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Promotion of Rice Production: A Likely Step to Making Kenya Food Secure. An Assessment of Current Production and Potential

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Abstract
This paper aimed at assessing the state of rice production in Kenya. The introductory part has established that Agriculture contributes enormously to the Kenya's Gross Domestic Product (GDP). An inquiry into the origin and domestication of rice (which is the third most important crop in Kenya) has revealed that there are two main species of cultivated rice: the African rice and the Asian rice. Since its introduction in 1907, the crop's consumption has been increasing at a rate of about 12%, a rate that is far much beyond the rate of production. This has necessitated the import dependency ratio to be very high (about 88% in the last decade). Since Kenya has a high potential for producing both irrigable and rain-fed rice which can meet the increasing demand, some measures have been suggested, which may help boost the production. One of such steps is the popularization of New Rice for Africa (NERICA), an improved upland variety; adoption of new variety of paddy rice called IR522, sensitization and adoption of System of Rice Intensification (SRI), among other strategies.
Keywords: Rice production, Food security, New Rice for Africa, IR522

1.0 Introduction

Kenya's economy largely depends on the agricultural sector. The sector directly contributes 24% of the Gross Domestic Product (GDP) [4]. The sector also contributes 27% of GDP indirectly through linkages with manufacturing, distribution and other service related sectors. Approximately 45% of Government revenue is derived from agriculture and the sector contributes over 75% of industrial raw materials and more than 50% of the export earnings. The sector is the largest employer in the economy, accounting for 60 per cent of the total employment. Over 80% of the population, especially living in rural areas derives their livelihoods mainly from agricultural related activities [6].

The agro-grain processing sub sector is one of the leading and well-established industries and it includes major cereal foods such as maize, wheat, rice, sorghum, millet and barley among others. This paper focuses on rice.

1.1 The Origin of Rice

There are only two species of cultivated rice in the world: *Oryza glaberrima*, or African rice, and *Oryza sativa*, or Asian rice [7]

Native to sub-Saharan Africa, *O. glaberrima* is thought to have been domesticated from the wild ancestor *Oryza barthii* (formerly known as *Oryza brevilugata*) by peoples living in the floodplains of the Niger River some 2000-3000 years ago. According to Portères (1962) the species spread to two secondary centers of diversification, one in the coast of Gambia, Casamance, and Guinea Bissau, the other in the Guinea forest between Sierra Leone and the western Ivory Coast [7]. Whether one or several centers of African rice domestication existed, the fact remains that African rice was first cultivated many centuries before the first Europeans arrived on the West African coast. The early Colonial history of *O. glaberrima* begins when the first Portuguese reached the West African coast and witnessed the cultivation of rice in the floodplains and marshes of the Upper Guinea Coast. In their accounts, spanning the second half of the 15th century and all of the 16th century, they mentioned the vast fields planted in rice by the local inhabitants and emphasized the important role this cereal played in the native diet.

On the other hand, the two strains of *O. sativa* (*Oryza japonica* and *Oryza indica*) were domesticated independently, both probably in China [2, 7]. A study of the rice genome by [12] suggests that the crop was domesticated only once, rather than at multiple times in different places. The work published in PNAS journal volume 108 Number 20, proposes that rice was first cultivated in China some 9,000 years ago. The view that the two major sub-species of rice - *Oryza sativa japonica* and *Oryza sativa indica* - were domesticated separately and in different parts of Asia, has gained strong support from observations of large genetic differences between the two sub-species, as well as from several efforts to reconstruct the evolutionary history of the crop. Using computer algorithms, the researchers came to the conclusion that *japonica* and *indica* had a single origin because they had a closer genetic relationship to one other than to any wild rice species found in China or India. The study indicates that the *japonica* and *indica* sub-species split apart from each other about 3,900 years ago. The team says this is consistent with archaeological evidence for rice domestication in China's Yangtze Valley about 8,000 to 9,000 years ago and the domestication of rice in India's Ganges region about 4,000 years ago. The single-origin model suggests that *indica* and *japonica* were both domesticated from the wild rice *Oryza*

rufipogon. The varieties grown in Kenya are mainly of Asian origin.

