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The Application of the Binary Logistic Regression Model in Examining the Effects of Input Factor Allocation on Tangerine Production: Empirical Evidence from Selayar Islands Regency, Indonesia

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Abstract: This study aimed to examine the effects of the input factor allocation on tangerine production in Selayar Islands Regency, South Sulawesi Province. Binary logistic regression was the data analysis method utilized to achieve the research objective. Based on the findings, it was found that the factors of length of education, farmer group membership, farm distance, labor, pesticides, herbicides, urea fertilizer, manure, and NPK fertilizer all had a significant impact on the output of tangerines in farming. Factors such as education duration, participation in farmer groups, labor availability, and the use of herbicides, urea fertilizer, NPK fertilizer, and manure all positively and significantly impact tangerine farm production. However, the distance between farms and insecticide application imposes a substantial negative effect on tangerine yields. These results suggest that the tangerine farmers at the research site should increase their production by learning farming management, joining farmer groups, cultivating additional land, and using more urea, NPK, and manure. Pesticide application optimization can also boost tangerine production. In addition, farmers need a mix of conventional and organic fertilizers and limited pesticide use to stay productive.

Keywords: production factors; input allocation; tangerine production; binary logistic regression; Selayar Islands Regency

1. Introduction

Agricultural development is essential to national progress, aiming to advance income parity, generate employment opportunities, augment agriculture production, enhance farmers' incomes, and conserve natural resources [1]. Furthermore, agricultural development contributes to the enhancement of national food security and the conservation of the environment [2], as well as the promotion of economic growth, sustainability, stability, equity, and efficiency [3,4]. The development

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of agriculture, which is a component of the development of the national economy, substantially influences the socioeconomic well-being of the community. This situation, in turn, encourages the development of economically significant centers ([1,5–7]; and other researchers.

Furthermore, the agricultural sector is generally the backbone of a country's economy and a parameter in managing its natural resources. It is the largest source of employment in most developing countries [8,9]. Therefore, the agricultural sector should receive more attention than other sectors [5]. Empirically, the agricultural sector is considered flexible, facing monetary and economic crises [10], and is the largest contributor to the Gross Domestic Product. In Indonesia, this sector, throughout the history of the Indonesian economy, has been one of the highest contributing sectors to national economic growth [11] and a provider of employment for some people in this country.

Indonesia possesses a diverse range of plant species that have the potential for cultivation, including various types of plantation crops, annuals, secondary crops, and horticulture [12]. Horticulture is an agricultural sector with the potential for development, offering the opportunity to create high-quality products that can enhance the welfare of farmers in Indonesia. This sector includes various horticultural products such as fruits, vegetables, medicinal plants, and ornamental plants [13,14]. The Indonesian region is appropriate for producing horticultural commodities due to its good land, agro-climatic characteristics, and distribution [15]. One of the agricultural sub-sectors that plays a vital part in contributing to the growth and development of the national economy is horticulture, as stated by [16]. Hybridization is one of the agricultural sub-sectors. Because of this, it is necessary to research and produce horticulture products in an environmentally friendly way. The necessity of developing this product is bolstered by a sizable population, which presents an opportunity for the home market [17]. However, despite having great potential, the implementation of horticultural commodity development in Indonesia still faces many obstacles, including inadequate technical guidance, inadequate human resource capacity, and the utilization of production inputs that are not optimal.

One important horticultural commodity not optimized for development in Indonesia is tangerine (*Citrus reticulata*) [18]. As stated in MOA 830/Kpst/RC.040/12/2016, the primary centers of local tangerine production have been developed in the provinces of East Java, South Sulawesi, South Kalimantan, East Kalimantan, and West Kalimantan, as well as in many other sites. This province is part of the national horticulture area development strategy. The purpose of this government regulation is to enhance the well-being of the community as well as the economic development of the region. Generally speaking, the varieties of tangerine fruits that are widely developed in Indonesia include siam oranges and tangerines, which account for 70–80 percent and 20–30 percent, respectively [19–21].

In South Sulawesi Province, the Selayar Islands Regency is one of the regency responsible for cultivating tangerine products. Tangerines are the sort of citrus that originated in the Selayar Islands Regency. In addition to being a source of vitamin C, this tangerine fruit is also highly well-liked by the population [19,22], which has resulted in it becoming a symbol of Selayar and a typical local souvenir. In 2017, tangerines ranked first as a typical souvenir of Selayar [11,23]. Annual production amounts to approximately 2,500-5,000 fruits per tree [23]. Tangerine production in this regency has increased from year to year. In 2019 it was 31,843 quintals, in 2020 it was 32,288 quintals, in 2021 it was 34,102 quintals [11]. Despite the increase in production, the production has not met the community's needs. Meanwhile, modern society is starting to realize the importance of health.

According to Hanif [24], Kowalska et al. [25] and Seminara et al. [26], tangerine fruits are currently considered to be one of the options that may be utilized to preserve the health of modern society. Tangerine fruits are the most important factor when selecting fruits for daily intake [26–30]. Tangerine fruits provide a variety of nutrients that are beneficial to the body. Agricultural producers are facing significant challenges in the production process and the growing demand for their products. Pest and disease attacks during the production period disadvantaged many farmers. Citrus Vein Phloem Degeneration (CVPD), fusarium, and diplodia are diseases that attack many tangerine plants during production [31]. In addition, the typical nature of tangerine produce, a horticultural crop product, is that it cannot be stored for long. Thus, it needs a specific storage place according to the product's characteristics. Then, this orange is also perishable in transportation, abundant in one season and scarce in another, and the price fluctuates [32–34].

Rational farmers aim to maximize the benefits obtained from their farms [35]. Orange cultivation is a business that requires considerable investment costs because, for two to three years, the capital is not offset by farm income [19,36]. Production factors are one of the key elements in agriculture that support the creation of value or increase the value of a commodity [16]. The benefits farmers would receive from annual crop farming are heavily reliant on the production cycle and the utilization of production factors. In the context of farming development, the productivity of agriculture is influenced by various aspects related to production [37–40]. The optimal use of production factors is one of the efforts to increase productivity [41,42]. Increased productivity will also affect farmers' profits, so there will be an increase in farmers' income. Optimizing the use of production factors that influence farmers' income is also expected to increase agricultural development [43–45]. Hence, this study aimed to examine the effects of input factor allocation on tangerine production in Selayar Islands Regency.

2. Materials and Methods

2.1. Literature Review and Conceptual Framework

Many government organizations and institutions in Indonesia have conducted numerous studies on using tangerine production inputs. As a result, this part will present the prior study's findings and the factors influencing tangerine production.

2.1.1. Literature Review

1. Educational Length and Farming Experience;

Mulyaningsih et al. [46] state that education is one of the elements that influence a farmer's decision to accept or implement a training program. Furthermore, Marhawati [47] stated that the amount of education will impact orange farmers' ability to absorb information and innovate in their farm development. In addition to education, farming experience can influence farm production [48]. This result aligns with previous research conducted by Nainggolan et al. [40], who discovered that the longer a farmer has been farming, the larger the produce they produce. These two aspects affect the production process. This viewpoint is consistent with studies by Chairunnisa and Juliannisa [49], illustrating how high education and a qualified workforce might impact output. Furthermore, Tania and Amar [50] emphasized that sufficient education and work experience will boost production. Therefore, education and farming experience have a substantial influence on farm production.

2. Pesticide Use and Fertilization;

In Indonesia, the tropical environment is one factor that contributes to the growth of pests and plant diseases, both of which can potentially diminish the amount of citrus plants produced. Aphids, fruit flies, stem borers, leafminers, leafworms, and cycads are some pests frequently discovered in citrus plants [51]. In addition to pests that threaten citrus crop production, diseases also pose as big a threat as pests in reducing citrus production. Diseases often found in citrus plants include CVPD (citrus vein phloem degeneration), anthracnose, stem base rot, tatter leaf, exocortis, and psorosis [52]. Proper handling is necessary to control pests and diseases [6]. Pest and disease control can be done by applying pesticides, proper nutrients, pruning, and controlling weeds [53]. Using pesticides and handling other factors properly can increase citrus crop production [54]. Fertilization is one way to improve soil fertility, where soil fertility will determine the quality and quantity of agricultural crop production [55]. During the vegetative phase, plants need nutrients in metabolism and photosynthesis [56]. Based on empirical evidence, a great amount of research has been carried out to investigate the impact of fertilizer application on the production of citrus crops. Sari et al. [57] did research that explains this phenomenon. Based on the findings of this research, it was determined that the fulfillment of nutrient requirements in citrus trees is a crucial factor in developing these plants. Then, Ramadhan et al. [58] and Ramadhana et al. [59] said that citrus plants will produce a

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high fruit set when NPK fertilizer is administered to them. As a result, citrus producers will be able to increase their output. NPK fertilizer can be applied to boost output in citrus plants, as stated by Sakhidin et al. [60]. This is accomplished by increasing the amount of fruits that these plants produce. According to Mario et al. 's [61] and Saragih and Harmain's research from [62], the application of fertilizer to grown plants has a sizable and beneficial impact on the amount of plant production.

3. Land Size and Ownership Status;

Based on empirical evidence, numerous studies have been carried out over the past five years to investigate the positive and considerable impact that land area has on citrus farm productivity. The scope of this research encompasses several different regions in Indonesia. According to Kharismawati and Karjati [63], land is significant in farm management concerning its role as a production component. As Pradnyawati and Cipta [64] point out, the area of land affects the amount of land planted. The amount of land planted is directly connected to the production [65]. The more land area planted, the higher its production will be. A substantial causal association between land area characteristics and citrus crop output has been reported by Langit and Ayuningsasi [66] in the Bangli Regency, Wijayanti and Hascaryani [67] in the Malang Regency, Namah et al. [48] in North Mollo Regency, and Kristiandi et al. [68] in the Sambas Regency. These findings are consistent with the research carried out in Egypt by Kassem et al. [69], which the same researchers undertook. Similarly, the study by Otieno [53] in Africa concluded that the land area element plays a key role in a positive and considerable impact on the quantity of citrus output.

Additionally, the size of the land area is another aspect that can affect citrus production. Land ownership status is another factor that can have an impact. The term "land ownership status" refers to the situation in which a farmer is granted permission to engage in farming activities on agricultural land on which they have the right to do so. Land ownership status is correlated with production outcomes, and this correlation exists between the two. The findings of several studies, including those conducted by Ainurrahma et al. [70] and Manatar et al. [71], indicate a substantial positive association between the status of land ownership and the quantity of harvest that farmers produce. This link is significant and can be considered beneficial. The findings of a study that was carried out by Pasaribu and Istriningsih [72] also demonstrated that the status of land ownership, which includes ownership, rent, and profit sharing, has been demonstrated to have a considerable impact on the quantity of production, which in turn would have a direct impact on the income of farmers. The investigation results led to the discovery of this piece of information. Additionally, Rondhi and Adi [73] asserted that the status of land ownership has a considerable and favorable influence on the quantity of agricultural output produced by farmers. An impact of this kind is beneficial. Research conducted by Koirala et al. [74] reveals that the status of land ownership significantly influences the amount of production that farmers produce.

4. Number of Family Members and Labor;

According to Kassem et al. [69], there is a very close connection between the number of dependents in farmer households and the requirements of each family member concerning their own needs. Both Nainggolan and Ulma's [39] study and Nainggolan et al.'s [40] study have demonstrated via research that an increase in the number of family members leads to an increase in the productivity of farmers, which in turn leads to an increase in the money that farmers derive from their agriculture. A study conducted by Marhawati [47] concluded that an increase in the number of dependents that farmers have will increase both their performance and their drive to provide for their family members. All of the findings from the research are in agreement with this result. According to Jamil et al. [75], the increased family requirement brought about by many dependents will also affect a person's ability to use all of their abilities, including hard and soft skills, because they anticipate a higher income. In addition, Khairunnisa et al. [76] stated that the number of family members who are financially dependent on the farmer's income has a beneficial impact on the amount of food the farmer produces. According to Purba and Purwoko [77], the number of family members who are employed not only contributes to an increase in production but also serves as a driving force behind that overall increase. According to Simanjuntak and Amrizal [78], people who work for farmers are an essential part of making more food.

