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Review

Irrigation potentials and rice self-sufficiency in Nigeria: A review

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Nigeria has abundant land and water resources to embark on irrigation schemes to ensure all year round rice production. Additional yield to annual rice production through dry season farming in 2012 in 10 pilot States of the country was found to be over 1 million metric tonnes. This shows that an intensive and consistent irrigated rice production scheme will set Nigeria on a pathway to rice self-sufficiency thereby bringing an end to the gross loss in foreign exchange due to importation and smuggling of the commodity. The study reviewed irrigation subsector in Nigeria, and revealed that the prospects of achieving rice self sufficiency through irrigation farming is hampered by some major challenges namely-underdeveloped subsector promoted by fragmented, inconsistent and unimplemented policies, multiple water regulatory institutions with overlapping and duplicating mandate and poor management system. Other challenges include- the absence of a viable market for local rice as well as high cost of labour inputs, irrigation equipments and other operating costs. The study concluded that for Nigeria irrigation potentials to be harnessed towards rice self-sufficiency there is need to amend policies on irrigation and water resources, create conducive market for local producers and provide subsidized and appropriate farm implements.

Key words: Irrigation potentials, rice self-sufficiency, challenges, Nigeria.

INTRODUCTION

Nigeria with an estimated 183, 523, 43 people is the most populous country in Africa (World Bank, 2014a). Increase in population growth rate, youth bulge, increasing urbanization, changes in dietary needs of the people as well as being a staple food has resulted in increase in the consumption of rice.

As a staple food in the diet of most Nigerians, there is a high demand for rice which has cumulated in a huge gap between the supply and demand for rice. In the last decade rice consumption has increased at an annual average rate of 10.3% (Maji et al., 2015). The per capita consumption of rice has grown from 3 kg in the 1960s to an estimated 37.5 kg in 2014 (UARK, 2015) and is expected to increase due to increase in population and urbanization.

Though production has also increased over the years from an average of 300,000 tonnes in the 1990s to over 4 million tonnes in the year 2013 (FAOSTAT, 2015) the

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increase in production has being by expansion in area harvested to rice which has increased from 14,000ha in the 1960s, and has grown through the years to 2,863.815 ha in the year 2013. But to meet the demand of the growing population, Talpur (2011) is of the view that intensification of yield from each unit of land harvested to a crop must be increased.

The inability of local supply to meet up with rice consumption needs has resulted in high imports of rice. The phenomenal rise in imports of 300 thousand tones annually in recent times has continued to drain the country of about ₦300 million annually in foreign reserves- on the average. Aside from the huge finances, rice imports exposes the country to international market shocks (in times of scarcity and rise in prices) thus with serious risk to food security.

To reduce the volume of imports and reduce external shocks, the Nigerian government over the years has formulated and used various policy instruments and interventions to boost local production. Some of these measures include: import restrictions, tariff restriction, and inauguration of presidential taskforce on rice (in 1980), inputs subsidies and ban on imports 1986-1995. These policies were put in place to stimulate local production and make local rice more competitive.

In 2003 the Federal Government set up a presidential initiative on rice production with the aim to become rice sufficient in 2007. The objective was to eliminate imports and generate exportable surplus and enhance food security through the production of 6 million tonnes of milled rice by the year 2005. A tariff of 100% was imposed then on rice imports (Daramola, 2005) and a levy of 10%.

Efforts to make the country become rice self sufficient was again renewed in 2010 which led to the formal lunch of the rice transformation strategy under the agricultural transformation agenda (ATA). The strategy was to produce more paddy and industrial grade milled rice that could compete with imported rice in the market. Since Nigeria has two production seasons; the raining season and the dry season. To this end, 268, 000 farmers were given leverage through subsidies in seeds, fertilizers, provision of watering pumps for irrigation farming in ten (10) states of the north namely: Niger, Kebbi, Sokoto, Kano, Zamfara, Bauchi Jigawa Katsina, kogi and Gombe. Other measures include; 35% tariff on brown rice imports, the establishment of fourteen integrated rice mills with capacity of 240,000 metric tonnes and also a tariff of 110% was imposed on rice imports in 2014. Also in June 23 2015 the CBN banned the sale of the foreign exchange to rice importers as a prohibition to discourage import.

Reports from the 2012 production activities in the 10 states showed that over 1 million metric tonnes of rice was harvested in the dry season irrigation farming (Adesina, 2013). A total of 2,170,000 metric tonnes was being expected from the dry and wet season farming from these 10 states. This has led to a downward review of 1.3 metric tonnes import quota for the year 2015 from 1.5 million metric tonnes of 2014. Though Nigeria has not attained self sufficiency as desired but a significant decrease has been observed in rice imports as shown in the proposed 2015 imports figures.

Most of the increase in local production has been attributed to irrigation farming embarked on in the 10 pilot states. Considering that Nigeria is well endowed with water and land resources for irrigation farming, utilization of these resources can close the demand supply gap of rice in the country. A considerable increase in production is essential for Nigeria to meet up with the growing demand considering its fast growing population. Meanwhile the Nigerian rice irrigation production has been left underdeveloped. Rice production generally in Nigeria is rain fed dependent, only about 293.000 ha of irrigable land has been equipped for irrigation and only about 218, 800 ha is being actually irrigated with about 173, 000 ha under private small scale while, 29,000 ha is under public irrigation scheme (FAO-Aquastat 2005).

An upgrade to irrigation will increase production significantly since it offers an opportunity for intensity in production of two to three times production in a year.

This paper therefore looks at challenges and also the potentials of irrigation farming in assisting Nigeria in attaining the desired rice self-sufficiency (Figures 1 and 2).

