World Environment 2014, 4(4): 172-179
DOI: 10.5923/j.env.20140404.03

Exploring Options for Improving Rice Production to Reduce Hunger and Poverty in Kenya

Amos Ouma Onyango

Department of Geography, Moi University, Kenya

Abstract This paper aims at finding possible ways of boosting rice production in Kenya. It reviews works from published peer review articles, agricultural research and development reports from national and international institutions. The introductory part has established that rice is increasingly becoming a food security crop for most of the developing countries. According to the statistics available, the rate of rice consumption in Kenya is around 12% per year. The annual production is around 50,000 metric tons against an annual demand of about 300000 metric tons. This has necessitated the import dependency ratio to be very high (about 88% in the last decade). It has been observed that through investment in agricultural research and development, price stabilization and adoption of New Rice for Africa (NERICA), Kenya can be sufficient in food production.

Keywords Rice production, Food security, New Rice for Africa, Agricultural research and Development

1. Introduction

Rice, a cereal crop, has been gathered, consumed and cultivated by many people worldwide for more than 10,000 years longer than any other crop [9]. The total area under rice cultivation is globally estimated to be 150 million hectares (ha), with annual production averaging 500 million metric tons (mmt). This represents 29% of the total output of grain crops worldwide. FAO in 2000 classified the crop as the most important food crop depended by over 50% of the world population for about 80% of their food need, especially in Asia and in West and Central Africa [9, 22]. Due to the growing importance of the crop and increasing challenges of the attainment of food security, it has been estimated that the annual rice production needs to increase from 586mmt in 2001to meet the projected global demand of about 756mmt by 2030 [20, 9].

In Sub-Saharan Africa (SSA) rice is the one of the food commodities whose demand is rapidly growing, mainly driven by urbanization. With the population of Africans living in urban areas expected to increase from current 38% to 48% by 2030, rice consumption in Africa is expected to increase tremendously [1, 2]. Household consumption surveys reveal that urban consumers on lower incomes tend to spend greater share of their total budget on rice than higher income households [1, 32] These developments mean that rice is no longer a luxury food but has become the main source of calories for low income households. Between 1970 and 2009, annual rice consumption in SSA increased at a faster rate (4%) than rice production (3.3%). In the period 2001-2005, rice production expanded at the rate of 6% per annum, with 70% of the production increase due mainly to land expansion and only 30% being attributed to an increase in productivity [9, 2]. The rate of expansion was still minimal to cope with the rate of consumption. Recent global trend in the rice industry shows that there is a growing import demand for the commodity in Africa. In 2006, Africa's global rice imports accounted for 32% of global imports in 2006 [9, 29]. In 2009, rice imports into SSA translated into 9.68mmt, worth more than $ 5 billion. Africa's emergence as a big rice importer is explained by the fact that during the last decade, rice has become the most rapidly growing food source in SSA. Due to population growth (4% per annum), rising incomes and a shift in consumer preferences in favor of rice, especially in urban areas the relative growth in demand for rice is faster in this region than anywhere in the world [9, 31].

1.1. Some Insight into the Food Situation in Kenya

Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life [6]. Globally, the number of hungry people rose from 800 million people to over one billion following the 2007/2008 food price spike in the world [26]. It is estimated that an additional 44 million have since fallen into extreme poverty due to the rise in food prices since June 2010. In 2010, the regional distribution of people suffering from hunger were as follows: 578 million in

* Corresponding author:
oumamos@gmail.com (Amos Ouma Onyango)
Published online at http://journal.sapub.org/env

the Asia Pacific region; 239 million in sub-Saharan Africa; 53 million in Latin America and the Caribbean; 37 million in North Africa; and 19 million in developed countries [4].

In Kenya, the years immediately following independence were characterized by rapid economic growth. This made the government pay only scanty attention to increasing levels of poverty. For instance, high economic growth rates that averaged 6.6 per cent occurred between 1964 and 1972 and this dropped only slightly to 5.2 per cent between 1974 and 1979. It was the steep decline in economic growth in the 1980s and the 1990s that jolted the government into focusing seriously on the growing poverty within the country [13]. In Sessional Paper No. 1 of 1986 on Economic Management for Renewed Growth and by the adoption of the Welfare Monitoring Survey (WMS) project, the government undertook specific measures to deal with mounting poverty in the country. The Welfare Monitoring Surveys were meant to gauge the socio – economic effects of Structural Adjustment Programmes (SAPS). Through the first and second WMS services in 1992 and 1994, respectively, the government realized that absolute poverty in Kenya was widespread [24].

