

# Determinants of potato consumption as a carbohydrate source in East Java, Indonesia: A household-level analysis

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**Abstract.** Diversification of food sources is crucial for enhancing national food security. Potatoes are an accessible source of carbohydrates for households; nevertheless, their prices frequently exhibit significant volatility. This study aims to examine the determinants affecting the demand for potatoes. The study was performed in East Java Province, utilizing secondary data from the Central Bureau of Statistics, namely the National Socioeconomic Survey (SUSENAS) for 2023. The study's sample size included 32,454 households. The data analysis employs a Multiple Linear Regression. The research findings indicate that the primary carbohydrate source for households is rice (78.5%), followed by wheat flour (36.7%) and subsequently potatoes (25.8%). The prices of potatoes, rice, shelled corn, cassava, and sweet potatoes affect the demand for potatoes. Simultaneously, the prices of sticky rice, wheat flour, sago, taro, and gaplek do not affect the demand for potatoes. Household income exerts a positive and significant influence on potato demand. The quantity of household members does not influence the demand for potatoes. Substitutes for potatoes include rice, cassava, and sweet potato, whilst corn is a complement to potatoes. This study's findings indicate that households in East Java utilize potatoes as a carbohydrate source alongside rice, particularly as household income rises.

**Keywords:** carbohydrates, potatoes, rice, sweet potatoes, tubers.

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## 1 Introduction

Staple foods are crucial for ensuring food security and influencing the consumption habits of Indonesian society. Diversification of food sources is crucial for enhancing national food security. This aims to advance the first and second Sustainable Development Goals (SDGs) of global development: No Poverty and Zero Hunger. In recent decades, rice has consistently been the primary source of carbs, commanding the biggest percentage of consumption in nearly all regions, including East Java. This overdependence on rice frequently results in susceptibility regarding supply and price stability, particularly amid harvest failures, distribution interruptions, or worldwide market volatility [1]. This scenario underscores the significant risk of food insecurity associated with dependence on a singular product. Consequently, the diversification of carbohydrate-based foods beyond rice is a strategic governmental initiative designed to alleviate pressure on rice, broaden dietary options, enhance food sovereignty, and elevate the nutritional quality of household consumption. In this sense, potatoes represent a primary choice for food diversification, given that this province is a significant national source for potato production [2].

Potatoes represent a significant horticultural commodity with substantial promise as an alternate carbohydrate source. Due to their elevated energy, vitamin, and mineral composition, potatoes can partially exceed domestic carbohydrate requirements. Moreover, East Java is recognized as a prominent hub for potato production in Indonesia, particularly in mountainous regions such as Malang, Batu, and Pasuruan. BPS data indicate that potato output in East Java has varied, attaining 320.2 thousand tons in 2019, rising to 354.2 thousand tons in 2020, declining to 324.3 thousand tons in 2021, and then markedly increasing to 381.1 thousand tons in 2022. Nonetheless, despite its significant availability, the public's consumption of potatoes is very low in relation to rice and other carbohydrate sources. According to the 2023 Susenas, around 25% of homes in East Java consumed potatoes, with an average weekly consumption of 1.31 kg among consumer households. Consequently, its contribution to overall carbohydrate intake remains far lower than that of rice, the primary staple grain.

This occurrence of diminished potato consumption prompts a critical inquiry: what determinants influence household choices regarding the incorporation of potatoes as a carbohydrate source? Food consumption behavior is essentially influenced by physical availability, market prices, social dynamics, economic factors, cultural influences, and individual household preferences. Economic variables, such as income levels, affect purchasing power, whereas social determinants, like education and nutritional understanding, increase awareness of the advantages of dietary diversification. Household demographics, including household size and age distribution, might affect variations in consumption patterns. The cultural factors and dietary practices of East Java's populace, who predominantly favor rice as a staple, frequently hinder the rise in potato consumption. The lack of innovation in potato processing at the household level, insufficient promotion as a nutritious food, and the high cost of distribution to peripheral regions all consolidate the status of potatoes as merely a supplementary food rather than a primary alternative. Low potato consumption is not solely a supply issue; it signifies a complex interaction of multiple structural and preference factors that necessitate additional examination.

