

Article

Fertilization Technology of Virginia Tobacco Farmers in Bojonegoro and Lamongan Districts and approach to IoT

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Abstract:

The districts of Jember, Bojonegoro, and Lamongan are home to Virginia tobacco shops. In Bojonegoro Regency, there are 11,522 ha and 11,517 ha of tobacco land, while there are 6697 ha and 6683 ha in Lamongan Regency. The quality of tobacco is lowered by excessive fertilization, the use of impure varieties, interplanting with chilies, and the neglectful pruning of shoots (Tirtosastro S and Taufik I, 2022). Inorganic fertilizers used in excess will deteriorate unhealthy soil (Arifin Z and Lolita ES, 2020). The issue of excessive chlorine fertilizer use results in a decrease in tobacco quality (low burning power, dull color). The Bojonegoro and Lamongan regions have lost many tobacco product industries as a result of excessive chlorine fertilizer restrictions on tobacco plants. Based on the aforementioned issues, a survey study on fertilization methods for Virginia farmers in the Bojonegoro and Lamongan Regencies is required. The goal of this study was to ascertain how fertilizers were applied by farmers and to measure the soil's and tobacco leaves' chlorine contents. The fertilization process is carried out with an approach to the Internet of Things which is necessary for fertilization automation and more optimal results.

Keywords: Virginia tobacco, fertilization, farmers, IoT, Automatic fertilization



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1. INTRODUCTION

East Java is the largest tobacco center in Indonesia. Based on data from the Statistik Agency in 2020-2021, the land area reached 111,678 ha – 111,884 ha with production reaching 130,268 tons-118,943 tons. Virginia tobacco centers are located in the Jember regency, Bojonegoro regency and Lamongan. The area of tobacco land in Bojonegoro Regency in 2020-2021 covers an area of 11,522 ha and 11,517 ha and Lamongan Regency covers an area of 6697 ha and 6683 ha. Tobacco production in Bojonegoro and Lamongan Regencies in 2020-2021 reached 13,123 tons and 10,512 tons in 2020 while in 2021 it reached 10,658 tons and 10,515 tons (BPS, 2020). The ups and downs of tobacco land area and production are caused by several factors, including decreasing land area, unfavorable weather and poor cultivation techniques. Cultivation techniques include land processing, selection of superior seedlings, watering, fertilization and control of pests. Excessive fertilization, the use of impure varieties, the presence of intercropping with chili

peppers, and pruning of shoots that are not paid attention to cause a reduction in tobacco quality (Tirtosastro S and Taufik I, 2022).

The use of fertilizers by farmers today still depends on inorganic fertilizers. The reason farmers use inorganic fertilizers is that they are able to have a rapid effect on tobacco growth. Excessive application of inorganic fertilizers will provide degradation to unhealthy soils (Arifin Z and Lolita ES, 2020). The low use of fertilization technology according to the specifics of the location will also affect the low production of tobacco (Hidayati SN, et al, 2020). Issu excessive use of chlorine fertilizer causes the quality of tobacco (less burning power, not bright color) to decrease. The constraint of excessive chlorine fertilizer on tobacco plants has caused many tobacco products to come out of the Bojonegoro and Lamongan regions. From the problems mentioned above, research on the fertilization technique survey of Virginia farmers in Bojonegoro and Lamongan Regencies needs to be carried out. The purpose of this study was to determine the use of fertilizer in farmers and obtain the chlorine content of tobacco leaves and chlorine in the soil.

2. METHOD

2.1 The slovin formula

The location of the study was determined purposively on farmers in Bojonegoro Regency and Lamongan Regency. The farmer sampling technique is carried out by systematic sampling. This sampling technique is used in conditions of large population size but has homogeneity. The sample was a member of a farmer group involved in tobacco cultivation. 36 farmers who were made repondents were calculated using the slovin formula (Rini D, 2017) as following equation 1.

$$n = \frac{N}{1+(N \cdot e^2)} \quad (1)$$

$$n = \frac{36}{1+(36 \cdot 0,1^2)} = 26 \text{ people}$$

Where:

n = sample size/number of respondents

N = population size

e = estimated error 10%

From the slovin formula in equation 1, this study can be sampled as many as 26 people. The data collection method is carried out by means of interviews, observations, and documentation. Interviews are conducted by visiting farmers directly to get the information needed as primary data. The data sources used in this study are:

1. The primary data source is direct data collection by interviewing respondents according to a predetermined sample.
2. The source of skunder data is data obtained through the study of literature and information from related instants, namely the agricultural service.