Preliminary results of the 1997 Welfare Monitoring Survey (WMS), the incidence of rural food poverty was 51%, while overall poverty reached 53% of the rural population. In urban areas, food poverty afflicted 38% and overall poverty 49% of the population [13]. The overall national incidence of poverty stood at 52%. According to available estimates, over the past 25 years food poverty has increased more than absolute poverty. The number of poor increased from 3.7 million in 1972-3 to 11.5 million in 1994. Thereafter, numbers increased to 12.5 million in 1997 and is now estimated to have reached some 15 million. According to the WMS 1994 and the Participatory Poverty Assessment (PPA) 1996, the prevalence of overall poverty in 1994 was highest in North Eastern Province (58% of population), Eastern (57%), and Coast (55%) while the lowest were Nyanza (42%) and Central (32%). However, by 1997 indications are that not only had poverty increased rapidly but that its distribution had changed with Nyanza (63%) recording the highest level followed by Coast (62%) although Central still recorded the lowest incidence (31%)) [13].

It is against this backdrop that this paper tries to explore ways of reducing the poverty levels of the citizens of Kenya. Promotion of rice production would help in making the majority of the citizen food secure. This is because rice plays a key role in providing food security for the poorer categories of the rural and urban population [1, 9, 22, 32].

2. Rice Production in Kenya

Rice cultivation was introduced in Kenya 1907 from Asia [16]. It is the third most important cereal crop after maize and wheat [11, 17, 28]. Though many regions grow the crop for domestic consumption, Kenya for a long time regarded rice as 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 Kenya.

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 Ministry of Agriculture (MOA) and those of the National Irrigation Board (NIB) for rice produced on its irrigation [18, 28] (**See Table 1**). About 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 [11]. 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 [11].

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

	Unit	2005	2006	2007	2008	2009	2010
MOA Estimates							
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 Estimates		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), Short et al (2013) and MOA (2010)

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 [18, 28].

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 [18, 17, 28]. 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 [14].

The data obtained from the MOA (2010) presented in Table1 indicates that 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 [17].

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 [28]. 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 are 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 [10, 17].

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 [10]. The deficit is met through imports. In 2008, rice imports into Kenya were valued at Ksh 7 billion [3, 9, 10] (See Table 2).

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

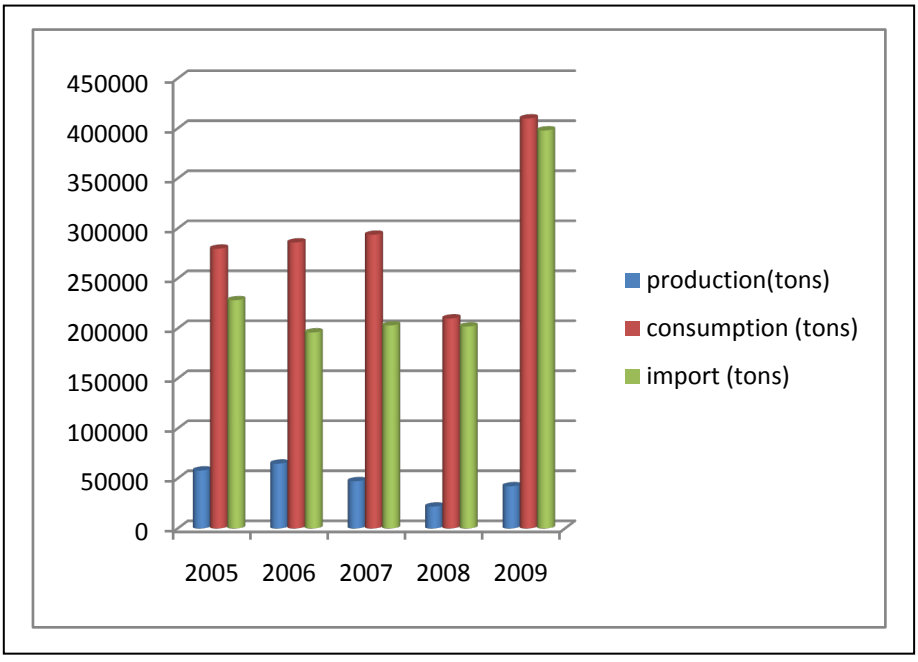

Figure 1. Trends in Milled Rice Production, Trade and Apparent Consumption in Kenya, 2005-2009

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 (2010), MAFAP (2013) and Short et al (2013)

From **Figure 1**, 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. Interventions aimed at boosting the production of this crop would significantly reduce the import bill.