5. Using Transportation and Tangerine Farming Distance to Farmer House;

According to Jamil et al. [75], one contributing factor that positively impacts labor productivity is the distance to the farmer's home between the worker's place of residence and the workplace area. The findings of a study that was carried out by Indraningsih [79] indicate that the distance that separates a farmer's house and farmland is a factor that adds to the overall agricultural performance of the farmer. According to the findings of Dewantoro et al. [80], which are comparable to the findings of this study, there is a negative correlation between the distance between the land and the farmer's residence and the productivity of farmers in managing their farms. However, when the distance to the farm is reduced, the productivity of the farm increases. This statement suggests that the distance between the farm and the farm positively influences the amount of farm food produced. Furthermore, the utilization of transportation instruments is intricately linked to the farm's proximity, hence facilitating convenient access for farmers to their fields. Consequently, transportation will indirectly exert a substantial beneficial impact on farmer production [62]. Furthermore, using technology, specifically transportation equipment, can effectively streamline and minimize production expenses in the transportation sector. Consequently, transportation equipment is pivotal in augmenting output levels [81].

6. Age, Gender and Farmer Groups.

The Farmers who play a big part in citrus production are distinguished by some qualities, one of which is its age. According to Saputra et al.'s [82] research, the economic value of citrus fruit will decrease with each extra year that farmers live. The findings Purba and Purwoko [77], which show that sweet orange growers have health difficulties with each extra age, seem to be slightly different from the findings of this study. However, health problems, such as fever, cold, cough, toothache, muscle discomfort, and so on, do not prevent people from going about their regular duties. The age range of 15 to 64 years is regarded as a person's productive age, as stated by Mulyaningsih et al. [46]. In order to increase the amount of work produced, it is strongly advised that individuals within this age group work or participate in various farming activities. According to Marhawati [47], citrus farmers of a productive age are more likely to receive information, innovate, and make decisions more quickly when it comes to developing their farms. Furthermore, farmer production is significantly influenced by their age. Kassem et al. [69] found that this was the case. Due to the fact that the capabilities of each individual are tremendously different, gender is one of the aspects that play a part in the production of citrus growers. Since the process involves more powerful physical abilities, the male gender is more required to prepare the land and transport such crops. According to Khairunnisa et al. [76], the female gender is found to be more necessary during planting and maintenance. Then, Mulyaningsih et al. [46] found that male farmers are generally more active in seeking knowledge and inventing in their farming activities. According to Iyai et al.'s [83] research, gender variations play a role in determining the level of productivity that farmers achieve. Furthermore, male farmers are likelier to be more innovative in their farming activities than their female counterparts.t continues here.

2.1.2. Conseptual Framework

The objective of establishing research variables, including dependent and independent variables, is to provide limitations in a study. According to Andrade [84], a variable is an item of observation that possesses a value that can be used to measure it, which allows for the variable to be specified within the context of an investigation. Moreover, the causal relationship that exists between the independent variable and the dependent variable is that which is included in the conceptual framework. One of the relationships, referred to as the causal relationship, is presented here. In order to develop the conceptual framework that is depicted in Figure 1, the foundation that was laid was the literature review that came before. This framework was developed to address the aim of this current inquiry. Because of this, we found many elements that were independent of one another. More specifically, the production of tangerines is the dependent variable being explored in this study (Figure 1).

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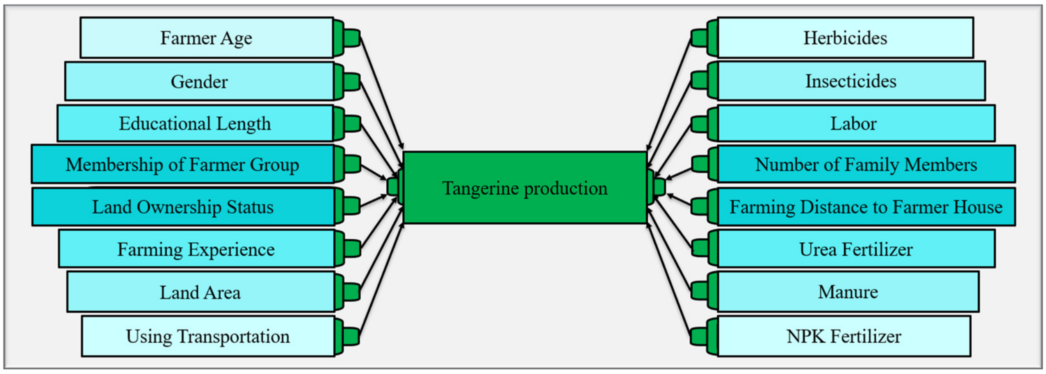

Figure 1. Conceptual framework.

2.2. Research Site, Data Collection Method, and Research Sample

The Bontomatene District, which is situated in the Selayar Islands Regency of the South Sulawesi Province in Indonesia, served as the location for the research that was carried out. The data collection took place in three different villages within the Bontomatene District, which we selected as the locations for the study. These villages are Bontona Saluk, Batangmata Sapo, and Tamalanrea. Tangerine-producing communities were considered when selecting the three villages that were picked. The core quantitative data for this study came from a representative sample of tangerine producers from each of the three communities. The production of tangerine crops harvested in 2023 was the primary factor considered while selecting these growers. In October 2023, primary data was gathered by conducting structured interviews with a certain group of farmers. A preset questionnaire was utilized to conduct the interviews.

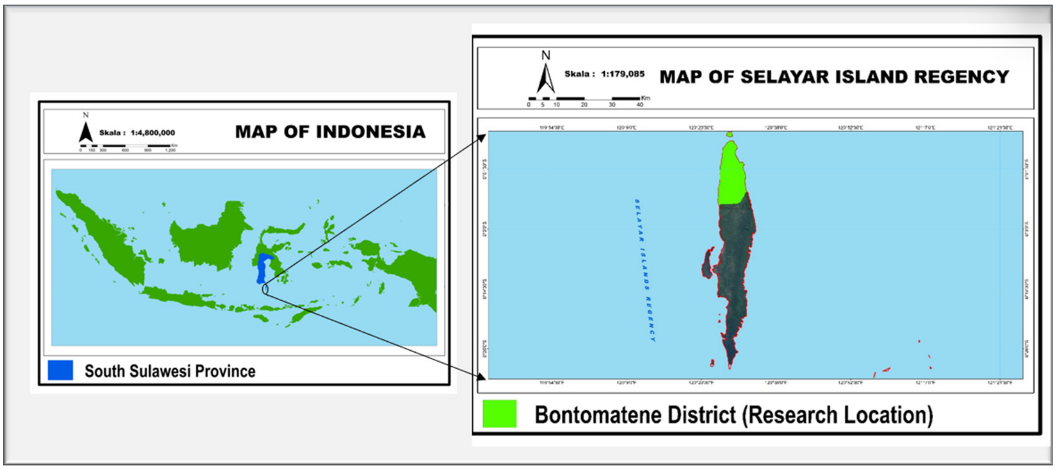

Figure 2. Research location.

This study used primary data, which was information obtained from individuals who supplied specific information through interviews [85]. The data-gathering process involved structured interviews with tangerine farmers in the Bontomatene District of the Selayar Islands Regency. The questionnaire that was used for the interviews had been written in advance. All of the participants in this study were farmers of tangerines in the district, with a total population of 1,622. Following that, the probability random sampling method was utilized to carry out the sampling for this investigation. Yamane's Formula, found in Equation 1 [86], was utilized to ascertain the quantity of samples

$$n = \frac{N}{1 + Ne^2}$$
$$n = \frac{1622}{1 + 1622(8\%)^2} \quad (1)$$
$$n = 156$$

Description: *n* = Number of samples; N = Total population; e = sample error rate (8%).

2.3. Binary Logistic Regression Analysis

To analyze and categorize binary and proportional response data sets, statisticians and researchers use a technique known as logistic regression (LR) [87]. This technique is applied to assess and classify the data. Numerous people consider it one of the most important ways because it is a statistical and data mining strategy. In addition, Brusco et al. [88] argues that the model is widely utilized and is widely considered one of the most essential statistical models in the field of predictive analytics. Moreover, he states that the model is prevalent. This investigation aims to ascertain whether there is a causal connection between a response variable and one or more predictor variables, as mentioned in the research conducted by Henning et al. [89]. According to the goals of this investigation, the dependent variable, which was the production of tangerines, was categorized as categorical-binary data, with high and low production levels assigned to it. This particular data attribute was advantageous to the model, according to Henning et al. [89]. The findings that they mentioned also indicate that this is the case. These statistical indicators are established to evaluate the amount of contribution the independent variable has to the evaluated variable [90]. The regression coefficient, the significance of the coefficient, and the odds ratio are some of the several indicators included in this set of indicators.

Table 1. Indicator test for binary logistic regression model

Indicators	Descriptions	Criteria	Interpretations
CR	Coefficient of Regression	CR > 0	The positive impact of the independent variable on tangerine production.
		CR < 0	The negative impact of the independent variable on tangerine production.
		CR = 0	There is no correlation between the independent variable and the amount of tangerines produced.
Sig.	A significance level represents the likelihood of making mistakes.	Sig. < 0.01	Tangerine production is significantly influenced by the independent variable, as evidenced by a confidence interval level of 99%.
		Sig. < 0.05	Tangerine production is significantly influenced by the independent variable, as evidenced by a confidence interval level of 95%.
		Sig. < 0.10	Tangerine production is significantly influenced by the independent variable, as evidenced by a confidence interval level of 90%.
Exp.(B)	An odds ratio (Exp. (B) describes the relationship between a variable and the likelihood of an event occurring.	Exp.(B) > 0	As the odds ratio (Exp (B)) increases, the probability of a farmer producing a significant amount of tangerines increases.
		Exp.(B) < 0	As the odds ratio (Exp (B)) increases, the probability of a farmer producing a significant amount of tangerines decreases.
		Exp.(B) = 0	The production of tangerines does not include any association with the independent variable.

Source: Adapted from Salam et al. [91].

2.4. General Model Analysis of Binary Logistic Regression

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The purpose of regression analysis, as stated by Salam et al. [91] Tampil et al. [92] And Yuniarsih et al. [93], is to ascertain the extent to which a single variable has an impact on several other factors or variables. According to Borucka and Grzelak [94], this is one of the many kinds of studies that might be carried out with the data. A simple linear regression model is the most fundamental type of regression model, and Equation 2 is the formula that represents this model. This particular model is the easiest to implement.

$$\mathrm{Y} = \beta_0 + \beta_1 \mathrm{X}_1 + \beta_2 \mathrm{X}_2 + \cdots + \beta_n X_n + \varepsilon \tag{2}$$

Where:

Y = variable of dependent; X = variable of independent; β_0 = constant; β_1 = regression coefficient (increasing or decreasing value); ε = random error.

Statistical analysis is a method that can be utilized to describe the relationship between dependent variables that have two or more categories and one or more independent variables that have categorical or continuous scales [91–93]. This method can be utilized to describe the relationship between the dependent variables and the independent variables. In order to describe the relationship, one way that can be utilized is statistical analysis. One of the methods that can be applied to describe the connection that exists between these variables is a technique known as logistic regression. Three distinct types of logistic regression can be distinguished from one another. These include binary logistic regression, multinomial logistic regression, and ordinal logistic regression. Every one of these different kinds of logistic regression has its own distinctive qualities. The binary logistic regression model can be used to examine the relationship between a single response variable and several predictor factors. The model's subjects are a single response variable and many predictor variables. The presence of a characteristic is indicated by a value of 1, whereas a value of not present indicates the absence of a feature. According to Salam et al. [91] Tampil et al. [92] and yuniarsih et al [93], the response variable is represented by dichotomous qualitative data. This type of data is characterized by a value of 1, indicating the presence of a particular trait. The binary logistic regression model is applied when the response variable creates two categories with values of 0 and 1. This model adheres to the Bernoulli distribution, which is depicted in Equation 3, illustrating the distribution. When the response variable produces two distinct categories, the analysis utilizes this model.

$$f(yi) = \pi i^{yi}(1 - \pi i)^{1-yi} \tag{3}$$

Where:

πi = probability of i-th event and yi = i-th random variable consisting of 0 and 1.

