# Impact of rising international rice prices on welfare and poverty in Senegal

**ABSTRACT:**

This paper aims at assessing the impact of rising international rice prices on real household income and poverty in Senegal. Our empirical analysis uses the NBR indicator developed by Deaton (1989) to assess the impact of a change in the international rice price on household welfare. The data come from the second poverty monitoring survey in Senegal (ESPS-II, 2011). To measure poverty, we use two indicators: (i) per capita spending and (ii) expenditure per adult equivalent. The results show that rising international rice prices negatively affect real income and poverty. This negative effect is more pronounced in urban areas and in areas with high rice consumption. Poverty also increases by 3.5% when the first indicator is used. However, it increases by 4.25% when the second indicator is used. To reduce Senegal's vulnerability, governments need to take steps to limit the country's dependence on rice imports. Therefore, it would be essential to invest more in the production and consumption of local rice.

**Keywords: Poverty Analysis, Agricultural Household, Net Benefit Ratio (NBR), Rice, Senegal.**

## 1. INTRODUCTION

Africa is the poorest continent in the world with more than half of its population living on less than $1.9 per day [25]. In Senegal, poverty is a phenomenon that affects about 56.5% of the population with an increase in the number of poor, from 6.3 million in 2011 to 6.8 million in 2016 [2]. On the other hand, in urban areas, one in four people live in poverty, while in rural areas, two in three people live in poverty. The country's situation worsened in the aftermath of the 2007-08 food crisis, which was manifested by a significant increase in international prices for staples such as maize, rice and wheat. For instance, rice prices tripled between November 2007 and May 2008 [12]. This is the main source of food for Senegalese, contributing 30% in terms of calorific inputs from cereals.

In addition, comparing the 27 years (1980-2006) that preceded the crisis with the 4 years (2007-2010) that followed it, there was an increase in international monthly prices of 52% for maize, 87% for rice and 102% for wheat (Minot 2014). This prices escalation has contributed significantly to the increase in poverty in food importing countries [18], [24] and [5]. Several reasons were cited for this price increase: export restraint policies in some emerging countries, the depreciation of the US dollar relative to the euro, and the rise in oil prices[1][1] and [15].

Senegal is also one of the largest consumers of rice in West Africa with a consumption of 90 kg per capita [13]. However, due to its rice cultivation predominantly practiced by small farmers, domestic production capacity (around 30%) remains low to meet national demand. As a result, the country is

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[1] The price of oil rose from US$30 per barrel in 2003 to more than US$140 per barrel in July 2008.

becoming increasingly dependent on food imports including rice [11]. However, as indicated by [10], the transmission of higher international prices to domestic markets in developing countries can have a high impact on farmers as well as low-income consumers. Low-income consumers spend a large part of their income on the consumption of commodities, making them more vulnerable to volatile food prices [18]. Thus, rising rice prices can negatively affect urban households (which are largely consumers) and positively rural households (which are largely producers and sellers of foodstuffs).

Analysis of the effects of rising food prices on welfare depends on the net position of households (net consumers or net producers). In the event of a rise in food prices, the household considered as a net producer wins while the net consumer loses. The issue of the impact of price shocks on household welfare has been the subject of considerable literature. Many studies show that most households are net buyers. For example, [22] shows that 58% of Thai rural households are net purchasers of rice while [21] indicate a rate of 51% in Vietnam. For Ghana, [20] shows that 46% of households are net buyers of maize. In addition, other analyses highlight the impact of rising food prices on the distribution of poverty. Some authors show that a 50% increase in the prices of some food items increases the poverty rate by an average of 2.5% to 4.4% [23]. Similarly, in low-income countries, [17] show that a 10% rise in food prices leads to a 0.4% increase in the incidence of poverty. In addition, [6] use 2006-2013 household survey data to study the dynamics of poverty in the Delta region of the Senegal River. Their results show that when average household income increases by 4.3%, poverty and inequality decrease by 29.5% and 4.2%, respectively.

For some African markets, [20] shows that a 36% increase in rice prices increases poverty at the national level by 0.4%, while an 81% increase in maize prices increases it by 0.6%. The author says that the increase in rice prices has a higher negative effect than maize prices when the same simulation rate is used. A recent study of Burkina Faso shows that rising international rice prices have a negative effect on poverty [4]. The authors indicate that the poverty line in Burkina Faso has increased by about 3%. For Kenya, [19] show that a 25% increase in maize prices leads to an increase in rural poverty by 1% and urban poverty by 0.5%. The authors point out that poor households (rural households without arable land) are more vulnerable than wealthy households (households with 5 hectares). For Ethiopia, [16] show that the recent surge in food prices has led to a 14% decline in urban household consumption. But in Chile, this price surge has led to a 2% increase in poverty [3]. Based on previous work, it can be seen that rising food prices would decrease the well-being of households and increase their level of poverty.