2.0 Rice Production in Kenya

Rice cultivation was introduced in Kenya 1907 from Asia [10]. Rice is the third most important cereal crop after maize and wheat [4, 9, 10, 18].Though many regions grow the crop for domestic consumption, Kenya for a long time regarded rice a cash crop. This long held perception is, however, rapidly changing, with many communities now appreciating the importance of rice a food crop for domestic consumption in addition to being a cash crop for income generation [16]. This change in perception has greatly influenced the balance between production and consumption of rice in many African countries, Kenya included.

There are a number of different estimates for rice production and area in Kenya. The two most often cited estimates for rice production, area and yield in Kenya are those of the MOA and those of the National Irrigation Board (NIB) for rice produced on its irrigation [8, 18]. (See table 1). 95% of the rice in Kenya is grown under irrigation in paddy schemes managed by NIB and the remaining 5% is from rain-fed rice farming [4]. This appears to be changing as Ministry of Agriculture (MOA) observes that about 80% of the rice grown in Kenya is from irrigation schemes established by the government and that about 20% of rice is produced under rain-fed conditions [10]. There is further decline in the trend as the data presented in ***Table 1*** indicates that on average only 78% of the total production came from the schemes between 2005 and 2010. Rain-fed rice is grown in Kwale, Kilifi and Tana River Districts in coast province and Bunyala and Teso Districts in western Kenya [4]

Table 1: Kenya milled rice production, area and yield, 2005-2010

	Unit	2005	2006	2007	2008	2009	2010
Total							
Production	Tons	57 942	64 840	47 256	21 881	42 202	44 468
Area	Ha	15 940	23 106	16 457	16 734	21 829	n.a
Yield	T/Ha	3.6	2.8	2.9	1.3	1.9	n.a
NIB Schemes		2004/5	2005/6	2006/7	2007/8	2008/9	2009/10
Production	Tons	39 173	39 366	33 196	25 041	23 249	45 313
Area	Ha	10 832	12 501	9 626	9 092	10 072	17 611
Yield	T/Ha	3.6	3.1	3.4	2.8	2.3	2.6

Source: MAFAP (2013) Page 78-Table 11; Short et al (2013) Page 7-Table 1 and MOA-Economic Review of Agriculture (ERA) 2010 Page 30 (table 5.7).

MOA estimates are larger than NIB estimates in all years except for 2010 because they include non-NIB irrigated production and production on lowland and highland rain-fed rice fields. Non NIB irrigated production includes private rice irrigation enterprises and small scale irrigation schemes established by other agencies, such as the Lake Basin Development Authority. It also includes production from Dominion Farms Limited (DFL), a large scale, vertically integrated farm, with nearly 7,000 ha of irrigable land in the Yala Swamp Region near Lake Victoria [8, 18]

There are four NIB schemes currently producing rice in Kenya. Mwea in central Kenya, accounting for 78% of the irrigated area, 88% of production and 98% of the gross value of output between 2005 and 2010, according to NIB data. The other three rice producing schemes Ahero, Bunyala and West Kano are located in western [8, 11, 18]. Rice in Kenya is mainly produced by small scale farmers in central (Mwea), Western (Bunyala), Coast (Tana delta, Msambweni) and Nyanza provinces (Ahero, West Kano, Migori and Kuria. The schemes have the following areas: west Kano and Ahero (3520 ha), Bunyala irrigation scheme (516 ha) and Mwea irrigation scheme covering an area of 9000 ha [3]. In total the irrigation areas cover approximately 13000 ha. The rice varieties grown in these schemes include Basmati 370, IR2793, ITA310 and BW196 [5]

From the data obtained from the MOA-ERA 2010 presented in Table1 as Total, there was a decline in production of rice between 2007 and 2008. The data from the NIB schemes also reveal that there was a drop in production from 2007-2009. The observed decrease in rice production may have been as a result of spike in world commodity prices in 2007-2008 which affected the costs and availability of fertilizers needed to maintain the rice yields. The civil disturbances that followed the December 2007 general elections and the subsequent drought that followed might have also led to the drop [11]

