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Review

A review of the evaluation of irrigation practice in Nigeria: Past, present and future prospects

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Irrigation practice across the world is vital to successful green revolution all year round to achieving sustainable development goals in food security, socio-economic and rural development. However, irrigation practice in Nigeria has not achieved the set goals despite the huge investment involved. Moreover, the level of investment and abundant water resources ought to have expedited the goals of food self-sufficiency and socio-economic development in the country. This review attempts to uncover the underline issues regarding the irrigation practice in Nigeria through the evaluation of past and present practices, and its future prospects. The review showed that the major persistent issues that have been hindering the performance of irrigation practice to achieving the set goals were inconsistent government policies, lack of political commitment, low awareness and lack of technical know-how among the farmers on irrigation farming system, and untimely financial intervention. In addition, the communication gap between the government and the farmers was responsible for some cases of underutilization and abandonment of large-scale irrigation system. The study concluded that to achieve food security and socio-economic development through irrigation systems practice in Nigeria, there is need to provide proper policy framework, appropriate technology, and farmers' awareness and their inclusion in the decision making process.

Key words: Irrigation practice, Green revolution, socio-economic development.

INTRODUCTION

Nigeria is located between Latitudes 4° and 14° N and Longitudes 3° and 15°E on the Gulf of Guinea with a land mass of 923,768 km^2, signifying about 14% of the West African landed area (Balarabe et al., 2016). Approximately, 13,000 km^2 (1.4%) of the land is covered by water and the remaining 98.6% ranges from thick mangrove forests and dense rainforests in the south to a near-desert condition in the north-eastern part of the country (Ibe and Nymphas, 2010). Additionally, the country has a coastline of over 853 km with about 80% in the Niger Delta region. The country is adjoined by four countries including the Republic of Benin in the West, Niger and Chad Republic in the North, the Cameroon Republic in the East, while the Atlantic Ocean forms the southern limits of the territory (FAO-Aquastat, 2016). There are three distinct ecological zones in the country

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Table 1. Agro-ecological zones of Nigeria with some climatic characteristics.

Zone description	Percentage of country area	Annual rainfall (mm)	Monthly temperature (°C)		
			Minimum	Normal	Maximum
Semi-arid	4	44 - 600	13	32-33	40
Dry sub-humid	27	600 – 1000	12	21-31	49
Sub-humid	26	1000 – 1300	14	23-30	37
Humid	21	1100 – 1400	18	26-30	37
Very Humid	14	1120 – 2000	21	24-28	37
Ultra Humid (Flood)	2	> 2000	23	25-28	33
Mountainous	4	1400 – 2000	5	14-29	32
Plateau	2	1400 – 1500	14	20-24	36

Source: Kundell (2008).

including Guinea savannah, Northern Sudan savannah and Southern rainforest (Cosmas et al., 2010). However, the agro-ecological zones, governed by the combined effects of rainfall variations, soil, humidity, and temperature, are divided into eight zones for the purpose of irrigation practice (Table 1).

The climate in Nigeria is characterized by relatively high temperature and variations in the amount of precipitation throughout the year with alternating two seasons (rainy and dry) (Ibe and Nymphas, 2010). The rainy season is generally from April to October and the dry season from November to March, with some degrees of spatial and temporal variations in the amount and distribution of rainfall across the agro-ecological zones (Akande et al., 2017; Bibi et al., 2014). The southern part of the country has the highest average annual rainfall, ranging from 1524 to 2035 mm with duration of eight to nine months. The middle belt ranges from 508 to 1524 mm while it is less than 508 mm annually for a period of five to six months in the north and less than four months in the far north (Oriola and Alabi, 2014).