Overall, several studies address the issue of the impact of the increase in the international price of rice, but few focus on the specific case of Senegal. This paper fills this void by assessing the impact of rising international rice prices on the well-being of Senegalese households. The empirical analysis uses the net profit ratio (NBR) indicator developed by [8]. The impact of rising rice prices on well-being and poverty will be estimated by simulating the impact of this increase on each household in the survey. To measure poverty, we use two indicators: (i) per capita spending and (ii) expenditure per adult equivalent. The results show that rising international rice prices negatively affect real income and poverty. This negative effect is more pronounced in urban areas and in areas with high rice consumption. Poverty also increases by 3.5% when the first indicator is used. However, it increases by 4.25% when the second indicator is used. [2]

The objective of this paper is to analyse the impact of rising international rice prices on the well-being of Senegalese households. Specifically, we simulate the impact of rising rice prices on real income and the incidence of poverty in Senegal.

## 2.. METHODOLOGY
## 2.1. Study Area

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[2] We use this indicator because it has the merit of: i) highlighting the difference in impact between households considered to be net sellers and those considered to be net purchasers, ii) measuring the impact of price increases relative to the overall level of household expenditures, iii) enabling the identification of effects before and after the household response to price increases

Senegal is a West African country limited to the North by Mauritania, to the East by Mali and to the South by Guinea and Guinea Bissau. With an area of 196712Km$^2$, the country currently has a population of 14 million people and a Sahelian Sudano climate. The climate is tropical in the south, semi-desert in the north and is characterized by the alternation of a dry season from November to mid-June and a wet and warm season from mid-June to October. The average annual rainfall is 1200 mm south to 300 mm north, with year-over-year variations. Three main rainfall zones corresponding to three climatic zones are thus determined: a forest zone in the south, a savannah with a central tree and a semi-desert zone in the north.

Poverty is a phenomenon that affects about 56.5% of the population with an increase in the number of poor, from 6.3 million in 2011 to 6.8 million in 2016 [2]. Rural households are more affected than urban households. There are significant regional disparities classified into three (03) groups: (i) regions that are highly poor (Kolda, Sédhiou, Kédougou, Tambacounda, Kaffrine, Ziguinchor, Fatick and Kaolack), (ii) medium-poor regions (Diourbel, Matam and Thiès) and (iii) low-poor regions (Dakar, Louga and Saint-Louis) (Map 1).
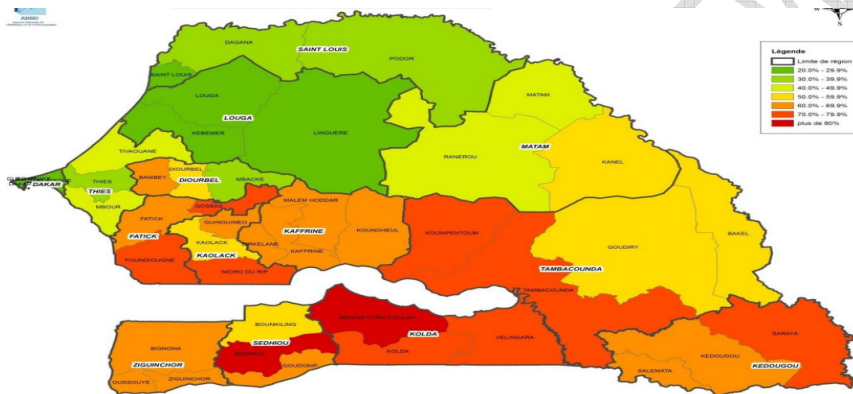


**Map 1:** Map of poverty in Senegal
**Source: ANSD, 2015**

## 2.2. Data
The data come from the second poverty monitoring survey in Senegal (ESPS-II, 2011). The survey is carried out by the National Agency for Statistics and Demography and covers 17891 households in 14 regions of Senegal. This survey has information on the income and consumption expenditure of different households, which allows us to simulate the impact of the increase in the rice price on real income and poverty in Senegal.

## 2.3. Method of Analysis
Food prices escalation not only affects the well-being of households, whether they are producers or consumers. To properly assess the impact of price shocks on households, it is important to know their net position. To do this, we will use the NBR indicator developed by [8] which is defined as the value of net sales of an asset as a percentage of income (total consumption expenditure). For a given asset, the NBR indicator is the difference between the production ratio[3] and the consumption ratio[4]. In other words, this indicator makes it possible to distinguish the net producer from the net consumer of a given property.

