An Overview of the "Sawah" Project and Its Implications for Future Rice Production in Ghana.

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Abstract

While farmers need improved technologies to increase production, such technologies must be easy to adopt and environmentally friendly for sustainability. Effective nutrient and water management in addition to suitable land preparation options are key factors for effective and sustainable utilization of rice growing ecosystems in Ghana. It was for these reasons that the "Sawah" system of rice production was developed and introduced to farmers. Since its introduction, not only have rice grain yield increased significantly (current yields: > 6.0 t ha^{-1} as against < 2.0 t ha^{-1} under traditional system) and could go higher with improved management, income has also correspondingly and significantly increased, thus creating an avenue for employment. In addition, it has been observed that the system supports the use of local resources to improve soil productivity. Water management, a major challenge to rice cultivation, has also significantly improved. The system is also environmentally friendly as soil movement is very minimal and land degradation almost non-existent. Since its inception, over 2000 farmers have been introduced to improved soil and water management practices either directly or indirectly with over 30 power tillers made available to farmers for land development. However, obstacles to the progressive adoption of this technology include lack of spare parts for the main machinery (power tiller - two wheel tractor) used for land preparation. Even though a few farmers have acquired these machines either individually or in groups, constant break downs accompanied by lack of spare parts poses a major challenge. Obnoxious land tenure systems which do not encourage effective planning and investment in land management is another disincentive. The initial construction of "Sawah" fields requires a sizeable commitment of resources and farmers will therefore require longer periods of guarantee over their farm lands. Ghana can increase paddy yield of between four to five fold when the "Sawah" technology is scaled out through effective policy interventions. In addition, the "Sawah" system relies more on intensification rather than extensification. While this will result in significant increases in yield per unit area, it will further reduce the amount of land cultivated, and hence a reduction in environmental degradation currently associated and aggravated by extensive cultivation.

Keywords: environment, rice paddy yields, revenue generation, rural, employment, sawah system, sustainability,

Introduction:

In Ghana naturally occurring rice growing environments mostly composed of inland valleys and river flood plains make up over one million hectors of lands. However, current rice production levels are said to be around 30% to 40% of total national requirements. Major causes for low productivity may be traced to lack of proper management of our soil resources and declining soil productivity. Several reports indicate the low fertility status of most rice growing environments in Ghana (Buri et al, 2008; 2009; 2010; 2011) and the West African sub-region (Abe et al, 2010; Buri et al, 1998; Issaka et al, 1995) as a whole. While for some time now too much emphasis has been placed on bio-technology leading to the development of improved rice varieties with higher input requirements, very little seem to have been done towards improving the environment (eco-technology) in which these improved rice varieties are grown. Hence the yield gap between real and potential continues to widen unless this problem is addressed. It has therefore been suggested that, to realize the green revolution in Africa, more and detailed research on natural resource management should be seriously and vigorously pursued (Wakatsuki et al, 2003, 2004, 2011a 2011b). In this light, the designing and implementation of comprehensive and integrated soil management programs that will not only improve and maintain soil fertility, arrest further environmental degradation but also make maximum use of limited water are necessary. The sawah system attempts to provide solutions to the outlined challenges facing rice cultivation in the country.

Materials and Methods

Following the introduction of the "Sawah" system of rice production to selected communities, mostly within the Mankran watershed (Figure 1), field developmental activities, productivity levels, and challenges facing farmers under "the improved system were monitored over the period across locations. The watershed covers an area of over 11000 ha. The project adopted two approaches: (i) developmental approach (technology transfer) where major activities conducted were farmer organization and on-the-job training (field development) for both farmers and extension staff of the Ministry of Food and Agriculture, monitoring of paddy yields of farmers' groups and estimation of revenue generated. (ii) Research and capacity building which involved the conduction of field experiments in the areas of soil, water, nutrient and environment, to improve upon the efficiency of the system and training for all levels of students, both local and international were conducted.