Despite the government's ongoing promotion of food diversification initiatives, its execution does not consistently correspond with consumer consumption preferences. Households, especially in East Java, continue to regard rice as their principal carbohydrate source; thus, increasing potato output does not necessarily result in heightened consumption. This scenario may induce an imbalance between production and consumption, potentially resulting in losses for farmers due to diminished demand and generating inefficiencies within the food supply chain. The efficacy of food diversification as a method to enhance food

security relies not solely on augmenting output, but also on comprehending and influencing household consumption choices [3]. Consequently, an investigation of the factors influencing potato consumption at the household level in East Java is essential. This research aims to identify the principal characteristics that facilitate or impede potato consumption, thereby establishing a foundation for developing more focused food diversification programs. In the absence of sufficient comprehension of these elements, programs aimed at enhancing non-food consumption.

## 2 Material and method

### 2.1 Data and data source

This analysis utilizes secondary data from the 2023 Susenas (National Socio-economic Survey) conducted by the Central Bureau of Statistics (BPS). The study's sample size included 32,454 households. The study data comprises household consumption and expenditure information, whereas the requisite data for analysis is price data. Due to the absence of pricing data in the Susenas dataset, commodity price information was derived by dividing the expenditure amount by the consumption quantity. Consequently, the prices of potatoes, rice, sticky rice, shelled corn, wheat flour, cassava, sweet potatoes, sago, taro, gaplek, household income, and the number of household members were acquired. Table 1 presents the list of codes and name of the research commodities.

**Table 1.** Staple food and tuber commodities in Indonesia.

Code	Cereal and Tuber Commodities
2	Rice (local rice, superior quality, imported)
3	Sticky rice
5	Shelled corn/corn rice/titi corn
6	Wheat flour
9	Cassava/tapioca
10	Sweet potato/yam
11	Sago
12	Taro
13	Potato
14	Gaplek

Source: Own summary based on data from Susenas 2023

### 2.2 Analytical approach: Multiple linear regression model

This study uses the multiple linear regression method for data analysis to estimate the potato demand [4]. Food price data is derived by dividing the total expenditure by the quantity consumed. The data analysis results indicate the link between two products, determining if they are substitutes or complements. A positive regression coefficient (>0) indicates that the two goods are substitutes; a negative regression coefficient (<0) signifies that the two items are complements. The model to determine household demand for potatoes in East Java Province is articulated as follows:

$$Y = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + e$$

Y = Potato Consumption (kg), X1 to X10 are Commodity Prices (Rp per kg), X1 = price of potatoes, X2 = Price of Rice, X3 = Price of Sticky Rice, X4 = Price of Shelled Corn, X5 = Price of Wheat Flour, X6 = Price of Cassava, X7 = Price of Sweet Potato, X8 = Price of Sago,

X9 = Price of Taro, X10 = Price of Dried Cassava, X11 = Per Capita Income (Rp per month), X12 = Number of Household Members (people),  $\beta_1$  = constant,  $\beta_2 \dots \beta_{12}$  = parameter,  $\varepsilon$  = disturbance variable.

Evaluate the potato demand model via the F-test. The F-test assesses the simultaneous impact of potato price, rice price, sticky rice price, shelled corn price, wheat flour price, cassava price, sweet potato price, sago price, taro price, gaplek price, income, and household size on potato demand. The subsequent analysis pertains to the coefficient of determination ( $R^2$ ) analysis.  $R^2$  is utilized to forecast the magnitude of the impact of an independent variable on a dependent variable. The coefficient of determination ranges from 0 to 1 ( $0 \leq (R^2) \leq 1$ ). A higher  $R^2$  value (approaching 1) indicates superior model performance; conversely, if the total insignificant variables approach 0, the explanatory power of all study variables about the factors impacting potato demand in households in East Java Province diminishes. The conclusive analysis employs a t-test to assess the distinct impact of each independent variable on potato demand.

### 3 Result and discussion

#### 3.1 Food Consumption Preferences for Carbohydrate Sources in East Java Province

Trends in potato consumption encompass the varied assortment of meals and their processed derivatives that an individual typically ingests, characterized by their quantity, type, frequency, and preparation methods. Diverse food consumption entails the intake of a wide array of foods from various sources, encompassing both animal and plant origins. Balanced nutrition is ingesting food in quantities and ratios that fulfill nutritional requirements. Optimal food consumption is characterized by diversity, balance, and safety. The dietary habits of the populace in East Java Province are insufficiently varied. A significant number of individuals continue to see rice as their primary staple diet. The Central Bureau of Statistics reports that potato consumption in both urban and rural areas has risen during the past seven years (Table 2). Nonetheless, potato consumption in urban regions surpasses that in rural areas. The subsequent data pertains to potato consumption in urban and rural regions of East Java Province over the last seven years, as illustrated in Table 2.

