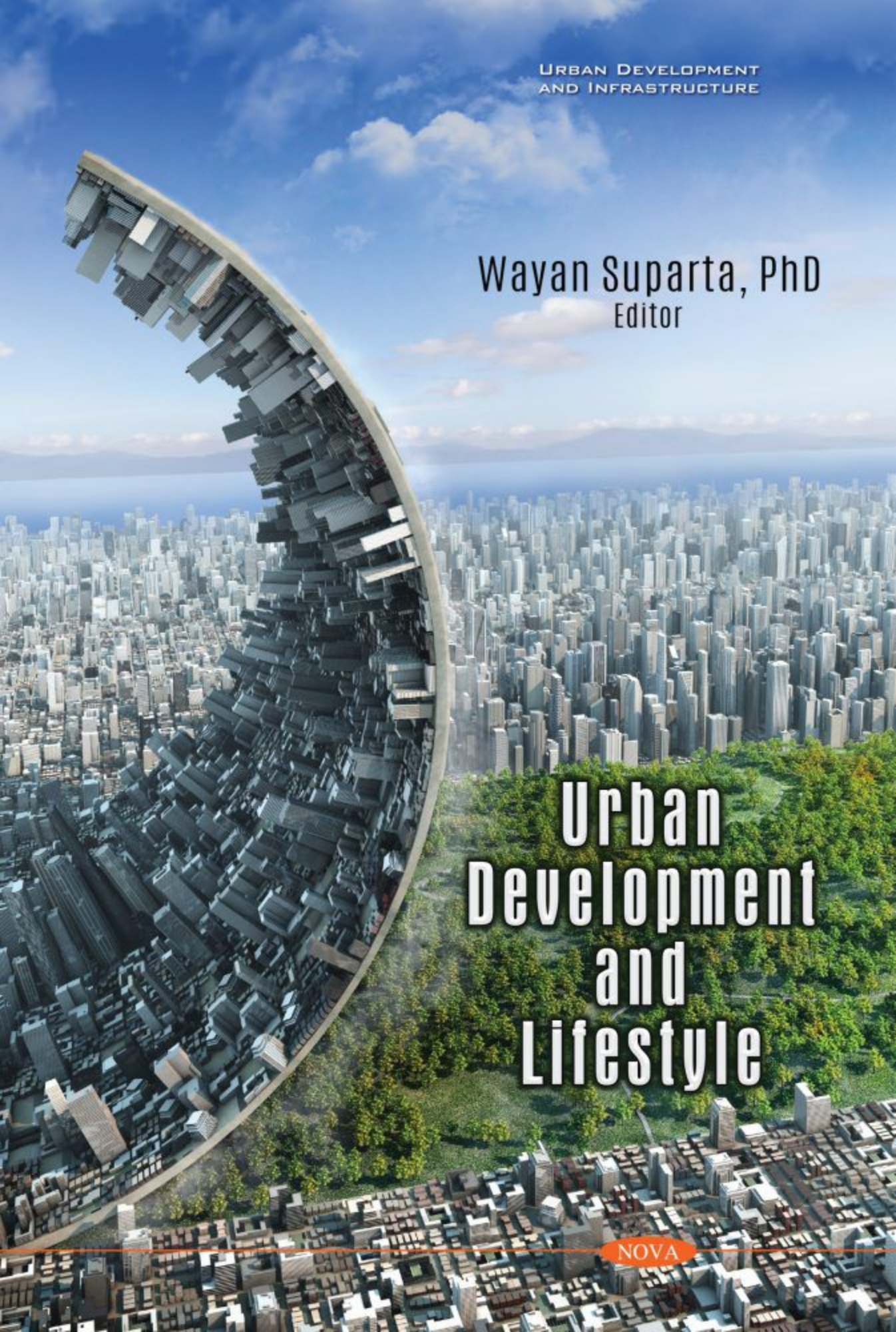
URBAN DEVELOPMENT
AND INFRASTRUCTURE
Wayan Suparta, PhD
Editor
Urban Development and Lifestyle
NOVA

As Professor at the Universitas Pembangunan Jaya, with daily activities in lecturing, doing research, as well as water resources development planning, I really praise Nova Science Publishers for publishing selected papers from "2020 International Conference on Urban Sustainability, Environment, and Engineering (CUSME 2020)". This publication would be useful for professionals, reseachers, scholar, policymakers, and NGO. I believe that currently, many professionals would like to give more attention to the development of sustainable urban. In addition, this publication could be used as a reference for city authorities to make appropriate policy choices to protect the provision of equitable housing, health, and transportation services.

