RICE DEMAND AND LOCAL FOOD SUBSTITUTABILITY: A HOUSEHOLD-LEVEL ANALYSIS IN EAST NUSA TENGGARA, INDONESIA

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ABSTRACT

Price increases reduce demand and welfare. On the other hand, if food sufficiency is low, then the potential for food substitution should be optimized. This study aims to analyze the demand for rice as a staple food for households. The study used secondary data, namely the 2024 SUSENAS. The study sample size was 6,933 households. The demand model approach used a multiple linear regression model. The results showed that the rice demand model in East Nusa Tenggara (NTT) was very significant. The coefficient of determination (R2) is 0.626. The price of rice has a significant effect on the demand for rice (α 0.01). The results of data analysis show that the substitute food for rice in NTT is sweet potatoes, indicated by a positive regression coefficient and sig at α 10%, meaning that if the price of rice increases, the demand for sweet potatoes increases. Or in other words, if the price of rice increases, households in NTT replace rice with sweet potatoes. Complementary foods for rice are wheat, cassava, and potatoes. Socio-demographic variables have a significant effect on the demand for rice with a positive regression coefficient, meaning that if income or the number of household members increases, the demand for rice also increases. The results of this study confirm that households in NTT consume rice as a staple carbohydrate source, and sweet potato can be a substitute for rice. As a policy implication, the importance of food diversification strategies in East Nusa Tenggara is focused on optimizing sweet potato as a buffer stock commodity. The findings on socio-demographic variables imply that local governments need to integrate independent food programs based on sweet potato to prevent excessive dependence on external rice supplies, especially in household segments with a large number of household members.

Keywords: *rice; rice substitute; staple food; carbohydrates; sweet potato.*

INTRODUCTION

Food security is a strategic pillar of Indonesia's national development, particularly in maintaining social and economic stability. As an archipelagic nation with extensive agro-climatic diversity, Indonesia possesses rich potential for local food resources. However, recent decades have shown a trend toward a single commodity, rice, as consumption patterns increasingly focus on rice (Rahayu et al., 2023; Rozi et al., 2023). This high dependence on rice creates systemic vulnerability, particularly when faced with global price fluctuations, supply chain disruptions, and climate change, which impact rice field productivity (Bahri et al., 2025; Jamal et al., 2023; Nagaraj et al., 2024).

East Nusa Tenggara (NTT) Province is one of the most interesting regions to study in the context of food demand dynamics. Geographically and climatologically, NTT is dominated by drylands with a semi-arid climate and low rainfall. These natural characteristics naturally favor the development of non-rice food crops such as corn, sorghum, and tubers. Traditional NTT communities have historically possessed local wisdom in consuming alternative foods as the primary carbohydrate source. However, along with the penetration of national food policies oriented towards rice self-sufficiency from the New Order era to the present, a massive shift in consumption patterns has occurred. The phenomenon of "rice-ization" has changed the structure of household tastes and preferences in NTT, which in turn places rice as a superior commodity and local foods as a secondary choice (Amfo et al., 2023; Cabral et al., 2024; Sumarwati, 2022).

The latest data from the 2024 National Socioeconomic Survey (SUSENAS) suggests that although NTT is not a national rice producer, household rice consumption continues to show a significant upward trend. This poses a serious challenge to regional food security. Dependence on rice supplies from outside the region (such as Java and Sulawesi) makes rice prices in NTT highly sensitive to logistics and inter-island distribution costs. When rice prices spike, low-income households in NTT become the most vulnerable group to food insecurity (Anindita et al., 2022; Khoiriyah et al., 2020). Under these economic pressures, households' ability to substitute food is a key factor in maintaining stable energy and protein consumption (Forgenie et al., 2024; Forgenie, Hutchinson, & Muhammad, 2024; Khoiriyah et al., 2023).

One strong candidate for a local food with the potential to become a counterbalance is sweet potato (Khoiriyah, Forgenie, et al., 2023). Sweet potato has a high adaptability to dryland conditions in NTT and is a commodity familiar to local farming culture. However, the economic position of sweet potato in the household demand structure remains frequently debated. Is sweet potato viewed as an inferior good consumed only in emergencies, or does it truly function as a substitute good responsive to changes in rice prices? The answer to this question is crucial, as the effectiveness of food diversification policies depends heavily on understanding actual consumer behavior at the household level.