**Table 2.** Food Consumption Preferences for Carbohydrates.

Commodity	Percentage (%)
Rice	78.5
Sticky rice	1.50
Shelled corn/corn rice/titi corn	10.8
Wheat flour	36.7
Cassava/tapioca	13.2
Sweet potato/yam	11.5
Sago	0.10
Taro	1.80
Potato	25.8
Gaplek	0.70

Source: Own calculation based on data from SUSENAS.

The research findings indicate that rice serves as the primary staple diet for the inhabitants of East Java. The percentage of the population consuming rice is 78.5%. The elevated intake of rice in East Java is attributable to its substantial carbohydrate content, measuring 45 grams per 150 grams of rice. Besides carbs, white rice comprises protein, iron, phosphorus,

potassium, and magnesium. Nevertheless, despite its elevated carbohydrate content, rice comprises a greater proportion of sugar and starch than fiber. Consequently, rice intake must be restricted to avert fluctuations in blood glucose levels. In East Java, 21.2% of households do not partake in rice consumption. Sticky rice is consumed alongside rice, although its consumption is somewhat lower. The percentage of individuals who consume sticky rice is about 1%. Notwithstanding this, sticky rice possesses a somewhat comprehensive nutritional profile, encompassing carbohydrates, calories, fiber, sugar, calcium, and iron. Nevertheless, sticky rice contains a lower carbohydrate content than regular rice, rendering it an inferior option for the community as a staple food. In East Java, the primary carbohydrate source for households, following rice, is wheat flour, comprising 36.7%, with potatoes ranking third at 25.8%. This figure is notably elevated, given that potatoes are more expensive than rice and wheat flour. The potential for gaplek is substantial; yet, household consumption preference for gaplek in the region is minimal, at about 1%. This indicates that approximately 1 in 100 households in East Java consume gaplek. Simultaneously, 99% of households in East Java do not partake in the consumption of gaplek. This is attributable to the East Java populace's unfamiliarity with ingesting gaplek. Gaplek contains a substantial carbohydrate content of 83.10 grams per 100 grams. Gaplek is utilized by households in East Java as a traditional snack.

### 3.2 Determinants of potato demand in East Java

Potatoes are among the tuber species predominantly utilized as a source of carbohydrates or staple food for the global population, following wheat, rice, and corn. As a tuber species, potatoes are notably rich in nutritional value. The protein-to-carbohydrate ratio of potato tubers much exceeds that of cereal grains and other tubers. The amino acid composition in potato tubers is considered balanced, indicating that potatoes are a beneficial source of amino acids for health. Potatoes can rival other sources of carbohydrates in domestic food consumption. Potatoes possess significant promise as a rice alternative. In numerous big cities, there seems to be a transition in utilizing potatoes as an alternative carbohydrate source to rice. The growing popularity of fast food establishments is manifest in their consistent inclusion of french fries on their menus. This phenomenon also occurs in East Java. Field research findings indicate that individuals in East Java incorporate potatoes into their regular diet. The average potato intake from March to September 2023, as reported by Susenas, is 0.6 kilograms per week. In East Java, merely 14% of households engage in potato consumption. Table 3 presents the results of the data analysis about factors influencing household potato consumption.

**Table 3.** Analysis results of factors affecting potato demand.

<b>Coefficients<sup>a</sup></b>					
Model	Unstandardized		Standardized	t	Sig.
	Coefficients		Coefficients		
	B	Std. Error	Beta		
(Constant)	5878.13	203.322		28.910	0.000
Price of Potato	0.042	0.009	0.049	4.426	0.000
Price of Rice	0.061	0.014	0.049	4.348	0.000
Price of Sticky Rice	-0.028	0.019	-0.016	-1.461	0.144
Price of Shelled Corn	-0.075	0.022	-0.036	-3.447	0.001
Price of Wheat Flour	-0.015	0.012	-0.014	-1.225	0.221
Price of Cassava	0.194	0.031	0.067	6.197	0.000
Price of Sweet Potatoes	0.061	0.032	0.020	1.888	0.059
Price of Sago	0.158	0.134	0.012	1.174	0.240

Price of Taro	0.050	0.054	0.010	0.933	0.351
Price of Dried Cassava	0.027	0.079	0.004	0.342	0.732
Income	0.0003	0.000	0.086	7.446	0.000
Household size	58.914	44.950	0.014	1.311	0.190

a. Dependent Variable: Potato consumption

Source: Own calculation based on data from Susenas.

