Application to forecast attacks on plant disturbing organisms

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Abstract. The agricultural sector is one of the sectors that should get the greatest attention from the government. It is directly related to the national food sovereignty. The agricultural development is an integral part of national development that aims to improve the productivity of farming. The government's efforts to improve the food agriculture can be seen by the programs such as Special Efforts to increase food production that focuses on three main commodities: Rice, Corn, and Soybean. The number of national soybean demand has recently increased. It is fulfilled by increasing the supply of imported soybean which has even reached 70-80%. One of factors that affects the level of food production security is climate. The aim of this study is to find out the relationship rainfall, rainy day, lose to the area of attack to pests, determine influence of the components on the occurrence of pests and diseases, predict the possibility of pest and disease attacks by utilizing component parameters, utilizing IT technology in predicting pests and diseases, implementing a model on soybean commodities. Given the high impact of plant distributing organisms, especially wereng and tungro on the level of soybean crop production, they can affect the food security.

1.Introduction

Agriculture plays a big role in the global economy, pressure on the agricultural will increase with the continuing expansion of the human population. Agriculture technology now also termed digital agriculture, have arisen as new scientific fields that use data intense approaches to drive agricultural productivity [1]. The agricultural sector is one sector that must get the attention of the Government. This is because of the agricultural sector is directly related to national food security and sovereignty. Agricultural development is an integral part of national development which aims to increase the productivity of farming, is expected to be able to move the economy of the community. Agricultural development programs are formulated in four programs, namely (1) improving food security, (2) diversification of crops and processed food, (3) increasing added value and competitiveness of agricultural products, and (4) improving the welfare of the community, especially farmers [2]. In agriculture sector where farmers and agribusinesses have to make innumerable decisions every day and intricate complexities involves the various factors influencing them [3].

Government has made efforts food agriculture can be seen from programs carried out such as Special Efforts (UPSUS) in increasing food production focused on three main commodities, namely Rice, Corn, Soybeans (PAJALE), Integrated Crop Management or PTT rice fields aimed at increasing crop productivity in terms of results and quality through the application of technology that is appropriate to the specific location and other programs. Corn rice and soybeans are strategic commodities that are unique in Indonesia. The role of soybeans is very important in population food. Soybeans have been known as a source of vegetable protein for Indonesian population [4].

In Jember Regency, it is difficult to increase the amount of agricultural land and reduce the population rate, but it needs to be followed up namely a strategy to solve food security on existing land. In Jember Regency various types of horticulture plants can be found and developed by the community. However, the potential possessed, has not fully been able to make a major contribution to efforts to increase food security. Climate and environmental are especially factors that affect food security. Climate change has a large potential impact on food security in East Java Province. Natural disasters and climate change have a large potential impact on food security in East Java Province. Extreme climate events that cause a significant loss of food crop production are related to the El Niño / Southern Oscillation (ENSO) phenomenon. An increase in sea surface temperature of one degree centigrade has a significant negative impact on rainfall in Probolinggo, Lumajang, Jember, Bondowoso, Banyuwangi and Kota Batu [5].

PAJALE is an acronym for rice, corn, and soybeans, which is currently a rampant government program to increase the production of all three in order to achieve sustainable food self-sufficiency. Food self-sufficiency is a condition where a country is able to meet its own needs in the field of food. In an effort to meet the increasing food needs, the government has determined the Achievement of Sustainable Food Self-Sufficiency that must be achieved within three years [6].

National soybean needs have been increasing lately, fulfillment by increasing the supply of imported soybeans which has even reached 70-80%. Figure 1 is soybean productivity based on BPS data from 1993 - 2015 showing fluctuations in soybean productivity.

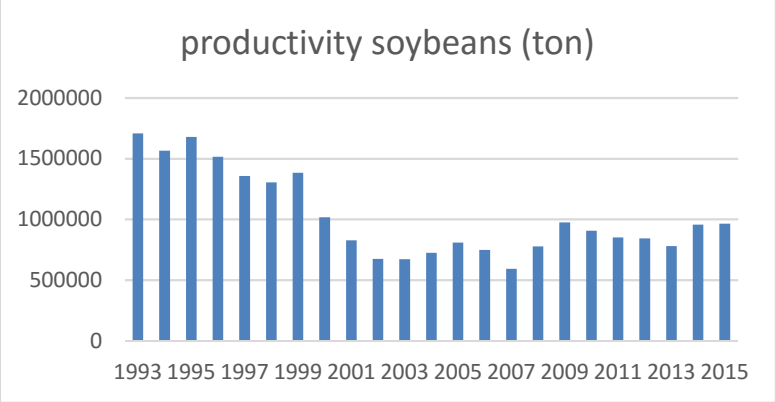

Figure 1. Productivity soybeans

Factors that influence the level of food security in production are climate [7]. Due to climate and weather have an important role both directly and indirectly to the spread, dispersal, abundance, and behavior of insects [8]. Air humidity affects the biological process of insects, where the optimum range of air humidity is generally around 73-100%. The rainfall in Jember regency is quite high so it greatly affects the productivity of soybean plants. An essential issue for agricultural planning intention is the accurate yield estimation for the numerous crops involved in the planning. Anticipation is the manner in which an organism or a community behaves in advance of a predictable event [9].