2.2 Fertilization Automation using IoT

Now, when viewed from a novelty aspect, the Fertilization process was developed by creating an automation system. This article does not discuss the details of the demonstrable system, but focuses on the concept of building the Internet of Things. Starting with the IoT Component, as shown in Figure 1, and the Flowchart of IoT Component for Fertilization Automation.

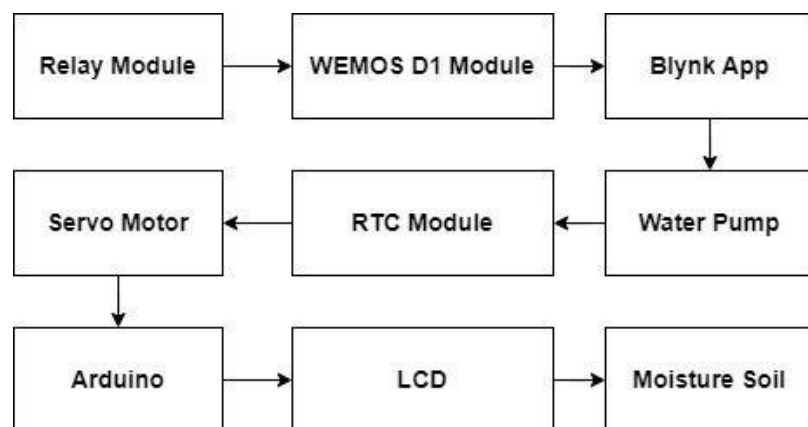


Figure 1. IoT Component for Fertilization Automation

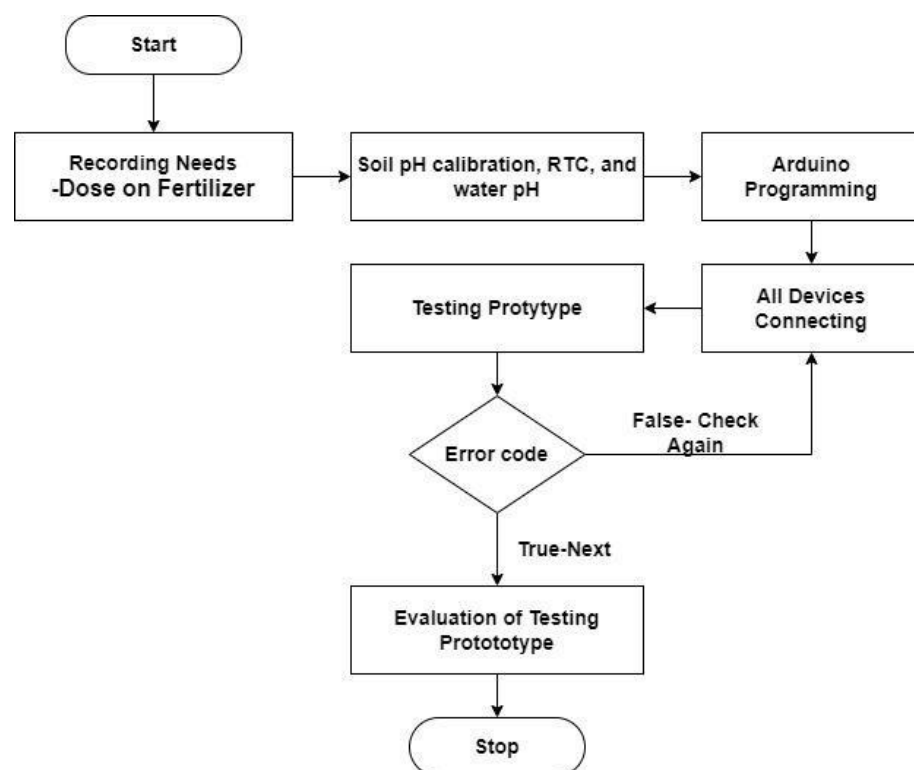


Figure 2. Flowchart of the Fertilization Automation IoT based

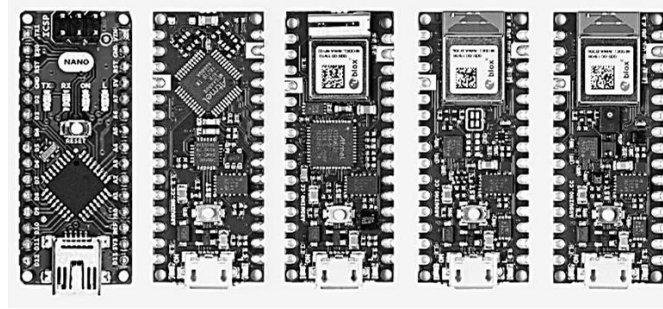


Figure 3. Various types of Arduino Nano boards (<https://www.makerguides.com/>)

Several components have essential functions to form an Internet of Things-based fertilization process, one of which is to provide certainty of fertilization, in this case fertilizer that has been mixed with water and then watered using a sprinkler on tobacco. The sprinkler is connected to the Water Pump, relay, and Microcontroller, as well as the RTC to regulate when the sprinkler will be activated, whether every 08.00 WIB and 15.00 WIB only. This will be a very helpful thing for farmers. While on the server is the Application Programming Interface (API) [14,15,16,18] used by the Blynk Application for users to use in monitoring any changes that occur from input, e.g., sensors and RTC.

The fertilizer discussed here is a type of liquid fertilizer, urea fertilizer can also be mixed with water. for example the ratio is 1 liter of fertilizer per 10 liters of water or 1:10. and to apply it, all we have to do is spray it on the plants, in this case tobacco, or sprinkle it on the planting medium around the plant's root area. So with the IoT approach [17,19,20], liquid fertilizer is placed in the container, if according to the specified time, the fertilizer will spray through a sprinkler that is connected to the Water Pump and Relay. Arduino Nano, Arduino Pro-mini and the like are used as processors, which will then be connected to telecommunication devices and actuators, as well as other devices that are directly related to the object being monitored.