### 2.3.1. Assessing the impact of rice price shocks on real income
The concept of a household includes not only consumers but also producers. As a results, the impact of price shocks on households can be seen at two (02) levels - the impact on consumers and the impact on producers.

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[3] Production ratio is equal to the share of income from the production of an asset
[4] Consumption ratio is equal to the budgetary share devoted to consumption of an asset

### 2.3.1.1. Impact on Consumers

Generally, three (03) measures of variation in welfare are used to capture the impact of price shocks on consumers. We have, among other, consumer surplus, compensatory variation, and equivalent variation[5]. But due to the limits of the equivalent variation and the consumer surplus, the compensatory variation is considered to be the most relevant measure of variation in well-being following a price increase. Indeed, this measure enables the income variation to be captured, allowing the consumer to achieve the same level of utility with different price vectors. In addition, it represents the difference between the consumer's expenditure functions assessed respectively at the prices of the final and initial situation, the reference level of usefulness being that of the initial situation. Thus, like [4], we use the concept of compensatory variation to assess the impact of price shocks on consumers. His expression is as follows:[6]

$$CV = e(p_1, u_0) - e(p_0, u_0) \quad (1)$$

Where $CV$ is the compensatory variation, $e(.)$ the expense function, $p$ the price vector, $P_0$ and $P_1$ prices before and after changes, $u$ the utility function. Taylor's second-order expansion of $e(p_1, u_0)$ around $e(p_0, u_0)$ will be used to assess the impact of price changes on household welfare. We have:

$$e(p_1, u_0) = e(p_0, u_0) + \frac{\partial e(p_0, u_0)}{\partial p_0} \Delta p_r + \frac{1}{2} \frac{\partial^2 e(p_0, u_0)}{\partial p_0^2} \Delta p_r^2 \quad (2)$$

We deduce the compensatory variation as follows:

$$CV = \frac{\partial e(p_0, u_0)}{\partial p_0} \Delta p_r + \frac{1}{2} \frac{\partial^2 e(p_0, u_0)}{\partial p_0^2} \Delta p_r^2 \quad (3)$$

Then the expression of the compensatory variation is substantially equal:

$$CV \cong q_r(p_0, x_0) \Delta p_r + \frac{1}{2} \varepsilon_d \frac{q_r(p_0, x_0)}{p_{0r}} \Delta p_r \Delta p_r \quad (4)$$

Where $q_r$ and $p_r$ are respectively the quantity requested and the purchase price of the property, $x_0$ the initial income of the household and $\varepsilon_d$ the price elasticity of the demand. Considering equation (2), when we divide the left and right hand side elements by $x_0$ and multiplying the numerators and denominators of the right hand side element by $p_{0r}$, we get:

$$\frac{CV}{x_0} \cong \frac{p_{0r} q_r(p_0, x_0)}{x_0} \frac{\Delta p_r}{p_{0r}} + \frac{1}{2} \varepsilon_d \frac{p_{0r} q_r(p_0, x_0)}{x_0} \left(\frac{\Delta p_r}{p_{0r}}\right)^2 \quad (5)$$

Equation (3) can be rewritten in reduced form:

$$\frac{CV}{x_0} \cong CR_r \frac{\Delta p_r}{p_{0r}} + \frac{1}{2} \varepsilon_d CR_r \left(\frac{\Delta p_r}{p_{0r}}\right)^2 \quad (6) \text{ with } CR_r = \frac{p_{0r} q_r(p_0, x_0)}{x_0} \quad (7)$$

Where $CR_r$ is the ratio of consumption of the good, that is, the ratio of the budgetary share attributed to consumption of the good over household income (approximated by total consumption expenditure).

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[5] Equivalent variation is the consumer's willingness to pay. It captures the maximum amount that the consumer is willing to pay in the event of a price increase.

[6] The main limitation of the consumer's surplus is that its calculation is based on the implicit assumption of constancy of the marginal usefulness of the currency along the integration path (Deaton and Muellbauer, 1980). Equivalent variation is more complex because of the large number of assumptions it requires. It uses as a reference utility level, the final situation while the compensatory variation uses the initial situation.