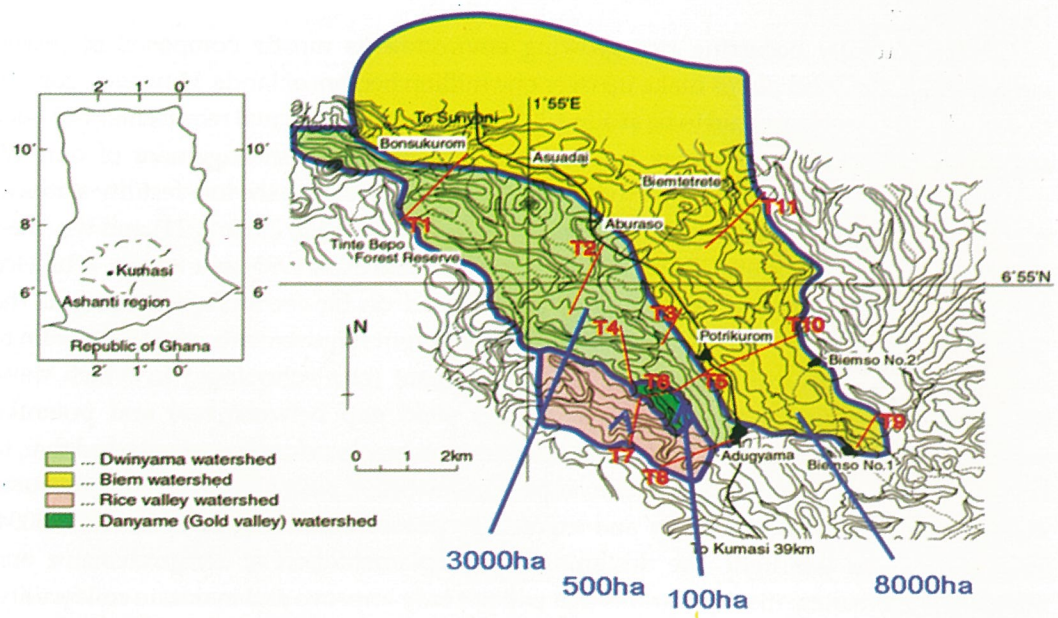

Figure 1. Map of Mankranso Watershed showing the Project Area

Results and Discussion

(a) Crop yields:

Since its introduction, farmers rice grain yields have increased significantly. "Sawah" rice farmers' now record almost 6.0 t ha^{-1} paddy as against less than 2.0 t ha^{-1} normally recorded under the traditional system (Figure 2). Mean paddy grain yield, with the introduction of "Sawah" started at 4.0 t ha^{-1} rising to a current level of almost 6.0 t ha^{-1} and could go higher with improved management. With such higher yields, the presence of guaranteed markets can serve as motivation for more farmers to go into rice production under the "Sawah" system. In addition income has also correspondingly and significantly increased (Table 4), thus creating an avenue for rural employment and increased food production with guaranteed food security.

(b) Improved fertilizer-use efficiency

Fertilizer management has been a major challenge for farmers over the years. Farmers tend to gain very little as larger amounts of applied fertilizer are not utilized by the intended crop (low-use-efficiency). Under "Sawah" systems, crop responds to applied fertilizer has been very great, an indication of a significant increase in the utilization of added nutrients. Buri et al (2007) amongst others reported of significant responses to mineral fertilizer application (particularly the macro-nutrient elements – N, P, K) from rice under the "Sawah" systems (Table 1) in

selected valleys in southern Ghana, and therefore recommended mineral fertilizer addition for effective and sustainable nutrient management. Such significant responses to mineral fertilizer additions is reflected in higher paddy yields as shown in Figure 2.

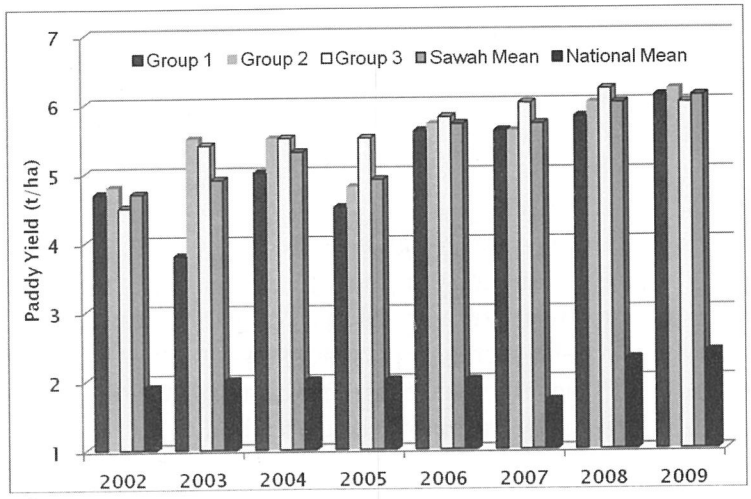

Figure 2. Comparison of yield (t ha^{-1}) performance of "Sawah" farmers with National (Ghana) mean

