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Implementation of integrated cropping calendar information system (ICCIS) to improve farmer's knowledge and to adapt the climate change

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Climate change, environmental damage, and natural disaster are treats of agricultural development in coming period. To overcome the situation, the Agriculture Ministry of the Republic of Indonesia created an Integrated Cropping Calendar Information System (ICCIS) as an information system to adapt the climate change. The aim of this study was to evaluate the level of knowledge and comprehension of farmers to adaptation in climate change through the ICCIS. This study was conducted using a survey method of 232 respondents who had received socialization about ICCIS that spread in six regions, namely North Sumatra, West Java, Yogyakarta, South Kalimantan, West Nusa Tenggara, and East Nusa Tenggara. The data were analyzed by a descriptive method and showed that 114 respondents (49.1%) understood about ICCIS and 93 respondents (40.11%) enough understood about ICCS. Then 106 respondents (45.7%) interesting and 99 respondents (42.7%) quit interesting to ICCIS. Then 24 respondents (10,3%) said not interesting and 3 respondent (1,3%) stated dont know. Furthermore, in terms of the implementation of ICCIS there were 123 respondents always applying, 74 respondents sometimes applying, 15 respondents said they had never applied, and 20 respondents said they did not know.. Furthermore, 130 respondents (56,03%) expressed their know climate change, 27 respondents (11,64%) stated know enough about climate change, and 75 respondents (32,33%) said dont know about climate change. Implementation of ICCIS could increase knowledge of farmers about climate change and understand the best schedule to plant crop and to penetrate technology.

Keywords: climate change, cropping calendar, knowledge of farmers.

INTRODUCTION

Climate change, environmental damage, and natural disasters are a threat to agricultural development in Indonesia in the next periods. Some studies show that climate change can affect food production and give rise to serious challenges to food security (Kumar 2016). Suciantini (2015) argues that climate change can affect the area of harvest and agricultural

production, especially in extreme climatic conditions which results in a number of production centers experiencing a decrease in productivity and crop failure. Climate change is a natural phenomenon that has occurred at the global, regional and local levels. According to Aribawa and Aryawati (2014) that climate change is considered a serious threat in increasing rice production because one of the impacts is a

change and shift in rainfall patterns which causes changes in the beginning and end of the planting season. Climate change also affects cropping patterns, planting area, and crop production. Onu and Ikehi (2016) suggest that climate change not only affects the production and prices of agricultural products, trade and food sufficiency, but also can affect environmental conditions such as water resources and infrastructure.

The impact of climate change is felt by farmers. Moshafi and Almasi (2015) stated that the impact of climate change will affect agricultural productivity which is uncertain and cannot be predicted well. Nuraisah and Kusumo (2019) revealed that the impact of climate change for farmers are the decline in crop yields, increased pest attack, increased risk of crop failure, and decreased farmers income. Aydinalp and Cresser (2008) revealed that the impact of climate change on agriculture is the decline in farmer's income which has an effect on the welfare of farmers. Aydinalp and Cresser (2008) revealed that the impact of climate change on agriculture is the decline in farmer's income which has an effect on the welfare of farmers. The effects of climate change on agricultural productivity are numerous, including decreases in crop yields, changes in cropping periods, and decreased water availability for irrigation (Onu and Ikehi 2016). Therefore it is necessary to develop an information system that can connect to farmers about climate, weather, and overall agronomic information for the success of farmers (Stone and Meinke 2006).

One of the strategic steps taken by the Indonesian government for climate change adaptation in the agricultural sector is by building an integrated cropping calendar information system (ICCIS) to determine cropping patterns based on climate change. ICCIS is one of technological innovations as an adaptive reflection to overcome climate change. Provision of climate change information can help in making decisions for stakeholders. Besides that, the development of an interdisciplinary system that connects climate and weather can be useful for field agricultural extension workers and farmers (Stone and Meinke 2006). Manandhar et al. (2011) suggested that farmers in developing countries expect an adaptation strategy in the form of appropriate new technology to be able to overcome the problem of climate change. ICCIS is able to inform the condition of the future planting season, includes the beginning of planting time, flood-prone areas, drought, plant pest organisms, technological recommendations in the form of varieties, seeds,

and balanced fertilization.