### 2.3.1.2. Impact on Producers

The impact of price shocks on the household as a producer is determined from the change in profit such as:

$$\Delta\pi = \pi(p_1, w_0, z_0) - \pi(p_0, w_0, z_0) \quad (8)$$

With $\Delta\pi$ variation, $\pi(.)$ profit function, $p$ a vector of output prices, $p_0$ and $p_1$ prices before and after changes, $w$ a vector of input prices, $z$ a vector of fixed factors. *Using Taylor's second order expansion of $\pi(p_1, w_0, z_0)$ around $\pi(p_0, w_0, z_0)$, we have:*

$$\pi(p_1, w_0, z_0) = \pi(p_0, w_0, z_0) + \frac{\partial\pi(p_0, w_0, z_0)}{\partial p_0}\Delta p_r + \frac{1}{2}\frac{\partial^2\pi(p_1, w_0, z_0)}{\partial p_0^2}\Delta p_r^2 \quad (9)$$

We deduce compensatory variation as follows:

$$\Delta\pi = \frac{\partial\pi(p_0, w_0, z_0)}{\partial p_0}\Delta p_r + \frac{1}{2}\frac{\partial^2\pi(p_1, w_0, z_0)}{\partial p_0^2}\Delta p_r^2 \quad (10)$$

Otherwise:

$$\Delta\pi \cong s_r(p_0, w_0, z_0)p_r + \frac{1}{2}\frac{s_r(p_0, w_0, z_0)}{p_{0r}}\Delta p_r \Delta p_r \quad (11)$$

Where $s_r$ and $p_r$ are respectively the supply and price of the property; $\varepsilon_s$ is the supply elasticity. When dividing the left and right members of equation (7) by the initial household income ($x_0$) and multiplying the numerators and denominators of the right member by $p_{0r}$, we have:

$$\frac{\Delta\pi}{x_0} \cong \frac{p_{0r}s_r(p_0, w_0, z_0)}{x_0}\frac{\Delta p_r}{p_{0r}} + \frac{1}{2}\varepsilon_s\frac{p_{0r}s_r(p_0, w_0, z_0)}{x_0}\left(\frac{\Delta p_r}{p_{0r}}\right)^2 \quad (12)$$

A reduced form of equation is:

$$\frac{\Delta\pi}{x_0} \cong PR_r\frac{\Delta p_r}{p_{0r}} + \frac{1}{2}\varepsilon_s PR_r\left(\frac{\Delta p_r}{p_{0r}}\right)^2 \quad (13) \text{ with } PR_r = \frac{p_{0r}s_r(p_0, w_0, z_0)}{x_0} \quad (14)$$

Where $PR_r$ is the ratio of production of the good, that is, the ratio of income from the production of the good to the household income (total consumption expenses). From the combination of equations (4) and (9), we have:

$$\frac{\Delta w^2}{x_0} \cong \frac{\Delta p_r^p}{p_{0r}^p}PR_r + \frac{1}{2}\left(\frac{\Delta p_r^p}{p_{0r}^p}\right)^2 PR_r\varepsilon_s - \frac{\Delta p_r^c}{p_{0r}^c}CR_r - \frac{1}{2}\left(\frac{\Delta p_r^c}{p_{0r}^c}\right)^2 CR_r\varepsilon_d \quad (15)$$

Where $\Delta w^2$ is the second-order approximation of the effect of net welfare of price shocks on the household, $p^c$ and $p^p$ are respectively the consumer price and the producer price. Equation (11) takes into account the response of consumers and producers after price change and is considered the long term effect. The impact of price shocks on household welfare is short-term, when supply and demand elasticities are equal to zero (0).

$$\frac{\Delta w^1}{x_0} \cong \frac{\Delta p_r^p}{p_{0r}^p}PR_r - \frac{\Delta p_r^c}{p_{0r}^c}CR_r \quad (16)$$

where $\Delta w^1$ is the first order approximation of the net impact of price changes on household welfare.

Two methodological problems emerged: (i) the existence of the relationship between producer price and consumer price and (ii) the use of the price elasticity of supply and the price elasticity of demand. Due to the difficulty in obtaining producer price data, particularly in sub-Saharan Africa, several studies have assumed that consumer price and producer price increase by the same proportion, i.e., the

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producer's profit margin is a consistent proportion of the consumer price [7]. Regarding the problem of price elasticities of supply and demand, several studies make the assumption that consumers and producers do not respond to the increase in prices, that is to say that the elasticities take the value of zero. This assumption may be accepted in the short term but not in the long term. In the long term, households (producers and consumers) are able to respond to rising prices. For example, we have two assumptions in this paper: (1) in the short term, supply and demand elasticities are zero and (2) in the long term, elasticities are not zero, which corresponds to the context of the countries of sub-Saharan Africa. We assume that demand elasticities vary between -0,20 and -0,40 and supply elasticities vary between 0,20 and 0,40. Then, from a law of uniform probability, we draw the averages of supply and demand elasticity as an element of analysis.