Table 1. Response of paddy grain yield (t ha^{-1}) to mineral fertilizer under the "Sawah" system

	Adugyama		Biemso	
(N-P_2O_5-K_2O) Kg ha^{-1}	2004	2005	2004	2005
0 - 0- 0	0.96	1.06	0.97	1.10
0 - 90 - 90	1.29	1.48	1.39	1.47
90 - 0 - 90	2.03	2.08	1.99	2.04
90 - 90 - 0	3.09	2.31	2.75	2.53
90 -90 - 90	6.84	6.89	7.07	7.11
SE	1.232	1.246	1.287	1.292

Source - Buri et al, 2007

(c) Integrated nutrient management

The affordability of mineral fertilizers by farmers is very limited. Most rural farmers cannot afford the ever rising cost of mineral fertilizers. In the light of increasing mineral fertilizer prices (farmers cannot afford to buy) and relative abundance of local amendments, an integrated approach for soil fertility management is encouraged under the "Sawah" system. This becomes easier and sustainable as farmers are trained to manage "Sawah" operation by themselves through on-the-job training and use of several locally available resources. There are several soil amendments which are common and available in most rice growing communities. As such, the use of such materials to compliment mineral fertilization has been recommended for most farmers. Depending on source and age, most soil amendments such as poultry droppings and cattle manure have been reported (Buri et al, 2008) to give significantly higher grain yields (Table 2) when used in combination with mineral fertilizers or solely. The promotion of the use of such materials will not only help increase productivity but is also sustainable and ecologically friendly. These are materials that also provide both physical and chemical support to our already fragile and depleted soils.

Table 2. Effect of integrated nutrient management under the "Sawah" system

Treatments	Paddy Grain Yield (t ha^{-1})		
	Potrikrom	Beimso I	Biemso II
Control (no manure, no mineral fertilizer)	1.68	1.59	1.50
N-P_2O_5-K_2O (120-90-90) Kg ha^{-1}	6.77	8.37	4.03
N-P_2O_5-K_2O (90-60-60) Kg ha^{-1}	6.57	7.09	3.90
Poultry Manure (7.0t ha-1)	5.96	6.36	3.82
Poultry Manure (3.5 t ha-) + Mineral fertilizer (45-30-30)	6.25	7.30	4.15
Cattle Manure (7.0 t ha-1)	4.54	6.25	3.05
Cattle manure (3.5 t ha-) + Mineral fertilizer (45-30-30)	4.86	6.49	3.72
LSD (0.05)	0.99	2.14	0.84
Mean (site)	5.23	6.09	3.58
LSD (site)		0.52	

Source - Buri et al, 2008

(d) Improved soil and water management

Under the "Sawah" system, there is improved soil and water management through the construction of bunds to retain water and puddling and levelling of the soil to enhance easy water distribution. Water management under the sawah system

implores the use of local resources. Water management structures are designed based on existing conditions within the rice growing environment and varies across locations. Issaka et al. (2008) reported that, rice grain yields across varieties significantly increased with improved soil and water management. Paddy grain yields increased in the order: farmers practice < bunded only < bunded and puddle < bunded, puddle and levelled rice fields (Table 3). Luck of proper soil and water management has been a major challenge to rice production across all agro-ecological zones in the country. The introduction of such technologies such as "Sawah" will significantly help to address such challenges. Water management structures under the sawah system can be modified to suit any ecology or prevailing conditions. Thus with significant improvement in water management under the sawah system, a solution has been found to one of the major challeges facing rice cultivation in the country.

Table 3. Rice paddy yield (t ha^{-1}) response to improved water management under the "Sawah" system

Management/Rice variety	Bouake. 189	Jusmine. 85	Sikamo	Wita 7	Mean
Year 1					
Farmers practice (no water control)	3.9	3.8	3.2	3.3	3.6
Only bunded	5.1	4.9	5.1	5.3	5.1
Bunded and puddled	6.8	5.5	6.5	6.2	6.3
Bunded, puddled and levelled	8.2	6.5	7.8	7.6	7.5
Mean	6.0	5.2	5.7	5.6	
Year 2					
Farmers practice (no water control)	3.5	3.7	2.2	3.3	3.2
Only bunded	4.2	4.0	3.2	4.5	4.0
Bunded and puddled	4.8	4.5	4.3	4.9	4.6
Bunded, puddled and levelled	6.2	5.5	5.6	5.4	5.7
Mean	4.7	4.4	3.8	4.5	
SE for each year	1.12				