HISTORY OF IRRIGATION IN NIGERIA

The history of irrigated crop cultivation in Nigeria dates back to the Colonial era but became more pronounced after the drought of 1970-1975 (postcolonial era). The need for continuous cultivation to escape the hardship of food shortage and insecurity led to emphasis on irrigation practice. Irrigation practice was initially mostly traditional (used by small scale farmers) in form of FADAMA, gravity or natural flow, calabash/bucket and pump methods and the facilities were provided and maintained by farmers with no assistance from government or donor organizations (Yahaya, 2002; Umar, 1994). As the need for irrigated crop cultivation grew between 1972 and 1974, three pilot public irrigation schemes were developed namely; Bakolori scheme, Kano river irrigation scheme and the Chad Basin scheme (NINCID, 2015)

Consequently, the success of the pilot irrigation schemes in mitigating the adverse effect of the early 1970s drought further led to the insightful development of 12 River Basin Development Authorities (RBDAs) across the country by the Nigerian government (FAO and US Bureau, 1970). These RBDAs include the; Upper Benue Basin, Lake Chad Basin, Benin-Owena Basin, Sokoto-Rima Basin, Itadejia-Jema'a, Iyola Basin, Maiduguri Basin, Lower Benue Basin, Cross River Basin, Ogun-Osun Basin, Anambra-Imo, Niger Basin.

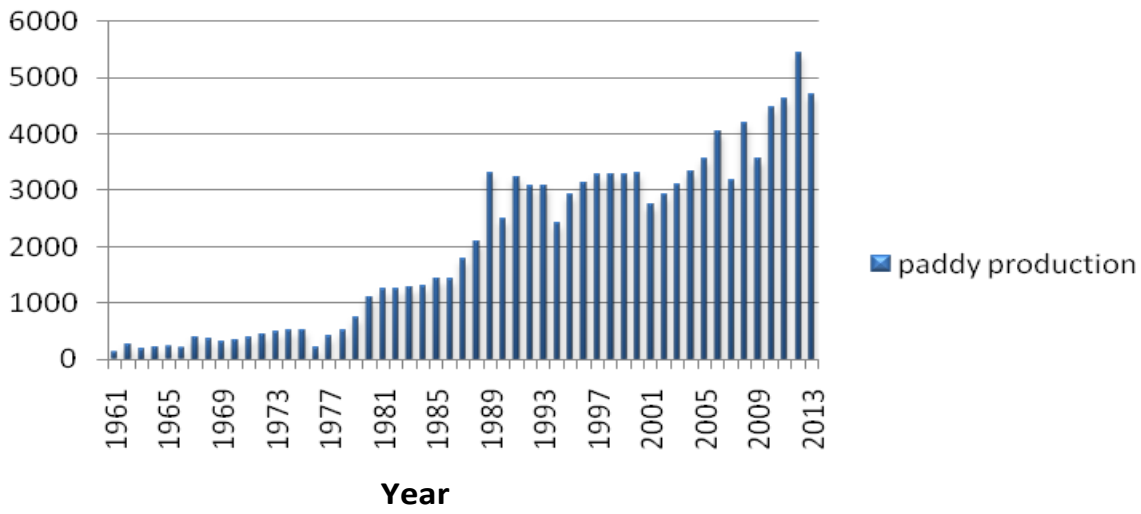

Figure 1. Rice paddy production in Nigeria 1961-2013. Authors illustration, data source: Fishfact (2014-2015).

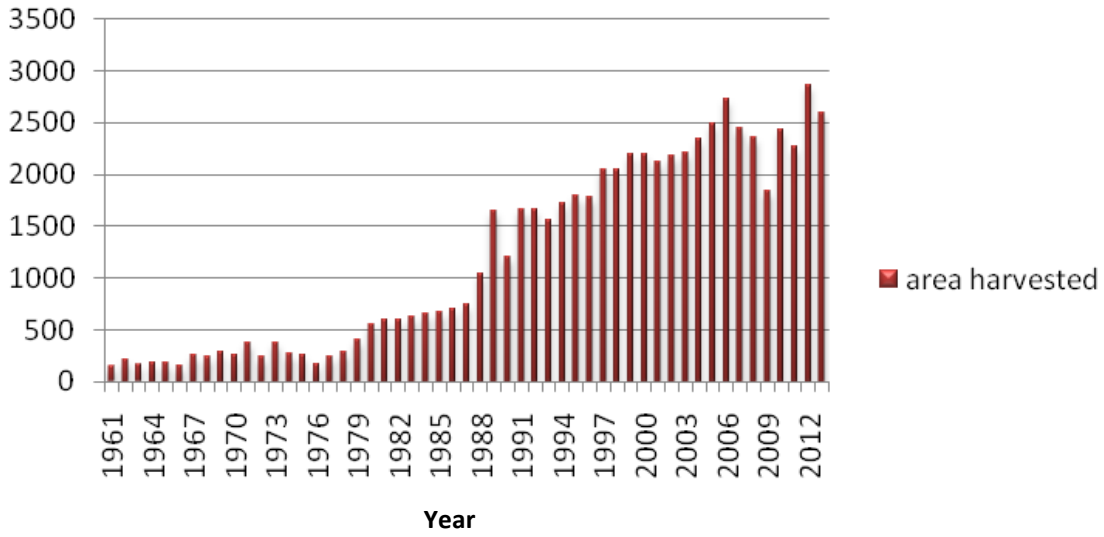

Figure 2. Area harvested to rice in Nigeria 1961-2013. Authors illustration, data source: Fishfact (2014-2015).

These RBDAs had the mandate of providing water for irrigation and domestic water supply, hydroelectric power generation, flood control, recreation facilities, fisheries projects and navigation improvement. RBDAs were also saddled with engendering big plantation farming and encouraging the establishment of industrial complexes that could bring about private-public business partnership, seed multiplication, livestock breeding and food processing. However, overburdening of the RBDAs with responsibilities and inconsistency in RBDAs policy framework has led to their inability to fulfill their core purpose of establishment as regards irrigated farming.

Until the establishment of these RBDAs, the water resource development for agricultural purposes was in the hands of the private sector. A notable example was in the production of sugar cane with few crops notably rice and vegetables by the States in Nigeria's northern part. Irrigation practice was mainly based on using residual flood waters and low lands (FADAMA-flash flood plains) and supplemented with the Shadoof (bucket-left system irrigation which originated from Sudan and introduced in Nigeria over a century ago). The major FADAMA areas were located along the flood plains of Rima, Sokoto, Niger, Benue and Yobe rivers.

Aside from the government, donor organisations like the World Bank and the Food and Agriculture Organisation (FAO) are today seen at the core of promoting irrigation practice in Nigeria. Promotion of

pumps and tube wells started in the late 1980s through the Agricultural Development Programmes (ADPs). By 1992 more than 80 thousand pumps each irrigating between 0.5-1ha had been distributed. From 1992 to 1999 the National FADAMA Development Project (NFDP) of the World Bank built on the ADP achievement and was able to distribute 55 thousand pump sets with an equipped area of 1ha per pump.

