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CLIMATE FIELD SCHOOL (CFS) FOR FARMERS AND STUDENTS: ADAPTATION STRATEGIES ON CLIMATE CHANGE WITH EDUCATION AND EMPOWERMENT

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ABSTRACT

Global warming leads to climate uncertainty that threats national food security, and thus the farmer education is required as an adaptation and mitigation strategy to cope with the negative impact. A climate field school is a technology to educate and empower farmers to increase the awareness and resilience on climate change. 0.5 hectare of farm land was cultivated by maize (hybrid variety of Pioneer-35). The land preparation, planting and crop maintenance was totally organized by 24 farmers and 6 students of Universitas Sebelas Maret, (UNS) Indonesia. Also, daily weather components (air temperatures, rainfall and relative air humidity) were observed by farmers according to schedule prepared by farmers. Every decadal (10 days), farmers and students met to observe and discuss the maize's growth and farm ecosystem. During the decadal meeting, staffs from Agency for Meteorology, Climatology and Geophysics of the Republic of Indonesia (BMKG), lecturers from university (UNS) and farm extension workers from government monitored, guided and advised the discussion in turn (according to planned schedule). The results showed that farmers and students' knowledge on climate change and eco-friendly farming system increase during the climate field school. Extreme rainfall (890 mm for 5 dry months) occurred which was double compared to proper water requirement for maize. Maize's yield was 10% lower (10.7 t/ha) compared to conventional system due to totally unused of pesticide, herbicide or other plant protection chemical substances. Farmers also observed that the use of organic fertilizer combined with inorganic fertilizer rather produced high yield which can reduce production cost and increase soil health, as well as food safety.

Keywords: Global warming, food safety, organic farming, extreme weather

1 INTRODUCTION

Various parties in Indonesia who have concern for the environment have been researching various issues as a result of climate change, particularly the issues related to agriculture. The inability to cope with the risks that are not disproportionate from climate change and the crisis of life due to climate change is only felt by people and farmers at the intermediate to lower level (Winarto and Stigter 2011; Stigter 2011a; Fox 2014 ; Stigter 2014a).

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Since the growing season in 2009-2011 and until the growing season of 2013 - 2014, many researchers have realized that the farmers in Java have difficulty in cultivation of food crops, especially rice. Significantly paddy experienced reductions in yield even experienced crop failed. This is compounded by the outbreak of brown plant hoppers, caused by increasing quantities of rain on average (Stigter 2012). Other than that this condition is accompanied by the increase in rat attacks, rice weevils, and some diseases are caused by changes in weather and climate conditions. As a result, these conditions resulted in the decrease of rice production in Indonesia in 2011 and continued until 2014 (Fox 2014; Anonymous[a] 2014).

One of the main factors that caused crop failures in Indonesia are extreme climate events that are often associated with ENSO phenomenon (El-Nino Southern Oscillation). ENSO phenomenon commonly referred to as El Niño events are generally associated with the occurrence of droughts or La Nina which is generally associated with the occurrence of rainfall tending to be abnormal (high). In general, there are three effects of El Nino on season conditions in Indonesia. First, the rainy season occurred late. Second, the end of monsoon tends to occurs faster than usual. Such conditions increase the risk of drought.

Climate Field School (CFS) is an activity organized by the Agency for Meteorology, Climatology and Geophysics of the Republic of Indonesia (BMKG), which aims to bridge the increased understanding of climate information for officials in the Office of the Agricultural Regional, Extension and farmers throughout the archipelago. CFS of BMKG has been held since 2011 until today, already had involved up to 33 provinces in Indonesia. On average, crop yields may increase by 20 to 30 percent by this CFS (Anonymousb 2015).

This CFS project is aimed at educating farmers and students together to understand the climate change phenomenon and the strategy of mitigation and adaptation to cope with it.

2 MATERIALS AND METHOD

Climate Field School (CFS) involved one farmer group (24 members) at Gondangrejo District and 6 students of Universitas Sebelas Maret (UNS), Central Java, Indonesia. The experimental field is at rain fed lands with approximately 0.5ha area which are prone to drought, from June to October 2016. The method was by arranging curriculum for CFS, manage and carry out the discussion every decadal (once in 10 days) in the field, and involve all the farmers and students (total 30 participants) in all the daily weather observation and maize’s culture from land preparation, maintenance until harvest. The maize used hybrid variety of Pioneer-35. The CFS disseminate climate information to farmers through the same process as other technologies. Before discussion, farmers and students observed the crops and surroundings ecosystem condition, and then discuss it with others.

Farmers and students have to be convinced by their own experience that the use of climate information can reduce the rate failure of farming and provide greater benefits. This simulation were prepared using the experience of farmers and students under the conditions of their respective regions.

