,53
Water sources in the area during the rainy season		Water spring	30,23
		Well	2,33
		Water reservoir	20,93
		Rain	46,51
Water sources in the area during the dry season		Water spring	42,31
		Well	3,85
		Water reservoir	30,77
		Rain	23,08
Changes in water resources volume for agricultural land	65,12		34,88

Source: Analysis of Primary Data, 2013

Farmers Adaptation Strategies to Climate Change

In terms of cultivation techniques, all respondents have implemented organic or semi-organic farming, adding organic material or manure to agricultural land. However,

from interviews with the respondents, it is known that in fact not all farmers in the study area have adopted organic or semi-organic farming. More than 90% of respondents also implemented multi-cropping or intercropping patterns (Table 4). This is important, given the intercropping will give farmers additional income from various crops produced. Moreover, intercropping also reduce the risk of crop failure, because if one crop failed harvest, farmers can still earn income from other plants that are still producing.

Table 4. Farmers Adaptation Strategies on Farm Management

Adaptation Strategies	Yes (%)	No (%)
Organic farming/ semi-organic farming	83,72	16,28
Adding organic material to land	97,67	2,33
Water-saving cultivation techniques	41,86	58,14
Multi-cropping patterns	90,70	9,30

Source: Analysis of Primary Data, 2013

Furthermore, in terms of land conservation, some respondents have made use of straw for composting, planting crops along the lines of slope to reduce runoff causes soil erosion, doing crop rotation with legumes to enrich the soil, using crop residues as fertilizer to enrich the soil and reduce the use of chemical fertilizers, and small terraces on land. Several respondents using drought resistant crop varieties, but not many respondents do this. Whereas what is meant by integrated farming in this case is that the farmers also raise livestock, manure from livestock which is added to agricultural land as fertilizer.

Table 5. Adaptation Strategies Farmers in Land Conservation

Adaptation Strategies	Yes (%)	No (%)
Using straw for compost	46,51	53,49
Planting cover crops on terraces to reduce erosion	76,74	23,26

Planting crops along the lines of slope to reduce run off causes soil erosion	72,09	27,91
Conduct crop rotation in fields	93,02	6,98
Conduct crop rotation with legumes to enrich the soil	90,70	9,30
Using crop residues as fertilizer to enrich the soil and reduce chemical fertilizers using	46,51	53,49
Making terraces on land	60,47	39,53
Cultivate land on slope by contour lines	62,79	37,21
Participate and maintain irrigation ditches in agricultural land	44,19	55,81
Implement integrated farming	76,74	23,26
Choose to use drought resistant varieties	27,91	72,09
Determine starting time to planting season	100,00	0

Source: Analysis of Primary Data, 2013

In terms of household food management, 97.67% of respondents stated that they keep stock yields, approximately more than half of their harvest. Some respondents even stated that the stock of rice crop harvest in one season is not enough food sometimes their families until the next harvest, so they still buy rice. Some farmers also combining staple foods, especially with the cassava or corn, even the numbers is just about 34,88% (Table 6).

Food diversification programs should be developed with the aim to reduce dependence on a single agricultural commodities only. Especially with the weather anomaly due to climate change could lead to crop failure. In this regard the government has made a Peraturan Menteri Pertanian No. 15/Permentan/OT.140/2/2013 about Diversification Program Improvement and Community Food Security (Anonymous, 2012).

Table 6. Farmers Adaptation Strategies in Household Food Management

Adaptation Strategies	Yes (%)	No (%)
Store stock yields	97,67	2,33

Based on this research, farmers' understanding of global warming and climate change seems not good even though the government has held a *Sekolah Lapang Perubahan Iklim* (Climate Field School Program for Farmers). It can be seen from the results that stated most of the respondents do not know about global warming and climate change. Farmers can stated that the air temperature is getting warmer in the last 10-20 years, as well as rainfall and an increasingly uncertain season, resulting in the difficulty of determining the initial planting. Crop production farmers also felt increasingly volatile, with a tendency of farmers experiencing crop failure and explosion of plant pests. The same was felt by farmers in Purwosari sub-district, Gunungkidul District, which has topographic condition hilly in the southern part of the region in accordance with the results of the study Utami (2012) with the limited availability of water similar to the geographical conditions in Wonogiri.

Conclusion

1. Farmers' understanding and perception of global warming and climate change seems not good enough even though they feel the change of climate elements.
2. More than half of respondents do adaptation strategies to adjust the effect of climate change.

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