

## Analyze of Domestic Price Incentives for Rice Production in MALI

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### Abstract

In Mali, rice is the subject of particular attention in terms of public policies. The authorities encourage its production to provide income for producers, for domestic consumption and for a net exporting country. However, local rice remains highly competitive with imported rice. In addition, food insecurity across the country is a major developmental issue that threatens health, productivity and often the survival of the population. This study helps overcome developmental problems due to food insecurity, which necessarily begins with an accurate assessment of the factors that influence the production of staple foods, namely rice. Therefore, the main aim of this study is to analyze the factors influencing rice production in the country and to examine more closely the relationship between rice production and rice sold on the domestic market. The study used a linear logarithmic model with the amount of rice produced as a dependent variable and the price of domestic rice, imported rice, and rice import price. The results show that domestic rice is more expensive than imported rice per ton, supporting the argument that rice imports undermine domestic rice production as a viable income-generating activity. The self-sufficiency rate is 93%, with strong imports from Asia, especially from Thailand, and hardly any exports. However, in order to control price and still increase rice production, the government should be able to purchase the rice from the farmers and then sell them to private retailers to put projects in place for reduce barriers to the transmission of prices between international and domestic prices along the marketing routes: Development of the road network (feeder roads) markets and reduction of illegal controls, in particular.

**Keywords:** Rice production; Domestic prices for rice; Food security; Incentives; MALI.

### 1. Introduction

Rice is a grain of Poaceae (herbaceous herbs) cultivated in tropical, subtropical and temperate regions of its starchy fruit or caryopsis. It refers to all the plants of the genus *Oryza*, among which the only two cultigenous species, which are cultivated most often in fields more or less flooded called rice paddy: *Oryza sativa* (commonly known as "Asian rice") and *Oryza glaberrima* (commonly referred to as "West African rice" or "Casamance rice") In common parlance, the term rice most often refers to its grains, which are a fundamental element of the diet of many populations in the world, particularly in South America, Africa and Asia<sup>1</sup>.

Rice is considered a strategic product in Mali; it is therefore the object of particular attention in terms of public policies and political issues. Rice is seen as the main commodity for achieving food security, improving farmers' incomes, and meeting growing urban demand at a reasonable price.

According to the (FAO 2000, J. O. Saka 2009), cultivation was the main food source, with more than 50% of the world's population relying on about 80% of the food needs. Due to the growing importance of the harvest and growing food security problems, annual rice production is expected to rise from 586 million tons in 2001 to a projected world demand of approximately 756 million tons by 2030 (FAO 2002, Kueneman 2006). The recent global trend in the rice sector is an indication of the growing demand for imports of this product in Africa, as global supply pressure and the steady growth in food prices over the past five years have shown in recent years (FAO 2017). Africa has become a huge player on the international rice markets, accounting for 32% of global imports in 2006, a record of 9 million tons this year (Rice 2008, Bola Amoke Awotide 2011). The emergence of Africa as the main rice importer is due to the fact that rice has become the fastest growing food source in sub-Saharan Africa over the last decade (Sohl 2005), due to the population growth (4%), income growth and changes in consumer preferences for rice, especially in urban areas (V Balasubramanian 2007, Bola Amoke Awotide 2011). Despite the fact that rice is a small crop for small and medium farmers in East and South Africa, it is a natural crop in West Africa, where most of the mainland rice is produced (Bola Amoke Awotide 2011). According to OSIRIZ<sup>2</sup> (CIRAD International Rice Statistics Observatory), about 9 million hectares of rice were cultivated in Africa in 2006 and by production, which exceeded 20 million tons for the first time, is expected to increase by 7% per year in the future. In West Africa, where the rice sector is the largest in sub-Saharan Africa,

<sup>1</sup> [wikipedia.org/wiki/Rice](http://wikipedia.org/wiki/Rice)

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the situation is particularly important. Despite rising world rice and rice prices, rice consumption is growing at an annual rate of 8%, exceeding the growth rate of domestic rice production by 6% per year. The gap in production and consumption in this region is being filled by imports worth more than \$ 1.4 billion a year (Eklou A. Somado 2008). The share of imports in consumption increased from an average of 43% between 1991 and 2000 to an average of 57% over the period 2002-2004 (Center 2005, Alhaji M. H. Conteh 2013).