Considering the high impact of pest attacks, especially planthoppers and tungro on the level of soybean production in Jember Regency, it is feared that it can affect very hard food security.Based on these problems, the objective of this studies are needed specifically to predict the cycle of plant hopper and tungro attack on soybeans so that strategies and action plans can be formulated to support Ministerial Regulation Nomor 03 / Permentan / OT.140 / 2/2015 and face and mitigate them to increase productivity and resilience food and make it easier for the Agriculture Service to carry out supervision and coaching because of the area mapping feature that has the highest attack on the application. The study also aims to contribute to the Jember State Polytechnic Research Master Plan in the field of food security, Information and Communication Technology in 2016-2020 and the Government's Special PAJALE Program.

Literature Review

Literature review that will be used for this research are

1.1. PAJALE

Food crops are an important sector, because food crops are a group of plants that produce food as a ssource of energy to sustain human life. Indonesia itself is currently prioritizing four types of food crops in Indonesia, namely rice, corn, soybeans and cassava. The availability of food crops is very important to meet the food needs of the community in a sustainable manner. The government issued ministerial regulation number 03 / Permentan / OT.140 / 2/2015 concerning special effort guidelines (UPSUS) increasing production of rice, corn, and soybeans through improvements to irrigation networks and supporting facilities for FY 2015. UPSUS in increasing focused food production in three main commodities, namely Rice, Corn, Soybeans (PAJALE), Integrated Crop Management or PTT, wetland rice aims to increase crop productivity in terms of yield and quality through the application of technology that is appropriate to the specific location and other programs. Corn rice and soybeans are strategic commodities that are unique in Indonesia. The role of soybeans is very important in the food menu of the population. Since long ago, soybeans have been known as a source of vegetable protein for the Indonesian population

1.2. Plant Disturbing Organisms

Wereng is a common term for plant-sucking insect liquids belonging to the order Hemiptera (true ladybug), suborder Fulgoromorpha, especially small ones. Curcuma was once classified as a hopper (under suborder Auchenorrhyncha) but has now been taxonomically separated. Because it is exclusively alive from plants, a number of its members become important pests in crop cultivation. Aside from being a direct eater, planthoppers are also a vector for the transmission of a number of important plant diseases, especially from the viral group.

Tungro virus disease is still a problem for farmers in the morning and has caused a lot of losses, of course this will affect production, productivity and is an obstacle to self-sufficiency and the security of national food procurement. Although the control of planthopper pests which is a vector of tungro viruses has been widely carried out, but it turns out that until now these pests are still the main pest for soybean plants in Indonesia. Therefore, the application of controls based on the concept of controlling risks and integrated diseases needs to be further improved. Diversification of farms is also intended to prevent the adverse effects of monoculture cultivation systems that in the long run can lead to degradation of soil quality and fertility, increased pest and plant disease resistance, low land productivity, and prevent the risk of drought and crop failure [10]

1.3. Forecasting

Forecasting is the process of estimating (measuring) the amount or amount of something in the future based on data in the past that was scientifically analyzed especially using statistical methods. Forecasting is the basis of all types of planning where this is very necessary for an unstable environment which is the bridge between the system and the environment. Estimates or measurements can be carried out qualitatively or quantitatively. Qualitative estimates usually use the opinions of experts in their fields, while quantitative estimates use statistical and mathematical methods which are then widely used, one of which is a periodic series method. For example previous research application can help farmers forecast performances were evaluated for maize fields of two farms in two irrigation seasons [11].

Working Methodology

1.4. Identification

Method requires extensive data added attacks to be bound and requires data on rainfall, rainy days and the extent of cropping for unbound data. Processed using the Double Linear Regression method and tested using Mean Square Error (MSE). The output is the result of forecasting for the following year based on sub-district and month.