To estimate the impact of price shocks, four (04) simulations were conducted, with the same percentage increase in producer and consumer prices (15%) and households not responding to price increases (*Simulation 1*); the percentage increase in producer price is 30% and the increase in consumer price is 15% and households do not respond to the increase in prices (*Simulation 2*); the percentage increase in producer and consumer prices is the same (15%) and households are responding to price increases (demand elasticity ranging from -0.20 to -0.40 and supply elasticity from 0.20 to 0.40) (*Simulation 3*) and the percentage increase in producer price is 30% and consumer price is 15% and households are responding to price increases (demand elasticity ranging from -0.20 to -0.40 and supply elasticity from 0.20 to 0.40) (*Simulation 4*).

### 2.3.2. Assessing the impact of rice price shocks on poverty

To assess the impact of price shocks on poverty in Senegal, we consider the above simulations and household characteristics. Our basic relationship is as follows:

$$x_{i1} = x_{i0} + \Delta\pi - CV \quad (17)$$

Where $x_{i1}$ are the consumption expenditure of the household i after the price rise, $x_{i0}$ consumption expenditure of the household i before the rise, $\Delta\pi$ and $CV$ are respectively the function of the change in profit and the compensatory function defined above. When we replace $\Delta\pi$ and $CV$ by their expressions in equation (17), we have:

$$x_{i1} = x_{i0} + s_r(p_0, w_0, z_0)p_r + \frac{1}{2}\varepsilon_s \frac{s_r(p_0, w_0, z_0)}{p_{0r}}(\Delta p_r)^2 - \left[ q_r(p_0, x_0)\Delta p_r + \frac{1}{2}\varepsilon_d \frac{q_r(p_0, x_0)}{p_{0r}}(\Delta p_r)^2 \right] \quad (18)$$

To assess the impact of price shocks on Senegalese household poverty, we will use the poverty measures defined by [14] as follows:

$$P_\alpha = \frac{1}{N} \sum_n^1 \left[ \frac{\bar{x} - x_i}{\bar{x}} \right]^\alpha \quad (19)$$

Where $P_\alpha$ is the measure of poverty, N the total number of households, $\bar{x}$ is the poverty line, $x_i$ represents the consumption expenditure of the poor household **i** of the equation (14).

- For $\alpha = 0$, we have $P_0$ that represents the incidence of poverty. This is the proportion of households with spending levels below the poverty line. It covers only the number of poor but does not take into account the severity of their poverty.
- We have $\alpha = 1$ we have $P_1$ that represents the poverty gap, which is the incidence of poverty multiplied by the average distance between the poverty line and the level of spending of the poor household, expressed as a percentage of the poverty line. This measure also does not take into account the severity of poverty, but it is able to determine the amount of resources needed

to eliminate poverty if it was possible to identify each poor and bring their spending level back to the poverty line.

- Finally, for $\alpha = 2$ we have $P_2$ which is the square of the poverty gap. This measure of poverty takes into account inequalities between the poor and focuses on the poorest.

Our task will be to compare levels of poverty before and after shocks. But the choice of the variable of interest to be used to determine the poverty indicator is tedious. The variables frequently used in the empirical poverty literature are total household consumption, per capita consumption and equivalent per adult consumption. Due to criticisms[7] of total household consumption, we use two types of indicators in this paper: per capita consumption and consumption per adult equivalent.

## 3. RESULTS AND DISCUSSION

### 3.1. Descriptive Statistics

Table 1 below shows that rice consumption in Senegal varies by income category (from the poorest to the richest). The richest households consume more rice than the poorest households. Rice is therefore a cereal heavily consumed by the rich class in Senegal. Indeed, the poorest are about 7% of those who consume rice, while the richest are around 37%. The other income categories are around 56%.

**Table 1: Share of rice consumers by income category**

| Class of income | Share of rice consumers (%) |
|---|---|
| 1st quintile (20% poorest) | 6,6 |
| 2 | 13,0 |
| 3 | 18,4 |
| 4 | 24,6 |
| 5th quintile (20% richer) | 37,4 |

**Source**: Calculated from household survey data in Senegal (ESPS-II, 2011)

Table 2 below shows the percentages of rice consumption expenditure in relation to total consumption expenditure by income category and region. An analysis by income category shows that the richest households allocate more resources to rice consumption than the poorest households. For example, in urban areas the richest affect 36.4% of rice consumption, while the poorest affect only 6.3%. In rural areas, the richest spend 37.7% of their income on rice, while the poorest spend only 6.8%. The consumption of rice in Senegal is more attributed to the rich class. An analysis by area of residence shows that households living in urban areas spend on average more on rice (25.0%) than households living in rural areas (24.4%).