The United Nations Food and Agriculture Organization (FAO) estimated in 2006 that rice imports in sub-regions of West and Central Africa have reached more than \$ 6 million a year (FAO 2006). The cost of importing rice is therefore still a major burden on the trade balance of the region.

Rice, a cereal plant, has been harvested, eaten and grown by many people around the world for more than 10,000 years (Onyango 2014). The total rice area is estimated at 150 million hectares, with an average annual production of 500 million tons. This represents 29% of the world's total grain production (Conteh, Yan et al. 2012, Onyango 2014). In 2004, more than half of the world's rice population was the main source of daily calories and protein, consuming 100 to 200 kilograms of rice each year. On the other hand, the green revolution of the 1960s / 70s saved the world from disaster due to food shortages. It is the drastic increase in rice production that has responded to the desperate nutritional needs of the growing population of the world (WILFRED 2006). Today, more than two billion people in Asia make up 80% of their calorie intake from rice. According to the projected population growth (WILFRED 2006), the number of people living on rice in the world in 2025 will reach 3.5 billion people (WILFRED 2006). The importance of harvesting for food security and socio-economic stability is therefore self-evident.

West Africa is structurally a deficient region in rice. On average, rice production covers 60% of the consumption in the region. Countries such as Senegal, Ghana, Benin and Côte d'Ivoire have a self-sufficiency rate of less than 40% (OECD 2011). In addition, the self-sufficiency rate in Mali, Guinea, Nigeria and Sierra Leone is over 60% (Ismaël FOFANA 2015, Erika Styger 2018).

Rice has been produced in Mali for centuries. The strong endowment of the country in natural resources, mainly its availability of water, seems to justify the position of the Malian authorities who assure that Mali has a relative comparative advantage in rice production, compared to regional and international competitors.

Mali is by far a country of the sub region that has the most soil / water resources for irrigation in the sub region (Moris 1987). With nearly 2,200,000 hectares of arable land, including more than 1,800,000 hectares in the Niger River Valley alone (Ministere 2016), Mali can be considered as the potential breadbasket capable of providing the quantity of cereals needed for all West Africa. However, in the normal year, Mali produces only about 2 000 000 tons of cereals, combined with rainfed and irrigated crops.

The Malian economy is essentially based on the agricultural sector. It employs nearly 75% of the labor force, contributes 44% of GDP formation, provides 30% of export earnings and employs 83.4% of the active population in 2010 (Zaslavsky 2005). The sole production of rice generates 5% of the country's GDP and thus represents about 1/9 of the agricultural sector, or about CFAF 220 billion per year (2012-2017 28 DECEMBRE 2011).