Source – Issaka et al, 2008

(d) Revenue Generation

The ultimate aim of every farmer is to produce enough for home consumption and to generate enough revenue to help address other challenges. With significant increases in grain yield under the "Sawah" systems, not only are farmers able to produce enough for family consumption, but are able to make extra money from rice, to cater for other family needs. Among groups of "Sawah" rice farmers, Buri et al reported of net revenue (Table 4) ranging from US $1284 to US $1547 per hector of land. With improved yields under the "Sawah" systems, local rice cultivation can therefore serve as a major source for revenue generation and rural employment under effective and efficient management system. The realization of much revenue from rice cultivation under the sawah system can significantly lead to higher total production and possibly a significant reduction in rice imports.

Table 4. Income generated per unit area (1 ha) under the "Sawah" system (2004)

Farmer-group	Paddy Yield (kg)	Gross Revenue (US $)	Production Cost (US $)	Net Revenue (US $)
Group 1	4334	1712	428	1284
Group 2	4675	1847	350	1497
Group 3	4736	1871	324	1547
Group 4	4675	1847	349	1498
Mean	4605	1819	363	1456

Source – Buri et al, 2011

(d) Coverage:

The transfer of any technology to end users is very crucial and can influence its rate of adoption. The on-the-job training approach was adopted for the transfer of the sawah system. Currently, over 1500 farmers have been covered by the project either directly or indirectly. Over 100 hectors of lowlands have been covered with over 30 power tillers put into the fields for the on-the-job training and farmer to farmer training. About six farmers have been intensively trained and currently serve as leading famers under the farmer to farmer training, which is on-going.

(e) Challenges:

Mechanization of rice production activities is very necessary if higher production and productivity, including good quality material are to be achieved. As such the use of simple machinery is encouraged under the "Sawah" system particularly for

land preparation. Major machinery used for land preparation activities is basically the power tiller (two wheel tractor). However, obstacles to the progressive adoption of this technology which also facilitates the rate of adoption include lack of spare parts and sometimes the availability of the machine itself on the market. Even though a few farmers have acquired these machines either individually or in groups, constant break downs accompanied by lack of spare parts poses a major challenge. Obnoxious land tenure systems which do not encourage effective planning and investment in land management is another disincentive as farmer's need minimum guarantee over land before they can invest their resources. The initial construction of "Sawah" fields is quite labour intensive and requires a sizeable commitment of resources. Farmers will therefore require longer land lease periods before committing such resources in the development of their rice fields.

Conclusions:

There is increased and improved nutrient utilization under the "Sawah" system with minimum environmental effects (environmentally friendly). The system has shown to be more productive with increased grain yields, increased income, rural employment opportunities and enhances food security. With the current national mean rice paddy yield of less than 2 t ha^{-1}, Ghana can increase paddy yield of over 300% when the "Sawah" technology is widely accepted and adopted. Adoption of the technology can be accelerated through effective policy interventions. Yields can go higher when certain challenges such as spare parts, land tenure and poor post harvest practices are improved. In addition, the "Sawah" system relies on intensification rather than extensification. While this will result in significant increases in yield per unit area, it will further reduce the amount of land cultivated, and hence a reduction in environmental degradation currently associated and aggravated by extensive crop cultivation.

Recommendations.

To make a national impact, the systems needs to be introduced to rice farmers across all ago-ecological zones where rice is cultivated (scaling out), which could be through policy, legislature or otherwise. There may also be the need to relook at the current land tenure systems, which can be modernize to make farming more attractive to potential farmers. Current land tenure systems in most parts of the country are a disincentive, to particularly rice farmers. The ministry of food and agriculture could facilitate private sector participation in the import of the necessary machinery and adequate spare parts, as mechanization of rice production under the systems will significantly result in increased production and good quality rice to compete favourably with imported rice which is currently cheaper and abundant in Ghanaian markets.