The FAO commenced a Special Food Security (SPFS) project in 1999 in three villages in Kano State through a participatory community development approach where farmers were responsible for planning and have ownership of the project. Motorized pumps and tube wells were provided for irrigation to meet the needs of farmers cultivating a total of 280 ha. After the success of this pilot scheme, the project was extended to the 36 States of the Federation and an additional 109 sites in 2002. By 2004, cultivated land area equipped for irrigation within the country was around 293117 ha (FAO, 2005).

Today, three main irrigation schemes exist in Nigeria they include: public irrigation schemes- which are systems controlled by the government and are popularly called formal irrigation, the farmer-owned and operated irrigation scheme, which receives assistance from government inform of subsidies and trainings (informal irrigation) and the residual flood plain FADAMA (purely traditional irrigation practice) which has now emerged in the World Bank assisted programme which started in the National FADAMA Development Programmes (NFDP).

While the initial purpose of irrigation development in Nigeria was based in part on the need to sustain growth in food supply that will in the long run lead to national food security, the attainment of this height is yet a mirage in rice production.

RICE PRODUCTION ECOLOGIES IN NIGERIA

Rice is produced in all agro ecological zones of Nigeria with the middle belt being the highest producer and enjoys comparative advantage in production over other parts of Nigeria (FAO, 2013). The potential land for rice production in Nigeria is between 4.6 to 4.9 million ha (Imolehin, 1991) of this rice is cultivated on an estimated 3.7 million ha covering about 10.6% of farmland that is under crop cultivation in the country (Cadoni et al., 2013). Rice production in Nigeria is majorly rain fed which represent about 77% of production. The rain fed production systems include:

Rain-fed upland ecology

Crops depend strictly on rain for growth and productivity in this ecology (Imolehin and Wada, 1999). This ecology accounts for about 30% of share of area cultivated to rice (Singh et al., 1997; Kebbeh et al., 2003), 17% share of domestic production and are characterized with average low yields of 1.7 tonnes/ha (Kebbeh et al., 2003).

Rain-fed low land ecology

Rice is produced in low land wet soils zone and it's the most favored ecology in the country given its resistance to drought (Kebbeh et al., 2003). An estimated 47% area is cultivated to lowland rice and it accounts for 57% of domestic production and an average yield of 2 tonnes/ha (Singh et al*.,* 1997; Kebbeh et al., 2003). Other rice producing ecologies include

Mangrove swamp

It covers 1% of land cultivated to rice but only 100ha has been developed so far (Imolehin and Wada, 1999). It contributes 1% to the total domestic production (Singh et al., 1997; Kebbeh et al., 2003) and characterized by low yields of about 2 tonnes/ha (Kebbeh et al., 2003).

Deep water floating rice ecology

This ecology covers about 5% of rice production area (Singh et al., 1997; Kebbeh et al., 2003), about 3% domestic share of rice and yields of about 1.3 tonnes/ha (Kebbeh et al., 2003).

Irrigated rice ecology

This ecology is the most recently developed ecology in Nigeria (Imolehin and Wada, 1999). This ecology is mostly found in the northern part of the country, irrigation water is being supplied from dams, bore holes and wells to supplement for rainfall which is not in much supply. This ecology accounts for about 17% of area share of rice production and 27% of domestic production. This ecology is characterized by average yields of 3.5 tonnes/ha but has high yields potentials of about 5-6 tonnes (Kebbeh et al., 2003) this ecology is noted to have best performance in terms of yields. It is therefore important that effort is made to develop this sector to its full potentials (Table 1).

IRRIGATION POTENTIALS IN NIGERIA

Water resources

About 221 km^3 of water resources are produced annually while total renewable water resources are estimated at 286.2 km^3 (FAO et al 2014). About 214 km^3 makes up surface water and the exploitable surface flow is about 96 km^3/ year while the volume of available groundwater

Table 1. Rice producing ecologies in Nigeria.

Production ecology	Major states covered	Estimated share of National rice-farmed area (%)	Share of total domestic production (%)	Average yield/ha in tonnes	Potential yield/ha in tonnes
Rainfed upland	Ogun, Ondo, Abua, Osun, Ekiti, Oyo, Edo, Delta, Niger, Kwara, Kogi, Sokoto, Kebbi, Kaduna, FCT, and Benue	30	17	1.7	3.5
Rainfed lowland (FADAMA)	Adamawa, Ebonyi, Ondo, Ekiti, Edo, Delta, Rivers, Bayelsa, Cross River, Akwa Ibom, Lagos, all major river valleys	47	53	2.2	5
Irrigated	Adamawa, Niger, Sokoto, Kebbi, Borno, Benue, Kogi, Anambra, Enugu, Ebonyi, Cross River, Kano, Lagos, Kwata, Akwa, Ibom, Ogun	17	27	3.5	6-7
Deep water floating	Flooded areas: Rima Valley in Kebbu State and deep floofef areas of Delta State	5	3	1.3	2.5
Mangrove swamp	Ondo, Delta, Edo, Rivers, Bayelsa, Cross River, Akwa Ibom	1	1	2	4

Source: Ezedinma (2008).

stands at 87 km^3. Extractable ground water is 59.51 km^3 (FAO et al., 2014). The permeable (sedimentary acquifers) ground water is distributed in about 10 provinces in Nigeria, these provinces include: coastal alluvium, river valley alluvium, dahomy basin, kerri-kerri formation, Chad basin, sokoto basin, middle Niger basin, Anambara basin, Cross river basin and Benue basin (Matins, 2001). The Chad and the Sokoto basins lie along the northern international boundaries with sokoto representing Nigeria's segment of the internationally shared Iullemeden Aquifer System (IAS). To the south, Nigeria also has its share of ground waters- the trans-boundary costal aquifers of the Gulf of Guinea Tano and Keta Aquifer Systems (Goldface-Irokalibe, 2008). Water resources from external sources (republic of Niger, republic of Benin and the republic of Cameroon) make up an estimated 65.2 km^3/year of the surface water.