In addition to price factors, the dynamics of rice demand in NTT are also significantly influenced by socio-demographic variables (Khoiriyah, Isnaini, et al., 2023; Nendissa et al., 2022; Sa'diyah et al., 2024). Growth in household size and income levels are determinants that directly change the volume of food demand. From a microeconomic perspective, understanding the influence of family size and income on rice demand will provide an overview of the elasticity of food demand in NTT. If rice demand is inelastic to income but highly responsive to family size, then food intervention policies should be directed at social protection for large families and the poor (Angelucci & Attanasio, 2013; Bellemare et al., 2024; De, 2017).

Although extensive research on food demand in Indonesia has been conducted, most studies tend to focus on rice production centers such as Java and Sumatra. A research gap remains regarding how households in dryland island regions like NTT respond to rising rice prices through specific substitution mechanisms for local foods. The use of 2024 SUSENAS microdata provides strong novelty in this study, as it captures a snapshot of community economic behavior post-pandemic and amidst current global food price uncertainty. This study aims to empirically analyze the determinants of rice demand and examine the potential of sweet potatoes as a local food substitute in East Nusa Tenggara Province. The results are expected to provide a theoretical basis for local governments in formulating food diversification strategies that are not merely advisory but based on evidence of real household economic behavior. By strengthening the position of local foods such as sweet potatoes, it is hoped that food self-sufficiency in the semi-arid region of NTT can be achieved sustainably.

METHOD

Data And Data Sources

This study focuses on the demand for rice as a staple food source of carbohydrates in households in Indonesia, including in East Nusa Tenggara Province. The commodities in this study comprise all staple foods, including grains and tubers. Details of all research commodities are presented in Table 1. The potential for rice substitutes is quite large in Indonesia, including in NTT Province, but this potential has not been optimized. This is suspected to be due to the still-low household knowledge of local food potential and also the low consumption preference for grains and tubers.

Table 1. List of staple food commodities and their substitutes

Code	Grain and Tubers Commodities
2	Rice (Local rice, premium rice, imported rice)
4	Fresh corn
5	Shelled corn (Corn kernels or corn rice or titi corn)
6	Wheat flour
9	Cassava
10	Sweet potato
11	Sago
12	Taro
13	Potato

Source: List of commodities based on SUSENAS's questionnaire

The research data is sourced from secondary data collected by the Central Bureau of Statistic (Badan Pusat Statistik), namely the 2024 SUSENAS. The research data consists of household consumption and expenditure data for all staple carbohydrate foods. In addition, socio-demographic data, including income and household size, are also included. The data analyzed, in accordance with the demand model, is commodity price data. This commodity price data is obtained by dividing expenditure by consumption data. The research sample size is 6,933 households. The Susenas data analysis technique begins by transforming the data from long to wide format. The Susenas data used in this study are household consumption and expenditure data, while the data required for analysis is price data. Therefore, food price data is obtained by dividing household expenditure by household consumption. Data analysis used STATA software.

Specification Model: Multiple Linear Regression

The rice demand model in this study uses a multiple linear regression approach, considering that this model can answer the extent to which each

commodity price variable influences rice demand. The results of the data analysis explain the relationship between two goods, regardless of whether they are substitutes or complements(Bazoche et al., 2023; Chen et al., 2024; Rahayu et al., 2023). If the relationship between two goods is positive, they are called substitutes, and if the relationship between two goods is negative, they are called complements. In general, the mathematical demand model is written as follows:

$$Y= \beta o + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + e$$

Note :

Y = Rice demand (Kg)
β_0 = Intercep
$\beta_1 \ldots \beta_{11}$ = Coefficient Regressions or parameter
X_1 = Price of rice (Rp per Kg)
X_2 = Price of fresh corn (Rp/Kg)
X_3 = Price of shelled corn (Rp/Kg)
X_4 = Price of wheat flour (Rp/Kg)
X_5 = Price of cassava (Rp/Kg)
X_6 = Price of sweet potato (Rp/Kg)
X_7 = Price of sago (Rp/Kg)
X_8 = Price of taro (Rp/Kg)
X_9 = Price of potato (Rp/Kg)
X_{10} = Income (IDR per month)
X_{11} = Household size (people)
e = Standart Error