Prof. Ir. Frederik Josep Putuhena M.Sc., Ph.D
Center for Urban Studies – Universitas Pembangunan Jaya

Urban Development and Lifestyle are trend issues for cities around the world. Learning from experience is the most effective way to support cities to be sustainable developed. This book offers knowledge sharing among countries and covers a variety of cities' issues. It also provides great lessons for researchers, officers and policy-makers who are coping with several urban problems.
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Chapter 48

PERCEPTION AND ADAPTATION OF FARMERS ON CLIMATE CHANGE (A CASE STUDY AT CLOVE FARMER IN SAMIGALUH KULONPROGO, YOGYAKARTA)

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ABSTRACT

The problem of farmers is climate change that causes decreasing on farmer's production. This research wants to analyze the perception and adaptation of farmers on climate change and the effect on the production. This research is a case study at clove farmers in Samigaluh Sub-district, Kulon Progo District, Yogyakarta. Primary and secondary data were collected which have been taken from 50 clove farmers from 5 villages by using stratified purposive sampling. Results of this research showed that farmers had perception and knew there was climate change in the last 5 years. It similar with climate change indicator from secondary data which showed there was a significant period of dry and wet season. The perception and adaptation of clove farmers on climate change was very low. This also indicated that there was no anticipation of clove farmers on the negative impact of climate change cause the limitation of their information and knowledge to anticipate climate change.

Keywords: adaptation, climate change, clove farmers, perception

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INTRODUCTION

Climate change indicated form the changes of temperature, humidity and rainfall. Global climate change is influenced by mainly on climate and natural elements that related on agriculture [1]. First, the rise of temperature that will impact on other climate component mainly humidity and dynamics of the atmosphere. Second, the changes of rainfall pattern and the increased intensity of extreme climate change such as El Nino and also La Nina. Third, the rise of the sea level because of the melting iceberg at the north pole. In Indonesia especially in Java island, the climate change will be very extrim where the wet season become very wet and dry season will become very dry and longer [2]. The impact of climate change on agricultural sector devided into positive and negative impact [3].

For agricultural sector, climate is a difficult external factor to be controlled as plant growth. Climate is one of obtacle factors for agriculture [4]. Therefore, the important think that the farmer has to adapt their farming to minimize the negative impact of climate change. The farmer's perceptions and adaptations in terms of climate change are very important to anticipate this impact. How far perception and adaptations' farmer to mitigate negative impact of climate change determine production of agriculture. The mitigation ability of farmer will give positive impact not only to keep the farmer income but also to sustain the existence plant of agricultural commodities.

Perception is a direction for someone to behave [5]. Perception can be a guide to actions based on the meaning given to the perceived stimulus. Adaptation to the environment is formed based on repetitive actions and is a form of adjustment to the environment [6]. Therefore, the farmers' perceptions and adaptation can show the level of farmer adjustment in facing climate changes to production. In order to optimize climate change resilience within a region, communities must be empowered to self-modify and thrive in the face of potentially severe impacts of climate change-related events [7].

There were some research have been done related to negative impacts of climate change on agriculture sector especially in annual crops. But, there was no research on perennial plant and their adaptation. Research by Amin in 2004 also showed that yield production decreased in west Java and East Java [8]. Meanwhile, climate change decreased production in Java island because land area harvested declined [9]. The combination of high temperature and decrease of rainfall dropped the agriculture production almost 50% [10]. Farmer with monoculture system in North Nigeria was more sensitive to climate change than farmers with intercropping system in South Nigeria [11].

Moreover, unsupporting climate in harvesting season will drop not only the quantity, but also the quality of agricultural production. The impact of climate change on agricultural sector could decrease land productivity due to disruption of the water cycle, changes in rainfall patterns. Furthermore, the increase frequency of extreme weather anomalies will result the shift of grow season. The climate change will give variation impact to the agriculture production [12]. Negative impact without mitigation on the impact will threat the food security and the sustainability of important commodities included plantation plant. Government has to support the farmer to adapt these negative impact.