Dissemination of ICCIS has been carried out to stakeholders including government institutions, the private sector, businessmen, field agricultural extension workers and to farmers. The dissemination of ICCIS to farmers is carried out by field agricultural extension workers together with the ICCIS Team at the Assessment Institute for Agricultural Technology in each province. The process of transferring ICCIS from field agricultural extension workers and ICCIS Team to farmers is done face-to-face so that farmers can give feedback and discuss about it. Information about ICCIS as a form of adaptation to climate change has been accepted by farmers, but it has caused different understanding and knowledge. Knowledge and understanding of farmers about climate change also varies. Therefore the purpose of this paper is to find out the extent of farmers' understanding and knowledge of climate change adaptation through ICCIS.

MATERIALS AND METHODS

This research was conducted with a quantitative approach. Data collection was carried out using descriptive explanatory survey research methods. The survey was conducted on 232 respondents who had received information of ICCIS. This survey approach was conducted to obtain primary data through a questionnaire as a research instrument. Then to deepen the description, interviews were conducted with farmers, direct observation, and focus group discussions (FGD).

The study was conducted in 6 regions representing the western, central, eastern, and Javanese regions. The western region is carried out in North Sumatra as one of the national rice production centers in Sumatra and has characteristics of wetlands. The central area is carried out in South Kalimantan which as a national rice production center and has characteristics of swamp land. Then for the eastern region carried out in East Nusa Tenggara and West Nusa Tenggara which in addition to being the national rice production center also has the characteristics of dry land. As for the Java region, it is carried out in West Java as the center of national rice production and Yogyakarta which has a type of wet and dry land.

The survey results were processed using excel and analyzed by descriptive method. The results of interviews, direct observation, and FGD were used to develop the decryption generated from the survey results. The deepening of the

results of the survey was carried out using interviews, direct observations, and FGD described.

RESULTS AND DISCUSSION

Farmer's knowledge of ICCIS

Farmers obtain ICCIS knowledge through socialization and technical guidance activities carried out by Assessment Institute for Agricultural Technology (AIAT) and Institute for Agricultural Extension (IAE). AIAT invited farmer groups in each region to conduct socialization and technical guidance on the ICCIS. Each farmer group is expected to be able to convey ICCIS information to the members of the farmer groups and other farmers.

The results of interviews with farmers showed that initially the information of the ICCIS only reached certain circles, namely the chairman and some of the administrators of the farmer groups. The chairpersons and administrators did not directly convey ICCIS information to members of the farmer groups and other farmers because there was no concrete evidence that showed the success of the ICCIS. Therefore, AIAT and Field Agricultural Extension Workers conduct experiments through demonstration plots on farmers' land in the area. The making of the demonstration plot was based on the directions and recommendations of the ICCIS. Then the farmers can see the results of the demonstration plot to be used as learning in considering the acceptance or rejection of ICCIS innovations.

The level of information received by ICCIS from each person is different. The survey results showed 114 respondents or 49.1% of the total respondents said they could understand or comprehend the information of ICCIS. Through socialization activities, technical guidance, and demonstration plots can provide farmers with a fairly good introduction, understanding and learning. This group usually participates in all activities carried out by AIAT and field agricultural extension workers. These respondents have participated in socialization, technical guidance, and most importantly, followed the process of the demonstration plot conducted by AIAT and field agriculture extension workers. Most of them are chairpersons and administrators of farmer groups, as well as farmers who have quite extensive knowledge in agriculture. Respondents understood the essence of the ICCIS recommendations after seeing firsthand the implementation of the ICCIS on the farmers' land.

Then a number of 40.1% or 93 respondents stated that they understood the explanation given by the informants. This group consists of farmers who only participate in one of the socialization activities, technical guidance, and demonstration plots and they lack agricultural insight. Respondents who claimed not to know were 6.5% or 15 people. This means that they have already received ICCIS information but cannot understand it. This group obtains ICCIS information from farmer groups or among other farmers so that it is possible to have different information from the main source. Furthermore, as many as 4.3% of respondents (10 people) have never gotten the ICCIS information. This group has never participated in socialization activities, technical guidance, and demonstration plots and does not want to try to find the latest information in agriculture.