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 [16]. 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.

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 [17]. 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 has been introduced for drier areas would further boost production.

2.2. Constraints to Rice Production in Kenya

The challenges plaguing rice sub-sector are as follows [22].

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.

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.

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 [10]

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.

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.

3. NERICA: Can this Variety Change the Current Rice Production Trends in Kenya?

NERICA stands for New Rice for Africa. It refers to the genetic material derived from the successful crossing that combine the best traits of both the two species of cultivated rice, the African rice (*Oryza glaberrima*) and Asian rice (***Oryza sativa***) and produce progeny known as interspecifics with high yields potential from the Asian parent and the ability of the African parent to thrive in harsh environments [19, 21]. Several studies on the suitability of NERICA for Africa have revealed positive results.

A comparative analysis of profitability of NERICA rice and local rice varieties production in Chukun local government area of Kaduna state (Nigeria) was conducted by Yakubu et al. The gross margin analysis showed that from one ha of the land cultivated, the total cost of production of NERICA rice and local rice were N116638.10 ($724.91) and N85803.45 ($533.27) and gross revenue of N351280.00 ($2183.21) and N157500.00 ($978.86)/ha respectively. Thus making a gross margin of N234 641.90 ($1458.30) and N71699.00 ($445.61)/ha respectively [33]. The gross margin analysis showed that with adequate management, NERICA rice production is more viable venture. Population adoption rate of NERICA variety, when the awareness and access to seed are not constrained have also been studied. A study by Nguzet et al [21] of Nigerian rice farmers revealed that potential NERICA adoption rate will be 54% when entire population is aware of the variety and up to 62% if they have NERICA seed. There was actual observed adoption rate of 19% implying a population adoption gap of 35% and 43% because of lack of awareness and access to NERICA seed respectively. This implies that farmers' awareness on the availability of the rice variety in the market and availing seed to the farmers is very crucial if increased production of the crop is to be realized.

Studies on the milled NERICA varieties showed that it has higher protein contents and better balance of amino-acids compared to both imported and the international rice standard. A number of NERICA varieties also show high micronutrient (iron and zinc) connections [19]. Hence the high protein content and good balance of essential amino acids in its varieties can play a significant role in combating malnutrition in the poor households, in Kenya, especially in urban areas where rice is a significant component of their diet. Other superior qualities of NERICA include: being able to smother weeds like the African parents, early maturity allowing for double cropping, can produce 6t/ha under good management and up to 2.3t/ha under drought conditions [15, 19].

Some success stories have been reported in Uganda. Since Uganda launched the upland rice project in 2004, in which NERICA is a major component, the Ugandan National Agricultural Research Organization (NARO) reported an almost nine-fold increase in the number of rice farmers from 4000 to 35000 in 2007, saving roughly $30 million in the process [19]. NERICA-4 dominates and it is appreciated for its hardiness, high yields and shorter maturation. The variety enjoys strong support from the Ugandan government, particularly for its contribution to increasing food security and incomes while reducing dependencies on foreign food imports [15]. Today, Uganda is one of the leading producers of NERICA-4 and ranks 12th in Africa in Africa for overall rice production [8].

The improved rice variety offers an attractive and sustainable alternative to other traditional rain-fed varieties in Kenya. In 2010 a yield of up to 4.4 tons/ha was achieved through an on-farm trials and demonstrations in Kerio Valley. 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 in Kenya include NERICA 1, NERICA 10 and NERICA 11 [5].