In the following step, it is necessary to construct a logistic regression model with a single predictor variable, as shown in Equation 4 [91,93,95].

$$\pi(x) = \frac{\exp(\beta_0 + \beta_1 \mathrm{X})}{1 + \exp(\beta_0 + \beta_1 \mathrm{X})} \tag{4}$$

The transformation of π (x) in Equation 4 is done to simplify the interpretation of regression parameters. This transformation leads to the logit form of logistic regression in Equation 5, represented by the equation [91–93].

$$\mathrm{g(x)} = \ln\left(\frac{\pi(x)}{1 - \pi(x)}\right) = \beta_0 + \beta_1 \mathrm{X}_1 + \beta_2 \mathrm{X}_2 + \cdots + \beta_n \mathrm{X}_n \tag{5}$$

2.5. Empirical Model Specification

The production of tangerines is influenced by sixteen different independent factors, as shown in Figure 1. Farmer age, years of education, land size, manure, urea fertilizer, NPK fertilizer, pesticides, herbicides, labor, farming experience, number of family members, using transportation, farm distance, gender dummy, farmer group dummy, and land ownership status are the sixteen factors that are being considered. However, the variable that is being relied on is tangerine production. In addition, regarding Equation 5, the empirical model specification for this study is constructed to test the effect of the sixteen independent variables described above on the production of tangerines. Equation 6 presents the results of this comparison.

$$g(PJ)_t = ln\left[\frac{\pi(PJ)}{1-\pi(PJ)}\right] = \beta_0 + \beta_1 AG_{t-1} + \beta_2 DG_{t-1} + \beta_3 LED_{t-1} + \beta_4 Pn_{t-1} + \beta_5 DFG_{t-1} + \beta_6 DLOS_{t-1} + \beta_7 TR_{t-1} + \beta_8 JAG_{t-1} + \beta_8 JU_{t-1} + \beta_{10} BL_{t-1} + \beta_{11} TEK_{t-1} + \beta_{12} INS_{t-1} + \beta_{13} HRB_{t-1} + \beta_{14} PKU_{t-1} + \beta_{15} PKD_{t-1} + \beta_{16} PNPK_{t-1} \tag{6}$$

Or

$$g(PJ)_{2023} = ln\left[\frac{\pi(PJ)}{1-\pi(PJ)}\right] = \beta_0 + \beta_1 AG_{2022} + \beta_2 DG_{2022} + \beta_3 LED_{2022} + \beta_4 Pn_{2022} + \beta_5 DFG_{2022} + \beta_6 DLOS_{2022} + \beta_7 TR_{2022} + \beta_8 JAG_{2022} + \beta_8 JU_{2022} + \beta_{10} BL_{2022} + \beta_{11} TEK_{2022} + \beta_{12} INS_{2022} + \beta_{13} HRB_{2022} + \beta_{14} PKU_{2022} + \beta_{15} PKD_{2022} + \beta_{16} PNPK_{2022} \tag{7}$$

Where:

g(PJ) = Quantity of Tangerine Production (1 = high production, 0= otherwise); AG = Age (years); LED = Years of Education (years); BL = Land Area (ha); PNPK = NPK Fertilizer (kg); PKU = Urea Fertilizer (kg); PKD = Manure (kg); INS = Insecticide (L); HRB = Herbicide (L); TEK = Labor (mandays); Pn= Farming Experience (years); JAG= Number of Family Members (people); TR= Using Transportation (TR=1, Yes; TR=0, No); JU = Farming Distance (km); DG = Gender (DG =1, male; DG =0, other); DFG = Farmer Group (DFG =1, farmer group member; DFG=0, other); DLOS= Land Ownership Status (DLOS=1, Owned; DLOS=0, other); β_0 = Constant; β_1-β_{16}= Logistic regression coefficients of predictor variables; t = time lag

2.6. Variable Definition and Measurement and Data Type

The properties, attributes, or characteristics of a person, object, or situation that can change are called variables [96]. Research in social sciences typically focuses on determining the causal linkages between various social events as its primary purpose. In this step, the influence that one or more independent factors have on the variable that is being studied will be examined. When an individual is explaining the relationship between cause and effect, the independent variable is typically referred to as the postulated cause. Conversely, the dependent variable is additionally referred to as the theorized consequence in some instances. The independent and dependent variables cannot be considered to exist since it is impossible to do so. An alternative study might use a dependent variable that, in actuality, is an independent variable. Three basic approaches can be utilized in order to include variables into study hypotheses to be tested successfully. The following are the three primary approaches that are included in the discussed strategies [91]: (1) comparing various groups in order to ascertain the influence that independent variables have on the variable that is being studied, (2) doing an investigation of the extent to which one or more independent variables are connected to one or more dependent factors, (3) establishing the nature of the link that exists between the independent factors and the dependent variables.

This study aimed to determine the impact of the independent factors and examine the influence of sixteen independent variables on a single dependent variable. There was just one dependent variable that was being investigated. In addition, the investigation was carried out to estimate the influence of the independent components. After that, as can be seen in Figure 1, we defined operational definitions that were crystal clear for each variable and the units of measurement that were going to be associated with it. The purpose of providing these definitions in Table 2 is to make them more explicit and more straightforward for all readers. The categories of dichotomous, continuous, and categorical variables are presented in Table 2, which outlines the process by which we discovered and classified the variables

2.7. Expected Hypothesis Signs and Significance Results of The Independent Variables

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A hypothesis is a short-term solution to a problem conveyed as a plain statement [97]. The hypothesis is used when researching a subject. When conducting quantitative research activities, most researchers do so intending to prove the hypothesis that was first created. This situation contrasts intending to solve the problem that requires investigation. Consequently, it is of the utmost importance for a researcher to have a reliable understanding of the significance and nature of the hypothesis established during the preliminary phase of a research attempt. In order to create a forecast about the causal relationship between the variables that have been observed, one of the goals of constructing a research hypothesis is to predict the relationship.

2.8. Coefficient of Determination and Simultaneous Test

The overall significance testing method is employed to examine the impact of every βi in the model that has been derived as a composite. The assessment's findings will indicate whether or not a predictor variable can be included in the model. According to Palkovič and Šoporová. [95], Salam et al. [91] and Yuniarsih et al. [93], the G value in the G Test is calculated and provided in Equation 8.

$$G = -2\log\left(\frac{\text{likelihood (Model B)}}{\text{likelihood (Model A)}}\right) \quad (8)$$

Table 2. Definition, measurement unit, expected hypothesis signs, and significance results of the independent variables.

Dependent Variables (PJ), where 1 = high production, 0= otherwise					
Independent Variables		Measur e-ment Unit	Data types	Expected hypothesis signs/ Significance*	References
Variable names	Symbols				
Farmer Age	AG	year	continuous	+/SIG	[69,85]
Gender	DG	1=male; 0=other	categorical	+/SIG	[46,76,83]
Educational Length	LED	year	continuous	+/SIG	[69,83,98]
Farming Experience	Pn	year	continuous	+/SIG	[69,76]
Farmer Group	DFG	1=yes; 0=no	categorical	+/SIG	[75,99]
Land Ownership Status	DLOS	1=own; 0=other	categorical	+/SIG	[70,72,74,100]
Using Transportation	TR	1=yes; 0=no	categorical	+/SIG	[10,62,100]
Number of Family Members	JAG	people	continuous	+/SIG	[47,69]

Tangerine Farming Distance to Farmer House	JU	km	continuous	-/SIG	[62,69,101]
Land Area	BL	Ares	continuous	+/SIG	[53,69,85,102]
Farm Labor	TEK	man-days	continuous	+/SIG	[63,66,67,91,100,102]
Insecticides	INS	ml	continuous	+/SIG	[39,53,100,103]
Herbicides	HRB	ml	continuous	+/SIG	
Urea Fertilizer	PKU	kg	continuous	+/SIG	[53,91,100,103–105]
Manure	PKD	kg	continuous	+/SIG	
NPK Fertilizer	PNPK	kg	continuous	+/SIG	

Decision-making criteria:

a. H_0 is rejected if $G > \chi^2$; the model with independent variables is significant at a 5% significance level.

b. H_0 is accepted if $G < 2$; the model with independent variables is insignificant at the 5% significance level.

2.9. Partial Hypothesis Test

The utilization of partial testing is employed to evaluate the impact of every individual βi in the developed model. Partial or individual test results might be used to establish whether or not it is possible to incorporate a predictor variable into the model. According to Salam et al. [91] , Yuniarsih et al. [93], and Pérez et al. [106], one can find a description of the hypothesis for each variable in Equation 9 and Equation 10.

H_0: $\beta i = 0$

H_1: $\beta i \neq 0$

Wald test statistic (W):

$$W = \frac{\hat{\beta}i}{SE(\hat{\beta}i)} \quad (9)$$

&

$$SE(\hat{\beta}i) = \sqrt{\left(\sigma^2\, 2(\hat{\beta}i)\right)} \quad (10)$$

Decision-making criteria:

SE($\hat{\beta} i$) = estimated standard error for coefficient $\hat{\beta} i$; $\hat{\beta} i$ = estimated value for parameter ($\hat{\beta} i$)

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In order to arrive at a conclusion, it is necessary to compare it with the conventional normal distribution (Z). This is because the ratio derived from the test statistics under the H_0 hypothesis will be typical of the normal distribution. The following are the criteria that go into making decisions:

a. $Wi > Z\alpha/1$ or probability (significance) <0.05, then the independent variable has a real effect on tangerine production.

b. $Wi < Z\alpha/1$ or probability (significance) > 0.05, then the independent variable individually has no significant effect on tangerine production.

2.10. Interpretation of Parameter Coefficients of Dichotomous Variables

The odds ratio is a set of odds divided by other odds. The odds ratio is presented in Equation 11 [91,93,106].

$$\psi = \frac{\frac{\pi(1)}{[1-\pi(1)]}}{\pi(0)[1-\pi(0)]} = \frac{e^{\beta 0+\beta 1}}{e^{\beta 0}} = e^{\beta 0+\beta 1} \tag{11}$$

If the value of ψ is identical to one, it can be concluded that these two variables do not possess any connection with one another. When the value of ψ is less than 1, it signifies a negative link between the two variables and the category change of the x value. On the other hand, if a value is greater than one, it indicates a positive link between the two variables.

3. Results

3.1. Simultaneous Test (Omnibus Test)

A simultaneous test is carried out to determine whether or not the independent factors influence the dependent variable in concert with one another. When doing this test, the dependent variable is also taken into consideration. The Likelihood Ratio test is one of the several tests that are performed in order to establish whether or not the model is significant. The generation of this test is accomplished by comparing the Log Likelihood function that incorporates all of the independent variables with the Log Likelihood function that does not incorporate any independent variables. In addition, there is the choice of referring to the omnibus test table, which involves comparing the calculated Chi-square value with the Chi-square table and the significance value with a significance level of 5% or 0.05. This rule involves a comparison of the Chi-square value with the significance value.