1.5. Analysis Data

Dependent variables used are Area Add Attacks (LTS) Pengangu Plant Organisms (OPT) and independent variables are Rainfall (CH), Rainy Day (HH) and Area of Add Planting (LTT). The regression equation for three predictors is as follows:

$$LTS = b_0 + b_1 CH + b_2 HH + b_3 LS$$

The Double Regression Process is done by calculating the following data:

a. Determine a descriptive size deviation score

$$\sum CH^2 = \sum CH^2 - \frac{(\sum CH)^2}{n}$$

$$\sum HH^2 = \sum HH^2 - \frac{(\sum HH)^2}{n}$$

$$\sum LS^2 = \sum LS^2 - \frac{(\sum LS)^2}{n}$$

$$\sum LTS^2 = \sum LTS^2 - \frac{(\sum LTS)^2}{n}$$

$$\sum LTS * CH = \sum LTS * CH - \frac{\sum LTS * \sum CH}{n}$$

$$\sum LTS * HH = \sum LTS * HH - \frac{\sum LTS * \sum HH}{n}$$

$$\sum LTS * LS = \sum LTS * LS - \frac{\sum LTS * \sum LS}{n}$$

$$\sum CH * HH = \sum CH * HH - \frac{\sum CH * \sum HH}{n}$$

$$\sum CH * LS = \sum CH * LS - \frac{\sum CH * \sum LS}{n}$$

$$\sum HH * LS = \sum HH * LS - \frac{\sum HH * \sum LS}{n}$$

b. Determine the coefficients and constants of multiple regression equations determination of coefficients

$$\sum CH * LTS = b_1 \sum CH^2 + b_2 \sum CH * HH + b_3 \sum CH * LS$$

$$\sum HH * LTS = b_1 \sum CH * HH + b_2 \sum HH^2 + b_3 \sum HH * LS$$

$$\sum LS * LTS = b_1 \sum CH * LS + b_2 \sum HH * LS + \sum b_3 LS^2$$

Constant

$b_0 = Average(LTS) - b_1$ Average(CH) - b_2 Average(HH)- b_3 Average(LTT)

c. Determine the Number of Squares (JK) the source of the variant needed

$$JK_{TR} = \sum LTS^2$$

$$JK_{REG} = b_1 \sum CH * LTS + b_2 3 \sum HH * LTS + b_3 \sum LS * LTS$$

$$JK_{RES} = JK_{TR} - JK_{REG}$$

d. Determine the degree of freedom (dk) the source of the variant needed, it is known that n is the total amount of data studied, k is the number of independent data

$$dk_{TR} = n - 1$$

$$dk_{REG} = k$$

$$dk_{res} = n - k - 1$$

e. Determine the Average Number of squares (RJK) the source of the variant needed

$$RJK_{reg} = \frac{JK_{reg}}{k}$$

$$RJK_{RES} = \frac{JK_{RES}}{n - k - 1}$$

f. Determine F count

$$F_h = \frac{RJK_{reg}}{RJK_{RES}}$$

g. Determine Ftable and test the research hypothesis Ftable is obtained from table F of the determination with α = 0.05 Testing Criteria: H0 = There is no significant effect between the three parameters on the LTS H1 = there is a significant effect of all three parameters on the LTS

3.Experiment and Result

This study forecasting application system use a linear method with three parameters rainfall (CH), rainy Day (HH), losess to the Area of Attack (LTS). There are two applications for predicting planthopper pest attacks and tungro disease attacks. Figure 2 – 5.