Furthermore, a short dry season is known as “August break” generally comes up in the month of August. The dry season persists from late October to early March. This period witnesses dusty north-east winds (Chineke et al., 2010). However, the Northern Nigeria which experiences short wet season, the dry season is very long, from October to mid-May. Annually, the average temperature ranges from 21 to 32°C in the south while the north has a temperature range of 13 to 41°C. Nigeria, the most populous country in Africa, was estimated to have a population of over 140 million in 2006 and the United Nation estimate in 2015 was roughly 181 million (United Nations, 2017). However, the exponential projection growth in the population has not translated to food sufficiency but rather the agricultural production is on the decline. There is an uneven spatial population distribution with about 65% living in rural areas and the rest in urban areas (Aidi et al., 2016). The major occupation of people in rural areas is agriculture but with a low level of productivity (Dayo et al., 2009). The level of food insecurity in the rural areas of Nigeria is alarming with 84.3 % reported in some communities in the north and about 56% in the south west of the country (Akinyele, 2009). The country relies mostly on the importation of agricultural produce to feed its growing population in spite of her production potential in agriculture. The only way out to address the challenges of food insecurity and rural poverty is to find the solution to agricultural production in the country (Xie et al., 2017).

In Nigeria, agriculture remains the bedrock of the economy as it provides a living for the majority of its populace. World Bank (World Bank, 2014) reported that the agricultural sector alone accounts for 33% of the total GDP of Nigeria and the sector employs around 23% of the total economically active population (FAO, 2014). Agriculture used to be the Nigerian major source of foreign exchange from independence in 1960 up to the mid-1970s when Nigeria was the world’s largest producer of groundnuts, palm oil, and cocoa, and one of the major producers of millet, maize, yam, cassava, coconuts, citrus fruits and sugar cane (Ladan, 2014). However, the sector has been on the neglect and contributed less economically since the early 1970s when attention was shifted to oil revenues. Notwithstanding the reliance of the country’s economy on proceeds from oil export, Nigeria remains agrarian with her endowed substantial natural resources including 68 million hectare of arable land, abundant freshwater resources covering about 12 million hactare, and an ecological diversity which enables the country to produce a wide variety of crops and livestock, forestry and fisheries products (Arokoyo, 2012). Moreover, the dry northern savannah is appropriate for sorghum, millet, maize, groundnuts, and cotton while cassava, yam, plantain, maize, and sorghum can successfully be grown in the Middle Belt. Cash crops like oil palm, cocoa and rubber can be grown in the South whereas low-lying and seasonal flooded areas can grow rice (FAO-Aquastat, 2016). The government has acknowledged the need to diversify the country’s economy by giving adequate attention and promoting the development of the agricultural sector in order to shift

from a mono-cultural economy of oil exports (Olajide et al., 2012).

Farming system in Nigeria can still be regarded as subsistence-based and it is predominantly rainfed, which makes it overly dependent on weather fluctuations. The irrigated agriculture only accounts for one percent of the cultivated area (FAO-Aquastat, 2017). Many farmers are out of jobs during the dry season and local food prices are on the rise as a result of food scarcity during this period. However, the green revolution requires all-year-round farming. The role of irrigation cannot be ignored as it is the only way to achieve the mandate of "Green Alternative" of the present administration. Hence, there is a need to evaluate the irrigation practices in the country so as to know what has been done in the past, the present status, and how to improve for the future developments.

HISTORY OF IRRIGATION PRACTICES IN NIGERIA

The irrigation practice in Nigeria can be traced back to 700 AD (Olubode-Awosola and Idowu, 2004), however, became more pronounced after the drought of 1970-1975. Sojka et al. (2002) defined irrigation as the practice of applying additional water, beyond what is available from rainfall, to the soil to enable or enhance plant growth and yield, and, in some cases, the quantity of foliage or harvested plant parts. Furthermore, water could be sourced from groundwater through pumping to the surface or surface water diversion from one landscape position to another. The traditional application of water to land for dry season farming was first conceived in northern Nigeria in form of gravity, bucket/calabash and pump methods by farmers without any financial assistance from the government (Yahaya, 2002). Food and Agriculture Organization of the United Nations (FAO) classified irrigation scheme into three, based on land mass size such that large irrigation scheme has over 10,000 ha, between 100 – 1000 ha is classified as medium-scale scheme while the small-scale scheme has less than 100 ha (Moris and Thom, 1990). Figure 1 shows some selected large-scale irrigation schemes across Nigeria.