3.2. Cox & Snell R-Square and Nagelkerke R-Square Test

We use the Cox & Snell R-Square and the Nagelkerke R-Square, two statistical tools, to find out how much the independent variables—age, gender, farming experience, land ownership status, farmer groups, transportation, family size, farm distance, land area, labor, insecticides, herbicides, urea fertilizer, and NPK fertilizer—variate concerning the dependent variable—tangerine production. Table 3 shows that the overall value of the Nagelkerke R-Square is 0.876. It can be stated that the independent variables, which consist of factors such as age, gender, farming experience, land ownership status, farmer groups, using transportation, number of family members, farm distance, land area, labor, insecticides, herbicides, urea fertilizers, and NPK fertilizers, are able to explain the dependent variable, which is tangerine production, by 87.6%. Other independent variables unrelated to the observation account for the remaining 12.4% of the variance being explained.

Table 3. Cox & Snell R Square dan Nagelkerke R-Square test result.

Model Summary		
-2 Log likelihood	Cox & Snell R-	Nagelkerke RSquare

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		Square	
Step 1	47,810	0,649	0,876

The Chi-square value is more significant than the Chi-square table, given that the former is equal to 26.296 and the latter is 164.451. Table 4, part of the omnibus test table, displays the results of the simultaneous test used to draw this conclusion. Because the significance value in the table is 0.000, which is less than the threshold of 0.05, the null hypothesis (H_0) is rejected. Because of this, we can say that the null hypothesis is false. Because this rejection is carried out according to the decision rule that says H_0 is rejected at a significant level α if G is more than the Chi-Square ($\chi 2$ (α, v)) value and the significance value in the test statistic is less than α. This finding establishes a causal relationship between the dependent variable and one or more independent factors. Several factors that are considered independent variables are as follows: age, gender, farming experience, land ownership status, farmer groups, using transportation, number of family members, farm distance, land area, labor, pesticides, herbicides, insecticides, urea fertilizers, manure, and NPK fertilizers. Each of these aspects has a major and actual impact on the production of tangerines.

Table 4. T Simultaneous test (Omnibus test) result of the effect of input use on tangerine production.

Omnibus tests of coefficients model				
		Chi-square	df	Sig.
Step 1	Step	164.451	16	0.000
	Block	164.451	16	0.000
	Model	164.451	16	0.000

3.3. Partial Test (Wald Test)

The Partial Test, often known as the Wald test (*W*), is a statistical procedure for identifying which model parameters are statistically significant. This test can be carried out by taking the square root of the parameter estimate's quotient, the parameter estimate α, and the standard error. A significance level of $\alpha = 0.05$ is used consistently throughout this test. In order to reject the null hypothesis (H_0) at the significance α, the value of *W* must be greater than or equal to $\chi 2$ (α, df). This information can be seen in Table 5.

Table 5. The result of the partial test (Wald test) the effect of input use on tangerine production.

Variable in the Equation						
Independent Variables	**B**	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**
Farmer Age (AG)	0.068	0.43	2.440	1	0.118	1.070
Gender (DG)	0.28	1.535	0.000	1	0.986	0.972
Educational Length (LED)	0.331	0.168	3.854	1	0.050**	1.392
Farming Experience (Pn)	-0.039	0.050	0.607	1	0.436	0.961
Farmer Group (DFG)	2.318	1.183	3.82	1	0.050**	10.157
Land Ownership Status (DLOS)	0.465	0.936	0.247	1	0.619	1.592
Using Transportation (TR)	0.185	0.990	0.035	1	0.852	1.203
Number of Family Members (JAG)	0.790	0.435	3.290	1	0.070	2.203
Tangerine Farming Distance to Farmer House (JU)	-1.875	0.791	5.626	1	0.018**	0.153
Land Area (BL)	4.301	4.872	0.779	1	0.377	73.777
Farm Labor (TEK)	0.050	0.025	4.078	1	0.043**	1.051

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Insecticides (INS)	-2.787	1.205	5.349	1	0.021**	0.062
Herbicides (HRB)	3.908	1.536	6.475	1	0.010**	49.821
Urea Fertilizer (PKU)	0.013	0.006	4.020	1	0.045**	1.013
Manure (PKD)	0.004	0.001	11.132	1	0.001***	1.004
NPK Fertilizer (PNPK)	0.020	0.010	4.553	1	0.033**	1.020
Constant	-19.426	6.476	8.995	1	0.003	0.000
Dependent Variable: tangerine production (PJ)						

Notes: **significant at 95% confidence level, ***significant at 99%.

The Chi-square (χ2) test results showed that the table's value was 3.841. This figure was ascertained using a 0.05 significance level and 1 degree of freedom. According to the data in Table 5, nine separate variables significantly affected the tangerine harvest. At this stage, several factors are taken into account, including the farmer's degree of education, the farmer's group, the distance from the farmer's house to the tangerine farm, the farm labor, the pesticides, the herbicides, the urea fertilizers, the manure, and the NPK fertilizers. The Wald test result for these variables is greater than the 3.841 value in the Chi-square table, and the significance value is less than 0.05, so keep that in mind. The alternative hypothesis (H_0) is accepted, and the null hypothesis (H_0) is rejected. It is clear from this study that other independent variables, especially pesticides, do not have a significant impact on tangerine output. There is a rejection of the alternative hypothesis (H_1) and an acceptance of the null hypothesis (H_0). This result is because the variable in question has a Wald test value below the 3.841 value seen in the Chi-square table, and the significance value is higher than 0.05. As a result, we accept the null hypothesis.

It was discovered, based on the findings of a significance test that was carried out on the model, that the factors of age, gender, farming experience, land ownership status, farmer groups, using transportation, number of family members, farm distance, land area, labor, insecticides, herbicides, urea fertilizer, and NPK fertilizer all had a significant impact on the production of tangerines. An example of this would be the number of family members. The binary logistic regression model built was supplied in Equation 12, even though the pesticide variable does not considerably impact the production of tangerines.

$$g(PJ) = ln\left[\frac{\pi(PJ)}{1-\pi(PJ)}\right] = -19.426 + 0.331LED_{2022} + 2.318DFG_{2022} - 1.875JU_{2022} + 0.050TEK_{2022} - 2.787INS_{2022} + 3.908HRB_{2022} + 0.013PKU_{2022} + 0.004\,PKD_{2022} + 0.020PNPK_{2022} \quad (12)$$

3.4. Model Fit Test

An evaluation of how well the model fits the data is carried out with the help of a model fit test. The purpose of this test is to assess whether the observed values are identical to or very comparable to those that the model predicts. The model used must have a Goodness of Fit (GoF) component to be considered valid. If there is a correlation between the data that is included in the model and the data that is seen, then the model is regarded as being in accordance with the GoF for compliance. When performing binary logistic regression, the Chi-Square value in the Hosmer and Lemeshow test can be used to evaluate the approach utilized to test the practicability of the model. This model can be used to determine whether or not the model is plausible.

Table 6. Model fit test result of the effect of input use on tangerine production.

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	2,772	8	0,948

The number of degrees of freedom was set to 8, and the significance level was 0.05. The Chi-square table calculation yielded a result of 15.507. The computation yielded this. Here, we made use of both of these considerations. A 0.948 significant value and a 1.504 Chi-square value were computed and obtained, respectively. Table 6 displays the provided information. Suppose there is no discrepancy between the 22 observations and the predictions. In that case, we can conclude that the null hypothesis (H_0) is accepted because the computed Chi-square value (2,772) is less than the Chi-square table value (15.507), and the significance value (0.948) is greater than the α value (0.05). The significance value is lower than the Chi-square table value, which is why this is the case. Another way of putting it is that the model suits its intended purpose.

3.5. Interpretation of Odds Ratio

Each time there is an increase of one unit of the independent variable, the odds ratio value depicts the change in the tendency, which can be either an increase or a decrease. The findings of our investigation are presented in Table 5, which displays the odds ratio (Exp. (B) value) for each independent variable responsible for the production of tangerines. Furthermore, the ninth significance independent variables on tangerine production were summarized in Figure 3, and the interpretation of the odds ratio of each significant independent variable is stated as follows:

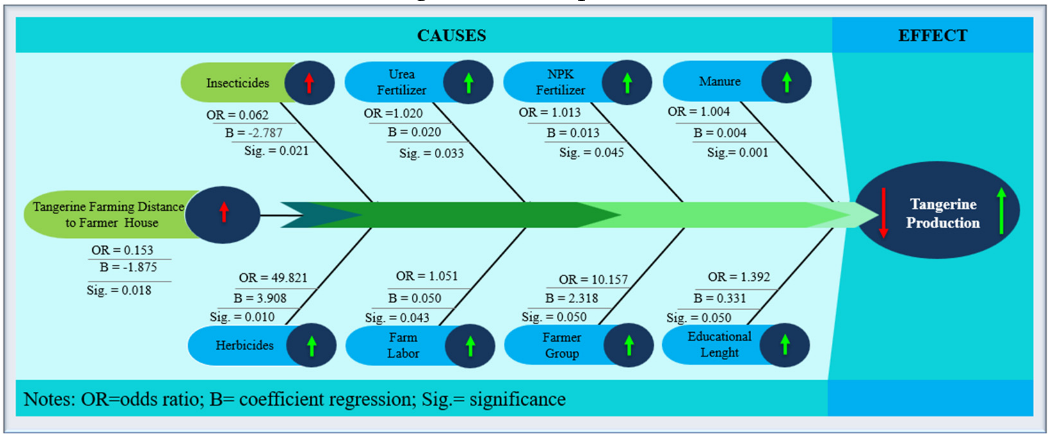

Figure 3. The graphical summary of the causes and effects of tangerine.

4. Discussions

4.1. Effect of Educational Lenght

The variable of educational length (LED) has a significant and positive impact on the productivity of tangerine farming. This variable includes both positive and negative effects. There is a value of 1.392 for the odds ratio associated with the LED variable, and its projected value is 0.331. They were following the value of the odds ratio. It is conceivable to conclude from these data that the length of time a farmer has spent in school tends to increase the quantity of tangerines they produce. The conclusions of this study, which are based on research carried out by Chairunnisa and Juliannisa [49], indicate that high levels of education and a competent workforce possess the potential to affect agricultural production. The degree of education that tangerine farmers have will also affect their ability to take in information and innovate when it comes to developing their tangerine farms, according to Marhawati [47], who also said this would be the case. Additionally, Farooq et al. [98] claimed that education plays a part in solving issues that farmers encounter and providing creative methods to resolve difficulties they face in producing agricultural goods. As a result, education plays a role in resolving issues that farmers face. Therefore, it is evident that education significantly impacts agricultural goods' output [50].

4.2. Influence of Farmer Groups

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The variables of the Farmer Group (DFG) and the production of tangerine farming were found to have a positive and significant relationship. There is a strong indication that this effect is present, as indicated by the odds ratio of 10.157, which has an estimated value of 2.318. Based on these figures, it appears that tangerine farmers who are members of farmer groups have a greater tendency to increase their tangerine production when compared to persons who are not members of agriculture organizations. This result is assuming that all other variables remain the same. Farmers can develop their knowledge and abilities and obtain better access to markets and agricultural technology by establishing farmer organizations. This way will ultimately lead to an increase in farm productivity. Jamil et al. [75] did a study that led to the discovery of this fact. Their findings show that extension workers deliver knowledge to farmers through farmer groups. As a result, farmer groups influence boosting farm production. Additionally, Wardani [107] stated that the participation of farmers in farmer organizations affects the amount of food the farms produce. Then, according to the findings of research by Ali et al. [99], study groups inside farmer groups have the potential to boost agricultural production.