The farmer's interest in ICCIS

Interest is an expression of wanting to know more about the ICCIS by farmers. The farmer's interest in the ICCIS begins with the socialization from the field agricultural extension workers. Interviews with respondents stated that the ICCIS was good enough and helped farmers in determining the start of planting time, getting good varieties, using good fertilizers, and knowing which pests would attack. Before getting the ICCIS socialization, most farmers determine the beginning of planting by looking at natural conditions. If the rain has started to fall continuously for 3 days a week or the water in the paddy fields has reached about 5 cm, then the head of the farmer group meets with members to determine the planting time. The existence of ICCIS, farmers are facilitated in obtaining early planting time information quickly. This indicates that the ICCIS is needed by farmers. Farmers need information systems that are linked to climate change (Stone and Meinke 2006). However, based on interviews with respondents, in determining the start of the growing season, farmers combine natural conditions with the recommendations of ICCIS.

Another effort undertaken by Indonesian Agency for Agricultural Research and Development (IAARD) to attract farmers to implement of ICCIS is to make a demonstration plot by the integrated cropping calendar task force team (ICC TFT) with the field agricultural extension workers. Demonstration plot planning that has been budgeted by the government is realized by the ICC TFT together with field

agricultural extension workers on farmers' paddy fields. The land used for the demonstration plot is the group leader's paddy field or other group administrator. All ICCIS recommendations are applied to the demonstration plot. This is to inform and show other farmers about ICCIS technology. Based on the results of interviews, most respondents revealed that the results of the demonstration plot showed an increase in rice productivity from 3-5 tons / ha to 6-8 tons / ha. However, there are some areas that have failed as happened in one of the farmer groups in Binjai, North Sumatra. The head of the farmer group in Binjai explained that the demonstration failure was caused by irregular irrigation. According to respondents, the irrigation in Binjai area came from company waste that had been filtered clean of dirt and adaptive material. However, when the ICCIS demonstration plot was in progress, the company's waste was diverted to other areas so that the rice that had already grown and started to contain had dried up and failed to harvest. This makes farmers not ready to implement the ICCIS. However, overall respondents expressed interest in the ICCIS as shown in Figure 1.

Figure 1 shows that the interest of farmers in ICCIS is quite large, namely 106 respondents (45.7%) of 232 respondents. This indicates the awareness of farmers about the need for information in agriculture, especially information on climate change adaptation. Stone and Meinke (2006) suggested that farmers need information on climate change to anticipate and plan in farming where many factors affect climate change and can change dynamically. Farmers want an increase in rice production results that are better so that it can improve the welfare of farmers. Figure 1 shows that 99 respondents (42.7%) stated that it was quite interesting because there were some farmers who saw no increase in rice productivity. Some other farmers revealed that the increase in rice productivity was relatively small. Furthermore, respondents who stated that the ICCIS was not attractive were 3 people (1.3%) and those who did not know the ICCIS were 24 people (10.3%). This condition is caused by respondents who have never received information on ICCIS or respondents have received information on ICCIS but have forgotten because since 2016 there has been no further socialization of ICCIS.

The interest of respondents who had never been socialized began when the survey

enumerators showed and explained how to operationalize the ICCIS in detail to them. The results of interviews with respondents showed that the ICCIS is quite good and is needed by farmers. They are interested in learning more and want to implement the recommendations suggested by ICCIS. They suggest that through ICCIS can find out when the ideal planting time, the type of variety that should be used, the proportion of ideal fertilizer that has been following only estimates, and know the type of pest that will interfere.

Implementation of ICCIS at the farm level

ICC TFT has disseminated ICCIS to field agricultural extension workers and farmer groups through various media socialization. In 2011 to 2016, the socialization was carried out on a massive scale so that many farmers knew and understood the ICCIS. The socialization media that have been used are through the internet, electronics, print and face to face. Dissemination through internet media is delivered via the web and the android system. Electronic media is delivered through television and radio both locally and nationally. While the print media is carried out by distributing brochures, leaflets, and print-out the results of the ICCIS recommendations which are then distributed to field agricultural extension workers and farmers.

During the period of 2011-2016 the application of the ICCIS was quite good because it had the support of various parties. The Indonesian government through the Ministry of Agriculture has made a national policy to encourage farmers to implement the ICCIS. In the FGD activity, the guest speaker stated that the implementation of the ICCIS as an effort to adapt to climate change had received a positive response from the president and was discussed in a cabinet meeting. This shows the seriousness of the Indonesian government in an effort to increase the productivity of agricultural products on climate change that is uncertain. The results of the survey on the application of the ICCIS by respondents can be seen in Figure 2.

Figure 2 shows that most farmers have already implemented ICCIS. Based on interviews that the respondent obtained information on the ICCIS from the ICC TFT and field agricultural extension workers who then applied it in their area.