The rice demand model was tested using the F-test. To determine how much of the rice demand model is explained by all research variables, the model was also tested using the coefficient of determination (R2). The coefficient of determination (R2) essentially measures how far the model's ability to explain variations in the dependent variable. A small coefficient of determination means that the ability of the independent variables to explain the dependent variable is very limited. Conversely, if the coefficient of determination value is close to 1 (one) and far from 0 (zero), it means that the independent variables have the ability to provide all the information needed to predict the dependent variable. To analyze the influence of each variable on rice demand, a partial t-test was used. The regression coefficient value indicates the change in demand caused by changes in each variable in the model. Price fluctuations affect consumers'

ability and interest in consuming goods. The sign of the regression coefficient indicates the type of good, with the following conditions: if the regression coefficient is positive, then the relationship between rice and other goods is substitution. In other words, an increase in the price of rice increases the demand for other goods, or the other goods are called substitute goods. Conversely, if the regression coefficient is negative, then the relationship between rice and the goods is complementary, meaning that if the price of rice increases, demand for rice decreases, followed by a decrease in other goods in the model. For the income variable, if the regression coefficient is between 0 and 1, rice is called a normal good. If it is greater than 1, rice is called a red good. Conversely, if the income regression coefficient is less than zero or negative, then rice is called an inferior good.

RESULT AND DISCUSSIONS

Statistic Discriptitve

The price data for each commodity explains the minimum, maximum, mean, and standard deviation food prices. Food prices have a significant impact on household consumption and demand patterns. Food prices influence the level of consumer or household welfare. Food prices can lead consumers to reduce their diet composition, necessitating food diversification. Table 2 describes the descriptive statistical data analysis of all research variables. The minimum rice price in East Nusa Tenggara Province is IDR 13,000 per kg and the maximum price is IDR 25,000 per kg. The average household rice price is IDR 9,723.83 per kg of rice. The minimum price of fresh corn is IDR 1,000 per kg to IDR 18,000 per kg with an average price of IDR 6,330.158 per kg. Thus, it can be concluded that the price of rice, and thus the highest price of fresh corn, is still significantly different from that of rice. East Nusa Tenggara (NTT) is a significant corn-producing province due to its flagship program, the Plant Corn, Harvest Cows (TJPS is Tanam Jagung Panen Sapi, local term), which means corn has significant potential as a staple food substitute for rice. This also aligns with NTT's predominantly dry land characteristics, which are ideal for corn cultivation.

Table 2. Statistic discriptive all variables

Variables	Min	Max	Mean	Std.Dev
Rice prices	13,000	25,000	9,372.8325	1,961.53283
Fresh corn prices	5,000	18,000	6,330.1581	2,678.05316
Shelled corn prices	5,000	24,000	7,636.4062	4,155.62003
Wheat flour prices	5,600	25,000	9,767.3635	2,611.77563
Cassava prices	2,300	16,000	6,315.8086	2,630.58005
Sweet potato prices	3,000	17,000	7,018.4863	2,974.50372
Sago prices	3.667	12,000	7,5547.6250	2,708.80943
Taro prices	2,000	15,000	6,943.7867	2,833.74814
Potato prices	11,111	45,000	20,346.0919	5,879.41239
Income (IDR/month)	288,286	20,959,000	4,191,146	4,032,881
Household size (people)	1	11	3.3782	1.38506

Source: Author's computation, 2025. Prices in IDR per kilogram.

The price of shelled corn ranges from Rp. 5,000 per kg to Rp. 24,000 per kg with an average of Rp. 7,636.406 per kg. The maximum price of shelled corn is almost the same as the maximum price of rice. The maximum price of corn is almost the same as the maximum price of rice, only differing by a thousand Indonesian rupiah, meaning that the price of shelled corn in East Nusa Tenggara is considered too expensive, which is one of the factors that makes NTT households not interested in consuming shelled corn, only 0.9% of people consume shelled corn, in other words, almost no one.