4.3. Effect of Tangerine Farming Distance to Farmer House

Tangerine production is significantly influenced negatively by the farm distance variable (JU), which has an odds ratio of 0.153 and an estimated value of -1.875. This variable has a significant impact on that output. Based on these data, it is feasible to conclude that there is a high probability that there will be a decline in the production of tangerines whenever there is an increase in the distance between the agricultural home of the farmer and the tangerine fields. To put it another way, a reduction in the distance that separates farms can potentially increase the quantity of tangerines produced. The conclusions of this study agree with the findings of the research conducted by Rosalia and Karyani [101], which asserts that the distance between farms impacts the quantity of products the farms generate. Furthermore, Saragih and Harmain [62] noted that access to farm ars affects farmers' performance and directly influences their output. This result means that it directly influences the production of farms. Furthermore, according to Kassem et al. [69], the distance between farms is a factor that also plays a role in determining the quantity of tangerines the farms produce. According to Widyawati and Pujiyono [108], the amount of space separating farms positively influences the amount of food that those farms produce.

4.4. Effect of Labor

A significant and positive influence on the productivity of tangerine farming is exerted by the contribution of labor (TEK), a variable independent of other factors. There is a difference between the estimated value for the labor variable, which is 0.050, and the actual value of the odds ratio, which is 1.051. With each additional effort put forth, the output of tangerines tends to increase, which is the conclusion that can be derived from this quantity. The results of this study, which align with the findings of research carried out by Nguyen et al. [100], indicate that the labor variable contributes positively and significantly to the enhancement of tangerine production. This finding agrees with those findings. The study's findings are supported by research conducted by Saragih and Harmain [62], which demonstrates that the utilization of labor has a partial impact on farm productivity, which in turn has a direct impact on farmers' income. This research gives credence to the conclusions of the previously mentioned study. This is because labor is an essential component of the production factor, which plays a significant role in maximizing our productive efforts in terms of quantity and quality [109]. Then, Salam et al. [91] stated that the addition of labor will increase agricultural output.

4.5. Effect of Herbicide and Insecticide Application

There is a substantial and positive relationship between the independent variable of herbicide (HRB) and the yield of tangerines on farms. There is a value of 49.821 for the odds ratio associated with this variable, and its projected value is 3.908. According to these data, any addition of herbicides can potentially increase tangerine production, which can be interpreted according to the given

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information. Based on the findings of Salam et al. [91], it was discovered that herbicides have a positive and significant impact on the production of tangerines, and the usage of herbicides has a major impact on the production of agricultural goods. This study's findings agreeth and lend credence to the conclusions of research carried out by Sutrantiyas et al. [110], which showed that herbicides had a beneficial and significant impact on developing tangerine output.

The production of tangerines is then considerably impacted negatively by the independent variable insecticide (INS). This variable's odds ratio is 0.062 times, and its projected value is -2.787 using the available data. The addition of pesticides tends to reduce the yield of tangerines, as may be deduced from this value. These findings agree with the findings of a study carried out by Saragih et al. [111], which found that the application of insecticides has a detrimental impact on the amount of food the farms produce. Additionally, Hendebo et al. [112] revealed that insecticides affected the production of tangerines on farms. This detrimental effect that the application of insecticides can cause has reached its maximum limit, which means that the applications of insecticides can no longer be increased. In addition, Saraswati et al. [44] discovered that the application of insecticide positively impacted agricultural production.

4.6. Effect of Using Urea, NPK, and Manure Fertilizers

In this research study, the three types of fertilizers assessed for their effectiveness on the production of tangerines were manure, urea fertilizer, and NPK fertilizer. Manure was the most successful of the three. The data analysis findings allow for the conclusion that the independent variable of urea fertilizer (PKU) has a significant and positive impact on the production of tangerines. This conclusion can be reached because of the findings themselves. The odds ratio value and the estimated value of this variable, which are 1.013 and 0.013, respectively, are the foundations for this conclusion. Given this figure, it is possible to conclude that the incorporation of urea fertilizer has a propensity to result in an increase in the output of tangerines. Urea fertilizer is considered to be one of the primary sources of nitrogen fertilizer. According to Purba and Purwoko [77], the use of urea fertilizers substantially impacts the increase in tangerine yield. Plant fertility is increased when urea fertilizer is applied in the proper amount. This helps plants avoid deviations in leaf growth, dead or drying out tissue, stunted plant growth, and symptoms of chlorosis [113]. According to Nooraminah et al. [114], the application of inorganic fertilizers that are applied in a reasonably high concentration and utilized continuously will affect the soil's physical structure. It will decrease the effectiveness of agricultural enterprises.

Additionally, the independent variable of NPK fertilizer (PNPK) has a large and favorable influence on the yield of tangerines. In order to arrive at this conclusion, the odds ratio value was calculated to be 1.020, and the estimated value was 0.020. As can be seen from these numbers, the application of NPK fertilizer tends to increase the production of tangerines. NPK fertilizer contains various nutrients, specifically nitrogen, phosphorus, and potassium, as stated by Nuranisa et al. [115]. According to Santoso and Hermiyanto [116], the use of NPK fertilizer at a specific dose has the potential to increase both the quantity and quality of tangerine. According to Fidiansyah et al. [117], two types of inorganic fertilize: urea fertilizer and NPK fertilizer. These fertilizers are responsible for the highest possible nitrogen (N) element levels. According to Sakhidin et al. [118], the use of NPK fertilizer has the potential to cause a large rise in tangerine yield. Additionally, Kiknadze et al. [119] stated that the application of NPK fertilizer can potentially benefit the development of fruits and the production of tangerine varieties. Furthermore, Li et al. [120] said that utilizing NPK fertilizers resulted in a substantial enhancement of both the quantity and quality of tangerine fruits generated.

Furthermore, the independent variable of manure (PKD) has a considerable and favorable influence on the production of tangerines on farms. The odds ratio value for the manure variable is 1.004, while the estimated value for this variable is 0.004. It is possible to conclude from these numbers that the incorporation of manure has the potential or the inclination to increase the production of tangerines. By providing organic fertilizer, it is possible to greatly boost production while simultaneously reducing the role that inorganic fertilizers play in the process of growing production. It was also mentioned by Revuelta et al. [121] that organic farming makes extensive use of manure as

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a means of boosting farm production. Then, Otieno [53] noted that organic fertilizers might be utilized to maintain soil fertility. The findings of this study are consistent with the findings of studies conducted by Karuniawati at al. [122], Nainggolan and Ulma[39] and Salam et al. [91], which explains the beneficial impact that fertilizer application has on agricultural production. In addition, Fidiansyah et al. [117] stated that the utilization of fertilizers can fulfill the requirements of nutrients in the soil, hence enhancing the growth and production of cultivated plants to their full potential. The amount of fertilizer that is applied must be following the recommendations [91,123].

5. Conclusions

This section is not mandatory but can be added to the manuscript if the discussion is unusually long or complex. This study aimed to examine the effects of input factor allocation on tangerine production in Selayar Islands Regency. Binary logistic regression was the method of data analysis that was utilized to answer the research objective. It was concluded, based on the findings of the data analysis that was described earlier, that the independent variables of educational length, farmer groups, farm distance, labor, insecticides, herbicides, urea fertilizer, manure, and NPK fertilizer that were tested with binary logistic regression models simultaneously had a significant effect on the production of tangerines from farming. Of the sixteen variables that were evaluated, it was discovered that seven of them have a positive and substantial effect on tangerine production. These seven variables are educational length, farmer groups, labor, herbicides, urea fertilizer, NPK fertilizer, and manure. Partial testing revealed that these seven variables contribute to the production of tangerines. In addition, there are two factors that have a negative and large impact on the production of tangerines. These factors include the changeable farm distance and insecticides. Furthermore, seven additional characteristics do not have a major impact on the production of tangerines. These variables include age, gender, land ownership status, using transportation, the number of family members, the land area, and farming experience.

This research indicated that there were chances for farmers in the area where the study was conducted to boost their tangerine production by adopting more efficient methods of allocating production inputs. For the purpose of increasing tangerine production, farmers in the Bontomatene District of the Selayar Islands Regency can increase their education in the management of tangerine farming, maximize their participation in farmer groups, expand the area of land that is cultivated, and increase the amount of urea fertilizer, NPK fertilizer, and manure that they use. Tangerine production can also be enhanced by increasing the number of workers and applying herbicides at optimal doses. Both of these measures contribute to maximizing farm efficiency. To prevent a decline in production, it's important to regulate pesticide use carefully to avoid overuse and to adopt a balanced approach by incorporating both inorganic and organic fertilizers. These practices are essential for maintaining sustainable yields.

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References

1. G. Hoang, H. T. Thi Le, A. H. Nguyen, and Q. M. Thi Dao, "The impact of geographical indications on sustainable rural development: A case study of the Vietnamese Cao Phong orange," *Sustainability (Switzerland)*, vol. 12, no. 11, Jun. 2020, doi: 10.3390/su12114711.
2. Fadli and Ibrahim, "Analisis Faktor Produksi Terhadap Pendapatan Usahatani Kakao (Theobroma cacao) Di Kecamatan Timang Gajah Kabupaten Bener Meriah," *Jurnal Pertanian dan Perkebunan*, vol. 4, no. 1, pp. 25–47, Dec. 2021.
3. C. Baldini, M. Edith M, P. Tittonell, and A. Alejandra D, "Urban, periurban and horticultural landscapes – Conflict and sustainable planning in La Plata district, Argentina," *Land use policy*, vol. 117, Jun. 2022.
4. M. Cammarata, G. Timpanaro, and A. Scuderi, "Assessing sustainability of organic livestock farming in Sicily: A case study using the Fao Safa framework," *Agriculture (Switzerland)*, vol. 11, no. 3, Mar. 2021, doi: 10.3390/agriculture11030274.
5. R. Cochard, B. T. Vu, and D. T. Ngo, "Acacia plantation development and the configuration of tree farmers' agricultural assets and land management-a survey in central Vietnam," *Land (Basel)*, vol. 10, no. 12, Dec. 2021, doi: 10.3390/land10121304.
6. T. T. T. Nguyen *et al.*, "Efficiency analysis of the progress of orange farms in Tuyen Quang province, Vietnam towards sustainable development," *Sustainability (Switzerland)*, vol. 12, no. 8, Apr. 2020, doi: 10.3390/SU12083170.
7. Iskandar, "Analisis Produksi Tanaman Karet Di Kabupaten Aceh Tamiang," *Jurnal Samudra Ekonomika* , vol. 2, no. 1, pp. 85–96, 2018.
8. R. Testa, S. Tudisca, G. Schifani, A. M. Di Trapani, and G. Migliore, "Tropical fruits as an opportunity for sustainable development in rural areas: The case of mango in small-sized sicilian farms," *Sustainability (Switzerland)*, vol. 10, no. 5, May 2018, doi: 10.3390/su10051436.
9. T. Zobeidi, M. Yazdanpanah, L. A. Warner, A. Lamm, K. Löhr, and S. Sieber, "Personal and Professional Mitigation Behavioral Intentions of Agricultural Experts to Address Climate Change," *Environ Manage*, 2023, doi: 10.1007/s00267-023-01815-y.
10. S. I. Kusumaningrum, "Pemanfaatan Sektor Pertanian Sebagai Penunjang Pertumbuhan Perekonomian Indonesia," *Jurnal Transaksi*, vol. 11, no. 1, pp. 80–89, 2019.
11. BPS, "Statistik Tanaman Hortikultura Kabupaten Kepulauan Selayar 2021," 2021.
12. M. Pangestika and Y. Yuliawati, "Pengaruh Lag Impor, Produksi, Harga Domestik, Harga Impor, Nilai Tukar dan PDB Terhadap Impor Jeruk Serta Peramalan Impor Jeruk di Indonesia," *Jurnal Ekonomi Pertanian dan Agribisnis*, vol. 3, no. 3, pp. 477–486, Jul. 2019, doi: 10.21776/ub.jepa.2019.003.03.3.
13. Y. Hilman, S. Suciantini, and R. Rosliani, "Adaptasi Tanaman Hortikultura Terhadap Perubahan Iklim pada Lahan Iklim Pada Lahan Kering (Adaptation of Horticultural Crops to Climate Change in the Upland)," *Jurnal Penelitian dan Pengembangan Pertanian*, vol. 38, no. 1, p. 55, Jun. 2019, doi: 10.21082/jp3.v38n1.2019.p55-64.
14. N. Musa, Nurdin, and Y. Rahim, "Pemanfaatan Lahan Kosong dan Pekarangan Melalui Pemberdayaan Petani Hortikultura di Desa Huntu Barat Kabupaten Bone Bolango," *Abdi Insani*, vol. 7, no. 3, pp. 346–353, Dec. 2020, doi: 10.29303/abdiinsani.v7i3.337.
15. F. Deviani, D. Rochdiani, D. Bobby, and R. Saefudin, "Faktor-Faktor yang Mempengaruhi Produksi Usahatani buncis di Gabungan Kelompok Tani Lembang Agri Kabupaten Bandung Barat," *Agrisocionomics*, vol. 3, no. 2, pp. 165–173, 2019, [Online]. Available: http://ejournal2.undip.ac.id/index.php/agrisocionomics
16. A. Setiadi, A. Gafaruddin, and A. Slamet, "Faktor-Faktor yang Mempengaruhi Produksi Usahatani Jeruk Manis Siam Madu (Citrus sinensis nobilis) di Desa Tanea Kecamatan Konda Kabupaten Konawe Selatan," *Jurnal Ilmiah Membangun Desa dan Pertanian*, vol. 8, no. 3, pp. 88–95, May 2023, doi: 10.37149/jimdp.v8i3.79.
17. M. Sosnowska, A. Kępkowicz, I. Woźniak-Kostecka, H. Lipińska, and Lena. Renaudie, "Exploring the potential for development of urban horticulture in the 1960 s housing estates. A case study of Lublin, Poland," *Urban For Urban Green*, vol. 75, Sep. 2022.
18. A. R. P. Pane, R. Alnanda, Herlisman, and A. Suman, "The exploitations status of the orange mud crub (Scylla olivacea Herbst, 1796) in Aru Islands and adjacent waters, Maluku, Indonesia," in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing Ltd, Oct. 2020. doi: 10.1088/1755-1315/584/1/012008.
19. M. N. Adlini, D. Hafizah, and K. Umaroh, "Karatkeristik Tanaman Jeruk (Citrus sp.) di Kecamatan Nibung Hangus Kabupaten Batu Bara Sumatra Utara," vol. 4, no. 1, 2020.
20. K. Kristiandi and D. A. Febrina, "Pemanfaatan Kulit Jeruk Siam sebagai Pestisida Alami," *Jurnal Agrotek Lestari*, vol. 6, no. 2, 2020.