**Table 2: Budgetary shares of rice consumption by income category and region**

| Class of income | Share of rice consumption in total expenditure (%) | |
|---|---|---|
| | Urban areas | Rural areas |
| 1st quintile (20% poorest) | 6,3 | 6,8 |
| 2 | 13,4 | 12,9 |
| 3 | 18,7 | 18,2 |
| 4 | 25,0 | 24,4 |
| 5th quintile (20% richer) | 36,4 | 37,7 |

**Source**: Calculated from household survey data in Senegal (ESPS-II, 2011)

Figure 1 below provides the proportion of Senegalese households living below the poverty line in 2011. Analysis of the figure shows that poverty affects more than half the population of the regions of Fatick, Kolda, Louga and Tambacounda. On the other hand, poverty affects about a quarter (1/4) of

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[7] The use of total household consumption does not take into account the size of households and this will tend to overestimate the well-being of individuals living in large households.

the population of the Dakar and Saint Louis regions. From the figure, it stand out that rural households are more affected than urban households.

**Figure 1: Households living below the poverty line in 2011**
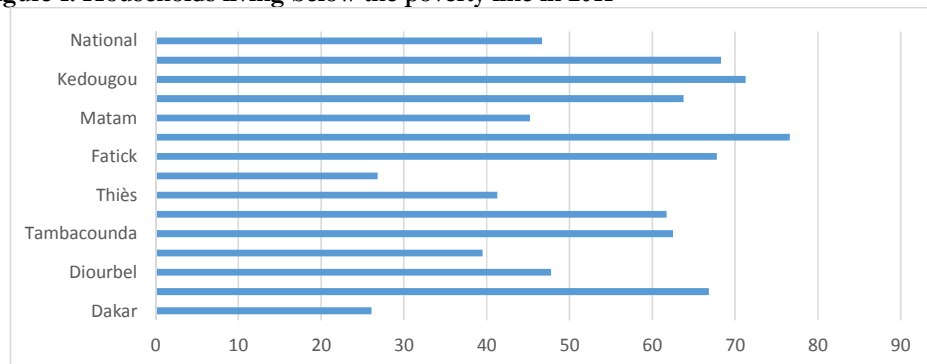


**Source**: Built from household survey data in Senegal (ESPS-II, 2011)

Table 3 shows the indices of poverty by area of residence and by region.

**Table** 3: Evolution of household poverty by residential setting and region

| Class of Households | Index of poverty | | | Contribution to poverty |
|---|---|---|---|---|
| | **P0** | **P1** | **P2** | |
| National level | 46,7 | 14,5 | 6,6 | 100 |
| **Area of residence** | | | | |
| urban areas | 30,8 | 8,5 | 3,5 | 13,3 |
| Rural environment | 55,6 | 18,8 | 8,9 | 70,1 |
| **Regions** | | | | |
| Dakar | 26,1 | 4,7 | 2,1 | |
| Ziguinchor | 66,8 | 19,7 | 13,5 | |
| Diourbel | 47,8 | 10,2 | 5,1 | |
| Saint-Louis | 39,5 | 11,8 | 4,9 | |
| Tambacounda | 62,5 | 21,7 | 9,9 | |
| Kaolack | 61,7 | 18,5 | 8,1 | |
| Thiès | 41,3 | 9,5 | 4,3 | |
| Louga | 26,8 | 5,6 | 2,1 | |
| Fatick | 67,8 | 18,73 | 9,5 | |
| Kolda | 76,6 | 29,5 | 20,8 | |
| Matam | 45,2 | 11,1 | 6,4 | |
| Kaffrine | 63,8 | 17,21 | 10,5 | |
| Kédougou | 71,3 | 21,42 | 14,1 | |
| Sédhiou | 68,3 | 19,5 | 11 | |

**Source**: Calculated from household survey data in Senegal (ESPS-II, 2011)

A regional analysis shows that there are significant disparities between regions. Analysis of the table shows that 46.7% of households in Senegal live below the poverty line. Disparities at regional level can be classified into three (03) groups. The first group is made up of regions with very high poverty (more than 60%). The regions are Kolda, Sédhiou, Kédougou, Tambacounda, Kaffrine, Ziguinchor, Fatick and Kaolack. The second group consists of regions where the incidence of poverty varies between 40 and 60%. They are Diourbel, Matam and Thiès. The third group includes regions where the incidence of poverty is below the national average (less than 40%). These are the regions of Dakar,

Louga and Saint Louis. As far as the Dakar is concerned, it is the least poor in Senegal because of the development advantages it enjoys as the country's historical and economic capital.

### 3.2. Impact of rising rice prices on household welfare

The impact on household welfare will be on twofold. First, we assess the impact of rising rice prices on the real income of Senegalese households and, second, we measure their impact on the incidence of household poverty.