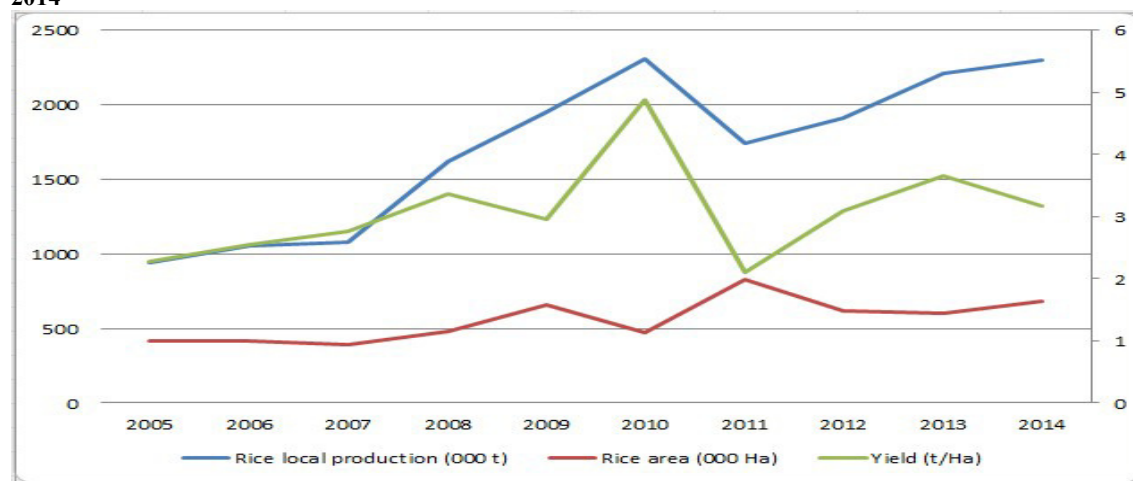
Annual rice production in Mali has increased from less than 20,000 tons in the early 1980s to nearly 1 million tons in the early 2000s and more than 2.5 million tons from 2010 (Commission SEPTEMBER 2017). Nevertheless, despite increasing production, Mali still has to rely on imports, mainly from Asia (India, Thailand, Vietnam, Pakistan and China), to satisfy the rice needs of its population. Agricultural techniques used in rice production range from traditional rice cultivation to irrigated rice cultivation under full control (Frédéric Lançon 2007, Lançon 2009).

The increase in production has not by far fulfilled the political objective of making the country a net exporter of rice. The increase in production has not, by far, fulfilled the political objective to make the country a net exporter of rice. (Lançon 2009) indicates that the need for large imports is fundamentally linked to a change in dietary habits rather than a decline in production, with consumption growing at a higher rate than production.

Rice production has actually increased significantly and continuously from 2008 to 2010, before stopping in 2011 and 2012 (Figure 1).

During the analysis period, domestic production reached its peak in 2010/11 with more than 2 million tons produced although there is a decrease in area under cultivation. This situation can be explained in particular by the improvement in the yield level during this season due to favorable weather conditions. Like all cereal production, rice production fell in 2011 due to poor rainfall, leading to lower yields. Although the 2012/13 cropping season took place in conditions of political and institutional crisis, production was supported by the State and technical partners, which allowed for a continuation of input subsidy programs and a slight increase in volume produced.

**Figure1. Changes in area (ha), production (tons) and yields (tons / ha) (right axis) of rice in Mali, 2005 to 2014**



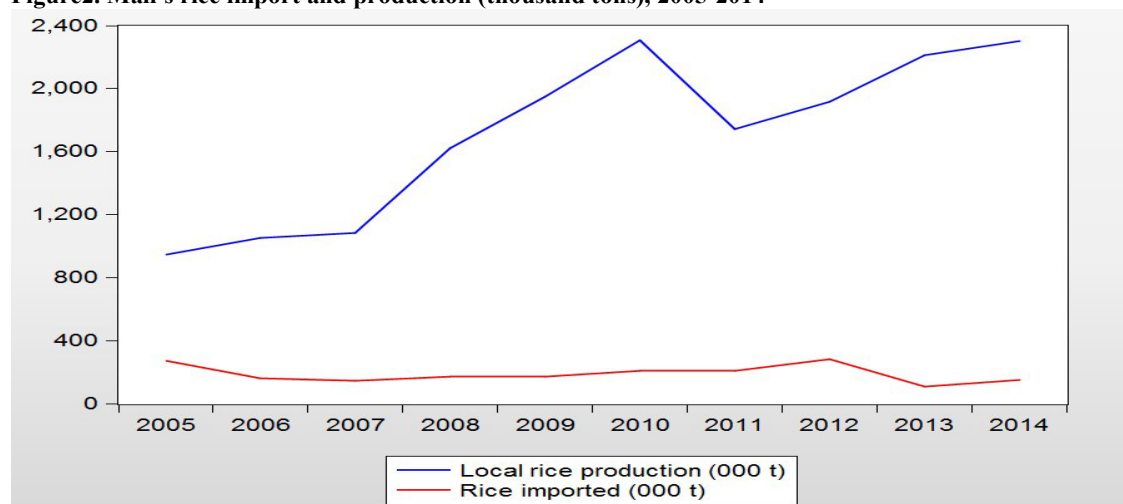
**Source: Author's computation, 2018**

Although production increased during the period, this was not enough to cover growing demand, with the self-sufficiency ratio averaging 86 percent between 2005 and 2014 (FAO 2014, Martin K. van Ittersum 2016).