$F_{test}=20.301$  (Sig 0.000)

Adjusted R Square= 0.381 (Std.Error of the Estimate=0.248)

Referring to Table 5, the potato demand model in East Java is as follows:

$$Y = 5878,13 + 0,042X_1 + 0,061X_2 (-0,028) X_3 (-0,075) X_4 + (-0,015) 0,194X_5 + 0,194X_6 + 0,061 X_7 + 0,168 X_8 + 0,050 X_9 + 0,027 X_{10} + 0,000 X_{11} + 58.914 X_{12} + e$$

### **Model Testing (F-Test)**

The F-test determines whether all independent variables in the model collectively affect the dependent variable, specifically assessing the influence of all independent variables on potato demand [7]. The F-test model yielded an F-calculated value of 20.301, with an F-table value of 1.75 derived from  $df_1 = 12$ ,  $df_2 = 32.454$ , and  $\alpha = 0.05$ . The estimated F-value of 20.301 exceeds the tabulated F-value of 1.75, and the F-significance is 0.000, which is less than  $\alpha$  0.05. This signifies the rejection of  $H_0$  and the acceptance of  $H_1$ , indicating that the independent variables (rice price, sticky rice price, shelled corn price, wheat price, cassava price, sweet potato price, sago price, taro price, potato price, gapek price, income, and household size) collectively affect household demand for potatoes.

### **Coefficient of determination ( $R^2$ )**

A  $R^2$  test was undertaken to ascertain the degree to which all prices account for potato demand. The data analysis revealed an  $R^2$  coefficient of 0.381, equivalent to 38.1%. Thus, 38.1% of potato consumption may be elucidated by the prices of rice, sticky rice, shelled corn, wheat, cassava, sweet potato, sago, taro, potatoes, gapek, income, and household size. The residual percentage ( $100\% - 38.1\% = 61.9\%$ ) is affected by external variables not accounted for in the model, such as protein, animal products, vegetables, fruits, oils, fats, nuts, and assorted spices. This can be elucidated by the government's Food Hope Program, namely PPH (local term: Pola Pangan Harapan), which mandates that households select a variety of healthful foods. This pertains to the PPH program, through which the government aims to enhance the nutritional status of the Indonesian populace, particularly to combat malnutrition and stunting. This is a comprehensive analysis of the impact of each factor on potato demand in East Java.

**Price of potatoes.** The results of the data analysis indicate that potato prices substantially influence potato demand. This is evidenced by a significance value of 0.000, indicating that a rise in potato prices results in a demand increase of 0.42 units. Consequently, it may be inferred that a rise in potato prices does not deter households from using potatoes as an alternative carbohydrate source to rice. This aligns with research from other countries indicating that potatoes serve as an alternative to rice.

**Prices of rice.** Rice is a predominant staple in Indonesia. East Java Province is one of the regions where rice serves as the primary source of carbohydrate consumption (10). The results of data analysis indicate that the price of rice in East Java influences the demand for potatoes. This is evidenced by a computed t-value of 4.348, exceeding the tabulated t-value of 1.753, and a t-value significance of  $X_2$  (Rice Price) of 0.000 (1%). The price of rice substantially influences the demand for potatoes. The positive regression coefficient of 0.061

indicates that a one-unit rise in rice price results in a 0.061 kg increase in potato demand. Consequently, it can be inferred that potatoes serve as a substitute for rice. Rice and potatoes are replacement products, indicating that customers can interchange them as sources of carbohydrates. As the price of rice escalates, people typically transition to potatoes. The implication is that if rice prices rise, residents in East Java substitute their rice consumption with alternative foods.

**Prices of sticky rice.** Sticky rice is a variety of rice that belongs to the Graminae family. This sticky rice resembles conventional rice in shape. In contrast to ordinary rice, sticky rice contains carbohydrate starch with a markedly low amylose percentage (1-2%) and a significantly high amylopectin level. Sticky rice is a variety of rice characterized by its elevated carbohydrate content. The elevated carbohydrate content renders sticky rice sticky and chewy in texture. Sticky rice serves as an excellent source of carbs for the body. Consequently, the outcome of this sticky rice is a softer texture, resistance to drying and hardening upon cooling, and an enhanced flavor.