The Consumer Price Index (CPI) expenditure weights for rice indicate its relative importance for different groups of consumers. For low income consumers in Nairobi, rice accounts for 3.9% of food expenditure compared to 11.5% and 10.7% for maize and wheat respectively. Expenditure on rice is 4.8% of food expenditure in other urban areas compared to 13.5% for maize and 9.7% for wheat [18]. Rice accounts for even lower expenditure for rural consumers. Mwea rice farmers in the 1980s sold most of the rice and relied on maize and beans they cultivated off the scheme for their own consumption. They considered rice as a cash crop consumed by people in urban areas. Though the consumption is lower in rural areas compared to urban areas, that of rural areas is rising steadily. Per capita rice consumption in Kenya is estimated to be 10-18kg per capita

per year [17]. The annual rise in rate of consumption is increasing at the rate of 12% compared to wheat (4%) and maize (1%). The changes are attributed to eating habits. The demand for rice is therefore expected to rise [3, 10]

Rice consumption has been growing much more rapidly than production at an average rate of 11% per year since 1960. As a result, imports have increased rapidly, and the import dependency ratio has climbed higher in most decades, averaging 23% in the 1960s, 15% in the 1970s, 53% in the 1980s and 88% in the 1990s import for the decade remained at about 88%. The national rice consumption is estimated at 300,000 Metric tons compared to an annual production range of 45,000 to 80,000 metric tons [9, 15]. The deficit is met through imports. In 2008, rice imports into Kenya were valued at Ksh 7 billion [3, 9, and 10] (See Table 2).

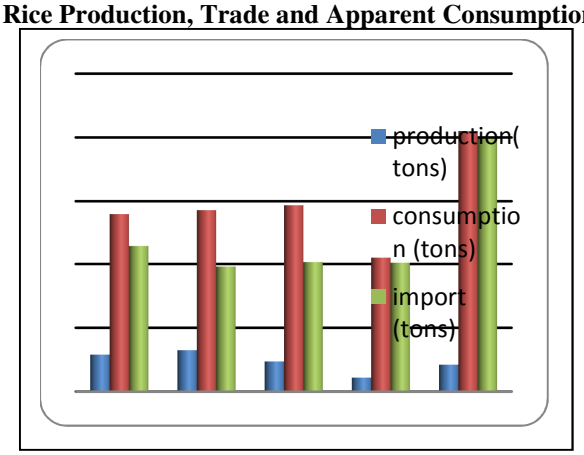
Table 2: Trends in Milled Rice Production, Trade and Apparent Consumption in Kenya, 2005-2009

	2005	2006	2007	2008	2009
Production (tons)	57 942	64 840	47 256	21 881	42 202
Consumption (tons)	279 800	286 000	293 722	210 000	410 000
Imports (tons)	228 206	196 000	203 000	202 000	398 000
Import dependency ratio-%	80	78	85	93	87

Source: MOA-ERA, 2010 Table 5.7 page 30, Import Dependency Ratios obtained from MAFAP (2013) table 9 page 68 and Short et al (2013) Table 2 Page 1

The data in Table 2 above is presented in figure 1 below.

Figure 1: Trends in Milled Rice Production, Trade and Apparent Consumption in Kenya, 2005-2009



From **Figure1**, it can be seen that in all the years, consumption outweighs production by far. This has forced the country to import a lot of rice to cater for the deficit. As Imports between the period presented in **Figure 1** have been dominated by rice from Pakistan which accounted for over 70% of rice imports. This is because rice from Pakistan was exempted from import duty while imports from other countries attracted the agreed East African Community tariffs and had to compete at a 40% tariff differential [11].

2.1 Kenya's Rice Production Potential

Kenya has a potential of about 540 000ha irrigable and 1 million hectares rain-fed for rice production. With improved water harvesting, storage, underground water resource utilization and innovative management technologies, the current irrigation potential can be increased by a further 800 000 hectares to about 1.3 million hectares [10]. One of the areas with greatest irrigation potential is the Lake Victoria basin. However, the Nile Treaty signed in the 1920s between British and Egyptian Governments restricts engaging in any major irrigation activity with the Lake water. The Government of Kenya should therefore engage with the Egyptian Government to review the Treaty.