Asia region also experiences adverse effects of climate change [13]. Since 2010, global climate change has been impacted to Indonesian. These condition not only impacted on the decrease of food crop but also plantation plant. The long wet season or wet in dry season (La

Nina) in 2010 gave positive impact and negative impact. The positive impact is the rise of planted area meanwhile the negative impact is the decrease of quality of grain caused unsupporting post harvest handling. The high temperature also push the increasing of pest and diseases that decline the productivity. High temperature rose intensity of pest disease of plant [14]. On the other side some kind of fungus will appear due to high rainfall that distrub the productivity of the plant.

In Samigaluh sub district, Kulon Progo district, Special Region of Yogyakarta, clove is mainly plant (47%) and planted almost few decays ago. Majority of the farmers in Samigaluh grew clove plant beside cacao, coconut, coffee and tea as their main income (Figure 1).

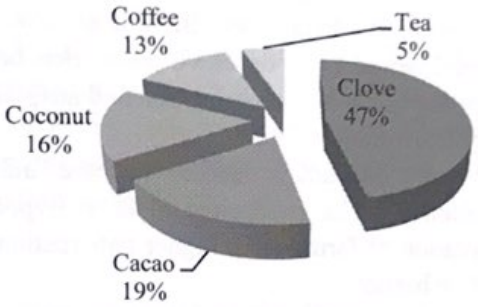

Figure 1. Percentage of Clove and perennial plants in Samigaluh Regency. (Source, BPP, Samigaluh, 2013)

The clove has been cultivated as commercial plant cause it was more profitable than other crops. All part of clove can be sold such as the flower, the steem and also the leaf. Therefore, the farmer keep the clove existence and depend on this plant as their main income for almost few decays. Are there any change as the impact of climate change in clove production is need further research. Many research just focus on the negative impact on season such as paddy and not much on annualy plant because the assume that it plant are annualy and not much influence by climate change. So, this research want to find how far climate change impact on clove production and how far perception and adaptations' of clove farmer to mitigate the climate change.

The impact of climate change on clove production in Samigaluh has been felt since 2010 and nowadays it still happened. Government has done many researchs related on climate change to anticipate dry season (El Nino) trough the Indonesian Center for Agricultural Land Resources (BBSDLP). Besides, technology in management of water resources such as irrigated either in village level or farm level held to anticipate the decrease production [15]. But, the research and technology mostly focus on food and horticulture crops [16-18]. The government subsidies such as clove seed did not help the farmers to rise the clove productivity in Samigaluh. The climate change that can not be predicted make clove seed do not growth well and it make worse the situation of clove tree in Samigaluh. Furthermore, some farmers has changed their clove tree to other plant such as *sengon laut* that was claimed easier than clove plant.

Therefore, this research want to know how far the impact of climate change and how far perceptions and adaptations of clove farmers' to the climate change. The aims of this research is to analyze the effect of climate change on clove production and how far perception and adaptation of clove farmers on climate change to clove production.

METHODS

The method of this research is descriptive. Survey was done by taking samples from one population and use questionnaires as a fundamental data collection. Farmers' clove as samples were collected from 5 villages in Samigaluh Sub-district, Kulon Progo District, Yogyakarta. There were 50 clove farmers has been taken by using stratified purposive sampling with snowball sampling method. In determining condition before and after climate change used the time period that bases on the changes that preceived by the clove's farmer when pre-survey and rainfall day data in Yogyakarta province that was obtained from Meteorology Agency. Base on these, time period before climate change was stated as the years before 2014, meanwhile above 2014 stated as after climate change period. To analyze the effect of climate change used paired t test on clove production before and after climate changes. Meanwhile, to analyze the effect of the perception and adaptation of clove farmer to clove production used Ordinary Least Square (OLS).