Inland, the country has very rich and abundant water resources with well drained land by rivers and streams some of which are seasonal (Gold-face, 2008; Takeshima and Adesugba, 2014; FAO, 2015). The surface water resource can be assessed by the major drainage basins covering various areas. These basins include; Niger basin, Lake Chad basin, the West Coast and West Central basins.

The country also has local ground water in shallow alluvial (FADAMA) acquifers adjacent to major rivers (FAO et al., 2014) and extensive ground waters in 8 hydrological areas namely: Niger North, Niger central, upper Benue, lower Benue, Niger south, western littoral, eastern littoral and the Lake Chad (FAO et al., 2014; Oyebande, 2015a). These are drained mainly by the River Niger, River Benue, Lake Chad and also the Oguta Lake and their several minor tributaries and rivers that discharge into them. Other perennial rivers that serve drainage include the Gongola, Hadejia-Jama'are, Kaduna, Zamfara and Yobe in the north, and the Ogun, Osun, Imo, Cross and Anambara rivers in the south (Goldface-Irokalibe, 2008).

The Niger River has an estimated annual drainage of 127 km^3 accounting for over 50% of the runoffs. The Niger River is shared by eleven countries and Nigeria benefits the most as 26% of its drainage lies within its boundaries (Matins, 2001). The river also houses the three major dams-

Table 2. Equipped and actual irrigation areas in Nigeria 2014.

Scheme type	Equipped area (ha)	Actual irrigated area (ha)	Actual irrigated as percentage (%) of equipped area
River basin development authorities	92,317	29,140	32
State schemes	12,200	6,700	55
Private sector- sugar schemes	5,600	0	0
Private small scale schemes	128,000	128,000	100
Improved FADAMA(equipped low land	55,000	55,000	100
Total	293,117	218,840	75

Source: World Bank (2014b).

the Kainji, Shiroro and Jebba (Martins and Olofin, 1992). The damming capacity of the country's water resources is estimated to be 45.6 km^3 (FAO et al., 2014).

There are a total of 200 dams in Nigeria as reported by Gold-face (2008) with 18 others (some of which are ongoing projects while others are in the pipe line to be constructed). Also, a total of other 83 water projects (ongoing and proposed) as reported by FAO et al. (2014) under the "Water for agriculture and energy: Nigeria". These projects are to expand irrigation to achieve the goals of the vision 20: 2020 aimed on transforming Agriculture to a sustainable profitable sector. These water projects include provision of boreholes, rehabilitation of existing dams and water reservoirs construction etc. These existing dams and ongoing irrigation projects are clear indications of irrigation development and are thus prospects for irrigation rice farming and self-sufficiency in rice production in Nigeria.

Also under the Agricultural transformation Agenda (ATA), (which also builds on the vision 20:2020) the federal government with the assistance of the world bank has proposed a rehabilitation of three major irrigation sites in the north; the Bakolori and Rima all in Sokoto states, Hadejia jama" are in Kano and the Dadin kowa in the old Gongola State. With so many large water bodies of lakes and water reservoirs Nigeria has the potentials to engage in irrigation farming.

However, the water resources of the country are reportedly being underutilized, for example in 2000 it was reported that the water withdrawal for agriculture is only 5.5 km^3. This could be explained by the findings of Valipour (2015a) that irrigation water requirement is affected by river basin management, water allocation policies and agricultural expansion which has earlier been discussed to be poor in Nigeria. Therefore, Nigeria needs the right policies for sustainable growth in the irrigation sector.

Land resource

The exact amount of land under irrigation in Nigeria is difficult to estimate because as observed by NINCID (2015), there is no commonly agreed definition of irrigation adopted by researchers and agencies. However, irrigation land potentials according to the estimates reported by FAO et al. (2014) vary from between 1.5 to 3.14 million hectares. According to this report, the potential irrigable land area is about 2.1 million ha. Of this, about 1.6 million ha is irrigable from surface water while 0.5million ha from ground water. Though, areas suitable for irrigation from ground water are yet to be assessed. However the World Bank (2014a) reported that areas which were equipped for irrigation at the FADAMA and for private small scale irrigation schemes are fully utilized while those for the RBDAs and sugar estate as well as the state development schemes are left underutilized. This situation shows potentials in land resources yet to be tapped.

About 150 new projects covering one million hectares of irrigable land, including dams, diver dams, inter basin water transfer and river training has been proposed for future implementation (Oyebande, 2015b). There are therefore, immense opportunities for prosperity for the Nigerian rice farmers and for development in the rice subsector (Table 2).

Higher returns over other ecologies

Irrigation is a technological input and productivity enhancing investment that stands out strongly as a result of its role in stabilizing yields (Sakairi, 2004). In addition to yield stabilization it avails the farmer the opportunity of multiple cropping in a year. Other advantages of irrigation farming that places it above other production systems is the fact that it increases food production and decreases

Table 3. Cost and returns structure to irrigation farming in Oshin irrigation scheme Nigeria (naira/ha).

Item	Averages
(a) Gross revenue (G.R) Less	76,833.61
(b) Total variation cost (TVC)	35,555.33
Seeds	3003.1
Agro-chemicals eg fertilizer, insecticide	10000.0
Hired labour	14773.2
Marketing/Transport Equals	7797.03
(c) Gross Margin (GM) Less	41278.3
Imputed interest on capital Less	1923.1
Imputed rental value of land Less	1500.0
Depreciations on hoes, cutlass, and other farm tools Less	2280.4
Imputed cost of family labour Equals	2034.9
Returns to Farmer's Labour and Management (RLM)	33539.5

Source: Fakayode et al. (2010).

the economic efforts of drought (Civil Engineers, 2015). This characteristics is of paramount importance in Nigeria in the face of climate change which has brought uncertainty to weather conditions in the country most especially in the northern part of the country which account for major food crops production in Nigeria e.g. cereals. Evidence from empirical studies has shown that higher yields are observed in irrigated crops particularly in rice. Average yields of 3.5 tonnes/ha has been observed in irrigated rice in Nigeria as against 2 tonnes/ha obtained in rain fed rice production even though these figures are far below observed yields of 6 tonnes/ha in other countries (Kebbeh et al., 2003).

These increases in yields are associated with a shift from traditional rice verities to modern varieties and also a shift in planting technique-from broadcasting to transplanting as well as increased in the use of other inputs like fertilizers (Mongkolsmai and Mark, 1989).