Rice imports into Mali are highly politicized, as already noted above, and can be characterized as a monopolistic situation with only two or three large importers accounting for at least two-thirds of total imports each year (Pierre BARIS 2005). The conditions for competitive markets are far from fulfilled, which has implications in terms of trade margins and price transmission along the value chain.

Rice is the main grain imported into Mali; it is followed by wheat and wheat flour. The average rice import for Mali in 2005 and 2014 is 188,200 tons per year (Figure 2).

**Figure2. Mali's rice import and production (thousand tons), 2005-2014**



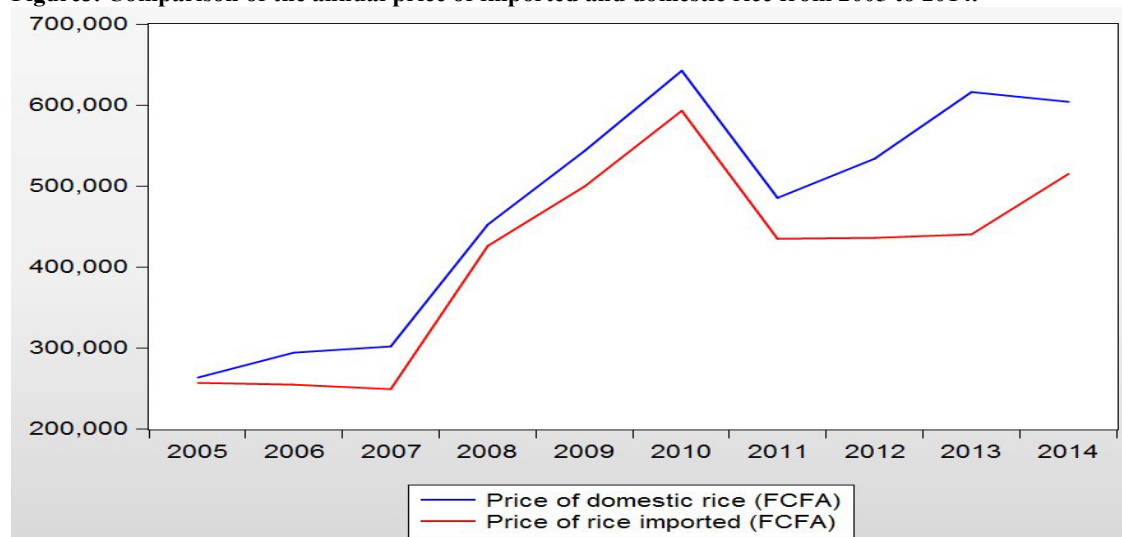
**Source: Author's computation, 2018**

Most of the imported rice comes from Asia (76 percent of the total). Burma, India, Thailand and Pakistan are the main sources of rice imports in Mali at 25 percent, 15 percent, 14 percent and 13 percent respectively. Data from (INSTAT 2014) indicate that, on average, Mali spends more than 26 billion FCFA per year on rice imports. Asian countries account for 75 percent of the value of imports against 25 percent for other continents. The finding is that as of 2007, rice imports have continued to increase with an average growth rate of 12 percent per year between 2007 and 2012, despite the increase in domestic production subsequent to government efforts to develop the industry. The import duty exemptions granted to rice importers have certainly played a key role in this development. This policy was adopted in 2008 to address the international food price crisis and in 2011 to respond to the national food crisis due to poor harvests that year.

Average prices of imported rice remained relatively lower at the country level compared to locally produced rice. These reasons can be explained by the high production costs of locally produced rice and especially by the various exceptional exemptions granted to traders for importing rice in recent years. The average price surveys

observed during the period 2005 to 2014 accurately reflect the difference in these average prices observed over the five years (Figure 3).