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Nigerian Policy on Agricultural Mechanization and Lowland Development: SERIF Achievement Strategy

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Abstract

It is a statement of fact that increased food and fibre production is a key issue facing developing countries, especially in the African continent. The main reason being that agricultural growth rate in these countries seriously lags behind their ever increasing population. In addition, there are various natural as well as institutional constraints which militate against rapid growth in the agricultural sector. Notably among these are climatic conditions, inadequate and untimely supply of inputs, limited funds and poor technological framework. These issues need to be seriously addressed if the trend must be reversed in the new millennium. Realizing that self sufficiency in food and fibre production is a major index for assessing a nation's developmental effort, policy makers were convinced that modernization of Nigerian agriculture through introduction and development of *need-based, home grown* agricultural mechanization technologies was the only way out of the log-jam of hunger and want. It was on this premise that NCAM was established in 1974 following the acceptance of the report of a team of experts set up by the Federal Government to advise her on the possible establishment of an agricultural mechanization institution based on its perceived roles elsewhere. This paper presents the Nigerian government policy on agricultural mechanization, lowland or river basin development as well as rice development strategies and policies and also provides ways of harmonizing all these policies and strategies for the speedy realization of sawah Eco-technology for Rice Farming (SERIF) in Nigeria.

Keywords: lowland, mechanization, policy, SERIF

Introduction

In Nigeria, agriculture has remained the largest sector of the economy. It generates employment for about 70% of the population and contributes about 40% to the Gross Domestic Product (GDP) with crops accounting for 80%, livestock (13%), forestry (3%) and fishery (4%) as stated in the Nigeria National Report (2006). It plays significant roles in the nation's economic development. These roles include: (i) contribution to the country's gross domestic product, (ii) source of income and decent living for a large proportion of the population, (iii) provision of adequate

food for the people, (iv) supply of raw materials required by the industrial sector, (v) generation of foreign exchange through export, and (vi) provision of employment opportunities for the teeming population.
Nigeria has a land area of 98.3m hectares. At present about 34m hectares (48%) are under cultivation. Under the 1999 Constitution, responsibility for agricultural and rural development is shared among the federal, state and local governments. There is no doubt that considering the vast area of uncultivated land coupled with the natural fertility of its soil, Nigeria has great agricultural potentials. The Nigerian rice sector is special within the West Africa context. First, rice is primarily a cash crop in Nigeria (produced primarily for the market). Therefore, in rice producing areas, the enterprise provides employment for more than 80% of the inhabitants in various activities along the production/distribution chain. Some remarkable developments have also taken place in the sector particularly within the last ten years. Both production and consumption have increased during the period, although the increased production was not sufficient to match the consumption leading to imports to make up for the shortfall. Since rice is now a major component of the Nigerian diet and therefore takes a greater percentage of Nigerian agricultural imports, there is considerable political interest in promoting the consumption of local rice. This has made rice a highly political commodity in Nigeria.

It is a statement of fact that increased food and fibre production is a key issue facing developing countries, especially in the African continent. The main reason being that agricultural growth rate in these countries seriously lags behind their ever increasing population. In addition, there are various natural as well as institutional constraints which militate against rapid growth in the agricultural sector. Notably among these are climatic conditions, inadequate and untimely supply of inputs, limited funds and poor technological framework. These issues need to be seriously addressed if the trend must be reversed in the new millennium. Recently, some exciting developments have taken place in the agricultural sector, which should be consolidated. The sector is sustaining the 7% growth rate attained in 2003/2004. This was occasioned by some strategic programmes under the National Agricultural Policy, the National Policy on Integrated Rural Development and the National Economic Empowerment and Development Strategy (NEEDS) which are being vigorously implemented in the various sub sectors within the limits of available resources. This paper will attempt to enumerate some of the experiences and achievements already being recorded under some of these strategic programmes:

(a) National Agricultural Policy

In an attempt to tackle the problems facing the Agricultural Sector in Nigeria, Government has put in place the National Agricultural Policy, which was jointly formulated by national stakeholders and International Development Partners and approved by the Federal Government in 2002. The major components of the National Agricultural Policy feed the National Economic Empowerment and Development Strategy (NEEDS) document. The National Economic Empowerment and Development Strategy (NEEDS) document adequately responds to the demands and strategies of the Millennium Development Goals (MDG).

Specifically, the National Agricultural Policy assigns supportive roles to the government, while investments in the sector are left to the private sector. The broad objectives of the National Agricultural Policy include: Promoting self-sufficiency in food and raw materials for industries; recognizing that agriculture is business, promoting reliance on local resources; diversification of the sources of foreign exchange earnings through increased agricultural exports arising from adoption of appropriate technologies.