The level of perception and adaptation (score) become independent variable in production function (see equation 1). The coefficient of $ß_6$ is hypothesized positive. The higher the perception and adaptation of farmers the higher anticipation of farmers to climate change and the production will be higher.

$$\ln PROD = ßo + ß1 \ln LAND + ß2 \ln MLAB + ß3 \ln HLAB + ß4 \ln PRCP + ß5 \ln ORFE + ß6 \ln PACF + e \quad (1)$$

$$e^2 = ßo + ß1 \ln LAND + ß2 \ln MLAB + ß3 \ln HLAB + ß4 \ln PRCP + ß5 \ln ORFE + ß6 \ln PACF + e \quad (2)$$

where,

PROD	= productivity of clove (quintal/ha)
LAND	= land area (ha)
MLAB	= maintenance labour (HKO/ha)
HLAB	= harvesting labour (HKO/ha)
PRCP	= productive clove plant (plant)
ORFE	= Organic Fertilizer (kg)
PACF	= perception and adaptation of clove farmer (score)
E	= random error

RESULT AND DISCUSSION

Characteristic of Clove Farm Household in Samigaluh Regency

The characteristic of farm household discribed that most of the clove farmer are productive age and indicated that the clove farm has been cultivated for many generations. Table 1 indicates that the age of respondents was ranging from 20 to 82 years, with an average age of 55.3 years. Thus, they categorized as productive age.

Table 1. Characteristic of farm household in Samigaluh Regency

Household characteristics	Maximum	Minimum	Mean
Age of respondents (year)	82	20	55.3
Formal education (year)	16	6	10.16
Household size (person)	3	0	2
Land area (ha)	0.1	1	0.35
Experiences (year)	>40	12	20
Age of Clove plant	60	1	33

The formal education of respondents is 10.2 years or intermediate school on average. Farm households showed that the farmers have the land between 0.1 and 1 hectare, with an average land area of 0.35 hectares. The age of clove trees were between 2 years and 40 years above, that the production still increased and some entered the stage of declining production. The average numbers of family members were around 2 persons. The average of farmers' experience in clove farming was more than 40 years which indicated that the clove farm was regenerated plant since their parents.

Climate Change in Yogyakarta Special Regional

One indicator of climate change is the number of rainfall day from [19]. From Figure 2, there was a decline trend of rainfall day that indicated a climate change start from 2014. This data was similar with the farmers perception that stated that there was a significant change on period of dry and wet season or there was a climate change in the last 5 years (2014).

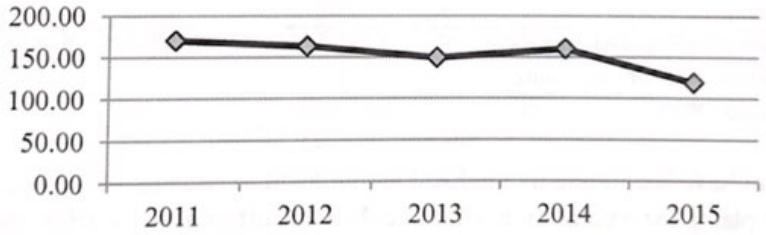

Figure 2. The rainfall day in Yogyakarta 2011-2015. (Source, BMKG (Badan Meteorologi, Klimatologi, dan Geofisika, DIY)

The Impact of Climate Change on Clove Production in Samigaluh

The impact of climate change can be seen from the number of clove plant a long to 5 and 10 years ago (Figure 3). The climate change is one of factors effecting the decrease and it also impact on the clove production. The indicator climate change impact was the number of clove plants. It shows that there was a changes in the number of plant that tend to decrease signifantly from all of the farmers. The decrease of plant also decrease clove production was caused by the increase of pest disease population and ruin the clove plant and some died.

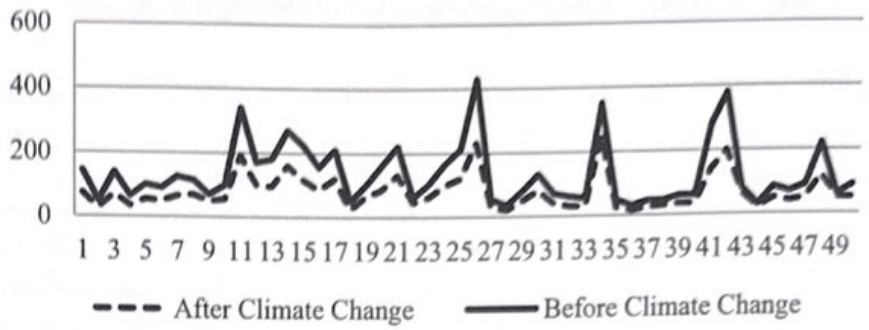

Figure 3. Number of Clove plant before and after climate change.