Irrigation has also been referred to as a driving force of agricultural income for farmers and the nation at large in that there is an opportunity for multiple harvests annually. Fakayode et al. (2010) in a study carried out at Oshin irrigation scheme in Kwara state reported that irrigation farming is profitable (Table 3). A farmer makes a return of about ₦33, 000 per hectare of irrigated rice. It is expected that since irrigation offers opportunity for multiple cropping a farmer will earn more income annually. These attributes of irrigation places it above other production ecology and offers high potentials for rice farmers and Nigeria as a whole towards the attainment of rice self-sufficiency and consequently food security in the near future.

CHALLENGES OF IRRIGATION IN NIGERIA

Policies and institutions

Policy fragmentation, implementation and inconsistency have been a major challenge in Nigeria and irrigation policies are not an exception. Water and agriculture policies have usually been developed independently by various government (formulating) agencies. Although the Federal Ministry of Water Resources (FMWR) has overall responsibility for formulating policies for irrigation development in Nigeria, the State Irrigation departments (SID) and River Basin Development Authorities (RBDAs) and the Federal Ministry of Agriculture and Rural Development (FMARD) also carry out their independent activities sometimes different from those of the FMWR. This situation has led to a fragmented and conflicting approach to irrigation development and resulted into a sort of competing rather than cooperating and complimenting approach (Goldface-Irokalibe, 2008; World Bank, 2014).

The World Bank (2014b) asserted that since the 1970s when the Federal government of Nigeria embarked on dam construction and large scale surface irrigation schemes, a number of policy documents have been produced. Only between 1998 and 2007, there were several policies and documents on irrigation which include; National Water Resources (NWR) policy, Draft of National Irrigation Policy, Water resources infrastructure operation and maintenance policy and financial report of the water resource strategy. Also, there is the NWR bill being currently prepared. This bill is in line with the global principles of Integrated Water Resources builds on much of the earlier works on irrigation and is aimed at addressing some of the irregularities of existing water policies in the country. The main component of the bill includes:

i. Assigning regulatory responsible to the Nigerian Integrated Water Resources Management commission (NIWRMC) an independent regulatory body and the water resource development to RBDAs.
ii. Promoting stakeholders participation in water

management such as Water Users Association (WUA).

However, except for a few countries like Egypt, Djibouti, and Ethiopia, Africa generally has an unfavorable/weak water management and land use policies (Valipour, 2014a). This weak framework has been a major challenge over the years particularly in Nigeria. A typical example is the RBDAs which according to Section 4(1) a-d of the RBDA Act has vested powers to construct and maintain irrigation dams and drainage system, supply water to all users, construct and maintain infrastructural services including roads and bridges in various project sites. Researchers (Goldface-Irokalibe, 2008; Worldbank, 2014) have identified inherent flaws in the Act and establishment of the institutions. Some of these flaws include RBDAs being simultaneous suppliers, regulators and consumers of water- engendering a conflict of interest. It has also been observed that rather than on hydrological boundaries, the operational domains of the country's RBDAs were chosen based on political boundaries. Goldface-Irokalibe (2008) argued that this political sentiments in delineating operational locations has led to RBDAs pursuing independent and single minded activities based on prevailing situations in their different local domains, thereby, resulting to lack of coordination between RBDAs and an unstable approach to water management. Another notable flaw is the empowerment of the RBDAs to supply water from their completed storage schemes to users for a fee to be determined by the concerned RBDA leaving the Authorities with no powers of recovering charges in any events of users defaulting.

The many policy documents and institutions all have common challenges which have led to somersaults in policies. Some of these challenges include the following:

1. A number of institutions have overlapping functions and duplication of mandates which are controlled by government with poor coordination. The result of this confliction is massive infrastructure procurement with little attention to operations and maintenance needs. And a lack of inter-sectoral coordination with each segment pursuing its independent agenda. This is so because of the institutional arrangement in the country's water resources (Goldface-Irokalibe, 2008) which has the Federal Government through the FMAWR (including 12 River Basin Development Authorities (RBDAs) and National Water Resources Institute (NWRI) – responsible for formulating and coordinating national water policies, development and management of large water resources infrastructure, dams, reservoirs, irrigation and water supply schemes.

The State Government on the other hand is vested with the responsibility of providing potable water through state Water Agencies (SWAs) while the Local Government level is responsible for provision of rural water supplies and sanitation facilities.

2. A weak stakeholder ownership and limited local autonomy. There has not been active participation of farmers who are the main users of irrigation water in policy formulation. Hence, there is not so much active involvement of users at the local level. Policy approach seems to be top-bottom with little or no community drive. Association such as the WUA has been weak from its inception and so could not carry out it functions of operating and maintenance of irrigation project. Although, participatory irrigation management is known to be effective it is yet to be institutionalized into the subsector. Therefore, participation of stakeholders continues to be weak. Invariably policies do not get to fulfill their intended purpose. WUA do not get sufficient incentives like better water delivery to keep paying and quite often farmers expect government to provide water for free.

3. Weak financial sustainability is another common challenge. This challenge has always resulted in some sort of short term investment on irrigation thus, lack of sustainability of irrigation schemes. Most often the Federal Government alone fully covers irrigation investment cost with very little or no contribution from State and Local Governments. Making the situation worse in that the recurrent cost of operation and maintenance are seldom recovered from farmers due to their refusal to pay for services which (in their opinion) are epileptic in nature (NINCID, 2015). This situation results in the inability of government to continue funding and stagnation in further cultivating the fields on the part of the farmers. This weak financial sustainability may be linked with short sightedness in maintenance and operation policies which has terribly reduced the economic life of irrigation facilities and consequently impaired water delivery capacities.

There is therefore a need for policy reforms and improvement on water service delivery to ensure a revitalized water subsector which will provide water to users and users in turn pay for the service rendered which will maintain a steady flow of revenue for continuous water supply and also reduce government financial burden.

Climatic change

Climate change is associated directly or indirectly with human activities which leads to global warming resulting in extreme weather conditions of drought, floods, storms etc. These extreme weather conditions as well as salt stress are the major problems associated with rice production (Ajetomobi et al., 2011) and are expected to worsen as time goes by subsequently affecting crop yields, productivity and food self sufficiency particularly in rice production (Odozi, 2014).