CFS curriculum consists of four parts as follows:

1) Theory regarding the basic concepts season forecasts. For example the concept of chance, the term in-season estimates, forecasts issued by BMKG information, and shifting seasons associated with changes in cropping patterns;

2) Substance concerning historical incidents related with agriculture. For example data history of drought, flooding, and a history of harvesting conditions, which aims to assess the impact of climate variability or climate events extremes, especially droughts and floods in the area and the introduction of some simple technology to cope with drought, such as rainwater harvesting.

3) Information regarding the use of climate forecasts. For example, to determine the strategy of cropping patterns and crop rotation.

4) Estimation of economic value of climate forecast information. This approach emphasizes on innovation and technology of implementing climate information to assure agriculture sustainability production.

3 RESULTS AND DISCUSSION

3.1 Climate Field School (CFS) Activities

Climate Field School (CFS) was conducted for approximately 4 months of total duration, with frequency 10 times of class meetings. The meetings were carried out in an 8x10 m2 bamboo-hut which was built on the field. Participants are divided into some groups, each group consisted of 5 members. One set of weather observation equipment namely manual ombrometer (rain gauge) to measure daily rainfall, psychrometer to measure air relative humidity and maximum minimum thermometer to measure air temperature, were settled on the field. Every week each group responsible to measure the daily observation of all the weather parameters in the morning (7 a.m.), afternoon (12 a.m.) and evening (6 p.m.). They will share the daily responsibility for each member. All the observation results are noted daily on the paper which is hanged out in the hut, so everyone can monitor (Figure 1).

Figure 1. Farmer participant of Climate Field School (CFS) noted the daily weather observation provided in the hut

During the decadal (10 days) class-meeting all participants must came at 7 a.m., each group must observe the crop growth (included plant age, plant height, leaves number) and surroundings agro-ecosystem condition, included soil moisture condition, plant performance, pests and insects (Figure 2a). The results of observation then written on an A0 size paper (Figure 2b), then each group must presented the observation results (Figure 2c).

(a) (b)

(c)

Figure 2. The observation of crop growth and agro-ecosystem per group (a); Writing the observation results (b); Report and discuss the observation results with all members (c)

In the decadal meeting, the problems regarding with the crop growth, water availability, soil fertility, pests and disease will be discussed, and the actions to overcome the problems will be formulated together considering weather condition and asking for advises from staff in charge at the moment, which can be from university, BMKG or government (Dept. of agriculture). After decided what actions shall be taken, participants will share the job description for each group. For example, if irrigation is required, they will share which group should be irrigate at particular day, the water volume, etc. Another example is if fertilizing is required, they will share which group to apply, when, how and the dose of fertilizer. So everything relate with crop culture is decided together and executed together. It is totally the responsible of CFS' participants.

During the decadal meetings, after discussion by CFS' participants, theory or information regarding with climate, weather, agriculture procedures, crops pests and disease management, or agricultural economic analysis were delivered by staff in charge at the moment for approximately 1 hour. The staff can be from government (Figure 3a), university (Figure 3b) or BMKG (Figure 3c).


(a) (b)

(c)

Figure 3. Theories and information regarding with climate, weather and agriculture delivered by staff from government, Dept. of Agriculture (a), university (b), and BMKG (c) according to schedule every ten days (decadal)

The Climate Field School (CFS) model implemented here is very useful for farmers and students participants, because they can share their knowledge and earn new information about climate change, sustainable agricultural practices, organic farming management and implementation. Furthermore, they get a new perception on how climate change impact on agriculture, and information regarding how to cope with it and to minimize the negative impact. They shared and received some information about strategies on how to mitigate and adapt with climate change, especially regarding with water availability because the site is very prone to drought. Some small water reservoirs to harvest rainwater are highly recommended to cope with water shortage for agriculture to cope with dry spell that frequently occurs at the site. Beside receiving and sharing information, they also experienced the method on weather observation and the benefits of it, as well as experienced better management practices of agriculture. The implementation of CFS in

Indramayu, Indonesia influenced farmers' ability and willingness to apply seasonal climate forecasts as adaptive tools (Siregar and Crane 2011).

No matter how successful now this CFS model is, it will need a monitoring on the implementation by participants after years. The use of forecast that had been informed during the CFS previously is still virtually nonexistent after 5 years since CFS program (Siregar and Crane 2011).

3.2 Observation on Weather and Maize Yield

The implemented model of Climate Field School in this project assigned farmers to observe and reported weather condition on the field for approximately four months. They also had to maintain the cultivation of maize in the project site, which employed an experiment to compare the conventional, semi-organic and organic cultivation method. Any maintenance procedures for irrigating, pests and disease control, as well as further fertilizer application shall be discussed together according to growth monitoring. Any actions required for maintenance will be carried out by participants after discussed and decided.