Testing Model and Coefficient of Determination

Before discussing what influences rice demand in NTT and what rice substitute foods are, the rice demand model needs to be tested using the Ftest. The results of the data analysis show that the rice demand model in NTT is very significant, indicated by the Ftest value of 1037.994 and sig at alpha 0.01. This means that rice demand is simultaneously influenced by the price of rice, and all the prices of its substitute foods, as well as socio-demographic variables, namely income and household size. Meanwhile, the results of data analysis on R2 obtained a value of 0.626, meaning that the rice demand model in NTT is explained by the price of rice and all variables in the model by 62.6%, the remaining 37.4% is explained by variables outside the model, for example, the price of complementary food

to rice, namely the price of fish, the price of beef, the price of tofu and tempeh, the price of milk and others.

Factors Affecting Rice Demand

To analyze the influence of each variable on rice demand, the model was tested using a t-test. The results of the t-test data analysis are presented in Table 4. Referring to Table 4, the rice demand model (Y) in NTT Province is as follows:

Y = -390,790 + 0.056 rice price + 0.000 fresh corn price + 0.004 shelled corn price -0.002 wheat flour price -0.003 cassava price + 0.003 sweet potato price -0.002 sago price + 0.000 taro price -0.002 potato price +0.0000344 income + 157.311 household size.

As seen in Table 3, rice prices significantly impact rice demand. This means that price increases significantly impact rice demand. The regression coefficient for rice prices is positive, indicating that price increases increase demand for rice. This contradicts the laws of economics, which dictate that price decrease demand for rice. The findings of the data analysis on the variables affecting traditions demand in NTT are shown in Table 3.

Table 3. Factors affecting the demand for rice

Model	Unstandardized Coefficients (B)	Std.Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	-390.790	0.461		-41.305	.000*
Rice prices	0.056	0.001	0.0581	75.918	.000*
Fresh corn prices	0.000	0.001	0.002	0.222	.824
Shelled corn prices	0.004	0.003	0.010	1.409	.159
Wheat flour prices	-0.002	0.001	-0.022	-2.785	.005*
Cassava prices	-0.003	0.001	-0.020	-2.578	.010*
Sweet potato prices	0.003	0.001	0.013	1.758	.079
Sago prices	-0.002	0.010	-0.002	-0.234	.815
Taro prices	0.000	0.002	0.002	0.271	.786
Potato prices	-0.002	0.000	-0.032	-4.047	.000*
Income	0.0000344	0.000	-0.151	18.122	.000*
Household size	157.311	1.987	0.601	79.171	.000*

Source: Author's computation, 2025. * is high significant

Rice substitute foods in Indonesia according to Susenas data, which is also available in NTT, are presented in Table 2. There are two food groups as carbohydrate sources: the grain group consisting of rice, wet corn, corn kernels, wheat flour, and the tuber group consisting of cassava, sweet potato, sago, taro, and potatoes. The results of the data analysis show that the rice substitute food in NTT is sweet potato, indicated by a positive regression coefficient sign and although significant at the 10% confidence level. This means that increasing rice prices increase demand for sweet potatoes. Or in other words, if there is an increase in rice prices, households in NTT increase sweet potato consumption. Sweet potato is not just an alternative commodity, but the most logical and resilient pillar of food sovereignty to address the fragility of NTT's dependence on rice. Agroclimatologically, sweet potatoes have extraordinary adaptability to the dry land and erratic rainfall characteristics of NTT, making it a far more reliable "defense fortress" than water-hungry rice. The sociocultural argument is also very strong; sweet potato is rooted in local agrarian traditions, so promoting its consumption is not a cultural imposition, but rather an effort to "return home" to appreciate the food heritage of our ancestors. Nutritionally, sweet potato is significantly superior to rice due to its lower glycemic index and high vitamin A (beta-carotene) and fiber content, which are crucial for combating the issues of stunting and malnutrition that remain major challenges in the region. Economically, developing sweet potato as a primary substitute will break NTT's dependence on outside rice supplies, which are vulnerable to price shocks and maritime logistics constraints. By making sweet potatoes a key player on the community's plate, NTT is actually building a more inclusive and independent food system, where local farmers become key actors in fulfilling nutritional needs, not mere spectators amidst the flood of imported rice or shipments from Java. The revitalization of sweet potatoes is a strategic step to shift the food narrative from "fragile dependence" to "deeply rooted independence," while also proving that food diversification does not mean decline, but rather intelligence in adapting to ecological limitations to ensure a healthier and globally competitive future for generations.