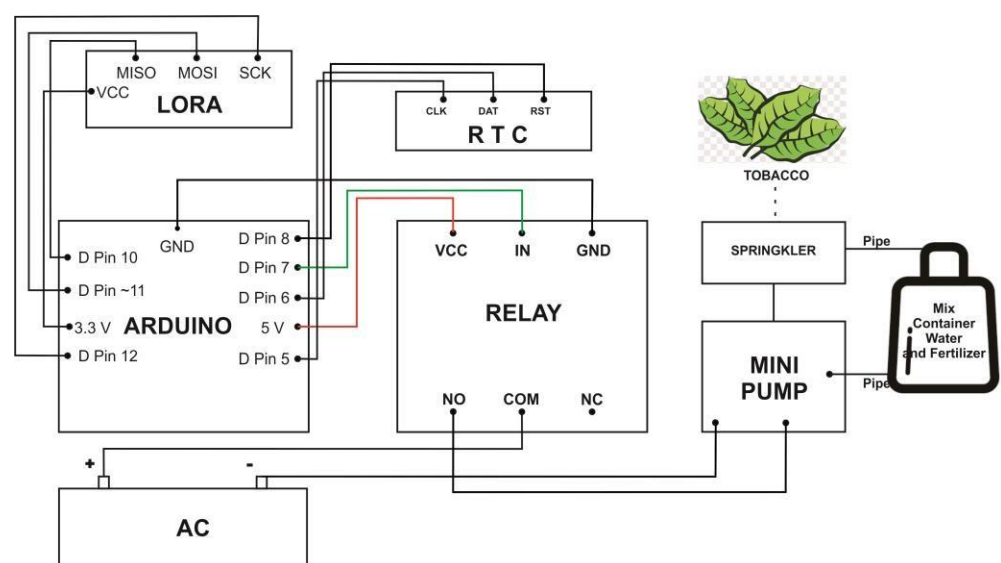


Figure 4. Schematic of Arduino LoRAWAN Automatic sprinkler

Figure 4 is a schematic design of the automation between Arduino and other devices, such as RTC, Mini Pump, LoRa, and sprinklers. Next, after this device has been calibrated in such a way as in Figure 2, the next step is to analyze the connection to the server, it can use LoRa or WiFi modules, WEMOS, etc. and ensure that the data sent to the internet server can be received by the IoT Application server which can then be viewed in real time on a smartphone.

3. RESULT AND DISCUSSION

The selection of land for tobacco cultivation is very important so that the planning of the farming business produces profits that are in line with the expectations of tobacco commodity agricultural land in Bojonegoro Regency and the average lamongan is dominated by paddy fields. The area of land owned by farmers in 2021 in Bojonegoro Regency averages 0.27 ha while in Lamongan Regency it is 0.24 ha. In 2022 the land area in Bojonegoro Regency is 0.33 ha and in Lamongan 0.22 ha can be seen in Figure 5. The rise and fall of the land area due to rainfall at that time was erratic and unfriendly, thus affecting the interest of farmers to grow tobacco.

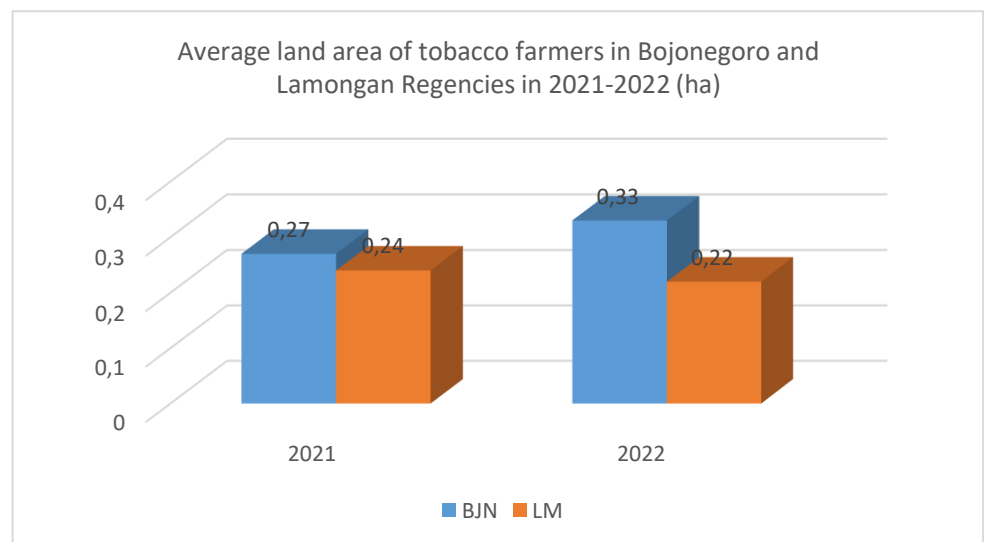


Figure 5. Average land area of tobacco farmers in Bojonegoro and Lamongan Regencies

Tobacco production in Bojonegoro Regency in 2021 averaged 650 kg and in 2022 as much as 169 kg. Tobacco production in Lamongan Regency in 2021 averaged 420 kg and in 2022 as much as 100 kg as shown in figure 6. The decline in tobacco production is due to the failure of many farmers. The farmers' intransigence in tobacco cultivation is caused by continuous rains causing the land to be flooded and many of them withering and dying.