**Figure3. Comparison of the annual price of imported and domestic rice from 2005 to 2014.**



**Source: Author's computation, 2018**

Local rice is more sensitive to periods of crisis. This is well explained for the 2005 production crisis, but is less "logical" for the 2008-2009 international crisis period and the national food crisis due to poor harvests in 2011(Bulo 2011). Local rice has not really become more competitive with the crisis. Since April 2008, the average price of rice, which was around 25,000 FCFA per bag, has risen significantly. It is on average around 32 500FCFA.

The lack of a comprehensive agricultural database and early warning information system makes it difficult to predict climatic, pest and disease hazards.

A recent survey of rice production showed that rice consumers in the country did not feel the effects of local rice production as they favored rice varieties imported from Asia and other countries. While the current level of rice production in the country has increased significantly, people needed to adjust their preferences for local foods.

This study therefore represents a new method of assessing rice production in the country, based on data collected by the Ricepedia and FAO. Greater country-level precision will be the basis for improving rice production and overcoming food insecurity in the country.

## 2. Objectives of the study

The main objective of this study is to analyze and more closely examine the constraints of rice production in the country using an econometric model: Examine the relationship between rice production and the price of rice in the domestic market.

## 3. Research methods

This section highlights the materials and methodology used in the study.

The main considerations in the design of the model were to integrate all the important variables on demand, supply and policy and to precisely explain the causes of fluctuations in rice production in the market. Period 2005-2014.

The amount of domestic rice is the dependent variable and the explanatory variables include the price of domestic rice, the price of imported rice and the amount of imported rice. These variables are central to understanding the fluctuations about rice production in the country.

From the theoretical and empirical discussion, the rice production equations used in this study is written as equation (1):

$$\ln Q_t = \alpha + \beta_1 \ln Pd_t + \beta_2 \ln QI_t + \beta_3 \ln PI_t + U_t \quad (1)$$

Where:

$Q$ : Quantity of domestic rice produced

$Pd$ : Price of domestic rice in FCFA

$QI$ : Quantity of rice imported into the country

$PI$  : Price of imported rice in FCFA

$U$  : White noise error term.

$t$  : Year

The price of domestic rice should have a positive relationship with the amount of rice produced as the price is a signal for high-demand producers, and it therefore encourages growers to produce more rice to take advantage of the high price to earn income. The imported rice quantity coefficient (QI) should have a negative sign as the two are convenient substitutes; the more rice that is produced, the less rice is imported and vice versa. The price coefficient of imported rice should be a positive sign, because the higher the price of imported rice, the lower the amount consumed and the lower the imported quantity. The lower the quantity of imported rice the higher the demand for domestic rice, and hence the higher the quantity of domestic rice produced to meet with the higher demand. The Eviews statistical package and excel were used to obtain the results.

#### 4. Results and Discussions

##### 4.1. Summary Statistics

Table1: *Summary Statistics*

Statistics	Local Rice Production (Mt)	Retail Price of local Rice (FCFA)	Rice imported (Mt)	Retail Price of imported rice (FCFA)
Mean	1713.076	473643.8	188.2000	410424.5
Median	1828.170	509437.7	171.0000	435443.1
Maximum	2305.610	642481.8	283.0000	592936.7
Minimum	945.8200	263563.0	109.0000	248921.7
Std. Dev.	524.1569	141840.8	55.19622	119604.5
Skewness	-0.353043	-0.399455	0.548145	-0.250802
Kurtosis	1.641182	1.655758	2.303106	1.888439
Jarque-Bera	0.977060	1.018852	0.703130	0.619656
Probability	0.613528	0.600840	0.703586	0.733573
Sum	17130.76	4736438.	1882.000	4104245.
Sum Sq. Dev.	2472664.	1.81E+11	27419.60	1.29E+11
Observations	10	10	10	10

**Source: Author's computation, 2018**

Rice is the staple food for most Malians and therefore rice production is an important agricultural activity. However, rice is produced by mainly small-scale farmers working at a subsistence level. As part of its food self-sufficiency efforts, the Malian government is supporting farmers in the form of improved seeds, fertilizers and some agricultural aids to facilitate the production process. Table 1 gives a descriptive analysis of the variables under consideration in this study.