Another region which harbours potential for rice production is the Coast region. The Coast Provincial Director of Agriculture Phoebe Odhiambo noted that the region's yields have been increasing steadily. In 2012, a total of 6018 metric tons of rice were harvested up from 1917 metric tons of rice in 2007. She noted that there is plenty of land available, with most of the flood plains being virgin and available from River Tana, River Umba which originates from the Tanzania highlands and the marshy lands spot [13]. Traditional knowledge of local communities on rice growing and production are also added advantages. Areas which are known to have potential for rice farming include the irrigated farmlands of Tana and Athi River Development Authority (TARDA) in Tana Delta, Bura and Hola irrigation schemes and Vanga in Msambweni Districts of Kwale County. She further noted that the New Rice for Africa (NARICA 4) which have been introduced for drier areas would further boost production.

3.0 Uses of Rice

The following uses of rice have been identified [16]

Food uses

- Rice is mainly consumed as a source of carbohydrates. Rice is used as staple food by more than 60% of world population.
- The starch from rice is used for making ice-cream, puddings and distillation of portable alcohol.
- Rice bran is used in confectionery products like bread, snacks, cookies and biscuits
- Rice broken is used for making food items like breakfast cereals, baby foods, rice floor, noodles, rice cakes among others. It is also used as poultry feed.
- Rice is a good source of insoluble fiber. Insoluble fiber reduces the risk of bowel disorders and fights constipation
- Rice is low in fat, contains some protein and plenty of B vitamins.

Non-food uses

- Rice husk is used as fuel, in board and paper manufacturing, packing and building materials. It is also used for compost making and chemical derivatives
- Rice straw is mainly used as animal feed, fuel, mushroom bed, for mulching in horticultural crops and preparation of paper compost.
- Defatted rice bran is used as cattle feed , organic fertilizer, medicinal purpose and in wax making
- Rice bran oil is used in soaps and fatty acids manufacturing

Due to its various uses, rice has continued to raise its popularity around the globe with its production receive a lot of attention in many development strategies and poverty reduction interventions. Development of rice therefore presents an opportunity to reduce the number of gravely food insecure people in Kenya.

4.0 Constraints to Rice Production in Kenya

The challenges plaguing rice sub-sector are as follows [3, 9, 10]

Pests such as quelea birds, rodents such as rats, and rice gall midge cause substantial losses in the field

Weeds such as Striga, False Finger Millet lowers the quality of the produce. They also make the farmers to spend more money and time controlling weeds which in the long run reduces returns.

Erratic rainfall in some of the potential areas for ran-fed production has discouraged farmers. The drought experienced in Mwea Scheme forced the Water Users Association to ration water and this affected the yields [9]

At times of excessive downpours, the floods have often broken the temporary ridges and ravaged the fields with up to 100%. This is mainly as a result of poor water management.

Thin profit margins caused by high input prices and high cost of electricity for pumping water in most of the schemes, have discouraged some farmers who have turned their plots into vegetable fields [16].

Land degradation and loss of soil nutrients either through soil erosion or continuous cultivation has significantly lowered rice production in most areas. Farmers are forced to spend a lot of resources on fertility enhancement. Some farmers who cannot afford adequate fertilizers have in most cases withdrawn from rice production or suffered severe losses.

Some potential areas are saline and are iron toxic. Correcting such toxicities is too expensive for many small holder farmers who form majority of the rice producers. This means that rice is to compete for favourable land with other crops such as vegetables. The end result is the reduction in the land under rice.

*Oryza sativa i*s susceptible to lodging. Once it gets flat on the ground, the rice becomes very difficult to harvest in addition to losing most of the grain through shattering and pest damage.

Poor access to credit facilities. Most farmers in the NIB schemes fear taking credit facilities as they think their land could be auctioned if they default in repaying the loan as the land is used as collateral. They discovered that 63% of the farmers had not taken loan in the last five years [3]

Land in the irrigation schemes has remained static over the years where as population has increased at a faster rate. As a result, there has been an informal subdivision of the land units in the irrigation schemes and increased renting of land to other people by the official NIB tenant farmers. This arrangement has led to large numbers of people living in the irrigation schemes leading to an increased demand for services such as provision of water which the current system cannot support.

Destructive diseases such as rice rust, bacterial blight, sheath rot, rice blast and rice yellow mottle virus lower the quality and reduce the yields per unit area.