The data analysis revealed that the complementary foods to rice are wheat flour, cassava, and potatoes. This is indicated by the negative regression coefficient, meaning that an increase in rice prices reduces demand for wheat flour, cassava, and potatoes. The analysis of Susenas data, which places wheat flour, cassava, and potatoes as complementary

goods to rice in NTT, presents a unique portrait of a consumption structure characterized by "complementarity in diversity" (interdependent consumption). Theoretically, this complementary relationship means that increases in rice consumption tend to be followed by increases in consumption of all three commodities, indicating that NTT residents do not view these foods as substitutes, but rather as part of a unified daily diet. Wheat flour is present as a complement in the form of processed foods or snacks that accompany main dishes made from rice, while cassava and potatoes often function as "accompanying foods" or additional carbohydrate sources on the same plate to increase satiety and vary texture. This phenomenon indicates a shift in culinary culture where people no longer rely on a single type of carbohydrate, but instead create synergy between foods to meet high calorie needs. The presence of these commodities as complements also reflects household food security strategies: when they have access to rice, they also seek to consume other foods to enhance their nutritional value or simply to satisfy their appetites. Therefore, food policy in NTT should not be viewed in isolation from just one commodity, as the interconnectedness of rice with wheat, cassava, and potatoes demonstrates that the price stability and availability of these three goods collectively determine the level of well-being and overall consumption satisfaction of the community.

Data study reveals that household size and wealth have a substantial and favorable impact on rice demand from a sociodemographic perspective. The finding that income and household size have a significant and positive influence on rice demand in NTT reflects a crucial economic-demographic reality. In the context of regional development, these two variables are not merely statistics, but rather a reflection of how the people of NTT strive to maintain their food security amidst limitations.

The positive correlation between income and a coefficient of less than one confirms that rice is an irreplaceable "normal good." Theoretically, a positive income coefficient indicates that rice in NTT is still viewed as a normal good. This means that any increase in purchasing power will directly translate into increased rice consumption. This phenomenon holds profound sociological significance: the people of NTT are still in a food transition phase, where "eating rice" is a symbol of increased social status and improved living standards.

In many developed regions, as incomes rise, households tend to reduce carbohydrate consumption (rice) and shift to protein or superior foods. However, in NTT, rising incomes actually strengthen the position of rice.

This occurs because for low-income households, wage increases or economic incentives are primarily allocated to satisfy a "decent" social need, namely white rice. As long as people still consider rice a measure of prosperity, any economic improvement policy in East Nusa Tenggara will always be followed by a surge in rice demand, which, if not balanced by local production, will widen the regional food deficit.

CONCLUSSION

This study explores rice demand in East Nusa Tenggara Province (NTT) while analyzing the potential substitution of carbohydrate-based staple foods as an alternative effort to strengthen provincial food security. The study aims to analyze the factors influencing rice demand. The research data used secondary data, namely data from the 2024 National Socio-economic Survey (SUSENAS). The research data includes food consumption and expenditure data, food expenditure data, non-food expenditure data, total household expenditure data, and socio-demographic data, namely income and number of household members. The research sample consisted of 6,933 households. Data analysis used a multiple linear regression model approach. The results of the data analysis indicate that the rice demand model is significant with a coefficient of determination of 62.6%. Rice prices are very significant on rice demand. This means that increases in rice prices significantly affect rice demand. The regression coefficient for rice prices is positive, meaning that increases in rice prices increase rice demand. Sweet potatoes are a substitute food for rice in NTT, indicated by a positive regression coefficient sign and although significant at the 10% confidence level. This means that increases in rice prices increase demand for sweet potatoes. In other words, if rice prices increase, households in NTT increase their consumption of sweet potatoes. From a socio-demographic perspective, income and household size significantly and positively influence rice demand. This study highlights the importance of rice as a staple food for households in NTT province. Furthermore, supporting the diversification of sweet potatoes as a rice substitute is crucial for strengthening food security in NTT. The socio-demographic perspective of income and income below one confirms that rice is an irreplaceable "normal good." Therefore, the people of NTT are still in a food transition phase where "eating rice" is seen as a symbol of increased social status and improved living standards.

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