**Price of shelled corn.** Shelled corn refers to corn kernels that have been detached from their husks, which are the protective coverings of the corn cob. Corn is a cereal crop of significance, as it serves as a staple food alternative to rice in initiatives aimed at diversifying food sources. In addition to serving as a carbohydrate supply, corn is utilized as flour and various industrial raw materials. Corn is an annual crop. The energy composition of rice and corn is comparable per hundred grams, with corn exhibiting a higher protein content than rice. In East Java, corn output is the second greatest after rice, totaling 6,335,252 tons in 2022. Production is steadily rising as additional land becomes accessible. Field research findings suggest that the substantial production of shelled corn in East Java Province correlates with its consumption as a staple food by the local population. The average consumption of shelled corn from March to September 2022, as reported by Susenas, is 0.7 kilograms per week. A substantial percentage of individuals continue to incorporate shelled corn into their daily household consumption. Nonetheless, when examining the consumption proportion, merely 11% of households utilize shelled corn. The data analysis results indicate that shelled corn in East Java considerably influences the demand for potatoes. This is denoted by a significance level of 1% for the price of shelled corn. The regression coefficient is -0.075. This implies that a 1-unit rise in the price of shelled corn results in a 0.075 kg increase in the demand for potatoes, or conversely. Consequently, shelled corn and potatoes are complementary goods. Shelled corn and potatoes exhibit a complementary and mutually advantageous interaction in multiple dimensions. The amalgamation of these two components can enhance nutritional value, diversify food sources, and facilitate the creation of novel food products. Households in East Java consume corn concurrently with potatoes.

**Price of wheat flour.** Wheat flour is a refined product derived from the wheat plant. Wheat flour has the potential to become a staple food for the Indonesian population. The reliance on wheat is escalating due to the rising quantity of processed products derived from wheat flour as a fundamental dietary source. Wheat flour has historically served as a fundamental ingredient in Indonesia for the production of bakery items, particularly bread. Wheat flour serves as a fundamental ingredient in the preparation of several fried dishes. Wheat flour is categorized according to its protein and gluten content as follows: 1) high protein content (12-14%) with wet gluten content (33-39%); 2) medium protein content (10-12%) with wet gluten content (27-33%); and 3) low protein content (8-10%) with wet gluten content (21-27%). This wheat flour's distinctiveness relative to other raw materials is its capacity to generate gluten. High-protein wheat flour, comparable to rice, has 14.45% protein, 2.01% fiber, and a substantial carbohydrate content of 78.36% in the form of starch. The findings of

the field investigation indicate that the price of wheat does not influence the demand for potatoes.

**Price of cassava.** Cassava is a primary carbohydrate source in Indonesia, ranking third behind rice and corn. Cassava is mostly cultivated for its tubers, which serve as food; however, it has also been employed as animal feed and industrial material over time. In addition to cassava tubers, cassava leaves may also serve as a food source. Cassava possesses a carbohydrate content comparable to that of rice; each hundred grams of boiled cassava comprises 36.8 grams of carbohydrates, 61.4 grams of water, 154 kcal of energy, 1 gram of protein, 0.9 grams of fiber, 0.3 grams of fat, 394 mg of potassium, 77 mg of calcium, 31 mg of vitamin C, and 24 mg of phosphorus. Moreover, cassava has other advantages, including the prevention of constipation due to its high content of resistant starch. Cassava fiber can reduce blood pressure, cholesterol levels, obesity risk, and the likelihood of heart disease. The research findings indicate that the cassava intake among the residents of East Java Province is 1.1 kilogram per week. In East Java, merely 13% of households partake in cassava consumption. The data analysis indicates that the price of cassava in East Java considerably influences the demand for potatoes, evidenced by a positive regression coefficient of 0.194. This indicates that a one-unit increase in the price of cassava results in a 0.194 kg increase in the demand for potatoes. Consequently, cassava and potatoes serve as alternatives. The implication is that if cassava prices rise, residents in East Java substitute cassava with potatoes in their diet. This discovery is noteworthy as it indicates that cassava is sought by households in East Java, thereby promoting the diversification of carbohydrate sources.

**Price of sweet potatoes.** Sweet potato is a non-rice carbohydrate alternative that offers numerous benefits and balanced nutrition for overall health. Sweet potatoes possess three advantages due to the amalgamation of cereal quality (high starch), fruits (elevated vitamin and pectin content), and vegetables (rich in vitamins and minerals). Rice serves as a carbohydrate source and has become a daily staple for the majority of Indonesians. In certain locations, a segment of the population relies on foods other than rice as their primary staple, including sweet potatoes. The sweet potato is a product of significant potential due to its substantial economic value and several advantages. Sweet potato is not only rich in carbs but also abundant in elements that are advantageous for bodily health, rendering it a primary food source and a viable alternative to rice. The data analysis results indicate that the price of sweet potatoes influences the demand for potatoes. The significance level for sweet potato prices is 5%. The regression coefficient is positive at 0.061, indicating that a 1-unit rise in sweet potato price results in a 0.061 kg increase in potato demand. The positive regression coefficient indicates that sweet potatoes and potatoes are replacements. Households exhibit sensitivity to fluctuations in potato prices. A rise in sweet potato costs may result in considerable substitution towards potatoes, thereby elevating the demand for potatoes. The implication is that if the price of sweet potatoes rises, households in East Java replace sweet potato intake with potatoes. This discovery is noteworthy due to the significant potential of sweet potatoes in East Java, establishing them as a viable source of carbohydrate nutrition.