The rising temperature may increase or decrease water needs for agricultural use. The consequences of Sevier drought or flooding are likely to cause evapotranspiration resulting to water shortages in the dams- in cases of draught; while flooding will cause overflow of the dams resulting in the washing away of farmlands and crops

down streams, being that most of the irrigated lands particularly the small scale irrigation sites (FADAMA) in Nigeria are low lying- located on the flood plain (Bamidele et al., 2010). An overflow of the dams could result in colossal lost of farm land and crops particularly rice.

Climate change as suggested by Nzeadibe et al. (2011) requires the development of natural resource management strategies that ensures the suitable use of soil and water etc. Being that the large irrigation sites in Nigeria are poorly managed and maintained due to lack of a proper management system makes irrigation farming unattractive because they are prone to disaster at all times. Most of the canals and drainages are poorly or not managed. Valipour (2014c) in his study of pressure on renewable water resources in 2060 observed a variability in National Rainfall Index (NRI) and this he says can be as a result of climatic and evironmental factors like: green house gases, global warming and climate change. A typical example was in the year 2012 when farmers lost all their farmland and crops to flood from Lagodo dam in cameroon due to heavy rains recorded that year. It was reported that Nigeria lost a total of 2.6 trillion naira to the floods.

Low access to capital

Accessing credit has been one of the major problems farmers face in Nigeria. Minimal or non-existent of credit facilities to farmers particularly small scale farmers who form the bulk of individuals involved in the agricultural sectors has left the production system underdeveloped-characterized with low input use and low productivity. Without credit, farming, particularly rice will not move from its present extensive low subsistence production to a more intensive production (IFDC, 2008).

Irrigation farming has been known to be a high capital intensive production system in Nigeria. Consequently farmers are not encouraged to participate hence a possible reason for the low development of this production system.The following reasons are known to account for the high capital intensive nature of the irrigation system:

High level and cost of labour

Labour is an important indicator for irrigation farming and water management. Several studies have shown that labour could constitute a major setback in irrigation farming across the world in the future. According to Valipour (2013, 2014a, b, c, d; 2015a, b) the observed decrease in rural population and the economic population that is involved in Agriculture signifies a decline in labour availability in the future.

Mechanization in irrigation farming is also low in Nigeria, available production equipment are not suitable for use in areas prepared for irrigation (FADAMA) due to the soil type and the weight of these machines. Therefore, farmers resort to the use of manual labour which is unavailable and expensive. To lean credence to this, in a study by IFPRI (2014) on irrigation potentials in Nigeria conducted at the Bakolori irrigation scheme in Sokoto state, irrigated rice was reported to be labour intensive. Labour alone accounted for the largest cost component; a total of 250 mandays while bird scaring alone accounted for over 70 mandays at a cost of $4 per manday. This has the potential to discourage irrigation farming and also prevent the expansion of the existing farms.

In addition to the normal production activities of clearing, ploughing, weeding etc, farmers employ labour for draining and distribution of water for the small irrigation schemes and construction of canals and water channels for the large irrigation scheme. In some instances where the terrain of the irrigated sight are not accessible, most often farmers make personal efforts to provide access roads to their farms for easy transport of harvested crops or in the alternative employ labour to transport them.

High operating and development cost of irrigation

the cost of development of irrigation is quite high, as reported by FAO the average cost of developing irrigation in Nigeria in 2003 was $US 15000/ha while the average cost of maintenance of irrigation scheme in the 1990 stood at an estimated $US50/ha, $US 290/ha and $US 800/ha for gravity, pump and sprinkle irrigation types respectively. Operating cost in irrigations is also high. In small irrigation schemes where pumping machines are used farmers are constantly faced with irregular fuel supply and faulty machines. The cost of fueling and maintenance of these machines are high particularly in times of fuel scarcity when farmers are forced to patronize the black market buying at exorbitant prices. All of these lead to poor financial returns to farmers.

Availability and high cost of inputs

Irrigation farming demands the use of more farming inputs of seeds, fertilizers, pesticides and other chemicals as reported by IFPRI (2002) and Frolking et al. (1999) that Chinese farmers simultaneously increased the use of fertilizers and irrigation and fertilizer is known to work more effectively in the presence of sufficient water and soil (Li et al., 2004). The high cost and low availability of these inputs contributes to the high cost of production in irrigation farming.

Rice marketing

Marketing has been known to be an important aspect of production, the absence of a readily available market to

Table 4. Traders margin as percentage of retail prices, imported and domestic rice value chain (milled).

Margins	Domestic (%)	Imported (%)
Retailer margin	16	9
Wholesale trader margin	12	5
Initial rice trader margin	6	15
Farm gate price(paddy trader margin)	19	n/a
Total traders' margin	54	29

Source: Adopted from FAO (2013).

of farm products discourages farmers from producing and intensifying production. It is evident that the market for locally produced rice in Nigeria is characterized with low prices. The prices of locally produced rice are not competitive with rice imported from other sources. The price gap especially the very low farm gate prices offered for the product acts as a disincentive to farmers (FAO, 2013). Also the market structure and the policies of government in the rice sector which are meant to stimulate and improve local production are not yielding desired results. These policies have rather shown incentives to traders (FAO, 2013) who most times determine the prices at which to buy these produce. These traders are reported to have the higher margins in the domestic rice value chain as shown on Table 4.

FUTURE OF IRRIGATION IN NIGERIA

To ensure sustainability and viability in irrigation farming, several studies have tried to determine the future by identifying important factors that affect the sector. Attempts are made by these studies to estimate the effect these factors (socio-economic, demographic, climatic or political) and unfavorable land use policies have on irrigation. These estimates are used to project future status of irrigation in Nigeria.

To meet the expected demand for irrigation in Nigeria, rapid population growth and urbanization play a major and significant role (NINCID, 2015; Takeshima and Adesugba, 2014). According to NINCID (2015) urban population in Nigeria is expected to grow at an average rate of 4.2%, the increased proportion of the urban area is expected to reach 63% of the national population in 2025. A major change induced by urbanization will be an increase in the demand for food like rice and wheat. Assuming rice consumption grows at the same rate as the population, the demand for rice is expected to reach 11 million tonnes by 2025. About 2 million hectares mostly of irrigated land is required to produce such quantity. This requires an expansion of the irrigated lands which is expected to grow by 0.6% annually from 1995 to 2020 (NINCID, 2014). While this expansion is desirable, it is expected to put pressure on renewable water resources in the future (Takeshima and Adesugba, 2014, NINCID, 2015; Valipour, 2014c). Nigeria's abundant water resource is thus a potential to be meet this requirement by 2025. But effort will have to be doubled to develop the water resources to make the expected expansion in irrigated rice production feasible (NINCID, 2015).