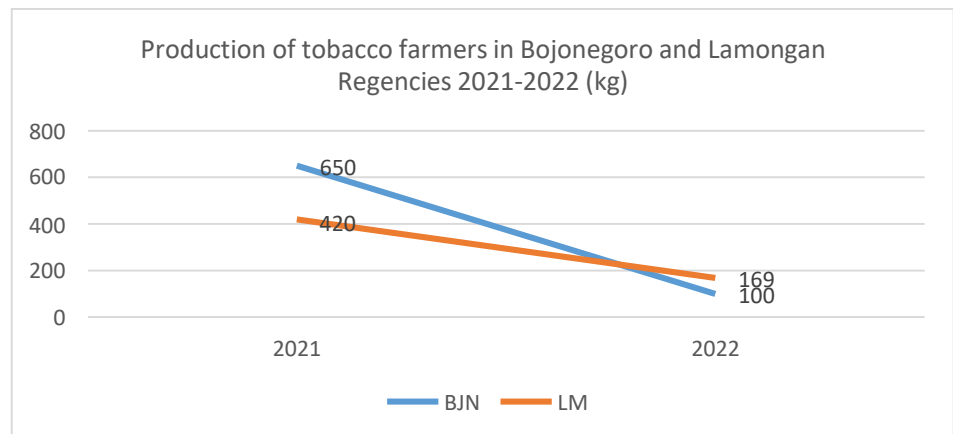


Figure 6. Average production of tobacco farmers in Bojonegoro and Lamongan Regencies

The most widely used types of fertilizers by tobacco farmers in Bojonegoro and Lamongan Regencies in 2021 are ZA 42%, ZK 31% and NPK 23%. Meanwhile, in 2022, it is dominated by the types of fertilizers ZA 68%, Urea and Fertila 58%, NPK and SP36 54% others under ZA in figure 7. Fertilizer has an important role in growth by providing the nutrients that plants need. Applying the right fertilizer will affect the quality and aroma of tobacco (Yan S et al,2020). Farmers in buying fertilizer in agricultural stores and some farmers get fertilizer assistance.

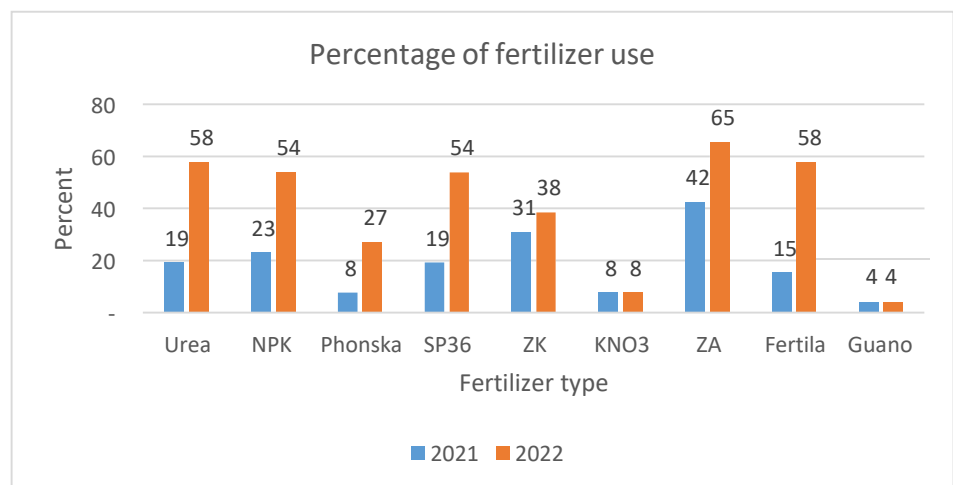


Figure 7. Percentage of fertilizer use of tobacco farmers in Bojonegoro and Lamongan Regencies in 2021-2022

The average dose of fertilizer used by farmers in Bojonegoro and Lamongan Regencies in 2021 is 77 kg of SP36, 38 kg of Urea 33 kg of NPK. In 2022 the highest dose of 47 kg ZA, 34 kg SP 36, 33 Urea 28 kg NPK the rest is less compared to the doses of ZA and SP36 as the Figure 8. The use of urea fertilizer in 2022 is quite a lot will lead to a further decrease in soil fertility. Excess urea with a high N content will worsen soil health and reduce tobacco quality, especially the holding power of Zhang L, et al, 2021). Adjusting N fertilizer to plant blindness will provide growth effectiveness and reduce losses due to washing Soares MT, et al 2020). Proper fertilization is able to provide significant results (Reynolds BC et al, 2022). The constraints of some brands of fertilizer make farmers reduce their

dosage. Nevertheless, there are also those who still buy. The application of fertilizer at the farmer level is given 3 to 4 fertilization.