**Price of Sago.** The sago plant is a significant carbohydrate-producing species, ranking as an important food source following rice, corn, and tubers. Sago possesses a sufficient quantity of carbs and calories and can effectively replace sago starch in the food business. Sago possesses significant potential to be cultivated as an alternate food source for the Indonesian populace in addition to rice. Indonesia possesses significant potential for sago, encompassing approximately 60 percent of the global sago cultivation area. The sago cultivation area in Indonesia is projected to encompass 1.2 million hectares. The sago plant is highly promising as a starch-producing species. The production of dry sago starch can achieve 25 tons per

hectare per year, but cassava yields merely 1.5 tons per hectare per year, and corn produces only 5.5 tons per hectare per year. The sago palm is located in several locations of Indonesia, such as Riau, Southeast Sulawesi, and West Kalimantan. The research findings indicate that individuals in East Java Province use sago as a staple meal, albeit in limited quantities among the population. The average sago consumption during the period of March to September 2022, as reported by Susenas, is 0.001 kg per week. Nonetheless, the proportion of households consuming sago is merely 0.3%. The results of the data analysis indicate that the price of sago does not influence the demand for potatoes. This is evidenced by the significance level of sago prices above 0.05%. It can be stated that households in East Java have not yet preferred sago as a carbohydrate source.

**Price of gaplek.** Gaplek is a desiccated form of cassava or tapioca that has been peeled and processed by drying. Gaplek is a classic dish characteristic of the Javanese ethnic group [9]. Nonetheless, it is also located in East Java Province. In East Java, 80% of cassava production is sold to provinces beyond East Java, while the remaining 20% is allocated for familial consumption. The field research findings indicate that individuals in East Java Province regularly consume gaplek as a staple dish. The average gaplek consumption for the period of March to September 2022 is indicated to be 1 kilogram per week, according to Susenas. In East Java, just 1% of households partake in the consumption of gaplek. The data analysis indicates that the price of gaplek in East Java does not influence potato consumption. This is evidenced by a significant threshold for gaplek prices exceeding 5%.

**Expenditure or income** is the monetary income generated by a firm from clients via the sale of goods or services. Revenue also indicates the economic condition of a household, and by extension, society. Consequently, every person employed in a certain role, whether within a corporation or otherwise, seeks to augment their professional income to fulfill the requirements of their household. Furthermore, income significantly influences household consumption. As household income rises, the percentage of expenditure allocated to food consumption diminishes. If household income declines, the percentage of expenditure on food increases [7]. As an individual's income increases, so does their expenditure on non-food necessities. The field research findings indicate that income substantially influences potato intake. The significance level of income is 0.000 (1%), accompanied by a positive regression coefficient, indicating that a rise in income correlates with an increase in potato consumption. According to microeconomic theory, potatoes are a more costly and nutritious carbohydrate source than rice; thus, an increase in household income leads to greater consumption of potatoes as a carbohydrate source. This indicates that an increase in income leads to a rise in potato consumption.

**Household size** denotes all individuals who cohabit and share meals within the same household. The quantity of household members substantially influences household food consumption. An rise in household income leads to an increase in household consumption. The increase in household members correlates with a greater diversity of consumed items, contingent upon the distinct preferences of each household member. This results from individual taste variations, which influence consumption growth within a household. The data analysis results indicate that the computed t-value is 1.311, which is less than the tabulated t-value of 1.753, and the significance level is 0.190, which is less than 0.05. Consequently,  $H_0$  is accepted, indicating that the number of household members does not influence the demand for potatoes. In other words, variations in household size do not influence the household's potato intake. This phenomenon can be attributed to East Java's status as one of Indonesia's provinces with comparatively high income levels, ensuring that households continue to consume potatoes regardless of price fluctuations [10].