Since the climate change a decay ago, the production of clove in Samigaluh has been changed. Many of clove plants were very old trees (more than 30 years) that become dried, got the disease and some finally died. Therefore, it causes not only impact on the clove population, but also decrease its production. The effort to maintenance the tree became worse after the price of clove (flower) also felt down and the high cost in clove harvesting make the clove is not beneficial any more for the farmers.

Table 2. Perception-adaptation of farmer to the climate change the last 3 years

No	Discription	Number of farmers	Percentage (%)
1	Aware of climate change	50	100
2	Experience no rain or limited rain	50	100
3	Experience heavy rain on flowering	50	100
4	Adaptation on irrigation or drainage	0	0
6	Adaptation on tillage	2	4
7	Adaptation on applying manure	1	2
8	Controlling on plant organisms	1	2

Source, Primary data (2019).

Many effort have been done by the local government to rise the clove production, such as providing new plants for replanting the old one. But this effort always failed cause the climate change unsupport for the growth of this plant. Such as the long dry season made the seed died. So, the farmer has no choice with their clove tree and just let them in the worse condition.

Table 2 shows the perception and adaptation of clove farmers in Samigaluh in facing climate change. All the farmer 100% in Samigaluh Sub-district knew that there was a the climate changes. Mostly (72%) farmers felt there were no rain or only limited rain within 3 to 5 years ago. But, there were limited or very low mitigation of farmer on their clove plant. The adaptation of the farmer very low (only 1 to 2%) in applying manure, doing pest control, soing tillage and there are no mitigation on irrigation or drainage. It show there was no activities in facing climate change even they knew the climate has changed sinificantly.

There was no activities of farmer in facing climate change even they knew it because some reasons. The result show that most of the farmer (98%) did not adapt at all. Most of the farmers (82%) did not know how to adapt because the lack of the information related to clove adaptation. It because there was no informations about climate change especially for

perennial plant both from the government information and from farmers' group. Few farmers (18%) thought that these adaption for perennials such as clove was not effective on clove production. Moreover, some of clove farmer (14%) has changed clove plant to other plant such as *sengon laut*, *mahoni* and fruit trees like durio. This condition show that there were no adaptation of the farmers in facing climate change.

The Factors Affecting Production of Clove

The output of the regression was presented in Table 3 and 4. Table 3 shows factors affecting production before climate change. It showed that the coefficient determination (R^2) was 0.583 which about 58.3% of total variation observed in the dependent variable was explained by the explanatory variables. The clove production (Y) were influenced by organic fertilizer (X_5) and perception adaptation (X_6), meanwhile the land area (X_1), harvesting labor (X_2), maintenance labor (X_3) and productive plant (X_4) were not significant.

It indicated that before climate change, the role of organic fertilizer has given positif impact on clove production. The higher organic fertilizer the higher production of clove. It means that before climate change, the use of organic fertilizer very effective to increase clove production. Meanwhile, the perception adaptation significant impact on the clove production but the sign was negative. The sign to clove production was negative because the farmer difficult to find labour for clove harvesting. This condition made many of clove flowers that must be picked up cannot be harvested and it impacted on the decreasing of clove production. Dominacy of old clove tree that were very high has made difficulty in clove harvesting and limited labour that ready in clove harvesting. In harversting the labour has to climbing and picking clove flower manually and facing the risk such as fall from the clove tree.