Poor seed delivery systems as middlemen, in most cases, overprice or deliver sub-standard seeds or both, resulting into low profit margins.

Poor access to extension services and research. Inability of farmers to access extension services could be the result of the changes in institutions providing extension to rice farmers. Before restructuring in early 2000, NIB used to offer extension services to rice farmers, especially in irrigation schemes. NIB withdrew from these

services which were to be taken by MOA, but this has not occurred in some regions. Research was also moved from NIB to KARI in early 2000. It has been observed that there are increased incidences of rice diseases attributable to non-release of new varieties.

5.0 Recommendations

To reduce the import burden caused by inadequate rice production and also to be a food secure country a combination or all of the following measures should be adopted:

Popularization of improved upland varieties such as New Rice for Africa (NERICA). This improved variety offers an attractive and sustainable alternative to other traditional rain-fed varieties. NERICA is cultivated under upland conditions without flooding thus require less water than lowland varieties such Basmati, Sindano and IR8 among others grown under flooding. In 2010 a yield of up to 4.4 tons/ha was achieved through an on-farm trials and demonstrations in Kerio Valley [1]. The results from several on-farm trials gave positive results. This has a new hope for having NERICA as an alternative food security crop in semi-arid areas of Kenya especially where supplementary irrigation is possible. Areas with potential include Kerio Valley (Elgeyo-Marakwet County), Perkerra irrigation scheme (Baringo County), Western, Nyanza and Central Provinces. Through trials it has been found that NERICA 4 is the most suitable variety for most parts of Kenya. Other varieties of improved upland variety include NERICA 1, NERICA 10 and NERICA 11. Another investigation by [15] puts NERICA 4 as the best rain-fed variety. The study compared traditional rain-fed variety (Dourado prococe) with NERICA varieties (1, 4, 10 and 11). After the analysis of Gross Margin it was evident that Dourado prococe had the lowest gross margin per hectare compared to 4 NERICA varieties and NERICA 4 had the highest gross margin per hectare. In addition to the advantages noted above, the NERICA variety would help to save the fragile wetland ecology of the country from further damage caused by paddy rice production.

Sensitization of farmers to adopt the System of Rice Intensification (SRI). SRI involves [9]

- Transplanting seedlings at very young age (8-12) days instead usual 3-4 weeks
- Raising seedlings in unflooded nurseries
- Transplanting seedlings quickly, carefully and at shallow depths
- Transplanting seedlings at wider distance and singly in square pattern (25x 25cm)
- Avoiding continuous flooding of the soil
- Weed control by use of simple mechanical hand weeders
- Providing as much organic matter as possible to the soil

The advantages of SRI over conventional flooded paddies include the fact that it gives more tons of rice per hectare, requires less seed and water, makes use of what the farmer has and that all rice varieties give higher yields with SRI (though some high yielding varieties respond better than others. Above all, SRI methods are particularly accessible to and beneficial for the poor who need to get the maximum benefit from their limited land, labour and capital. Added demand on labour especially during weeding is provided by the family.

Adoption of the newly released rice variety called IR522. This variety was developed by KARI in partnership with International Rice Research Institute in the Philippines. Lusike Wasilwa, KARI scientist stated that the variety uses 70% less water than most varieties, has 40% more protein than most Asian and African breeds of rice and that the variety is high yielding (produces 6 tons/ha) [14]

Innovative ways need to be formulated to provide credit to small-holder farmers. To enhance borrowing and use of credit by rice growers, credit schemes and credit institutions in partnership with the government need to formulate educational programs to educate the farmers on management and use of finances and especially on how to acquire and use credit.

The relevant institutions that provide rice seed should be strengthened and distribution mechanisms formulated to improve availability of high quality rice seed to farmers. Farmers should also be encouraged to use high quality seeds in order to improve their yields. The seeds and other inputs such as fertilizer should be provided to the farmers at subsidized rates.

Relevant ministries and research institutions should develop Information Communication Technology (ICT) systems to provide timely information to farmers on rice production prices and markets. Research should be conducted to come up with drought, pest and weed resistant varieties of rice.