### 3.3 Environmental and bio-environmental issues related to carbohydrate consumption in East Java

Carbohydrate consumption in East Java is strongly linked to local dietary patterns, which rely heavily on rice, corn, cassava, and increasingly wheat-based products such as noodles and bread. These consumption patterns have important environmental and bio-environmental implications. From an environmental perspective, rice production remains the dominant contributor to carbohydrate supply. However, rice cultivation requires significant water resources, with irrigation systems depending on rivers and reservoirs that are increasingly stressed due to climate change and seasonal variability. The intensive use of chemical fertilizers and pesticides in paddy fields also raises concerns about soil degradation, water pollution, and greenhouse gas emissions, particularly methane from flooded rice paddies.

In the case of corn and cassava, which are important secondary carbohydrate sources, their cultivation can be more resilient to drought compared to rice. However, expansion of corn farming in East Java often leads to land conversion, particularly in upland areas, contributing to deforestation, soil erosion, and loss of biodiversity [43]. Similarly, cassava farming, while requiring fewer inputs, can cause soil nutrient depletion if not managed with proper crop rotation. From a bio-environmental viewpoint, the heavy reliance on rice as the primary carbohydrate source creates nutritional vulnerabilities. Limited dietary diversity may lead to micronutrient deficiencies, particularly among low-income households. In addition, the cultural and economic attachment to rice consumption in East Java reduces the acceptance of alternative carbohydrate sources, despite their potential environmental benefits. Finally, the sustainability of carbohydrate consumption in East Java is influenced by both production and consumption patterns. Environmentally, reducing the ecological footprint of rice farming through water-efficient irrigation, organic fertilizer use, and methane-reducing practices is crucial. Bio-environmentally, promoting dietary diversification by encouraging the consumption of local carbohydrate alternatives such as corn, cassava, sweet potatoes, and sorghum could reduce pressure on rice production while improving nutritional outcomes.

## 4. Conclusion

This research investigates potatoes as a carbohydrate source. The study employs secondary data obtained from the Central Bureau of Statistics (BPS), notably data from the National Socioeconomic Survey (Susenas) conducted between March and September 2022. The research findings suggest that diversifying food sources using potatoes is a crucial initiative to enhance national food security. Potatoes serve as an alternative and readily available source of carbohydrates for the population. Enhanced potato consumption can elevate the nutritional quality of the Indonesian populace. This study aims to examine the factors affecting household potato demand in East Java Province. This study was carried out in East Java Province, utilizing secondary data sourced from the 2022 National Socioeconomic Survey (SUSENAS). The data analysis employs a Multiple Linear Regression Model methodology. The sample size comprises 32,454 households. Potato usage in East Java Province is deemed low, at about 25%, as the populace predominantly relies on rice as their basic cuisine. Furthermore, the cost of potatoes in East Java is comparatively greater than that of rice. The potato demand model is statistically significant ( $F\text{-test } 20,301 > F\text{-tab},75$ , sig 0.000), indicating that the independent variables (rice price, sticky rice price, shelled corn price, wheat flour price, cassava price, sweet potato price, sago price, taro price, potato price, gaplek price, income, and household size) collectively exert a substantial influence on potato demand. The coefficient of determination ( $R^2$ ) is 0.381, indicating that 38.1% of potato demand is elucidated by the prices of rice, sticky rice, shelled corn, wheat flour, cassava,

sweet potato, sago, taro, potato, gaplek, as well as income and household size. The remaining 61.9% is affected by external variables, such as egg costs, chicken meat prices, tofu prices, tempeh prices, and others. The costs of potatoes, rice, shelled corn, cassava, and sweet potatoes influence the demand for potatoes. Nonetheless, the costs of sticky rice, wheat flour, sago, taro, and gaplek do not influence the demand for potatoes. Household income positively affects the demand for potatoes, indicating that an increase in income results in heightened potato demand. The quantity of household members does not influence the demand for potatoes. Rice, cassava, and sweet potato serve as substitutes for potatoes, whilst shelled corn is complementary to them. This study's results confirm that households in East Java utilize potatoes as a carbohydrate source alongside rice, particularly as household incomes rise.