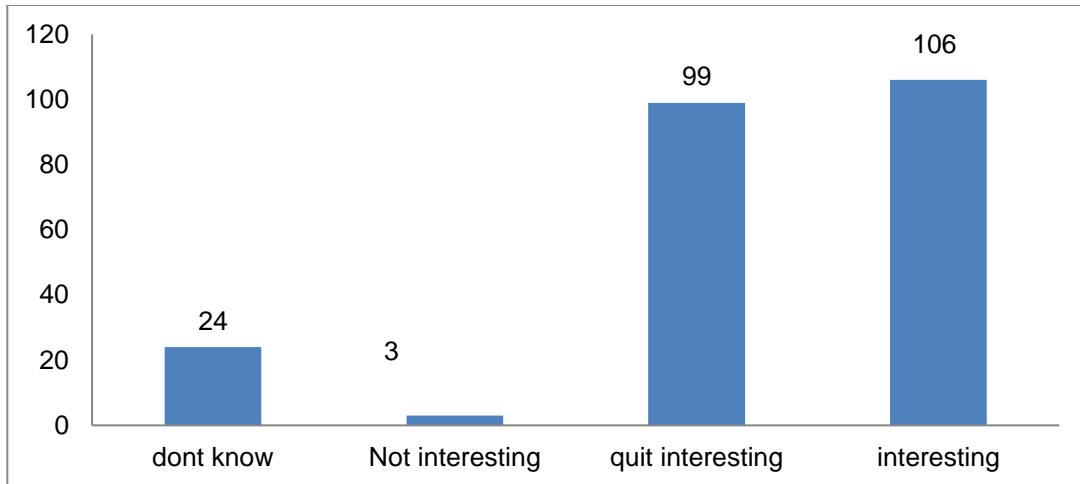


Figure 1; Farmers' interest in ICCIS

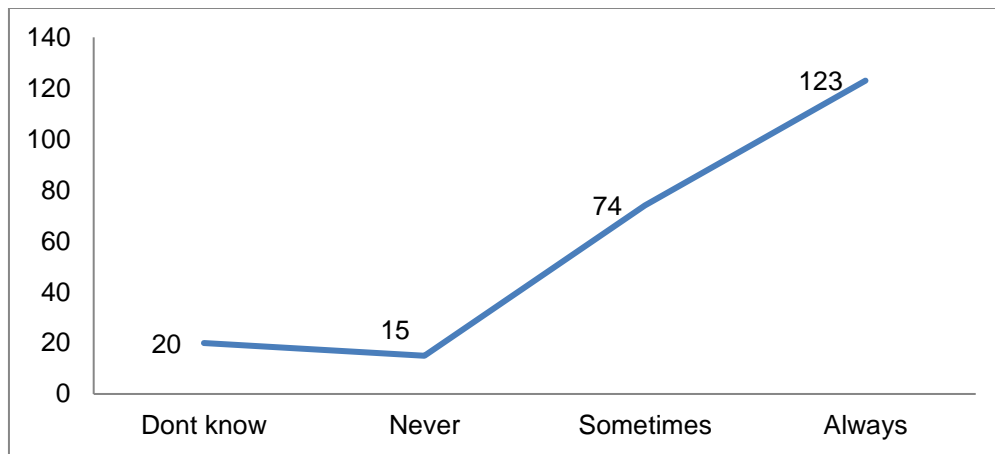


Figure 2; Implementation of ICCIS by farmers

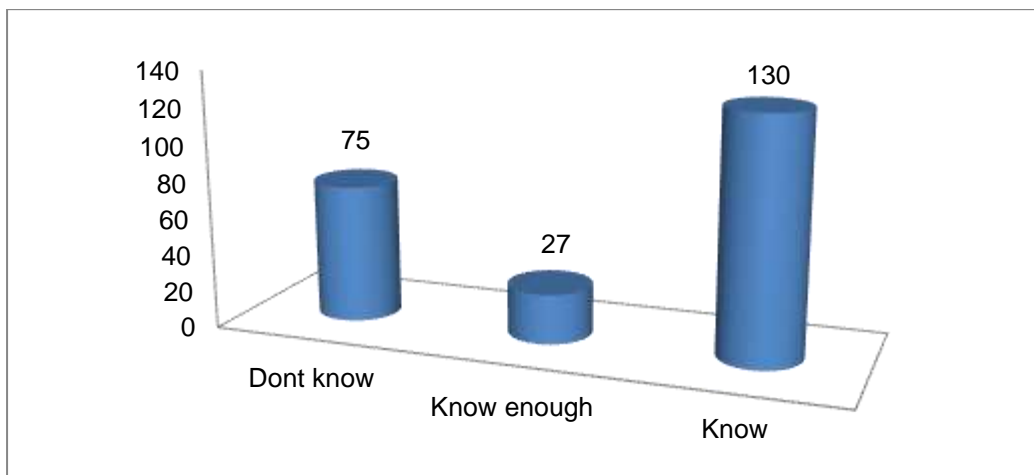


Figure 3; Farmers' knowledge of climate change

Farmers' confidence in the field agriculture extension workers has an impact on the implementation of the ICCIS that has been delivered by field agriculture extension workers. The results of an interview with one of the field agriculture extension workers that they always convey information about ICCIS recommendations to farmers both interpersonal and group. This approach makes familiarity between field agriculture extension workers and farmers. Then the farmers consider that what is recommended by ICCIS is good for the productivity of food crops. However, the problem is the lack of venture capital that must be prepared by farmers. Fertilizer recommendations that should use 250 kg / ha urea fertilizer, but due to lack of venture capital, farmers only apply part of what is recommended.

The farmers implement ICCIS by following the recommendations suggested. Interviews with respondents revealed that when determining when to start planting, farmers usually wait for rain. If the rain has fallen at least three times a week, the farmers discuss to determine the beginning of planting time. But with the ICCIS, farmers can already know when the ideal planting time is easy and fast without having to wait for rain. Farmers have also implemented varieties recommended by ICCIS. Although many farmers do not directly access the ICCIS application, they always ask the extension agent about suitable and good varieties planted on their land. Respondents said that the harvest time for local varieties was longer than the varieties recommended by ICCIS..

Table 1; ICCIS recommendations that are needed by farmers

No	Type of recommendation	Statement of need by respondent	
		Need	No need
1	Planting time	203	29
2	Varieties	193	39
3	Fertilization	193	39
4	Plant-disturbing organisms	192	40
5	Agricultural tools and machinery	191	41

The results of an interview with ICC TFT in Yogyakarta that during the socialization activities, farmers were very enthusiastic about asking which types of varieties were good for planting. This proves that recommended varieties are needed by farmers. The survey results show that recommendations that are often needed and used