21. R. Qomariah *et al.*, "Kajian Pra Panen Jeruk Siam (Citrus suhuiensis Tan)untuk Ekspor," *Seminar Nasional Inovasi Teknologi Pertanian*, pp. 417–430, 2013.
22. S. Suriadi, R. Jasiyah, and L. Kasman, "Strategi Pengembangan Jeruk Manis Di Kecamatan Siompu Kabupaten Buton Selatan," *Media Agribisnis*, vol. 5, no. 2, pp. 95–107, Nov. 2021, doi: 10.35326/agribisnis.v5i2.1680.
23. I. Ahmad, "PIPK agrowisata jeruk keprok Selayar," *Prosiding Semnas Politani Pangkep*, vol. 3, pp. 738–746, 2022.
24. Z. Hanif, *Iptek Hortikultura : Pengembangan Agribisnis Jeruk Nusantara*, vol. 16. https://www.researchgate.net/publication/350578577, 2020.
25. M. Kowalska, J. Konopska, M. Feszterová, A. Zbikowska, and B. Kowalska, "Quality Assessment of Natural Juices and Consumer Preferences in the Range of Citrus Fruit Juices," *Applied Sciences (Switzerland)*, vol. 13, no. 2, Jan. 2023, doi: 10.3390/app13020765.
26. S. Seminara *et al.*, "Sweet Orange: Evolution, Characterization, Varieties, and Breeding Perspectives," Feb. 01, 2023, *MDPI*. doi: 10.3390/agriculture13020264.
27. A. A. Isa, S. Samsuri, and N. A. Amran, "Integration of Maceration and Freeze Concentration for Recovery of Vitamin C from Orange Peel Waste," in *IOP Conference Series: Earth and Environmental Science*, Institute of Physics Publishing, Jul. 2019. doi: 10.1088/1755-1315/268/1/012101.
28. E. Lbban, A. Ashor, O. M. Shannon, I. Idris, and M. Siervo, "Is vitamin C a booster of the effects of dietary nitrate on endothelial function? Physiologic rationale and implications for research," *Nutrition*, vol. 109, p. 111995, May 2023, doi: 10.1016/j.nut.2023.111995.
29. M. Silalahi, "Pemanfaatan Citrus aurantifolia (Christm. et Panz.) sebagai Bahan Pangan dan Obat serta Bioaktivitas," *Sainmatika: Jurnal Ilmiah Matematika dan Ilmu Pengetahuan Alam*, vol. 17, no. 1, p. 80, Jun. 2020, doi: 10.31851/sainmatika.v17i1.3637.
30. T. Turner and B. J. Burri, "Potential nutritional benefits of current citrus consumption," *Agriculture (Switzerland)*, vol. 3, no. 1, pp. 170–187, 2013, doi: 10.3390/agriculture3010170.
31. C. Wati *et al.*, *HamadanPenyakitTanaman*, 1st ed. Yayasan Kita Menulis, 2021.
32. K. Y. Dwiastari, K. B. Susrusa, and W. P. Artini, "Analisis Preferensi Konsumen terhadap Buah Jeruk Impor dan Buah Jeruk Lokal di Kota Denpasar, Bali," *Jurnal Agribisnis dan Agrowisata*, vol. 8, no. 3, pp. 391–400, 2019.
33. L. Rahayu and M. P. Dewi, "Analisis Faktor-Faktor yang Mempengaruhi Produksi Jeruk di Kenagarian Kototinggi Kecamatan Gunuang Omeh Kabupaten 50 Kota Menggunakan Regresi Linear Berganda," *UNPjoMath*, vol. 2, no. 3, pp. 33–38, 2019.
34. D. Rosalina and M. R. Zati, "Analisis Daya Saing Jeruk Lokal Terhadap Jeruk Impor di Kabupaten Tanah Karo," *Jurnal Samudra Ekonomika*, vol. 3, no. 1, pp. 26–33, 2019.
35. E. Purnawan, G. Brunori, and P. Prosperi, "Financial support program for small farmers, and its impact on local food security. Evidence from Indonesia," *Horticulturae*, vol. 7, no. 12, Dec. 2021, doi: 10.3390/horticulturae7120546.
36. R. C. D. Sumartono, S. Tarumun, and J. Yusri, "gunung Omeh (Citrus microcarpa L.) (Studi Kasus Nagari Koto Tinggi Kecamatan Gunung Omeh Kabupaten Lima Puluh Kota Provinsi Sumatera Barat)," *Indonesian Journal of Agricultural Economics*, vol. 10, no. 1, pp. 35–48, 2019.
37. M. K. Agatha and E. Wulandari, "Analisis Faktor-Faktor yang Mempengaruhi Produksi Kentang di Kelompok Tani Mitra Sawargi Desa Barusari Kecamatan Pasirwangi Kabupaten Garut," *Jurnal Ilmiah Mahasiswa*, vol. 4, no. 3, pp. 772–778, 2018.
38. S. Gracia and E. D. Martauli, "Analisis Pendapatan dan Faktor-Faktor yang Mempengaruhi Produksi Usahayani Padi Sawah di Kabupaten Deli Serdang," *Jurnal Ilmiah Manajemen*, vol. 18, no. 2, pp. 120–135, 2021.
39. S. Nainggolan and R. O. Ulma, "Dampak Penggunaan Input Produksi Terhadap Efisiensi Teknis Usahatani Jagung Program Upaya Khusus (UPSUS) Di Kabupaten Muaro Jambi - Indonesia," *SEPA: Jurnal Sosial Ekonomi Pertanian dan Agribisnis*, vol. 16, no. 2, p. 139, Feb. 2020, doi: 10.20961/sepa.v16i2.32382.
40. I. C. Nainggolan, K. Tarigan, and Salmiah, "Analisis Usahatani Jeruk dan Faktor-Faktor yang Mempengaruhi Penerimaan Petani," 2014.
41. V. I. Afrianika, S. Marwanti, and I. Khomah, "Analisis Faktor-Faktor Yang Mempengaruhi Produksi Usahatani Bawang Merah di Kecamatan Tawangmangu," vol. 3, no. 2, pp. 79–86, 2020, doi: 10.22219/agriecobis.
42. Didik, "Analisis Efisiensi Faktor-Faktor Produksi Usahatani Jeruk Keprok Terigas di Kecamatan Tebas Kabupaten Sambas," *Jurnal Social Economic of Agriculture*, vol. 10, no. 2, p. 71, Jul. 2022, doi: 10.26418/j.sea.v10i2.52479.
43. P. K. Gusti and S. H. Kusuma, "Penentuan Faktor–Faktor yang Berpengaruh terhadap Pengembangan Budidaya KomoditasJeruk Keprok di Desa Punten,KecamatanBumiaji, Kota Batu," *Jurnal Teknis ITS*, vol. 11, no. 1, pp. 23–28, 2022.