On the other hand, urbanization has also been projected to reduce rural population and the economic population that is involved in agriculture. Movement of people from rural to urban areas will imply low labour supply in agricultural activities. Though Takeshima and Adesugba (2014) has reported abundant availability of labour in Nigeria, Valupour (2013; 2014a, b, c; 2015a, b) warns that labour availability in irrigation farming in future would generally be affected with the decline in rural population and the economic population involved in Agriculture.

Climate change, agricultural research and development effort are other constraints that are expected to limit irrigation expansion (Takeshima and Adesugba, 2014). The area cropped to permanent crop for example is a factor which is dependent on climatic conditions, farmers' tendency and government polices (which influences government policies). All these play an important role in the decision to allocate the required quantity of water for irrigation.

Other factors such as Human Development Index (HDI) and contribution of agriculture to Nations' GDP have significant effect on irrigation generally in Africa. Valipour (2014a) in his study on land use policy and agricultural water management of the previous half of the century in Africa based on 2011 FAO data, reported that the value of permanent crops to cultivated area, HDI and GDP were 8%, 0.471 and 31% respectively for Nigeria. However, Egypt having better agricultural water management than Nigeria has HDI of 0.662 and 22% as value of crops to cultivated area. This shows a low values for these important factors in Nigeria. An insightful look at the author's findings indicate that intense development of irrigation will earn farmers additional income which will in turn improve farmers welfare and raise agriculture contribution to GDP. Consequently, government will be better encouraged to invest in agricultural research and development which is a critical factor that will determine whether water is used more intensely in Nigerian

agriculture (Takeshima and Adesugba, 2014).

Finally, owing to the unfavourable land use policy in Africa particularly Nigeria, the future of private ownership which is believed to be an effective way of irrigation water management is bleak because no farmer would be willing to invest on a land which he owns no title or ownership. There is a therefore, a need for good and concerted government polices to encourage farmers to use irrigation system and raise cropping intensity for irrigated areas (Valipour, 2014a).

CONCLUSION AND RECOMMENDATION

This paper demonstrates that Nigeria has high potentials in rice irrigation farming particularly in areas of land and water resources which are relatively in abundance. Though yet to be fully developed, can afford the country the opportunity to attain rice self sufficiency in the nearest future. In addition to these important factors of production, irrigation also has higher yields potentials and offers opportunities for multiple cropping since water is guaranteed. Though, cost intensive, this production system brings reasonable returns to rice producers which boost the income of the farmers and the household.

To promote available and sustained rice irrigation production system, these bottle necks to increased irrigation rice production must be addressed. Amending some of these policies such as greater farmer participation in irrigation development should be encouraged; functions of water regulatory institutions should be streamlined with each institution given specific and defined roles to enhance efficiency in water resource management. Policies which also promote direct link of producer and consumers are necessary, this will provide protection for farmers ad avail them the opportunity of better prices for their produce. It is also important that assistance is given to farmers in the areas of subsidized inputs supply and well developed credit market for farmers to be able to access loans to purchase farm inputs as well as purchase and maintenance of farm equipment like the water pump. Another area of intervention which is of utmost importance is the purchase and even distribution of appropriate farm implement suitable for the irrigation ecology which will reduce the high cost of labour and the drudgery involved in manual labor employed in rice irrigation farming.

Conflict of Interests

The authors have not declared any conflict of interests.

REFERENCES

Adesina A (2013). Dry Season Rice Farming Injects 77 Billion Naira into Nigerian Economy Newsherald 45 June 17, 2013. [Online] www.newsherald.com.ng/2013/06/17/dry-season rice-farming-injects-n77b-into-nigeria-economy-adesina Assessed 12 May 2015.

Ajetomobi J, Abiodun A, Hassan R (2011). Impacts of climate change on rice agriculture in Nigeria. Trop. Subtrop. Agro. Syst. 14:613-622.

Civil Engineers (2015). Civil Engineers Forum: Advantages and Disadvantages of Irrigation [Online] civilengineersforum.com/irrigation-advantages-disadvantages

Daramola BC (2005). Government policies ad competitiveness of Nigerian Rice Policy and Food Security in sub-Saharan Africa" Organized by WARDA Cotonou, Republic of Benin.

Ezedinma C (2008). Impact of Trade on Domestic Rice production and Challenges of Self Sufficiency in Nigeria. Conference paper presented at "Rice Policy ad Food Security in sub-Saharan Africa at Africa Rice Center (WARDA) Cotonou, Benin Republic.Kormawa p and Ture A. A. (eds.) workshop proceedings pp. 141-159.

FAO (2015). FAOSTAT Country Selection. [Online] http://FAOstat3.FAO.org/home/index.html#DOWNLOAD Assessed 19 June, 2015Fakayode SB, Ogunlade I, Ayinde O, Olabode P (2010). Factors Affecting Farmers Ability to Pay for Irrigation Facilities in Nigeria. A Case of Oshin Irrigation Scheme Kwara State. J. Sustain. Dev. Afr. 12:1.

FAO (2005). AQUASTAT Country Profile: Nigeria. [Online] http://www.FAO.org/nr/water/aquastat/countries_regions/NGA /index.stm

FAO, AgWA, IFAD (2014). National Investment Profile: Water for Agriculture and Energy, Nigeria. [Online] www.FAO.org/fileadmin/user_upload/agwa/docs-NIGERIA MAY%202014-BTI-AM-DM-v6.pdf Assessed 8 April, 2015

Takeshima H, Adesugba MA (2014). Irrigation potentials in Nigeria: some prospective Based onFactor Endowment, Tropical Nature and patterns in Favorable Areas. IFPRI Discursion Paper 01399 Nssp.ifpri-ifo/2014/12/22.