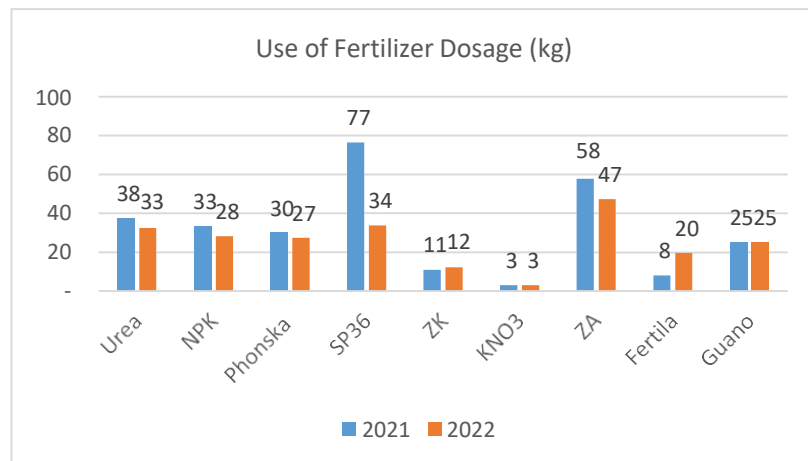


Figure 8. Average fertilizer dose of tobacco farmers in Bojonegoro and Lamongan districts in 2021-2022 (kg)

The percentage of varieties grown in Bojonegoro and Lamongan Regencies in 2021-2022 is T45 and Poiton of other varieties is less as a Figure 9. This shows that the T45 and Paiton varieties are favored by farmers because they provide good quality. High-yielding varieties can encourage quality improvement and increase farmers' incomes so as to reduce losses (Ma J et al, 2022; Martey E, et al, 2022). Success in tobacco cultivation in addition to environmental factors and fertilization is influenced by high-yielding seedlings. Success in the use of high-yielding varieties will provide purity and have an impact on the quantity and quality produced.

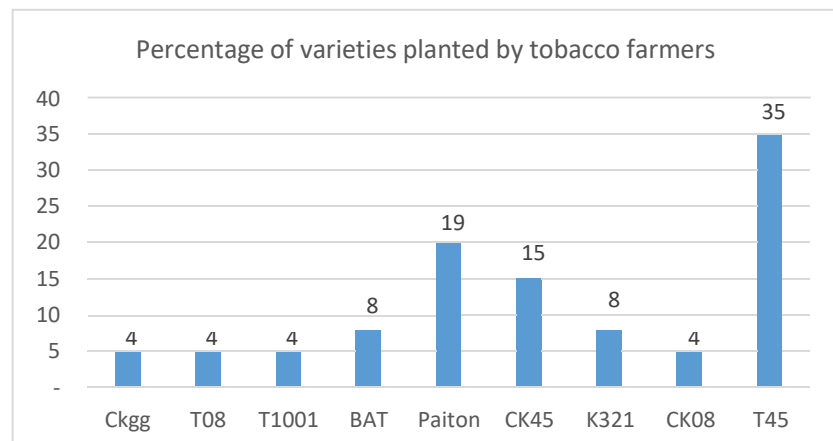


Figure 9. Percentage of varieties grown by tobacco farmers in Bojonegoro and Lamongan Regencies in 2021-2022

The distribution of varieties in Kabupaten Bojonegoro is dominated by the Paiton variety while Lamongan variety T45 as Figure 10. The identification of the distribution of varieties resulting from the interview will provide supporting data on the mapping and distribution of varieties grown by farmers. Farmers in choosing seedlings by purchasing in one area with the origin of the seedlings is unknown.