### 3.2.1. Impact on Real Household Income

Table 4 below displays the net benefit ratio (NBR) values as well as the different simulations of the impact of rising rice prices on real income of Senegalese households. The first two simulations (1 and 2) assess the short-term impact and the last two simulations (3 and 4) assess the long-term impact. Equations (11) and (12) will be used for simulations. Analysis of net benefit ratio (NBR) values shows that Senegalese households are net importers of rice. At national level, this ratio has a negative value of (-4,7). In urban areas, the value of the NBR ratio is (-5.2), so it can be concluded that urban households are net purchasers of rice because the value of the ratio is negative. This result confirms the assumption that rice is more consumed in urban areas of Senegal. The ratio in rural areas (-3.05) is lower in absolute terms than in urban areas (-5.2), so rural households are also net purchasers of rice but are less consumer than urban households. Analysis of the short-term and long-term simulations show that the increase in the international rice price negatively affects the well-being of Senegalese households. This negative effect is more pronounced in urban areas than in rural areas. Indeed, since Senegalese households are net consumers, they are subject to the rise in the international rice price. These results confirm those of [20], [18], [4], [10] and [5] for whom the rise in food prices negatively affects the well-being of households in developing countries.

**Table 4: Impact of rising rice prices on real income**

| Class of Households | NBR initial | Impact of the Short Term | | Impact of Long Term | |
|---|---|---|---|---|---|
| | | Simulation 1 | Simulation 2 | Simulation 3 | Simulation 4 |
| National level | -4,7 | -0,51 | -0,49 | -0,49 | -0,49 |
| **Area of residence** | | | | | |
| Urban Areas | -5,2 | -0,67 | -0,63 | -0,62 | -0,6 |
| Rural environment | -3,05 | -0,48 | -0,44 | -0,4 | -0,36 |
| **Regions** | | | | | |
| Dakar | -5,21 | -0,62 | -0,59 | -0,55 | -0,55 |
| Ziguinchor | -2,5 | -0,33 | -0,31 | -0,29 | -0,28 |
| Diourbel | -2,72 | -0,36 | -0,35 | -0,33 | -0,3 |
| Saint Louis | -5,36 | -0,52 | -0,5 | -0,45 | -0,44 |
| Tambacounda | -3,88 | -0,57 | -0,56 | -0,52 | -0,51 |
| Kaolack | -2,77 | -0,44 | -0,41 | -0,39 | -0,35 |
| Thiès | -4,44 | -0,52 | -0,49 | -0,49 | -0,49 |
| Louga | -5,09 | -0,61 | -0,55 | -0,45 | -0,38 |
| Fatick | -2,97 | -0,51 | -0,39 | -0,35 | -0,29 |
| Kolda | -4,13 | -0,38 | -0,33 | -0,30 | -0,30 |
| Matam | -4,07 | -0,32 | -0,31 | -0,29 | -0,27 |
| Kaffrine | -3,34 | -0,28 | -0,25 | -0,23 | -0,21 |
| Kédougou | -4,57 | 0,50 | -0,48 | -0,4 | -0,4 |
| Sédhiou | -3,46 | -0,31 | -0,29 | -0,22 | -0,18 |

**Source**: Simulations calculated from household survey data in Senegal (ESPS-II, 2011)

### 3.2.2. Impact of rising rice prices on poverty

To capture the impact of rising rice prices on poverty indices (Incidence of Poverty (P0), depth of poverty (P1) and severity of poverty (P2)), we use equations (14) and (15). Our various simulations will be based essentially on the incidence of poverty. It will then be a question of assessing the impact of the increase in rice prices on the incidence of poverty in Senegal. This is done by adjusting the real income of each household and then assessing the share of households with an income below the poverty line. Table 5 below presents the results of the rise in rice prices on the incidence of poverty, taking into account consumption per capita expenditure as a measure of poverty. The analysis of this table shows that, on average in Senegal, the increase in rice price causes an increase in the poverty rate of about 3.50%. This increase is greater in urban areas than in rural areas. This result is consistent with that of [4] but contrary to the work of [19] then [16]. According to the various simulations, in the short term or in the long term, the poverty rate is increasing throughout Senegal, varying between 2.04 and 3.97%.