IFPRI (2002). Green Revolution Curse or Blessing? International Food Policy Research Institute: Sustainable Options for Ending Hunger and Poverty. Washington, D.C. [Online] http//www.ifpri.org/ Assessed 13 June, 2015

Imolehin ED (1991). Rice Improvement and Production in Nigeria. Paper presented at WARDA Upland Breeding Task Force Workshope. Bouake Cote Divooire, 4th October.

Imolehin ED, Wada AC (1999). Meeting the Rice Production and consumption demands of Nigeria with Improved Technologies: International Rice Commission Newsletter-BulletinRepository. [Online] www.FAO.org/docrep/X714T/x71t04.htm Assessed 14 May 2015.

Kebbeh M, Haefale S, Fagade SO (2003). Challenges for Improving Iirrigated Rice Productivity in Nigeria. Project Report: The Nigerian Rice in a Competive World: Constraint, Opportunities and Strategic Choices Abijan: WARDA pp. 24. [Online] http//:pdf.usaid.gov/pdf_docs/PNADB849.pdf Assessed 12 May, 2015.

Li W, Li W, Li Z (2004). Irrigation and Fertilizer Effects on Water Use and Yield of Spring Wheat in Semi Arid Regions. Agricultural Water Management 6:35-46 [Online] http//dxdoiorg/10.1016/.agwat 2003.12.002 Assessed 25 June, 20015

Maji AT, Bashir M, Odoba A, Gbagba AU, Audu SD (2015). Genotype X Envirinmental Interaction and Stability Estimates for Grain Yield of Upland Rice Genotypes in Nigeria. J. Rice Res. 3:2 [Online] http:/dx.doi.org/10.4172/2375-4338.100013

Martins O, Olofin EA (1992). Environmental Impact of Man-made Lakes on River Phscio Chemical System. Case Studies of Nigeria. [Online] Mitll/.Geol_paHiont.Inst. Univ. Hamb, 72,113-121 Assessed 12 May, 2015

Matins O (2001). Water Resources Management and Development in Nigeria: Issues and Challenges in the New Millennium.

Mongkolsmai D, Mark WR (1989). The Effect of Irrigation on Seasonal Rice Prices, Farm Income and Labour Demand in Thailand in: Sahn D (eds.): Seasonal Variability in Third World Agriculture: The Consequences of Food Security. IFPRI. The John Hopkins University Press, Baltimore, MD, USA. [Online] www.ifpri.org/site/default/files/pubs/books/sahn89/sahn89ch15.pdf.

NINCID (2015). Nigeria National Committee on Irrigation and Drainage. [Online] www.NINCID.org/cp_nigeria.html Assessed 12 May, 2105

Nzeadibe T C, Chukwuone NA, Egbule C L, Ag VC (2011). Climate Change Awareness and Adaptation in the Niger Delta Region of Nigeria. Africa Technology Policy Studies Network Working Paper Series/ NO 57 ISBN 978-99-1552-9 [Online] www.researchgate.net publication/272490454 Assessed 15 May, 2015

Odozi JC (2014). Rice Self Sufficiency and Farm households: The Role of Climate Change and Technology Response in Nigeria. Journal of Poverty, Investment and Development 3 [Online] www.iist.org/jornals/index.phip/JPID/article/dowload/9283/9496

Oyebande L (2015a). Water Resources [Online] www.olinenigeria.com/water Assessed 15 May, 2015

Oyebande L (2015b). Water Resources Development ad Utilization [Online] www.onlinenigeria.com/water/?blurb=521 Assessed 15 May, 2015

Sakairi Y (2004). Issues and Recommendations for the Irrigation Sector Support; Final Report: DAC Network on Poverty Redction.ING/ Natsource Japan. [Online] www.oecd.org/dac/povertyreduction/36567989.pdf Assessed 12 May, 2015

Singh BN, Fagade S, Ukungwu MN, William C, Jagtap SS, Oladimeji O, Effisue A, Okhidieubie O (1997). Rice Growing Environment and Biophysical Constraints in Different Agro Ecological Zones of Nigeria. Met. J. 29:35-44.

Uark (University of Arkansass) (2015). Rice Per Capita Consumption of Some Selected Countries. [Online] http://www.uark.edu/ua/ricerscg/pdfs/per_capita_rice_consumption_0_scle

Umar FB (1994). Factors Affecting the Adoption of Small-holder Irrigation Technology by Farmers in Jega LGA of Kebbi State, Nigeria. Unpublished Thesis University of Ibadan.

Valipour M (2013). Need to Update of Irrigation and Water Resources Information According to the Progresses of Agricultural Knowledge. Agrotechnology. 2013, S10 [Online] http://dx.doi.org/10.4172/2168-9881.S10-e001 Assessed 29 August, 2015

Valipour M (2014a). Land use Policy and Agricultural Water Management of the Previous Half of Century in Africa. Appl. Water Sci. DOI 10.1007/s13201-014-0199-1.

Valipour M (2014b). Future of agricultural water management in Europe based on socioeconomic indices. Acta Adv. Agric. Sci. 2:1-18 ISSN: 2345-6817 [Online]www.aaasjournal.com Assessed 29 August, 2015

Valipour M (2014c).Pressure on renewable water resources by irrigation to 2060. Acta Adv. Agric. Sci. 2:1-18 [Online] www.aaasjournal.com Assessed 29 August, 2015.

Valipour M (2015a). Variations of Irrigated Agriculture Indicators in Different Continents from 1962 to 2011. Adv. Water Sci. Technol. 1: 1-14. [Online] www.ajournals.com/index.php/journals/awst Assessed 29 August, 2015.

Valipour M (2015b). Assessment of important factors for water resources management in European Agriculture. J. Water Resour. Hydraulic Eng. 4:171-180 Assessed 29 August, 2015.

World Bank (2014a). Transforming Irrigation Management in Nigeria. [Online] www.wds.worldbank.org/external/default/WDScontentserver/WDSp11B/2014/06/12/003500812014061210350 4/Rendered/PDF/PAD10010REVISE020Box 385226B000OuO090.pdf

World Bank (2014b). World Bank Indicators. Washington, D.C.: World Bank [Online] http://worldbank.org/indicator Assessed 25 June, 2015 www.formfed,org/en/globalthematic/water_papers/joe%20Goldface_en.pdf

Yahaya MK (2002). Development and challenges of bakolori irrigation project in Sokoto State Nigeria. Nordic J. Afr. Stud. 11:411-430.