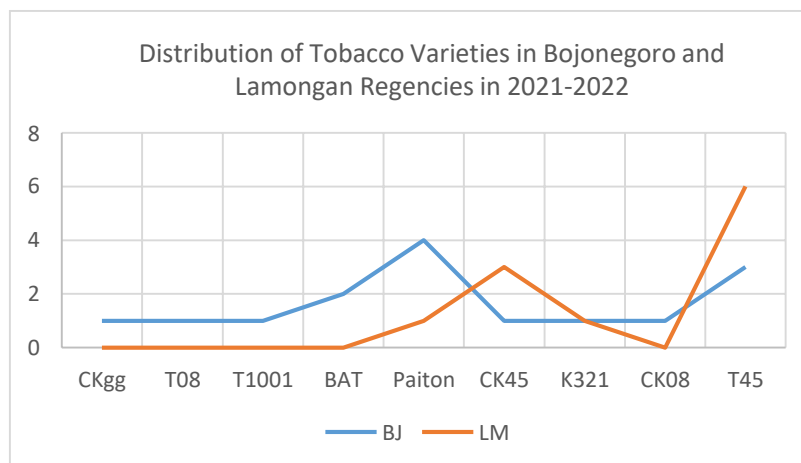


Figure 10. Distribution of tobacco varieties in Bojonegoro and Lamongan Regencies in 2021-2022

Tobacco prices in 2022 increased by around 59% from 2021. Reduced raw materials cause prices to rise as a Figure 11. This is according to the law of demand where supply is limited then the price will increase. The reduction in price of raw materials is caused by the large number of farmers experiencing crop failure. From the observations in the field, farmers who can still harvest are farmers which apply a high guludan system so that when there is rain tobacco is not flooded.