by farmers can be seen in Table 1

In fertilizing techniques, farmers provide fertilizer based on estimates but through ICCIS they can find out the ideal fertilizer dosage given to rice plants. Recommendations related to pest or plant pest organisms that will interfere can also be known through the ICCIS so that farmers can anticipate what needs to be done to prevent the pest reduction. The farmers also implement recommendations on agricultural tools and machinery from ICCIS. However, from a variety of agricultural machinery recommended, only hand tractors are often used because they are supported by the government. Besides that, it is easy to get in their area and the price is still affordable by farmers. Farmers want assistance from other agricultural machinery such as planting equipment, harvester and rice thresher. Agricultural tools and machinery are needed so that farmers can engage effectively and efficiently. Through agricultural tools and machinery, farmers' work can be done quickly and save costs.

Knowledge of climate change by farmers

The phenomenon of climate change has occurred in Indonesia for a long time, which is marked by a shift in the season. The conditions of long rain or extreme heat often occur in Indonesia, which has an impact on farmers. The amount of rainfall will cause flooding in paddy fields so that many farmers experience crop failure. Likewise the prolonged heat conditions will result in a lack of water supply in the rice fields so that farmers experience crop failure.

The traditional habits of farmers are no longer a benchmark for conducting farming activities. In the past, our ancestors started farming by looking at natural signs around them such as animals, trees, wind, stars, and so on. These natural signs are then made into a dating system for farming. The calendar system in Java is called the Pranotomongso calendar, in South Kalimantan the Kapat Bulan system, in NTB the Warige system, and so on.

The dynamics of seasonal shifts encourage farmers to know and understand climate change. The traditional system is no longer suitable to be applied in farming. This is because farmers have realized and are aware of climate change. The results of surveys of farmers related to farmers' knowledge on climate change can be seen in Figure 3.