Table1 shows that the average rice production for the 10-year period is 1713.076 metric tons, while the maximum registered in 2014 is 2305.610. The average retail price per ton is 473643.8 FCFA, while the average selling price of imported rice is 410424.5 FCFA. This shows that local rice is more expensive.

##### 4.2. Logarithmic Regression Model Results

This model is run on the log of the data obtained for each variable without checking for time series properties of the variables themselves and it is specified below:

$$\ln Q_t = \alpha + \beta_1 \ln Pd_t + \beta_2 \ln QI_t + \beta_3 \ln PI_t + U_t \quad (1)$$

**Table 2: Model 1.**

Dependent Variable: LQ  
 Method: Least Squares  
 Date: 08/10/18 Time: 22:10  
 Sample: 2005 2014  
 Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LPD	0.903183	0.155425	5.811045	0.0021
LQI	-0.036517	0.042801	-0.853179	0.4325
LPI	0.091295	0.134356	0.679498	0.5270
LFERT	0.137640	0.206888	0.665285	0.5353
C	-7.501937	2.658598	-2.821764	0.0370
R-squared	0.997576	Mean dependent var		7.397284
Adjusted R-squared	0.995637	S.D. dependent var		0.341452
S.E. of regression	0.022553	Akaike info criterion		-4.439043
Sum squared resid	0.002543	Schwarz criterion		-4.287751
Log likelihood	27.19522	Hannan-Quinn criter.		-4.605011
F-statistic	514.4930	Durbin-Watson stat		1.425789
Prob(F-statistic)	0.000001			

**Source: Author's computation, 2018**

This imported rice per ton underlines the argument that rice imports undermine national efforts to promote domestic production as a viable source of income. Although the imported quantity is relatively small (109 tons per year), it is able to feed the urban population of the country. The result in Table 2 shows that the R squared has a value of 0.997576, which means that 99.76% of the variations in the dependent variables (Log Qt) are explained by variations of the explanatory variables.

The Adjusted R-square, which measures the relational effect of an additional variable on the dependent variable, also has a high value of 99.56%. This shows that the model fits well. Moreover, the F-statistic, which tests the common meaning of the explanatory variables, is significant on the 1% level.

This means that the explanatory variables are important together to determine changes in the dependent variable (the amount of rice produced); that the common changes in the explanatory variables significantly affect the evolution of rice production in the country. Table 2 shows that only the price of domestic rice is significant at 1%; the other two explanatory variables are not significantly related to the dependent variable.

The model that was estimated in its level as stationary tests show that log variables were stationary in their level. For this purpose, the log model for rice production in Mali is evaluated. The results of the model are shown in Table 2.

As already mentioned, it's clear that the model suffers from multicriteria problems; As a result, the retail price of the imported rice was removed from the model, as there is a strong correlation with the retail price of domestic rice (Table 3).

The model is found to have improved considerably and the final model is

$$\text{Shown in equation (2). } \ln Q_t = \alpha + \beta_1 \ln Pd_t + \beta_2 \ln QI_t + U_t \quad (2)$$

**Table 3: Model 2**

Dependent Variable: LQ  
 Method: Least Squares  
 Date: 10/08/18 Time: 22:17  
 Sample: 2005 2014  
 Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LPD	1.005606	0.036163	27.80789	0.0000
LQI	-0.014973	0.027433	-0.545826	0.6049
LFERT	0.051823	0.156344	0.331467	0.7516
C	-6.429569	2.041283	-3.149769	0.0198
R-squared	0.997353	Mean dependent var		7.397284
Adjusted R-squared	0.996029	S.D. dependent var		0.341452
S.E. of regression	0.021518	Akaike info criterion		-4.550718
Sum squared resid	0.002778	Schwarz criterion		-4.429684
Log likelihood	26.75359	Hannan-Quinn criter.		-4.683492
F-statistic	753.4298	Durbin-Watson stat		1.557516
Prob(F-statistic)	0.000000			

**Source: Author's computation, 2018**

The results (Table 3) show that R-square is 0.997353, which shows 97.74% of variations in rice production. The F- statistic is significant at 1%, which means that explanatory variables are important to determine changes in rice production in Mali. This underlines the fact that the model is very suitable.