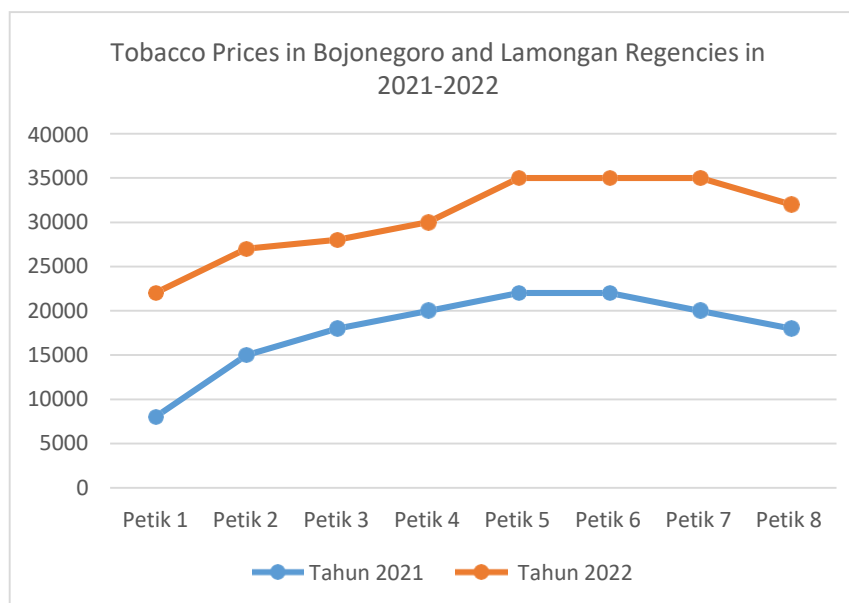


Figure 11. Tobacco prices in Bojonegoro and Lamongan Regencies in 2021-2022

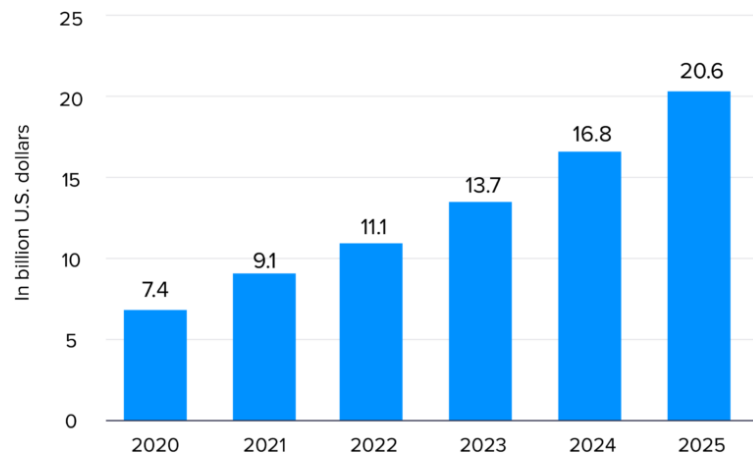


Figure 12. Internet of Things (IoT) Impacting the Food & Agriculture Industry include tobacco

As shown in Figure 12, the role of the Internet of Things in the field of Plantations and Agriculture is predicted to be quite large, in 2025 it is predicted to reach 20.6 Billion U.S. Dollars from the Global market for Agriculture robots and IoT.

4. CONCLUSIONS

Land area determines the amount of crop yields in the Bojonegoro and Lamongan areas, in 2022, agricultural land in Bojonegoro experienced an increase of 0.6 ha, while Dilamongan decreased by 0.02 ha in 2022. for Production of tobacco farmers in Bojonegoro and Lamongan Regencies, in 2022 the same will decrease, in 2021 tobacco production in Bojonegoro will reach 650 kg, dropping drastically in 2022 to 100 kg, while in Lamongan tobacco production is 420 kg, decreasing to 169 kg in 2022. from the results of a survey study on fertilization methods for Virginia farmers in the Bojonegoro and Lamongan Regencies it was found that the type of fertilizer used with the highest percentage was 65% ZA, 58% Urea and Fertila, 54% NPK and 38% ZK in 2022, this will experience a drastic increase from 2021 which is only a maximum of 31% in ZK. while the use of fertilizer dosage form SP36 reaches the highest percentage in 2021, namely 77%, while ZA is 58%. this will decrease in 2022, namely 34% use of SP36 in 2021 and 47% ZA in 2022. while the Percentage of varieties grown by tobacco farmers in