During the project, total rainfall on the project site was 890.8 mm, which described extreme weather due to dry season. The annual record of rainfall during the project period (June-October) from 2006-2015 is 252 mm, but during the project the rainfall more than triple compared to annual average. So, an unexpected extreme weather condition occurred during the project, which required intensive drainage monitor because maize's crop requirement was only 400-500 mm. Unfortunately, the period distribution of rain was uneven, so irrigation was still required during the early stage of maize's growth. Total of 6 times irrigation interval was taken place to fulfilled maize's water requirement, based on direct monitoring by participants on crop performance and soil moisture.

The average air temperature and relative air humidity during the project were 27.3oC and 80%, respectively, which were suitable for maize but promoted pests attacked by 20-35% (grass hopper) and 3-27% (caterpillar). According to crop performance and attack level, government and university staffs advised to avoid pesticide to protect the natural enemies of pests and disease. This was very contradictive with farmers' habit as they usually will immediately spray with pesticide whenever any grasshopper or caterpillar attacks emerged. Farmer and student participants experienced the importance of controlling the pesticide usage.

In general, maize's yield in the project plot with the implementation of CFS was 10% lower (10.7 t/ha) compared to conventional system due to totally unused of pesticide, herbicide or other plant protection chemical substances. During the project, total fertilizer application was 5 ton/ha (organic) and 550 kg/ha TSP+Urea (chemical conventional) as recommended by government (Dept. of Agriculture), and the combination of organic and inorganic (semi-organic) experiment. The results of the experiment on organic farming in the project site is presented in Figure 4.

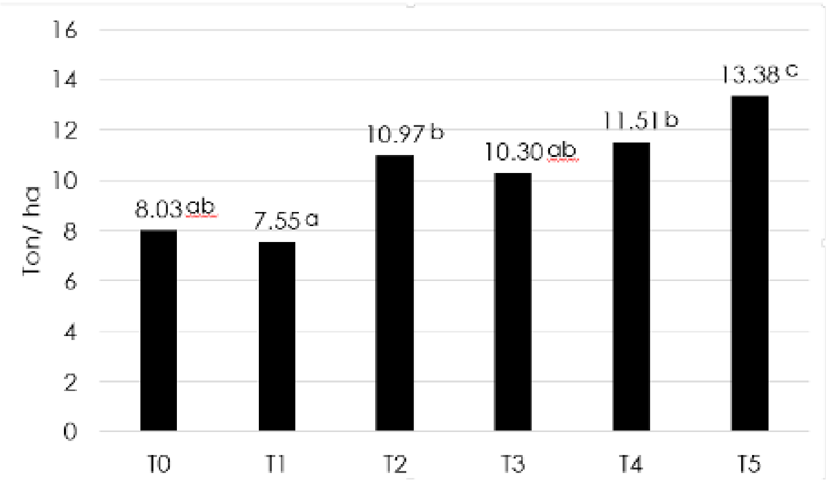

Figure 4. Maize's yield on project site according to organic farming experiment

(**Note:** T0: control; T1: 100% organic fertilizer; T2: 75% organic + 25% chemical; T3: 50% organic + 50% chemical; T4: 25% organic + 75% chemical; T5: 100% chemical fertilizer; number/mean of maize's yield followed by same letter is not significantly different at α=0.05)

Figure 4 shows that implementing 100% of organic farming by using 100% of organic fertilizer significantly resulted in lowering yield of maize compared to 100% of conventional farming (100% chemical fertilizer). The same results were found by many researchers, because organic farming needs time to enhance the soil fertility and higher biodiversity as well as reduce the dependent on external inputs (Maeder et al. 2002). In spite of resulted in the highest yield, conventional farming highly depends on external inputs, which also means higher cost as well as disrupted the ability of soil to provide vital ecosystem services (Williams and Hedlund 2013). However, the information on food safety for human health as well as eco-friendly farming system for sustainability delivered by the unniversity and government staffs, confirmed farmers the importance of organic farming. The most important is they visually observed in direct soil different performance between organic and conventional farming.

The semi-organic farming, by mixture the organic and inorganic farming (T2-T4), resulted rather lower yield compared to totally conventional farming, but contributed to better soil environment than conventional farming. The semi-organic system can help farmer to prepare for organic farming by prevent too low yield during the conversion period. Through this experiment, farmers experienced and realized the importance of maintain soil services in the natural ecosystem as well as produce healthy food for human health. This simple experiment motivated farmers to convert to oragnic farming.

4 CONCLUSIONS

Climate Field School (CFS) effectively educated farmers and students about climate change and the mitigation as well as adaptation strategy to cope with it, as well as motivated for organic farming practices. CFS also established a harmonious synergy between farmers, academics, and government.

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