44. Saraswati, B. Widayanto, and D. A. Puspitaningrum, "Pengaruh Efikasi Diri, Motivasi dan Komitmen Terhadap Keberhasilan Agribisnis Petani Milenial di Daerah Istimewa Yogyakarta," *Jurnal Pertanian Agros*, vol. 24, no. 2, pp. 750–760, 2022.
45. N. D. Seran and S. J. Kune, "Faktor-Faktor yang Mempengaruhi Produksi Usahatani Jeruk Keprok di Desa Suanae Kecamatan Miomaffo Barat Kabupaten Timor Tengah Utara," *Jurnal Agribisnis Lahan Kering*, vol. 1, no. 3, pp. 67–69, 2016.
46. A. Mulyaningsih, A. V. S. Hubeis, D. Sadono, and D. Susanto, "Partisipasi Petani pada Usahatani Padi, Jagung, dan Kedelai Perspektif Gender," *Jurnal Penyuluhan*, vol. 14, no. 1, pp. 145–158, 2018.
47. M. Marhawati, "Analisis Karakteristik dan Tingkat Pendapatan Usahatani Jeruk Pamelo Di Kabupaten Pangkep," *JEKPEND: Jurnal Ekonomi dan Pendidikan*, vol. 2, no. 2, p. 39, Jul. 2019, doi: 10.26858/jekpend.v2i2.9969.
48. C. N. Namah *et al.*, "Faktor-Faktor yang Mempengaruhi Produksi dan Pendapatan Usahatani Jeruk Keprok Soe Di Kabupaten Timor Tengah Selatan," *Partner*, vol. 19, no. 1, pp. 14–25, 2019.
49. C. Chairunnisa and I. A. Juliannisa, "Pengaruh Pendidikan, Kesehatan, Usia dan Upah Terhadap Produktivitas Tenaga Kerja Di Dki Jakarta," *Jurnal PROFIT: Kajian Pendidikan Ekonomi dan Ilmu Ekonomi*, vol. 9, no. 1, pp. 62–72, May 2022, doi: 10.36706/jp.v9i1.16878.
50. L. Tania and S. Amar, "Pengaruh Pendidikan Kesehatan dan Tingkat Upah Terhadap Produktivitas Tenaga Kerja di Indonesia," *Jurnal Kajian Ekonomi dan Pembangunan*, vol. 4, no. 4, pp. 41–46, 2022, [Online]. Available: http://ejournal.unp.ac.id/students/index.php/epb/index
51. Y. L. Foda, L. Wibowo, P. Lestari, and R. Hasibuan, "Inventarisasi Dan Intensitas Serangan Hama Tanaman Jeruk (Citrus sinensis L.) di Kecamatan Sekampung Udik Kabupaten Lampung Timur," *Jurnal Agrotek Tropika*, vol. 9, no. 3, p. 367, Oct. 2021, doi: 10.23960/jat.v9i3.5276.
52. Megawati and R. M. Candra, "Diagnosa Hama dan Penyakit pada Tanaman Jeruk dengan Menerapkan Jaringan Syaraf Tiruan Learning Vector Quantization (Studi Kasus : Badan Penyuluhan Pertanian Kuok)," *Jurnal CoreIT*, vol. 3, no. 2, 2017.
53. H. M. O. Otieno, "Simplified Orange (Citrus spp.) Production Guide for Small-scale Farmers," *Asian Journal of Agricultural and Horticultural Research*, pp. 23–27, Jan. 2020, doi: 10.9734/ajahr/2020/v5i130040.
54. T. Saikia, K. C. Bora, H. Gogoi, and J. K. Gogoi, "Resource Use Efficiency of Mandarin Orange Production in Tinsukia District of Assam," *International Journal of Research in Social Sciences*, vol. 9, 2019.
55. N. Y. Tadjema, I. Mowidu, and M. Pangli, "Pengaruh Pemberian Pupuk Kandang Kambing Terhadap Pertumbuhan dan Hasil Jagung Pulut (Zea mays certain kulesh)," *Jurnal Agropet*, vol. 15, no. 1, pp. 48–57, 2018.
56. F. P. Putra, N. Ikhsan, M. Virdaus, and N. Ikhsan, "Respon Pertumbuhan Jagung(Zea mays L.) Terhadap Pupuk Kandang dan Urea Media Pasir," *AGROSCRIPT*, vol. 3, no. 2, pp. 70–77, 2021.
57. D. K. Sari, Sutopo, and S. Supriyadi, "Pengaruh Pupuk Lengkap Berpelepasan Hara Lambat (Slow Release Fertilizer) terhadap Pertumbuhan Vegetatif Tanaman Jeruk Siam (Citrus nobilis var. microcarpa Lour)," *Agrovigor: Jurnal Agroekoteknologi*, vol. 13, no. 1, pp. 33–42, Mar. 2020, doi: 10.21107/agrovigor.v13i1.5884.
58. R. A. W. Ramadhan, M. Baskara, and A. Suryanto, "Pengaruh Pemberian Pupuk NPK Terhadap Fruit Set Tanaman Jeruk Manis (citrus sinesis Osb) Var. Pacitan," *Jurnal Produksi Tanaman*, vol. 3, no. 3, pp. 212–217, 2015.
59. Muh. N. F. Ramadhana, M. K. Ahmadin, and M. S. Madjid, "Petani Jeruk di Bumi Tanadoang 1979-2017," *Jurnal Pattingalloang*, vol. 5, no. 1, pp. 141–158, 2018.
60. Sakhidin, A. S. D. Purwantono, and S. R. Suparto, "Produksi Buah Jeruk pada Beberapa Dosis Pemupukan NPK dan Frekuensi Pemberian Pupuk Daun," *Prosiding Seminar Nasional dan Call for Papers*, pp. 241–247, 2019.
61. Mario, P. Astuti, and A. P. Sujalu, "Pengaruh Pupuk Organik Cair NASA dan Pupuk Kompos Terhadap Pertumbuhan Bibit Jeruk Manis (Citrus aurantium)," *2020*, vol. 9, no. 1, pp. 23–32, 2020.
62. J. R. Saragih and U. Harmain, "Faktor-faktor yang Mempengaruhi Kinerja Kewirausahaan Petani Kopi Arabika di Kecamatan Dolog Masagal, Kabupaten Simalungun, Provinsi Sumatera Utara," *Journal of Regional and Rural Development Planning*, vol. 5, no. 2, pp. 101–109, Jun. 2021, doi: 10.29244/jp2wd.2021.5.2.101-109.
63. D. H. K. Kharismawati and D. P. Karjati, "Pengaruh Luas Lahan dan Jumlah Tenaga Kerja terhadap Produksi Padi di 10 Kabupaten Jawa Timur Tahun 2014-2018," *Economie*, vol. 03, no. 1, pp. 50–66, 2021.
64. I. G. A. B. Pradnyawati and W. Cipta, "Pengaruh Luas Lahan, Modal dan Jumlah Produksi Terhadap Pendapatan Petani Sayur di Kecamatan Baturiti," *Ekuitas: Jurnal Pendidikan Ekonomi*, vol. 9, no. 1, p. 93, Jun. 2021, doi: 10.23887/ekuitas.v9i1.27562.
65. U. Usman and Juliyani, "Pengaruh Luas Lahan, Pupuk dan Jumlah Tenaga Kerja Terhadap Produksi Padi Gampong Matang Baloi," *Jurnal Ekonomi Pertanian Unimal* , vol. 01, no. 01, pp. 31–39, 2018.
66. A. A. I. D. S. Langit and A. A. K. Ayuningsasi, "Pengaruh Luas Lahan, Tenaga Kerja, dan Modal terhadap Produksi Usahatani Jeruk," *E-Jurnal EP Unud*, vol. 8, no. 8, pp. 1697–1946, 2019.

67. L. Wijayanti and T. D. Hascaryani, "Analisis Pengaruh Kegiatan Kelompok Tani, Luas Lahan, Jumlah Tenaga Kerja dan Biaya Pupuk terhadap Produksi Jeruk di Desa Selorejo Kecamatan Dau Kabupaten Malang," 2021.
68. K. Kristiandi, R. Fertiasari, N. F. Yunita, T. W. Astuti, and D. Sari, "Analisis Produktivitas dan Luas Lahan Tanaman Jeruk Siam Sambas Tahun 2015-2020," *MIMBAR AGRIBISNIS*, vol. 7, no. 2, pp. 1747–1755, 2021.
69. H. S. Kassem, B. A. Alotaibi, F. O. Aldosari, A. Herab, and R. Ghozy, "Factors influencing smallholder orange farmers for compliance with GobalGAP standards," *Saudi J Biol Sci*, vol. 28, no. 2, pp. 1365–1373, Feb. 2021, doi: 10.1016/j.sjbs.2020.11.070.
70. A. Ainurrahma, N. Nuryartono, and S. H. Pasaribu, "Analisis Kesejahteraan Petani: Pola Penguasaan Lahan di Kabupaten Lamongan," *Jurnal Ekonomi dan Kebijakan Pembangunan*, vol. 7, no. 2, pp. 102–117, 2018.
71. M. P. Manatar, E. H. Laoh, and J. R. Mandei, "Pengaruh Penguasaan lahan Terhadap Pendapatan Petani Padi di desa Tumani, Kecamatan Maesaan, Kabupaten Minahasa Selatan," *Agri-Sosio Ekonomi Unsrat*, vol. 13, no. 1, pp. 55–64, 2017.
72. M. Pasaribu and Istriningsih, "Pengaruh Status Kepemilikan Lahan Terhadap Pendapatan Petani Berlahan Sempit di Kabupaten Indramayu dan Purwakarta," *Jurnal Pengkajian dan Pengembangan Teknologi Pertanian*, vol. 23, no. 2, pp. 187–198, 2020.
73. M. Rondhi and A. H. Adi, "Pengaruh Pola Pemilikan Lahan Terhadap Produksi, Alokasi Tenaga Kerja, dan Efisiensi Usahatani Padi," *AGRARIS: Journal of Agribusiness and Rural Development Research*, vol. 4, no. 2, pp. 101–110, 2018, doi: 10.18196/agr.4265.
74. K. H. Koirala, A. K. Mishra, and S. Mohaty, "Impact of Land Ownership on Productivity and Efficiency of Rice Farmers: A Simulated Maximum Likelihood Approach Intensification of Rainfed Rice-fallows in Odisha View project," *Agricultural and Applied Economics Association*, pp. 1–19, 2014, doi: 10.13140/2.1.4979.0729.
75. M. H. Jamil, N. Rahma Azizah Basmahuddin, E. B Dammallino, and M. Ridwan, "Faktor-Faktor yang Mempengaruhi Kinerja Penyuluh Pertanian dalam Masa Pandemi Covid-19 di Kabupaten Jeneponto," *Jurnal Penyuluhan*, vol. 19, no. 01, pp. 80–92, Jan. 2023, doi: 10.25015/19202341935.
76. N. F. Khairunnisa, Z. Saidah, H. Hapsari, and E. Wulandari, "Pengaruh Peran Penyuluh Pertanian terhadap Tingkat Produksi Usahatani Jagung," *Jurnal Penyuluhan*, vol. 17, no. 2, pp. 113–125, Jun. 2021, doi: 10.25015/17202133656.
77. E. C. Purba and B. S. Purwoko, "Teknik Pembibitan, Pemupukan, dan Pengendalian Hama Penyakit Tanaman Komoditi Jeruk Siam(Citrus nobilis var. microcarpa) Di Kecamatan Simpang Empat dan Kecamatan Payung, Kabupaten Karo, Sumatra UTARA, INDONESIA," *Pro-Life*, vol. 6, no. 1, pp. 66–75, Mar. 2019, doi: 10.33541/pro-life.v6i1.940.
78. R. Simanjuntak and Amrizal, "Analisis Kelayakan Dan Faktor-Faktor yang Mempengaruhi Produksi Usahatani Jagung Manis(Studi Kasus di Nagori Negeri Malela Kecamatan Gunung Malela)," *Jurnal Agrilink*, vol. 1, no. 2, pp. 83–90, 2019.
79. K. S. Indraningsih, "Faktor-Faktor yang Mempengaruhi Kinerja Usahatani Petani Sebagai Representasi Dtrategi Penyuluh Pertanian Berkelanjutan di Lahan Marjinal," *Jurnal Agro Ekonomi*, vol. 13, no. 1, pp. 71–95, 2013.
80. R. Dewantoro, S. Nainggolan, and Y. Fitri, "Pengaruh Faktor Internal dan Eksternal Petani Terhadap Produktivitas Usahatani Padi Sawah di Kecamatan Batang Asam Kabupaten Tanjung Jabung Barat," pp. 4–12, 2021.
81. M. Fazri, H. Siregar, and N. Nuryartono, "Efisiensi Teknis, Pertumbuhan Teknologi dan Total Faktor Produktivitas pada Industri Menengan dan Besar," *Jurnal Ekonomi dan Kebijakan Pembangunan*, vol. 6, no. 1, pp. 1–20, 2017.
82. T. M. D. Saputra, M. N. Soedjoni, and Z. Arifin, "Analisis Faktor Sosial Ekonomi yang Mempengaruhi Pendapatan Usahatani Jeruk Siam Di Desa Selorejo Kecamatan Dau Kabupaten Malang," *Jurnal Sosial Ekonomi Pertanian dan Agribisnis*, 2020.
83. D. A. Iyai *et al.*, "Pengaruh Tingkat Pendidikan dan Jenis Kelamin Peternak terhadap Tingkat Produksi Babi (Studi Kasus di Manokwari, Papua Barat Indonesia)," *Jurnal Ilmu Peternakan Terapan*, vol. 3, no. 2, pp. 49–57, Jul. 2020, doi: 10.25047/jipt.v3i2.1941.
84. C. Andrade, "A Student's Guide to the Classification and Operationalization of Variables in the Conceptualization and Design of a Clinical Study: Part 1," *Indian J Psychol Med*, vol. 43, no. 2, pp. 177–179, Mar. 2021, doi: 10.1177/0253717621994334.
85. G. Issahaku and A. Abdulai, "Sustainable Land Management Practices and Technical and Environmental Efficiency among Smallholder Farmers in Ghana," *Journal of Agricultural and Applied Economics*, vol. 52, no. 1, pp. 96–116, Feb. 2020, doi: 10.1017/aae.2019.34.
86. A. M. Adam, "Sample Size Determination in Survey Research," *J Sci Res Rep*, pp. 90–97, Jun. 2020, doi: 10.9734/jsrr/2020/v26i530263.
87. M. Maalouf, "Logistic regression in data analysis: An overview," 2011, *Inderscience Publishers*. doi: 10.1504/IJDATS.2011.041335.