Bojonegoro and Lamongan Regencies in 2021-2022 T45 shows the highest percentage, namely 35%, was compiled by Paiton 19%. This causes the distribution of T45 tobacco varieties to be very high in Bojonegoro and Lamongan in 2021 and 2022. The price of tobacco in Lamongan is still above the price in Bojonegoro, namely 35,000 IDR, while in Bojonegoro 20,000 IDR. the size of the land, the climate of an area, and the use of the type of fertilizer, the use of the right dose of fertilizer will determine the quality of tobacco that determines the price. this also needs attention, namely the time of fertilization, with fertilization-based automation internet of things in the future, it is felt that it will be quite helpful in maintaining the quality of tobacco.

AUTHOR CONTRIBUTIONS

Conceptualization; Supriyadi [S], Djajadi [D], Gatot Suharto Abdul Fatah [G.S.A.F], Rumanintya Lisaria Putri [R.L.P], Yoga Angangga Yogi [Y.A.Y], methodology; [S],[D],[G.S],[R.L.P],[Y.A.Y], validation; [S],[D],[G.S],[R.L.P],[Y.A.Y], formal analysis; [S],[D],[G.S],[R.L.P],[Y.A.Y], investigation; [S],[D],[G.S],[R.L.P],[Y.A.Y], data curation; [S],[D],[G.S],[R.L.P],[Y.A.Y], writing—original draft preparation; [S],[D],[G.S],[R.L.P],[Y.A.Y], writing—review and editing; [S],[D],[G.S],[R.L.P],[Y.A.Y], visualization; [S],[D],[G.S],[R.L.P],[Y.A.Y], supervision project administration; [S],[D],[G.S],[R.L.P],[Y.A.Y], funding acquisition; [S],[D],[G.S],[R.L.P],[Y.A.Y], have read and agreed to the published version of the manuscript.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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