In Nigeria, irrigation schemes and projects consist of three categories; the public irrigation schemes, which are government-executed schemes, the farmer-owned irrigation scheme, and the floodplains called fadama irrigation scheme. As the dire need for irrigated crop cultivation grew, a study was carried out in 1972 to examine the water resources and irrigation development potential in the country. Consequently, the study led to the institution of three models public irrigation schemes; namely the Bakolori scheme, the Chad Basin scheme, and Kano River irrigation scheme (NINCID, 2015). Subsequently, additional eleven more River Basin Development Authorities (RBDAs) were added across the country after the success of the pilot schemes in 1976. These RBDAs include the Niger Basin; Lower Benue Basin, Upper Benue Basin, Lake Chad Basin, Benin-Owena Basin, Sokoto Rima Basin, Hadejia Jama'are Basin, Cross River Basin, Ogun Osun Basin, Anambra-Imo Basin, and Niger Delta Basin. Their mandates among other things were to carry out developmental functions of irrigation infrastructures in their respective agro-ecological zones so as to promote irrigated agriculture in order to enhance food self-sufficiency.

Moreover, the rural water supply function was added to the functions of the established river basins and this brought about the change of name from the initial River Basin Development Authorities (RBDAs) to River Basin and Rural Development Authorities (RBRDAs) in 1995. Figure 2 shows the Map of River basins and their locations in Nigeria. Through the RBRDAs, about 162 dams with 11 billion m^3 reservoir capacity were constructed, with the intention to irrigate about 725,000 ha. However, the expected efficiency and sustainability of these large-scale public irrigation schemes to provide food sufficiency were not met as only about 32% of actually irrigated areas of equipped areas were covered (Table 2). Most of these schemes have become obsolete due to high operating costs, poor maintenance culture by the beneficial of the schemes.

In order to arrest these situations, with the available abundant water resources, there was a policy shift to small-scale irrigation through state's Agricultural Development Projects (ADPs) funded by the World Bank. Boreholes and tube wells were constructed across Nigeria's northern states and motor pumps were distributed to lift the water for irrigation (Kimmage, 1991). Inland valley bottoms were explored and executed in phases, Fadama I, II and III, as National Fadama Development Program by providing financial support to farmers for the procurement of irrigation facilities including boreholes, irrigation pumps, and tube wells in such fadama areas (Takeshima and Yamauchi, 2012, Nkonya et al., 2012). Despite these efforts, with large and small-scale irrigation systems combined, the earlier performance of agricultural production in terms of food production and economic growth has not been matched.

Regardless of the combined outputs of the irrigations systems, the private small-scale schemes and improved fadama development program have witnessed improved performances based on the Federal Ministry of water resources assessment as presented in Table 3. Kolawole (1988) opined that the declining in the performance of the irrigation schemes is as a result of the combination of technical, economic, social, institutional, and political factors. Moreover, Olowa and Omonona (2008) identified higher value in actually irrigated areas of Hadejia Jama'are in comparison to the equipped areas as a result of importance of irrigation in the region, where the rainfall is very low and there are incidences of drought, compare to the southern parts of the country where the rainfall is