Figure 2 Application Forecasting

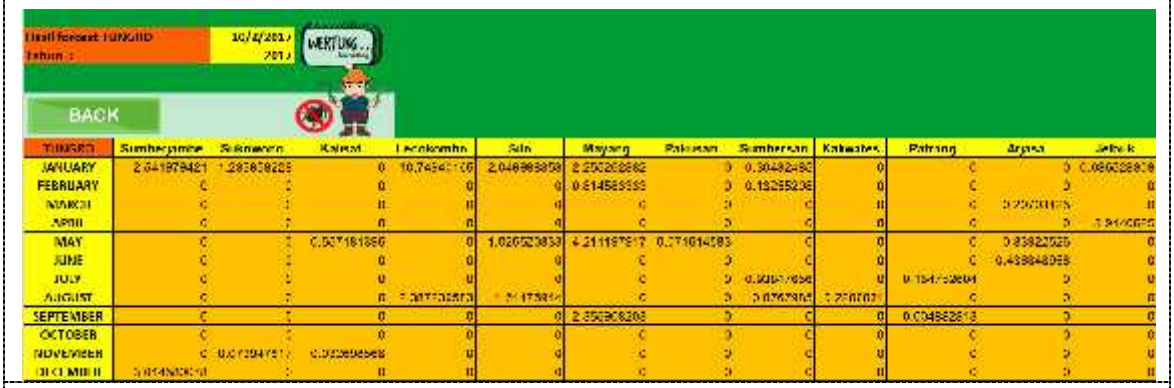

Figure 3. Process Forecasting

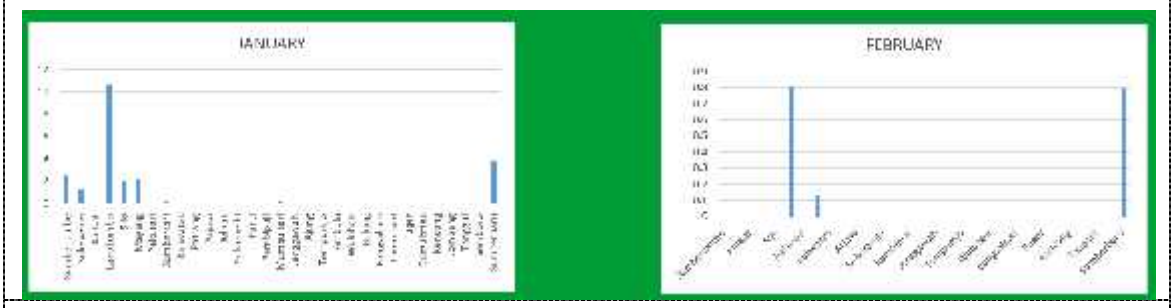

Figure 4. Graph

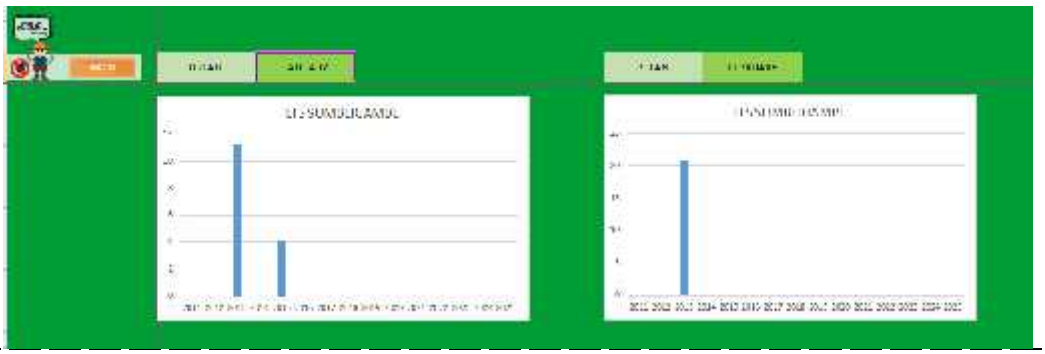

Figure 5. Forecasting by districts

4.Conclusion

Based on the problems that exist in the identification, the following conclusions: the production data of food crops agricultural commodities are associated with data on the cycle of wereng and tungro pest attacks on soybean which affect the level of commodity production fluctuations by designing application systems for forecasting cycle of plant hopper and tungro pests in Jember Regency. "Wereng" and "Tungro" attacks on rice was affected by rainfall (CH), Rainy day (HH) and the area of planting (LTT), Forecasting the attacks of Wereng and "Tungro" diseases based on rainfall (CH), Rainy day (HH) and the area of planting (LTT), The application run on Microsoft Excel program to make easier for user and this forecasting method is also potential to predict The Pest and Disease on Soybean and Corn

References

[1] Liakos et all. 2018. Sensors 2018 18.2674. doi:10.3390/s18082674.
[2] Damanhuri dkk. 2018. Conference Series 953012121. https://doi.org/10.1088/1742-6596/953/1/012121
[3] Majumdar et all. 201. Journal of Big Data. https://doi.org/10.1186/s40537-017-0077-4.
[4] Supadi. 2009. Pusat Analisis Sosial Ekonomi dan Kebijakan Pertanian.
[5] Ponto, J dkk. 2017.Jurnal Agri-Sosio ekonomi Unsrat,ISSN 1907 – 4298. Vol. 13. No 2A.
[6] Trismayanti, dkk. 2018. Konferensi Nasional Sistem Informasi 2018.
[7] Ahmadi, A. 2011. Skripsi. IPB Press. Bogor.
[8] Nugroho, A, D. 2017. Jurnal. JKPM. Vol 3.No 1. ISSN 2460-9447/2541-5883.
[9] Ponge.2013. doi: 10.1002/ece3.505.
[10] S Anwar et all.2018. Conference Series 953012123. https://doi.org/10.1088/1742-6596/953/1/012123
[11] Chirico et all. 2018. The Journal of Agricultural Science, 1-9. Doi:10.1017/S0021859618000084

Acknowledgments

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