4. Impact of Agricultural Research on Poverty Reduction and Food Security

Several studies conducted to evaluate the impact of agricultural research in Africa and elsewhere widely demonstrate the positive impact of agricultural growth on poverty reduction and food security with a major component of this growth being driven by investment in agricultural research [27]. High rates of return are commonly achieved from agricultural research and development as evidenced in an analysis by International Food Policy Research Institute (IFPRI). The analysis indicates an average return of about 60% per year for research in developing countries [Alston et al, 2000]. A study by Thirtle et al [30] on the impact of research led agricultural productivity growth on poverty reduction in Africa, Asia and Latin America, revealed that research led technological change in agriculture generates sufficient productivity growth. It indicates high rates of return in Africa and Asia and has a substantial impact on poverty reducing the number by 27 million per year. The per capita 'cost' of poverty reduction by means of agricultural research expenditures in Africa is $144 and $180 in Asia [27,

30].

The relationship between agricultural research and rural poverty in India and China was studied by Fan et al. The results indicated that rice varietal improvement research has contributed tremendously to increase rice produce, accounting for 14-23% of total production value over a two decade period. The research also revealed that agricultural research has helped reduce large numbers of rural poor. In 1999, for every $1million invested at International Rice Research Institute (IRRI), more than 800 and 15000 rural poor were lifted above the poverty line in China and India respectively. These poverty-reduction effects were even larger in earlier years [12]. The Green Revolution in Asia in the 1960s resulted into high yielding rice varieties released by national and international agricultural research centers, which had powerful poverty reducing effects. The rural poor benefitted directly from income increases as a result of production growth [27]. The IR8 rice variety released in 1966 changed the face of Asian agriculture with yields ranging from 6-8 tons/ha in experimental fields [12]. In another investigation by Consultative Group for International Agricultural Rice (CGIAR) in SSA, it was revealed that without varietal improvement regional balance of payment deficits for rice imports would have been 40% higher. Moreover, an additional 658000ha of land would have been required to maintain current levels of consumption [7]. Despite all these evidences, however, investment in agricultural research has declined since the mid 1980s in Africa [3, 27].

5. Some Lessons-What have Others Done?

Reducing hunger and extreme poverty is goal number one of the United Nations' (UNs') Millennium Development Goals. This was the main reason for the UN declaration of the year 2004 as the International Year of Rice. In 2002, rice was the source of more than 500 calories per person per day for over 3 billion people. Furthermore, rice cultivation is the principal activity and source of income for more than 100 million households in developing countries in Asia, Africa and Latin America [22]. The concerted and coordinated efforts to improve rice production through science, research and development in the 1970s and 1980s enabled global rice production to meet the demand of a growing population, created employment opportunities, increased the income of rice farmers, and enhanced access to rice of the poor populations living in urban centres across the world. The gains made by the Green Revolution have begun to show diminishing returns [31, 32].

For four decades there was food sufficiency in Indonesia. This was as a result of improvements in food security by pro-poor economic growth and successful Green Revolution led by high yielding rice varieties, massive investments in rural infrastructure including ready irrigation and ready availability of fertilizers. In 2004, rice market was manipulated by the politicians. As quoted by Timmer (2004), Siswono Yudhohusodo, one of the contenders for vice presidency in the Presidential elections in 2004 advocated for high tariffs on imports or outright ban on imports. This was meant to woo the voters-majority of whom, were farmers. The end result was high prices which were unaffordable by the poor people. It also minimized diversification by the farmers. In a bid to establish the influence of price in rice production in Sierra Leone [Sanko et al, 2012] used log linear model with the quantity of rice produced as the dependent variable and the price of domestic rice, quantity of rice imported and the price of imported rice as explanatory. The findings indicated that domestic rice is more expensive than imported rice per ton. This underscores the argument that rice importation is undermining domestic rice production as a viable income generating activity. The study also revealed that that almost all people in the major urban area prefer imported rice.

Rice prices are important for poverty alleviation [Sanko et al, 2012], not only in terms of their direct effects on the poorest segments of the population but also because of the key role they play in the structural transformation, both within agricultural sector and for the economy as a whole. Within the agricultural sector, lower rice prices encourage rice farmers to diversify their cropping pattern by making rice less profitable to grow and making it cheaper for farmers who diversify into other activities to buy rice from the market. These rice ex-farmers then begin to purchase other crops such as fruits and vegetables which are more profitable but also allow consumers to diversify their diets and increase their intake of proteins, vitamins and minerals. This is a slow process under the best circumstances and must be market driven [31]. Appropriate government support for research, extension and marketing initiatives can also speed up the process.