Table 3. Determinants of Clove production before climate change

Variables	Cofficient	Standart error	t	p>|t|
Constant	8.904	3.102	2.870	0.008
Land area (m^2)^{ns}	- 0.470	0.343	1.368	0.184
Harvesting labour (days) ^{ns}	0.133	0.140	0.950	0.352
Maintenance labour (days) ^{ns}	0.237	0.183	- 1.292	0.209
Productive plant (plant) ^{ns}	0.132	0.246	0.538	0.596
Organic fertilizer (kg)*	0.411	0.207	1.985	0.059
Perception adaptation (score)**	-1.823	0.792	- 2.302	0.030

Table 4 shows factors affecting production after climate change. It gave the coefficient determination (R^2) was 0.369 which about 36.9% of total variation observed in the clove production was explained by the explanatory variables. The rest of clove production were caused by the others variables. The results showed that after climate change, the clove production (Y) was influenced by land area (X_1) and maintenance labor (X_3), meanwhile harvesting labor (X_2), productive plant (X_4), organic fertilizer (X_5) and perception adaptation (X_6) were not significant.

Perception and adaptation of clove farmer only effected on clove production before climate change. Meanwhile, the perception and adaptation of clove were not significant after climate change. Before climate change, production of clove influenced by organic fertilizer,

but after climate change the using of organic fertilizer not effective on clove production although the production. Before climate change, perception and adaptation of the farmer influenced the clove production but after climate change this variable was no effect on production cause there was no action of the farmer on adaptation. The price of clove tend to push down the farmer adaptation on in the lower level [3].

Table 4. Determinants of clove production (kg) after climate change

Variables	Cofficient	Standar error	t	p>|t|
Constant	0.051	2.474	0.021	0.984
Land area (m^2)**	0.792	0.274	2.895	0.008
Harvesting labour (days) ns	0.048	0.111	0.435	0.668
Maintenance labour (days) *	- 0.272	0.146	- 1.862	0.075
Productive plant (plant) ns	0.083	0.196	0.423	0.676
Organic fertilizer (kg) ns	0.031	0.165	0.190	0.851
Perception adaptation(score) ns	-0.780	0.631	- 1.235	0.229

After climate change, factor land area (X_1) and maintenance labor (X_3) were significant on clove production. The wider land area the higher clove production. But, the maintenance labor influenced clove production negatively. The climate change has resulted in whatever maintenance has been done by the farmers do continues to reduce clove production. So, this made the clove farmer not kept the clove plant maintenance. The extrim climate changed such as long dry season and wet season, has stimulated many kind of clove diseases on clove plant in Samigaluh that made the plant dry and die and made production down [14].

Perception and adaptation of clove was not significant to clove production because there were very low adaptation of clove farmer on climate change. It caused by the knowledge limitatiton of farmers clove to anticipate negative impact of climate change. Mostly (82%) of the farmer did not have information related to clove. The government anticipated the production clove by replanting trough distribution of the new plants. But the climate change made the new plant did not grow well.

Therefore, the complete information on climate change are very important to rise the production of clove in Samigaluh sub-district. Most of clove farmer has known the climate change on their plant but the limit infomation has made the did not do any adaptation. The adaptation of the farmer only are applying manure, doing pest control and doing tillage. Irrigation or drainage did not do to because the area of clove are steep hill and very difficult to reach. Most of farmer (98%) prefer to not adapt because they think these adaption not effective on clove production because clove are perennial plant. The last alternatif by changed the plant to other plant as a source of farmers' income. This condition will threat the existence of clove plant in the future.

In case of heavy rain, excess water become a limiting factor that can inhibit plant growth and even reduce yields. In upland areas with dry climate, lack of water or drought is a limiting factor that can inhibit plant growth and even reduce yield or cause plants to die. Some effort to anticipated climate change for perennials plant that planted in upland areas can be done. Overcome the drought, a deep groundwater well equipped with a submersible pump must be made or it can be done by building a dam or ditch depending on local conditions [15]. In adapting dry land which is constrained by the unavailability of water, appropriate technology for managing water resources, soil and plants is needed. Water resources

management in dry land for agriculture is carried out to increase water availability, extend planting period, and reduce the risk of yield loss to create agriculture. Apply the right technology in the sense of efficient and effective, and accepted by farmers to be developed for the increases of agricultural production.

CONCLUSION AND RECOMMENDATION

Perception and adaptation of clove farmers on climate change was very low. There were no anticipation of clove farmers on negative impacts of climate change cause the limitation of the information. To rise the level perception and adaptation of clove farmer, there are need to give the clove farmer a complete information and knowledge about climate change. So, they can adapt to climate change and minimize the negative impact of clove production.

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