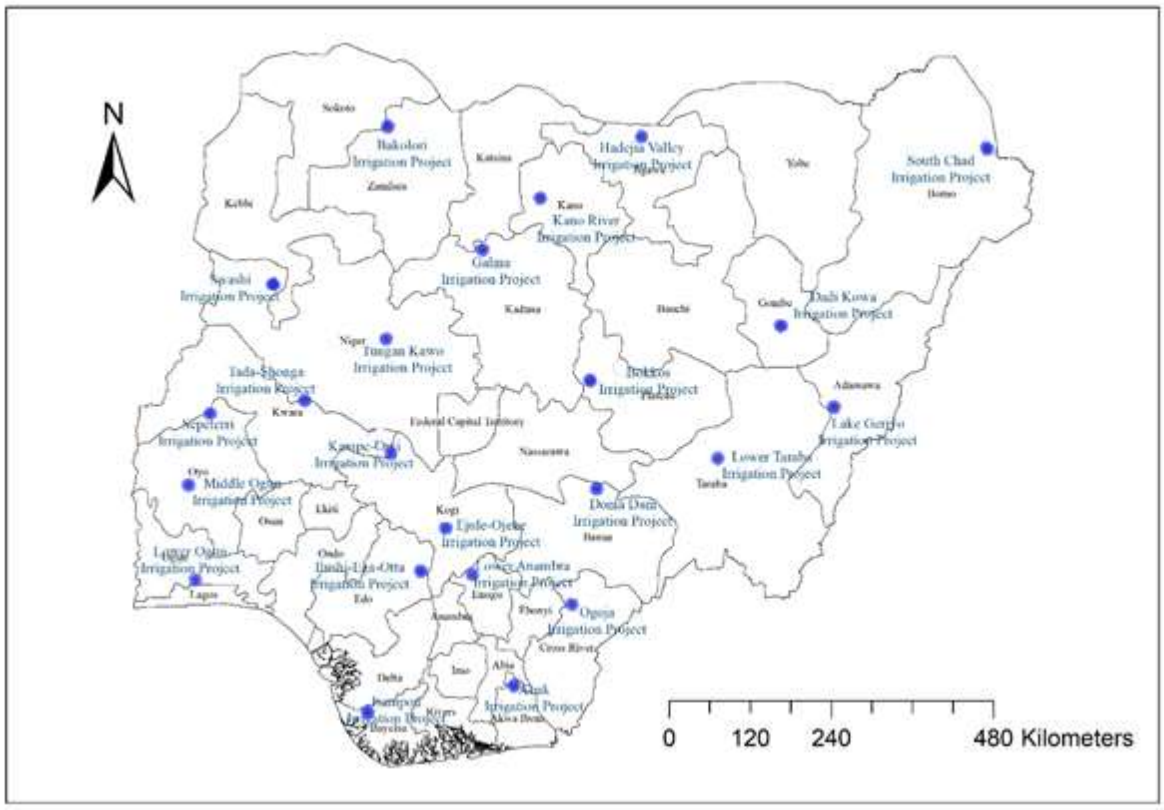

Figure 1. Map of Nigeria showing the locations of some selected major irrigation schemes.