There is need to institute and strengthen farmers, organizations, especially the Water Users Associations (WUA) and the farmer's cooperatives. This will allow for participatory irrigation management and eventually irrigation management transfer.

There is need for construction of gravity abstraction system, in schemes which use electricity for pumping, to reduce the cost of production.

6.0 Conclusion

The paper has established that rice is significant crop in the Kenyan economy. Promotion of its development will significantly reduce the import bill and remarkably solve the cases of food insecurity.

References

[1]Bunyatta, D.K (2012) *Guideline for Growing New Rice for Africa (NERICA): An Upland Rice Variety as an Alternative Food Security Crop in Semi-Arid Lands of Kenya*. Ministry of Agriculture, PDA, office, Nairobi.
[2]Crawford, G.W and Chen, S. (1998) *The Origins of Rice Agriculture. Recent Progress in East Asia*. Antiquity Vol.72 Issue 278. 858-866
[3] Emongor, R.A., Mureith, F.M.,, Ndirangu, S.N., Kitaka, D.M and Walela, B.M(2009) *The Rice Value Chain in Kenya With Reference to Rice Producers*. KARI, Nairobi.
[4] Export Processing Zone Authority (2005) *Grain Production in Kenya.* PKF consulting L.t.d. Kalamu House, Waiyaki Way, Nairobi.
[5] http://www.nib.or.ke
[6] Kenya Agricultural Research Institute (2012) *Food security Report: Policy responses to Food Crisis in Kenya*. Foodsecurityportal.org.
[7] Linares, O.F (2002) *African Rice (Oryza glaberrima): History and Future Potential*. Proceedings of the National Academy of Sciences of the United States of America. Vol.99 No.5, 16360-16365.
[8] Monitoring African Food and Agricultural Policies (2013) *Review of Food and Agricultural Policies in Kenya 2005-2011*. MAFAP country Report Series. FAO, Rome, Italy.
[9] Mati, B.M (2009). *System of Rice Intensification (SRI). Growing More with Less Water. Promoting the adoption of SRI in Kenya. Brief notes.* Improved Management of Agricultural Water in Eastern and Southern Africa. Nairobi.
[10] Ministry of Agriculture (2009) *National Rice Development Strategy 2008-2018.* Information and Documentation Services. KARI, Nairobi.
[11] Ministry of Agriculture (2010) *Economic Review of Agriculture 2010.* Central Planning and project monitoring Unit. Nairobi.
[12] Molina, J., Sikora, M., Garud, N, Flowers, J.M.., Rubinstein, S., Reynolds, A, Huang, P., Jackson, S, Schaal, B.A, Bustamante, C.D, Boyko, A.K and Purruganan, D.(2011) *Molecular Evidence for a Single Evolutionary Origin of Domesticated Rice*. Proceedings of the National Academy of Sciences of United States of America. Vol.108, No.20, 8351-8356.
[13] Mwakio, P. (2012) *Rice Farming Becomes New Fad In Coast*. The Standard Newspaper, Monday, 10th December, 2012.
[14] Njeru, G (2013) *Going With the Grain: New Breed of Rice Raises Hopes for Kenya's Domestic Rice Production.* Think Africa Press 31 July, 2013.
[15] Okech, J.N.O., Warire, N.W.O, Kor, W.A.O, Okiyo, T.O., Otieno, V.O and Onyango, G (2009). *A Comparative Economic Analysis of the traditional and improved Upland Rain-fed Rice Varieties in Kisumu District, Kenya*. KARI, Kibos and KESHREF, Kisumu.
[16] Olembo, N., M'mboyi, F. and Oyugi, K. (2010) *Success Stories in Crop Improvement in Africa . The Case of Rice in Sub-Saharan Africa*. African Biotechnology Stakeholders Forum (ABSF). Nairobi.
[17] Ruigi, G.M. (1988) *Large Scale Irrigation Development In Kenya. Past Performance and Future Prospects. Report No. 23*. Food and Nutrition Planning Unit. Ministry of planning and National Development.
[18] Short, C., Mulinge, W.,and Witwer, M., (2013) analysis of incentives and Disincentives for Rice in Kenya. Technical Notes Series. MAFAP, FAO, Rome, Italy.