(b) Agricultural Mechanization Policy

Realizing that self-sufficiency in food and fibre production is a major index for assessing a nation's developmental effort, policy makers were convinced that modernization of Nigerian agriculture through introduction and development of need-based, home grown agricultural mechanization technologies was a way out of the log-jam of hunger and want. It was on this premise that the National Centre for Agricultural Mechanization (NCAM) was established in 1974. NCAM is under the Federal Ministry of Agriculture and was established as a research and development Centre with the primary mandate to fast- track the positive transformation of the Nigerian agriculture through the use of appropriate mechanization technologies. This mandate is being achieved through the following specific functions: (i) to encourage and engage in adaptive and innovative research towards the development of indigenous machines for farming and processing techniques, (ii) to design and develop simple and low cost equipment which can be manufactured with local materials, skills and facilities, (iii) to standardize and certify, in collaboration with the Standards Organization of Nigeria (SON), agricultural machines, equipment and engineering practices in use in Nigeria, (iv) to bring into focus mechanical technologies and equipment developed by various institutions, agencies or bodies and evaluate their suitability for adoption, (v) to assist in the

commercialization of proven machines, equipment, tools and techniques, (vi) to disseminate information on methods and programmes for achieving speedy agricultural mechanization, and (vii) to provide training facilities by organizing courses and seminars specially designed to ensure sufficiently trained manpower for appropriate mechanization.

NCAM, being the only agricultural mechanization outfit with her peculiar mandate is not only accredited by the Federal Government of Nigeria but also standardizes, tests and certifies the production and utilization of agricultural machineries, tools, and equipment in Nigeria. The standardization component is done in liaison with the Standards Organization of Nigeria (SON). For instance, all tractors imported into the country, today must be tested and certified by NCAM.

(c) Rice Policy

Rice production in Nigeria is dominated by small holder farmers with 0.5 - 1.5 hectare per farmer, relying on manual labour for all operations. Presently over 52 rice varieties with yield potentials of 2 – 8 tonnes of paddy per hectare and maturity periods of 95 – 140 days have been developed by both National and International Research Institutions. Most of these varieties have been found to be suitable for cultivation in diverse agro ecological zones. Current national demand for rice is estimated at 5.0 million metric tonnes of milled rice while the current production status is estimated at 3.0 million metric tonnes leaving a deficit of 2.0 million metric tonnes which has to be provided through imports. Thus, the urgent need to address the production constraints for increasing output to satisfy domestic consumption and even produce for export becomes paramount. Prior to the oil boom of the 1970s, the government placed a high tariff on imported rice at about 66%. In 1974, the tariff on rice was reduced to 20% and further reduced in 1975. This led to increased importation of cheaper rice which provided disincentive to local farmers who stopped growing rice because they could not compete with cheaper imports. However, during the Nigerian second republic, the elected government decided to restrict the importation of rice and later in December 1980 introduced the presidential task force on rice. Two months earlier, rice was placed under a general import license. Both systems later became embroiled in controversy. From 1985 up to 1995, rice importatation was totally banned. In 1995, a tariff system was re-introduced with a 100% tariff (Wikipedia online encyclopaedia).

(d) Trade Policy

Nigeria has employed various trade policy instruments such as tariff, import restrictions, and outright ban on rice import at various times. During the 1970s and

early 1980s, increased export earnings coupled with the highly over valued exchange rate of the naira made it possible for Nigeria to finance huge food imports. The high naira exchange rate cheapened food imports and consequently helped to depress domestic prices. Large importation of food items especially rice was allowed into the country at relatively cheap prices. This eroded the competitiveness of domestically produced rice and served as major disincentive to rice farmers.

(e) Fertilizer Policy

Nigeria has been largely an importer of fertilizer. Domestic production of fertilizer on a significant scale did not begin until 1987. Subsidy on fertilizer was introduced in 1976. By this, fertilizer which was largely imported by the federal government was distributed to farmers at prices below the cost of importation. Subsidy on fertilizer was completely removed in 1997 before the inauguration of the democratic government in May 1999. After the inauguration, however, the federal government re-introduced fertilizer subsidy to the tune of 25%. After six months in February 2000, government completely liberalized procurement, trade and distribution of agricultural inputs including fertilizer. By this policy, the authority to import agricultural inputs including fertilizer became vested in the hands of private individuals and firms, (Daramola, 2005).