In china, rural market reforms after 1978 provide a lesson in the role of food availability in supporting decisions by local entrepreneurs to diversify out of grain production. One of the most important policies to support the development of small scale rural industries in China was the freeing of food grain markets in rural areas in the early 1980s. This impact has not been lost on the Chinese leadership, which has committed itself to keeping domestic grain prices in line with world prices as part of their entry into World Trade Organization (WTO) [31]. Their argument is that low grain prices will maintain China's competitive advantage in labour intensive manufactures and encourage Chinese farmers to seek more profitable crop and livestock activities as a way out of the trap of low incomes from the grain production [32].

6. Conclusions

There is greatly increased awareness that rice has become a strategic commodity to fuel economic growth and to contribute toward hunger and poverty reduction across the continent. Many African countries have embarked on

ambitious programs to boost their rice production capacity. Good practices should be identified and examples of successful agricultural development should be publicized, that is, the agricultural models that will lead to sustainable development must be prioritized, if Kenya is to be food secure.

The frequency and increased intensity of extreme climatic events such as drought and floods have become additional challenges for global agriculture, which is already facing higher demand due to both population increase and new consumption habits. In order to respond to this challenge, the selection of drought resistant crops is part of the solution. Research in this area should be intensified and it should target crops with high economic potential such as rice. This crop is essential for feeding the poor, majority of whom, are in Kenya. Farmers confronted with weather vagaries or climate change should be assisted by the government in the improvement of irrigation systems.

NERICA rice variety can have a strong impact on the livelihoods of Kenyans. Detailed characterization of NERICA varieties is therefore required to support farmers' decision making. Agronomic and past harvest technology packages should be developed or released in order to enhance performance and quality. Prerequisites for enabling technologies such as NERICA to raise food security in the country include farmers having improved access to seed and information as well as favourable policies supporting the development of agricultural sector.

Policy decisions should focus on rice price stability as an important long-term objective, although the measures to achieve it need to vary with changes and shocks in production and trade. This is to ensure that the policies do not protect producers at the expense of consumers by raising the domestic prices high. Stabilized low prices are likely to alleviate poverty than prohibitively high domestic prices.

REFERENCES

[1] Africa Rice Center (AfricaRice) 2011 Boosting Africa's Rice Sector, a Research for Development Strategy 2011-2020. Cotonou, Benin.

[2] Africa rice center (AfricaRice) 2013. Africa Rice Center (AfricaRice). Annual Report 2012. Africa-wide Rice. Agronomy Taskforce. Cotonou, Benin.

[3] Alston, J.M., Chan-kang, C, Marram, C., Pardey, P.G., and Wyatt, T.F (2000) A Meta Analysis of Rates of Return to Agricultural Research and Development. Ex pede Herculem?. Research report No. 113. IFPRI, Washington D.C.

[4] Beddington, J.R., Asaduzzaman, M., Clark, M.E., Bremauntz, A.F., Guillou, M.D, Jann, M.M., Lin, E., Mamo, T., Negra, C., Nobre, C.A., Scholes, R.J, Sharma, R., Bo, N.V and Wakhungu, J (2012) The Role for Scientists in Tackling Food Insecurity and Climate Change. Journal of Agriculture and Food Security 1(10), 1-9.

[5] 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.

[6] Carletto, C., Zezza, A. and Banerjee, R (2012) Towards Better Measurement of Household Food Policy. Harmonizing Indicators and the Role of Household Surveys. Journal of Global Food Security 2 (2013), 30-40.

[7] CGIAR (2006) Transforming Trans-Saharan Africa's Rice Production Through Research. Available at http://cgiar.org/monthly/monthlystory/september/2006.

[8] CGIAR (2013) Benefits and Burdens of New Rice Varieties in Uganda. Available at http://cgiar.org/consortium

[9] Conteh, A.M.H., Yan, X., and Sankoh, F.P (2012) The Influence of Price on Rice Production in Sierra Leone. Agricultural Sciences 3(4), 462-469.

[10] 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.