**Table 5: Impact of rising rice prices on poverty: *Expenditure per capita***

| Class of Households | Initial poverty rate | Impact of the Short Term | | Impact of Long Term | |
|---|---|---|---|---|---|
| | | Simulation 1 | Simulation 2 | Simulation 3 | Simulation 4 |
| National level | 46,7 | 3,61 | 3,36 | 3,64 | 3,25 |
| **Area of residence** | | | | | |
| Urban areas | 30,8 | 3,97 | 3,63 | 3,45 | 3,88 |
| Rural environment | 55,6 | 2,05 | 2,04 | 3,01 | 2,25 |
| **Regions** | | | | | |
| Dakar | 26,1 | 4,02 | 4,0 | 3,78 | 3,77 |
| Ziguinchor | 66,8 | 3,13 | 2,89 | 3,5 | 3,14 |
| Diourbel | 47,8 | 2,45 | 2,86 | 2,55 | 2,32 |
| Saint Louis | 39,5 | 3,55 | 3,48 | 3,85 | 3,77 |
| Tambacounda | 62,5 | 3,08 | 3,05 | 3,12 | 3,09 |
| Kaolack | 61,7 | 2,75 | 2,68 | 2,77 | 2,86 |
| Thiès | 41,3 | 3,12 | 3,08 | 3,22 | 3,15 |
| Louga | 26,8 | 3,22 | 2,98 | 3,29 | 3,33 |
| Fatick | 67,8 | 3,15 | 3,19 | 3,05 | 3,07 |
| Kolda | 76,6 | 2,96 | 2,92 | 2,52 | 2,44 |
| Matam | 45,2 | 3,30 | 3,28 | 3,25 | 3,18 |
| Kaffrine | 63,8 | 3,21 | 3,17 | 3,10 | 3,05 |
| Kédougou | 71,3 | 3,22 | 3,20 | 3,21 | 3,05 |
| Sédhiou | 68,3 | 3,18 | 3,22 | 3,21 | 3,19 |

**Source**: Simulations computed from household survey data in Senegal (ESPS-II, 2011)

Table 6 below presents the results of the increase in rice prices on the incidence of poverty, taking into account consumption expenditure per adult equivalent as a measure of poverty. The results of this table are more alarming in terms of increasing poverty than in the previous table. Whatever the time periods (short term and long term), the impact of rising rice prices on poverty is very high. Poverty is more prevalent in urban areas than in rural areas. The rate of increase in poverty is around 4.25% at national level and 5% in urban areas. In rural areas, rising rice prices cause poverty to increase by about 3%. These results confirm those of [23] and [4] for whom rising food prices increase poverty in developing countries. On the other hand, our results infirm those of [16] which show that rural poverty is higher than urban poverty

**Table 6: Impact of rising rice prices on poverty: *Expenditure per adult equivalent***

| Class of Households | Initial poverty rate | Impact of the Short Term | | Impact of Long Term | |
|---|---|---|---|---|---|
| | | Simulation 1 | Simulation 2 | Simulation 3 | Simulation 4 |
| National level | 38,7 | 4,35 | 4,29 | 4,26 | 4,23 |

| Area of residence | | | | | |
|---|---|---|---|---|---|
| Urban Areas | 27,8 | 5,28 | 5,15 | 5,66 | 5,47 |
| Rural environment | 35,2 | 2,75 | 2,70 | 2,55 | 2,48 |
| **Regions** | | | | | |
| Dakar | 23,1 | 4,33 | 4,12 | 4,25 | 4,10 |
| Ziguinchor | 48,2 | 5,12 | 5,09 | 4,89 | 4,55 |
| Diourbel | 39,8 | 4,11 | 4,1 | 4,03 | 4,01 |
| Saint Louis | 28,3 | 4,52 | 4,4 | 4,35 | 4,31 |
| Tambacounda | 52,1 | 3,75 | 3,66 | 3,22 | 3,21 |
| Kaolack | 53,23 | 3,44 | 3,41 | 3,39 | 3,35 |
| Thiès | 41,3 | 4,22 | 4,2 | 4,19 | 4,12 |
| Louga | 23,3 | 4,61 | 4,55 | 4,45 | 4,32 |
| Fatick | 58,5 | 2,51 | 2,39 | 2,35 | 2,29 |
| Kolda | 67,6 | 3,78 | 3,72 | 3,69 | 3,68 |
| Matam | 34,2 | 4,32 | 4,31 | 4,29 | 4,27 |
| Kaffrine | 48,8 | 3,81 | 3,55 | 3,5 | 3,5 |
| Kédougou | 71,3 | 4,50 | 3,28 | 3,27 | 3,25 |
| Sédhiou | 57,01 | 4,61 | 4,22 | 4,2 | 4,12 |

**Source**: Simulations computed from household survey data in Senegal (ESPS-II, 2011)

## 4. CONCLUSION

This paper aims at assessing the impact of rising international rice prices on real household income and poverty in Senegal. To measure poverty, we use two indicators: (i) per capita spending and (ii) expenditure per adult equivalent. The results show that rising international rice prices negatively affect real income and poverty. This negative effect is more pronounced in urban areas and in areas with high rice consumption. Poverty also increases by 3.5% when the first indicator is used. However, it increases by 4.25% when the second indicator is used. To reduce Senegal's vulnerability, governments need to take steps to limit the country's dependence on rice imports. Therefore, it would be key to investing more in the production and consumption of local rice.

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