Figure 3 shows the dominance of farmers who already know climate change. As many as 56.03% of respondents said they already knew

about climate change and 11.64% of respondents said they knew enough about climate change. They said that climate change was marked by a shift in the rainy and dry seasons. Other indications are that the rainy season which usually falls in the period from October to March and the dry season in the range from April to September has now changed and the timing is uncertain. Farmers' knowledge of climate change is also felt by the high heat evaporation in the long dry season so that many leaves fall. Other signs felt by respondents are the presence of hot temperatures at night, rainy summer suddenly, prolonged heat and prolonged cold, when there is no gusts of heat, there is a shift of the sun to the south, and the number of pests that attack plants. Rakib and Anwar (2016) suggest that farmers believe that the temperature is warmer and the time of rainfall has changed resulting in an increase in the frequency of drought.

Respondents who stated they did not know were 32.33%. Respondents revealed that they never received information about climate change and never paid attention to the weather conditions around them. Interviews revealed that some of them still used the traditional system which was inherited from their ancestors. The results of interviews with respondents in Indramayu stated that farmers started planting by looking at the tamarind shoots that had begun to grow. Respondents in Tanah Bumbu Regency, South Kalimantan said that if the water was not yet above 5 cm from the ground, they would not start planting. Farmers in Gunung Kidul, Yogyakarta will start planting if they hear the roar on Mount Merapi.

CONCLUSION

ICCIS provides information relating to climate change adaptation so that knowledge about climate change for farmers is increasing. The socialization of ICCIS to farmers makes farmers understand the purpose of ICCIS technology. The recommendations suggested by ICCIS make farmers aware of the importance of adaptation in dealing with climate change. Demonstration plots on farmers land can be used as an effective media of dissemination to improve farmers' knowledge on climate change.

Increasing knowledge of climate change adaptation can be done by disseminating information on the ICCIS in an intensive and continuous manner. ICCIS socialization activities must continue to be carried out and must receive support from the government. Technical guidance

and training for ICCIS need to be provided to field agricultural extension workers and farmers to better understand and know about climate change and its impacts.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

ABA designed and performed the experiments and also wrote the manuscript. PJM, IRL and RSH designed experiments, data collection, data analysis and reviewed the manuscript. All authors read and approved the final version.

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REFERENCES

- Aribawa, I.B. and Aryawati, S.A.N. 2014. Penggunaan sistem informasi kalender tanam terpadu untukantisipasi perubahan iklim pada tanaman padi di Kabupaten Tabanan Bali. Di dalam: Susila E.T., Panjisakti B., Taryono, Endang S., Makruf N., Muhammad S.R., Donny W. dan Dyah W.R., penyunting. *Pengembangan dan Pemanfaatan IPTEKS untuk Kedaulatan Pangan*; 2014 Sept; Yogyakarta (ID): Fakultas Pertanian UGM. 357-362.
- Aydinalp, C. and Cresser, M.S. 2008. The effects of global climate change on agriculture. *American-Eurasian J. Agric. and Environ. Science*, 3 (5), 672-676.
- Kumar M. 2016. Impact of climate change on crop yield and role of model for achieving food security. *Environmental Monitoring and Assessment*, 188 (8), 465.
- Manandhar, S., Vogt, D.S., Perret, S.R., and

- Kazama F. 2011. Adapting cropping systems to climate change in Nepal: a cross-regional study of farmers' perception and practices. *Reg Environ Change*, 11, 335–348.
- Moshefi, P. and Almasi, A.B. 2015. Effects of climate changes on agriculture. *Biodiversity Journal*, 6 (2), 633-636.
- Nuraisah, G. and Kusumo, R.A.B. 2019. Dampak perubahan iklim terhadap usahatani padi di desa Wanguk kecamatan Anjatan kabupaten Indramayu. *Jurnal Pemikiran Masyarakat Berwawasan Agribisnis*, 5 (1), 60-71.
- Onu, F.M. and Ikehi, M.E. 2016. Mitigation and adaptation strategies to the effects of climate change on the environment and agriculture in Nigeria. *IOSR Journal of Agriculture and Veterinary Science*, 9 (4), 26-29.
- Rakib, M. and Anwar, S.M.H. 2016. Farmer's perception and knowledge of climate change in Bangladesh – an empirical analysis. *Research in Agriculture, Livestock, and Fisheries*, 3 (1), 27-35.
- Stone, R.C. and Meinke, H. 2006. Weather, climate, and farmers: an overview. *Meteorol Appl. (Supplement)*, 7-20.
- Suciantini. 2015. Interaksi iklim (curah hujan) terhadap produksi tanaman pangan di Kabupaten Pacitan. *Pros Sem Nas Masy Biodiv Indon*, 1 (2), 358-365.