[11] Export Processing Zone Authority (2005) Grain Production in Kenya. PKF consulting L.t.d. Kalamu House, Waiyaki Way, Nairobi.

[12] Fan, S., Chan-kang, C., Qian, K., and Krishnaiah, K. (2003) National and International Agricultural Research and Rural Poverty. The Case of Rice Research in India and China. EPTD Discussion Paper No. 109. IFPRI, Washington D.C, USA.

[13] Government of Kenya (GOK) 2000 Kenya: Interim Poverty Reduction Strategy Paper 2000-2003. Government printer, Nairobi, kenya.

[14] http://www.nib.or.ke

[15] Lodin, J.B (2012) Intra-household Bargaining and Distributional Outcomes Regarding NERICA Upland Rice Proceeds in Hoima District, Uganda. Sage Journals, Gender, Technology and Development 16(3), 253-278.

[16] Ministry of Agriculture (2009) National Rice Development Strategy 2008-2018. Information and Documentation Services. KARI, Nairobi.

[17] Ministry of Agriculture (2010) Economic Review of Agriculture 2010. Central Planning and project monitoring Unit. Nairobi.

[18] Monitoring African Food and Agricultural Policies (2013) Review of Food and Agricultural Policies in Kenya 2005-2011. MAFAP country Report Series. FAO, Rome, Italy.

[19] Nassirou, T.Y and He, Y (2011) NERICA.: Hope for Fighting Poverty and Hunger in Africa. Journal of Molecular Plant Breeding 2(11), 75-82.

[20] Nguezet, D.P.M, Diagne, A., Okoruwa, V.O and Ojehomon, V (2011) Impact of Improved Rice Technology on Income and Poverty among Farming Households. A local Average Treatment Effect (LATE) Approach. Contributed Paper Prepared for the 25th Conference of the Centre for the Studies of African Economies (CSAE). St. Cathrine College, University of Oxford, United Kingdom.

[21] Nguezet, D.P.M, Diagne, A., Okoruwa, V.O., Ojehomon, V and Mayong, V. (2013) Estimating the Actual and Potential

Adoption Rates and Determinants of NERICA Rice Varieties in Nigeria. Journal of Crop Improvement 27(5), 561-585.

[22] Nguyen, N.V (2006) Global Climate Changes and Rice Food Security. International rice commission, FAO, Italy, Rome.

[23] 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.

[24] Organization for Social Science Research in Eastern and Southern Africa (OSSREA) (2006) Assessment of Poverty Reduction Strategies in Sub-Saharan Africa. The case of Kenya. Addis ababa, Ethiopia.

[25] 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.

[26] Sasson, A. (2012) Food Security for Africa. An Urgent Global Challenge. Journal of Agriculture and Food Security 1(2), 1-16.

[27] Seck, P.A., Agboh-Noameshie, A., Diagne, A and Bamba, I (2013) Repackaging Agricultural Research for Greater Impact on Agricultural Growth in Africa. Journal of Food Security 1(2), 30-41.

[28] Short, C., Mulinge, W. and Witwer, M., (2013) analysis of incentives and Disincentives for Rice in Kenya. Technical Notes Series. MAFAP, FAO, Rome, Italy.

[29] Somado, E.A, R.G, R. Guei and S.O., Keya (eds) (2008) NERICA. The New Rice for Africa- a Compendium. Africa rice center (WARDA), Rome, Italy.

[30] Thirtle, C., Lin, L and Piesse, J (2003) The Impact of Agricultural Led Productivity Growth on Poverty Reduction in Africa, Asia and Latin America. Journal of World Development 31(12), 1959-1975.

[31] Timmer, C.P (2004) Food Security in Indonesia. Current Challenges and the Long Run Outlook. Center for Global Development. Working Paper No. 48.

[32] Timmer, C.P (2013) Food Security in Asia and Pacific. The Rapidly Changing Role of Rice. Asia and Pacific Studies. Wiley Online Library.

[33] Yakubu, R., Kudi, T.M and Nasa'I, D.H (2010) Comparative Analysis of Profitability of NERICA Rice and Local Rice Varieties Production in Chukun Local Government Area of Kaduna State, Nigeria. Journal of Agriculture and Social Research 10(2), 65-68.