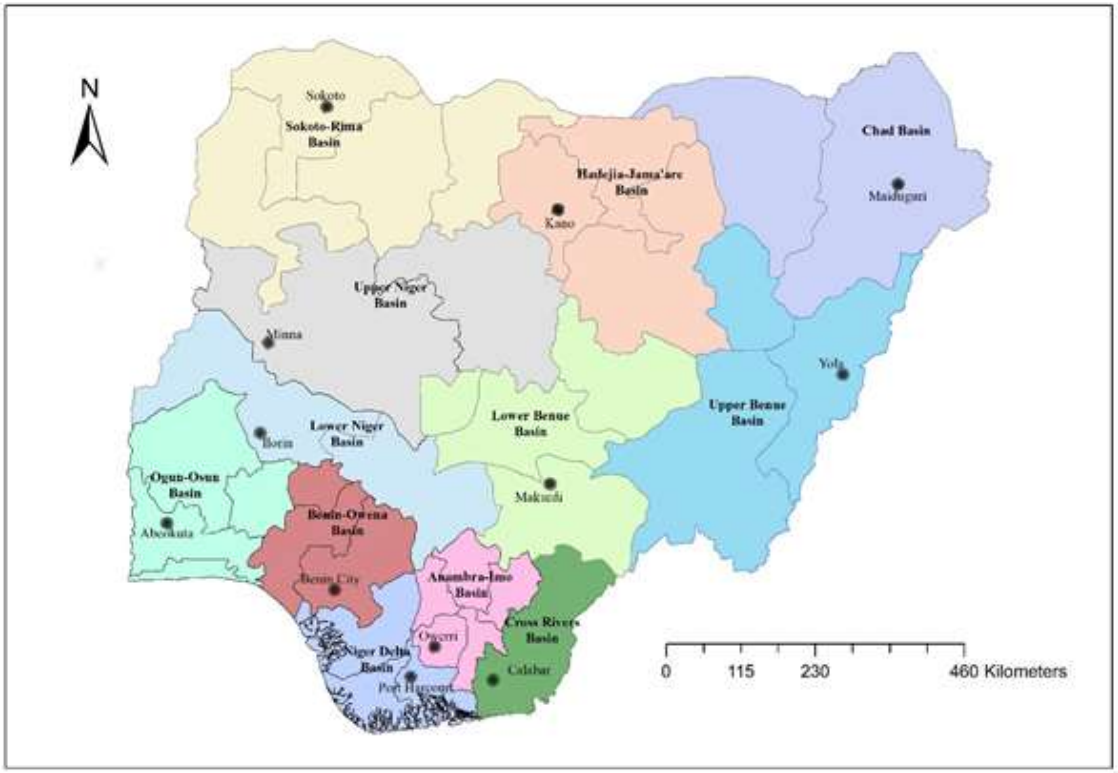

Figure 2. Map of Nigeria showing the River Basins.

Table 2. Equipped and irrigated areas in the River Basin development authorities for the year 2004.

River Basin Development Authority	Equipped area (ha)	Actually irrigated area (ha)	Actually irrigated as a percent of the equipped area (%)
Anambra-Imo	3941	10	0.3
Benin-Owena	317	0	0.0
Chad Basin	26180	1000	3.8
Cross River	364	40	11.0
Hadejia Jama'are (areas outside the equipped area used water from the main canal for irrigation)	18475	21000	113.7
Lower Benue	1310	70	5.3
Niger Delta	187	0	0.0
Lower Niger	1344	115	8.6
Upper Niger	3697	722	19.5
Ogun-Osun	512	110	21.5
Sokoto Rima	27580	5290	19.2
Upper Benue	8410	783	9.3
Total	**92317**	**29140**	**31.6**

Source: FAO-Aquastat (2016).

Table 3. Structure of the irrigation sub-sector in Nigeria for the year 2004.

Scheme type	Equipped area (ha)	Actually irrigated area (ha)	Actually irrigated as percent of the equipped area (%)
River Basin Development Authorities	92317	29140	32
State schemes	12200	6700	55
Private sector-sugar schemes	5600	0	0
Private small scale schemes	128000	128000	100
Improved fadama (equipped low land)	55000	55000	100
Total	**293117**	**218840**	**75**

Source: FAO-Aquastat (2016).

relatively high.

CURRENT CONDITIONS OF IRRIGATION DEVELOPMENT

Irrigation farming allows farmers to produce all year round thereby resulting in higher agricultural outputs and improved farmers income. However, in Nigeria, the current state of irrigation development has not been fully explored. Currently, only 45% of the total irrigation potential of 2.0 million ha, is under irrigation. The northern part of the country where the average rainfall is very low as 70% of the total irrigation potential and about 20% can be found in the humid south with the balance in the central and western plateau areas. The country has huge potentials for irrigation with dam projects spread all over the country. However, most of the dams, the ones that the government has invested in, are either under-utilized for irrigation or abandoned (Yahaya, 2002). Irrigation scheme like the Hadeja-Jama'are river project, the utilization of the project is just about 50% while the Zobe dam in Dutsin-Ma in Katsina, which was constructed 40 years ago, currently has very the little irrigation activities. Also, at the Bakolori irrigation dam in Zamfara State, under the Sokoto Rima Water Project, the area cultivated is not commensurate with the amount of water in the dam.