88. M. Brusco, "Logistic Regression via Excel Spreadsheets: Mechanics, Model Selection, and Relative Predictor Importance," *INFORMS Transactions on Education*, vol. 23, no. 1, pp. 1–11, Sep. 2022, doi: 10.1287/ited.2021.0263.
89. J. I. F. Henning, D. A. Bougard, H. Jordaan, and N. Matthews, "Factors affecting successful agricultural loan applications: The case of a South African credit provider," *Agriculture (Switzerland)*, vol. 9, no. 11, Nov. 2019, doi: 10.3390/agriculture9110243.
90. J. K. Harris, "Primer on binary logistic regression," *Fam Med Community Health*, vol. 9, Dec. 2021, doi: 10.1136/fmch-2021-001290.
91. M. Salam *et al.*, "The causal-effect model of input factor allocation on maize production: Using binary logistic regression in search for ways to be more productive," *J Agric Food Res*, p. 101094, Mar. 2024, doi: 10.1016/j.jafr.2024.101094.
92. Y. A. Tampil, H. Komalig, and Y. Langi, "Analisis Regresi Logistik Untuk Menentukan Faktor-Faktor Yang Mempengaruhi Indeks Prestasi Kumulatif (IPK) Mahasiswa FMIPA Universitas Sam Ratulangi Manado," *JdC*, vol. 6, no. 2, pp. 56–62, 2017.
93. E. T. Yuniarsih, M. Salam, M. H. Jamil, and A. Nixia Tenriawaru, "Determinants determining the adoption of technological innovation of urban farming: Employing binary logistic regression model in examining Rogers' framework," *Journal of Open Innovation: Technology, Market, and Complexity*, vol. 10, no. 2, Jun. 2024, doi: 10.1016/j.joitmc.2024.100307.
94. A. Borucka and M. Grzelak, "Application of logistic regression for production machinery effciency evaluation," *Applied Sciences (Switzerland)*, vol. 9, no. 22, Nov. 2019, doi: 10.3390/app9224770.
95. J. Palkovič and M. Šoporová, "Application of the logistic regression analysis to assess credibility of the farm," *Mathematics in Education, Research and Applications*, vol. 3, no. 2, pp. 49–56, Dec. 2017, doi: 10.15414/meraa.2017.03.02.49-56.
96. Marudhar, "Identifying Variables," *International Journal of Science and Research*, vol. 8, no. 3, pp. 865–868, 2018.
97. S. Binoy, "Significance of Hypothesis in Research," *Indian Journal of Holistic Nursing*, vol. 10, no. 01, pp. 31–33, Nov. 2019, doi: 10.24321/2348.2133.201905.
98. U. Farooq *et al.*, "Situation Analysis of Physical Rehabilitation Policy and Social Health Protection Initiative, in Pakistan View project Child Rights View project," *Multicultural Education*, vol. 7, no. 9, pp. 52–57, 2021, doi: 10.5281/zenodo.5368413.
99. M. M. Ali, Nruliani, and I. Rosada, "Kajian Peran dan Kinerja Kelompok Tani Terhadap Produksi Usahatani Padi Sawah (Studi Kasus di Kelurahan Pancaitana, Kecamatan Salomekko Kabupaten Bone)," *WIRATANI : Jurnal Ilmiah Agribisnis*, vol. 4, no. 2, p. 2021, 2022, [Online]. Available: http://jurnal.agribisnis.umi.ac.id
100. T. T. T. Nguyen, T. M. H. Ho, T. N. Bui, and P. Lebailly, "Input Factors Affecting of Orange Production in Tuyen Quang Province, Vietnam," *Asian Soc Sci*, vol. 15, no. 11, p. 17, Oct. 2019, doi: 10.5539/ass.v15n11p17.
101. E. Rosalia and T. Karyani, "Faktor-Faktor Yang Mempengaruhi Petani Kopi Di Desa Pulosari Kecamatan Pangalengan Dalam Memilih Sistem Pola Tanam Monokultur dan Polikultur," *MIMBAR AGRIBISNIS*, vol. 6, no. 2, pp. 486–499, 2020.
102. N. M. Mokodompit, J. S. Tambas, and J. R. D. Lumingkewas, "Pengaruh Luas Lahan, Modal Dan Tenaga Kerja Terhadap Produksi Usahatani Nanas (Studi Kasus: Desa Bulud Kecamatan Passi Barat Kabupaten Bolaang Mongondow)," *Agri-SosioEkonomi Unsrat*, vol. 17, no. 3, pp. 2685–063, 2021.
103. L. Ma, Y. Zhang, S. Chen, L. Yu, and Y. Zhu, "Environmental effects and their causes of agricultural production: Evidence from the farming regions of China," *Ecol Indic*, vol. 144, Nov. 2022, doi: 10.1016/j.ecolind.2022.109549.
104. D. H. Pangaribuan, D. H. Pangaribuan, K. Hendarto, S. R. Elzhivago, and A. Yulistiani, "The effect of organic fertilizer and urea fertilizer on growth, yield and quality of sweet corn and soil health Integrated Organic and Inorganic Fertilizer on Vegetable View project Agronomy of Potato and True Potato Seed (TPS) View project The effect of organic fertilizer and urea fertilizer on growth, yield and quality of sweet corn and soil health," 2018. [Online]. Available: https://www.researchgate.net/publication/328651015
105. S. Kramchote and S. Glahan, "Effects of Led Supplementary Lighting and NPK Fertilization on Fruit Quality of Melon (Cucumis melo L.) Grown in Plastic House," *Journal of Horticultural Research*, vol. 28, no. 1, pp. 111–122, Jun. 2020, doi: 10.2478/johr-2020-0014.
106. M. D. Pérez, Á. C. Ortega, J. A. S. Andújar, and Á. J. C. Ferre, "Logistic regression to evaluate the marketability of pepper cultivars," *Agronomy*, vol. 9, no. 3, 2019, doi: 10.3390/agronomy9030125.
107. Wardani, "Peranan Kelompoktani dalam meningkatkan Produktivitas Usahatani (Kasus di Wilayah BP3K Sukalarang, Sukabumi)," *Jurnal Penyuluhan Pertanian*, vol. 12, no. 1, 2017.
108. R. F. Widyawati and A. Pujiyono, "Pengaruh Umur, Jumlah Tanggungan Keluaga, Luas Lahan, Pendidikan, Jarak Tempat Tinggal Pekerja ke Tempat Kerja, dan Keuntungan Terhadap Curahan Waktu Kerja Wanita Tani Sektor Pertanian di Desa Tajuk, Kec. Getasan, Kab. Semarang," *DIPONEGORO JOURNAL OF ECONOMICS*, vol. 2, no. 3, pp. 1–14, 2013.

109. A. M. Linda, "Faktor-Faktor yang Mempengaruhi Produksi Jagung di Desa Kiritana Kecamatan Kambera Kabupaten Sumba Timur," *MIMBAR AGRIBISNIS*, vol. 6, no. 2, pp. 765–773, 2020.
110. R. R. Sutrantiyas, Masyhuri, and A. P. Siregar, "Efisiensi Alokatif Usaha Tani Jagung di Kecamatan Bantul, Kabupaten Bantul, Daerah Istimewa Yogyakarta," *Jurnal Agrikultura*, vol. 33, no. 3, pp. 429–438, 2022.
111. W. Saragih, A. E. Lubis, and M. Rahayu, "Analisis Agribisnis Jeruk Manis (Citrus sp) di Desa Merek, Kecamatan Merek, Kabupaten Karo," *jurnal Agrilink*, vol. 2, no. 2, pp. 119–132, 2020.
112. M. Hendebo, A. M. Ibrahim, F. Gurmu, and H. M. Beshir, "Assessment of Production and Utilization Practices of Orange-Fleshed Sweet Potatoes (Ipomoea Batatas L.) in Sidama Region, Ethiopia," *International Journal of Agronomy*, vol. 2022, 2022, doi: 10.1155/2022/4922864.
113. G. Shaila, A. Tauhid, and I. Tustiyani, "Pengaruh Dosis Urea dan Pupuk Organik Cair Asam Humat Terhadap Pertumbuhan dan Hasil Tanaman Jagung Manis," *Agritrop : Jurnal Ilmu-Ilmu Pertanian (Journal of Agricultural Science)*, vol. 17, no. 1, p. 35, Jun. 2019, doi: 10.32528/agritrop.v17i1.2185.
114. N. F. Nooraminah, R. A. Wulandari, and H. H. Ilmiah, "Pengaruh Kombinasi Pemupukan Organik dan Anorganik terhadap Pertumbuhan dan Kandungan Flavonoid Kangkung Darat (*Ipomoea reptans* Poir) varietas Bangkok dan varietas Serimpi," *Vegetalika*, vol. 12, no. 4, p. 312, Nov. 2023, doi: 10.22146/veg.82224.
115. Nuranisa, M. Amiruddin, D. Dwiyanto, and S. A. Karim, "Peningkatan Produksi Tanaman Jagung pada perlakuan Pupuk NPK Mutiara dalam Meningkatkan Perekonomian Petani Di Kelurahan Malotong," *Jurnal Abdi Masyarakat Multidisiplin*, vol. 1, no. 3, pp. 35–42, 2022.
116. M. E. Santoso and B. Hermiyanto, "Diagnosa Keseimbangan Hara N, P, K dan Mg pada Jeruk Siem Menggunakan Metode Dris Di Kecamatan Cluring," *Jurnal Bioindustri*, vol. 1, no. 1, pp. 10–27, 2018.
117. A. Fidiansyah, Sudirman Yahya, and Suwarto, "Produksi dan Kualitas Umbi serta Ketahanan terhadap Hama pada Bawang Merah," *Jurnal Agronomi Indonesia (Indonesian Journal of Agronomy)*, vol. 49, no. 1, pp. 53–59, Apr. 2021, doi: 10.24831/jai.v49i1.33761.
118. Sakhidin *et al.*, "Produksi dan Kualitas Buah Jeruk pada Beberapa Dosis Pupuk NPK dan Frekuensi Pemberian Pupuk Daun," *Agronomika (Jurnal Budidaya Pertanian Berkelanjutan)*, vol. 12, no. 1, pp. 1–6, 2022.
119. N. Kiknadze, G. Tavdgiridze, and D. Jashi, "Influence of various forms of nitrogen fertilizers at productivity of mandarin Unshiu and red soils," *Ann Agrar Sci*, vol. 16, no. 3, pp. 344–347, Sep. 2018, doi: 10.1016/j.aasci.2018.05.009.
120. Z. Li *et al.*, "Interactions between N, P and K fertilizers affect the environment and the yield and quality of satsumas," *Glob Ecol Conserv*, vol. 19, Jul. 2019, doi: 10.1016/j.gecco.2019.e00663.
121. J. B. Revuelta, R. Musule, F. S. N. Pineda, and C. A. García, "Evaluating the environmental performance of orange production in Veracruz, Mexico: A life cycle assessment approach," *J Clean Prod*, vol. 343, Feb. 2022.
122. Y. Karuniawati, A. Laapo, and L. Damayanti, "Analysis of the Efficiency of use of Production Inputs in Sweet Corn in the Maranatha Village, Sigi District Biromaru, Sigi District," *1464 j. Agrotekbis*, vol. 9, no. 6, pp. 1464–1472, 2021.
123. Nurmi and A. Azis, "Pemanfaatan Pupuk Organik untuk Meningkatkan Kesuburan Tanah pada Pertanaman Kacang Tanah," *Jurnal Pengabdian Masyarakat Teknologi Pertanian*, vol. 2, no. 2, pp. 166–171, 2023.