## References

1. F. Retiaty, N. Andarwulan, NS. Palupi, F. Ernawati, R. Kazimierczak, D. Średnicka-Tober, Contribution of Food, Energy, Macronutrients and Fiber Consumption Patterns to Obesity and Other Non-Communicable Disease Risks in the Indonesian Population. *Nutrients*. **17**, 9 (2025). <https://doi.org/10.3390/nu17091459>
2. W. Adzawla, PS. Bindraban, WK. Atakora, O. Camara, Gouzaye A. Economic viability of smallholder agriculture in the Savannah and transitional zones of Ghana: Implications of farm output commercialization and farm diversification. *Sustainability*. **14**,18 (2022). <https://doi.org/10.3390/su141811548>
3. AM. Amr, GH. Anderson, S.Vien, H. Fabek, Potatoes Compared with Rice in Meals with either Animal or Plant Protein Reduce Postprandial Glycemia and Increase Satiety in Healthy Adults: A Randomized Crossover Study. *The Journal of Nutrition*. **154**, 10 (2024). <https://doi.org/10.1016/j.tjnut.2024.08.017>
4. Forgenie D, Khoiriyah N, Mahase-Forgenie M, Adeleye BN. An error-corrected linear approximate almost ideal demand system model for imported meats and seafood in Indonesia. *Heliyon A Cell Press Journal*. **9**, 11 (2023). [https://www.cell.com/heliyon/fulltext/S2405-8440\(23\)08598-5](https://www.cell.com/heliyon/fulltext/S2405-8440(23)08598-5)
5. BH. Baker, MM. Melough, AG. Paquette, ES. Barrett, DB. Day, K. Kannan, et al. Ultra-processed and fast food consumption, exposure to phthalates during pregnancy, and socioeconomic disparities in phthalate exposures. *Environment international*. **183**, 108427 (2024). <https://doi.org/10.1016/j.envint.2024.108427>
6. A. Thomas, Who Would Win from a Multi-rate GST in New Zealand. (Evidence from a QUAIDS Model. 2019).
7. X. Zhang, C. Rao, X. Xiao, F. Hu, M. Goh, Prediction of demand for staple food and feed grain by a novel hybrid fractional discrete multivariate grey model. *Applied Mathematical Modelling*. **125**, 85–107 (2024). <https://doi.org/10.1016/j.apm.2023.09.026>
8. UT. Jayalath, H. Samaraweera, A. Samarasinghe, Development and characterization of gelatin-starch bioplastics: A comparative study of cassava, corn, and rice-based alternatives. *Sustainable Chemistry for the Environment*. **9**, 100190 (2025). <https://doi.org/10.1016/j.scenv.2024.100190>
9. D. Forgenie, N. Khoiriyah, Analyzing Food Import Demand in Indonesia: An ARDL Bounds Testing Approach. *International Journal of Food and Agricultural Economics (IJFAEC)*. **11**, 01 2023. Retrieved from <https://ideas.repec.org/a/ags/ijfaec/330861.html#download>

10. CP. Adekunle, AA. Kutu, DA. Alori, Effects of Food Price Shocks on Dietary Composition of Farm Households' in Nigeria. *Journal of Agricultural Extension*. **24**, 3 (2020). DOI: [10.4314/jae.v24i3.3](https://doi.org/10.4314/jae.v24i3.3)
11. FN. Fitriana, N. Khoiriyah, M. Mahfudz, Tiwul consumption preferences during the Covid-19 pandemic in Nganjuk, East Java, Indonesia. In *Proceeding of 2021 International Conference on Green Agro-industry and Bioeconomy, IOP Conf. Series: Earth and Environmental Science 924* (2021) 012003. doi:[10.1088/1755-1315/924/1/012003](https://doi.org/10.1088/1755-1315/924/1/012003)
12. Z. Aklilu, T. Berihun, S. Zena, A. Alemu, Impact of Potato Commercialization on Producers' Consumption Expenditure. *American Journal of Potato Research*. **102**, 68–83 (2025). DOI:[10.1007/s12230-025-09980-y](https://doi.org/10.1007/s12230-025-09980-y)
13. EJ. Price, EM. Barrett, MJ. Batterham, EJ. Beck, Exploring the reporting, intake, and recommendations of primary food sources of whole grains globally: a scoping review. *British Journal of Nutrition*. 132, 10 (2024). DOI:[10.1017/S0007114524002678](https://doi.org/10.1017/S0007114524002678)
14. R. Anindita, F. Amalina, AA. Sa'diyah, N. Khoiriyah, AW. Muhaimin, Food Demand for Carbohydrate Sources: Linear Approximation-Almost Ideal Demand System/LA-AIDS Approach. *International Journal of Horticulture, Agriculture and Food science(IJHAF)*. **6**, 2 (2022). DOI [10.22161/ijhaf.6.2.3](https://doi.org/10.22161/ijhaf.6.2.3)
15. Satmalee P. Sweet potato: alternative carbohydrate source for the health conscious consumers. *วารสารวิจัย และ พัฒนา ผลิตภัณฑ์ อาหาร*. **54**, 1 (2024). Retrieved from <https://kuojs.lib.ku.ac.th/index.php/JFRPD/article/view/5593>