(f) National Seed Policy and Seed Development Plan

A policy that stresses the importance of ensuring adequate supply of good quality seeds at affordable prices for both rice and other crops is currently in place. The major objective of this policy is to provide a framework for future development of the seed sub-sector through: (i) establishment and governmental support of varietal improvement, registration, release and multiplication of released varieties, (ii) re-organisation of both the public and private sectors involved in the seed industry and (iii) encouragement of the private sector participation and take-over by the seed industry.

(g) Land Policy

In Nigeria, land provides source of livelihood to over 90 percent of the population. This explains why the first law of society was a land law. Prior to the promulgation of the land use decree of 1978, different land law operated among the regions of the federation. In the Northern region, the land belongs to the state. The emirs and chief supervised the use of land and issued out certificates of occupancy. The people have the right to use the land but not to own it. But in the Eastern region there were individually owned small pieces of land. Also, the communal lands were owned by

the village, town or clan. The ownership of land in the Western region was a bit similar to that of the East. There were the communal (held on tribal, village, clan or family basis), collective (a group of people buy and share lands) and individual ownership. On the agricultural scene, millions of independent peasant farmers control land and cultivate a variety of crops including rice. The land use decree was promulgated in 1978. The decree did not alter the Northern region traditional land tenure system but changed the system that operated in the East and Western regions. The ownership of land in each state was vested in the state governments in trust for the people of the state.

(h) International Trade Policies Affecting the Nigerian Domestic Rice Production

There is virtually none. Nigeria is an importing country and may be affected by international trade policies only to the extent that such policies affect countries from which Nigeria imports rice. Nigeria does not have the 'Agreement on Agriculture' reduction commitments. She does not have either regional or bilateral trade agreement that affects rice trade and production. But as stated earlier, the structural adjustment programme tended to have restored Nigeria's ability to produce rice, having created an environment that made local production somewhat profitable but not fully competitive with imports, (Akande, 2005)

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The rice needs of Nigeria will be significantly addressed if the following can be considered.

(i) The present agricultural mechanization level in Nigeria shows that agricultural work done with engine powered technology is estimated at only 3%, hand tools application stands at 90% and animal drawn technology takes 7% (Onwualu and Pawa, 2004). The number of serviceable tractors available nationwide is estimated at 30,000 units. Further actions are therefore required from the Federal government, with the support of development partners, such as JICA, JIRCAS, and the World Bank to provide incentives for appropriate mechanization intervention.

(ii) Sustainable agricultural production is realized by balanced application at farmers' field of both (1) Varietal improvement through biotechnology and (2) the improvement of rice ecological environment through eco-technology. In comparison to the biotechnological research and technology development, eco-

technological research and technology development have been largely neglected in Nigeria. The eco-technological research and development gap has to be bridged.

(iii) Low rice yield despite huge investment in agricultural inputs is a serious issue to be addressed. Thus, the 'sawah' eco-technology is the prerequisite condition to apply the three green revolution technologies of High Yielding Varieties, Fertilizer and Irrigation successfully.

(iv) There is a wide gap between rice yield on research fields (7-9 ton/ha) and farmers' field (1-2.2 ton/ha) in Nigeria. This is because results of research work in the various national research institutes are not well transferred to the farmers. To address this problem, the 'Sawah' Project can use the Participatory Learning and Action Research (PLAR) as well as Participatory Varietal Selection (PVS) approaches to bridge this gap.

(v) Upland ecologies are cultivated at the expense of the forest leaving the lowland under-utilized. This situation encourages deforestation and consequently contribute to global warming. Lowland development should be the major focus of the 'Sawah' eco-technology project. This will help to combat global warming too.

Conclusion.

Many a times the Nigeria government does not have problem with policy making. Policy implementation however has been lacking, largely because the political will to make them succeed has been weak. However, the current Presidential Initiative on rice provides the enabling environment for private sector-led rice production. Rice farmers and processors receive government support through provision of inputs and services at affordable prices as private sector operators. The Presidential Initiative on Rice Production, Processing and Export laid a solid foundation for sustainable rice production and development in Nigeria. However, a lot still needs to be done in order to make rice production and processing to become internationally competitive especially under zero tariff regimes. There are a few areas that need closer investigation and attention by policy-makers in order to make the rice sub-sector more competitive. These areas include; strengthening of the rice processors associations by building their capacities through training on value addition, consumers' preference and packaging.

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