The D-W statistic (1.6) shows that the problem of multicollinearity does not significantly distort the results of the model.

The domestic price of rice on the domestic market has the expected positive sign, which is also very important, namely 1%.

This indicates that there is a positive and significant correlation between the amount of rice produced and the price of rice in the market. This means that a 1% increase in the local price of local rice will result in an increase in rice harvest in the country.

The result clearly underscores the role of price as an incentive for increased supply of agricultural production in the market. As with any other manufacturer, the price is a very good indicator of the expected result; and as the government introduced the "tractor" program, farmers became more aware that they had to produce and sell their products. Agriculture is currently considered an active commercial activity that should be able to make a profit.

The logarithm of the imported rice quantity variable is negative as the document predicted. It has a capacity of self-sufficiency in rice (93%) according to the study results on the impact of rice imports, their seasonality, donations and food aid on the marketing of local rice, therefore the influence of Imported rice is declining but persists because of the strong preference of consumers for local rice, especially the "Gambiaka" variety, partly explains its relatively high price relative to imported rice.

Rice occupies a central place in the eating habits of populations, mainly in urban areas. In urban households, an average of more than 60 kilograms of rice is consumed per person annually.

**4. Conclusion and Policy implications**

Production incentives are consistent with the Malian government's national priority to increase rice production. There is an obvious net flow of rice from Mali to neighboring countries. Periodically, when rice prices are high, mainly due to external forces, government agencies tend to impose export restrictions on rice. It is clear that this measure had virtually no impact on rice prices in that country. As a result, this study shows that the need for large imports is fundamentally linked to changes in eating habits and not to a decline in production, with consumption growing faster than production. Rice is increasingly consumed by urban dwellers and plays a key role in the urban household diet.

Rice occupies a central place in the environment of agricultural policies in Mali. The overview of rice growing in Mali shows that rice still plays a central role in food security, which remains a crucial problem for the country. The combination of several factors has resulted in a large increase in global rice production, but some major institutional, technical and organizational constraints remain. Improving the competitiveness of local rice requires a better knowledge of commercial channels, opportunities related to different value chains and strong

advocacy actions. In terms of volume, rice accounted for 40% of cereals consumed in Mali in 2011 (INSTAT 2014). National level increased by 3 percent between 2012 and 2013. The domestic retail price is a good signal for farmers to increase demand, encouraging them to produce more rice. Several Malian farmers grow rice as the main product and consider the country's political culture. The development of rice therefore not only provides food for the population but also creates jobs for a large number of farmers, saves valuable currency and affects the economy of the country as a whole.

Agriculture is an important aspect of the economic life of most people in sub-Saharan Africa, as the economy is mainly an agricultural economy. In West Africa, rice production is an integral part of agricultural activities and Mali becomes the second largest rice producer in the region in 2015. The price of rice as an economic indicator will affect the decision of farmers to produce more. The study found that the price of rice inland is higher than that of imported rice, suggesting that:

The study will, therefore, be useful in helping agricultural researchers to support the setting up of agricultural policy monitoring and analysis systems that allow for better anticipation and management of domestic price crises.

On the basis of such systems, to properly assess the effects of pro-consumer policy measures on production incentives, consumer price levels and to consider the establishment of policies that support demand without affecting supply (social safety nets, use of stocks, food canteens ...).

Projects are put in place to reduce barriers to price transmission between international and domestic prices along marketing routes: development of the road network (service routes) and rural markets and reduction of illicit controls, in particular.

The political emphasis on self-sufficiency in rice production, therefore, appears economically justified. It is necessary for the government to restore product marketing tips to help farmers' access materials and sell their products. In order to control the price and increase rice production, the government should be able to buy rice from farmers and then sell it to private retailers.

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