According to the Federal Ministry of water resourcess (FMWR, 2017), in Nigeria, there are about 264 dams with a combined storage capacity of 33 billion m^3 of water for multipurpose use that includes water supply, irrigation, hydropower, fisheries and eco-tourism, of which 210 are owned by the Federal Government, 34 by the States and 20 by the private organizations. These dams have combined of about 350,000 ha of irrigable land around the vicinities ready for development. Moreover, there are 27 on-going small earth dams nationwide with a total potential irrigable land 2,700 ha. The government is currently making frantic efforts to revive the agricultural

Table 4. Comparative yields of selected crops in rainfed and irrigated agriculture.

Crop	Yield	
	Rainfed (tonnes/ha)	Irrigated (tonnes/ha)
Rice	2.51	3.58
Maize	2.97	3.87
Tomato	6.41	8.42
Pepper	4.25	5.76
Onions	6.10	6.60
Sugarcane	6.50	26.00
Wheat	-	2.80

Sources: Tashikalma et al. (2014) and Kundell (2008).

sector among which is a policy on placing a ban on the importation of some agricultural products like rice, cocoa, vegetable, among others, that can be abundantly produced in the country. This is to enable the farmers to have the confidence to produce more by exploring the available irrigation infrastructures. Tashikalma et al. (2014) investigated the profitability of rice, maize, tomato and pepper under both rainfed and irrigated agriculture for 2007 to 2009 seasons. Similarly, Kundell (2008) compared the yields of selected crops including onions, sugarcane, and wheat for the 1998/1999 season. The result as presented in Table 4 shows that there is an appreciable increase in the yields of agricultural production in irrigated agriculture as compared to rainfed agriculture.

Apart from the provision of irrigation infrastructures, the Nigerian farmers have also recently benefitted financial supports of US$495.3 million under the Transformation Irrigation Management in Nigeria (TRIMING) project from the World Bank (World Bank, 2014). This is to enhance improvement of the existing irrigation on 27,000 hactare and benefit more than 140,000 farmers while mobilizing private sector investment. The project aims to expand food production and spawn economic growth in rural areas through large-scale public irrigation improvement. Currently, the total investment for Nigeria in irrigation projects from 2016 to 2017 is estimated at $443 million (World Bank, 2014). The investment expected to cover small-scale irrigation development, rehabilitation/ modernization of irrigation schemes, and large-scale irrigation development. The source of funding for the project is dominated by public sources such as the Federal and State Government of Nigeria. The project is expected to bring about 34,881 ha under irrigation while the surface benefitting from the rehabilitation of irrigation schemes would be 57,198 ha (World Bank, 2014).

Nigeria agricultural sector has witnessed policies instability by the different administrations over the years. This has not only made the application of policy instruments unstable but also hinders the general developmental objectives of the agricultural sector in the country. A sizeable number of policy documents have been produced ever since Nigeria started dam construction and large-scale irrigation schemes in the 1970s (Ugalahi et al., 2016). National water resources (NWR) policy, Draft of National Irrigation Policy, water resources infrastructure operation and maintenance policy and financial report of the water resources strategy are examples of policies and documents on irrigation between 1998 and 2007 (World Bank, 2014). Among the recently set up policy frameworks is the project resettlement framework under the need for transforming irrigation management in Nigeria (Elufioye, 2017). The policy is designed to provide the procedures and guidelines that would be followed in taking care of any anticipated resettlements. The farmers are in dire need of this policy to restore the trust and build harmonize the relationship between them and the government. Similarly, a new policy on agricultural promotion (Agricultural Promotion Policy 2016-2020) was recently launched to institutionalize all the stakeholders involving in agricultural production to find a lasting solution to the perceived challenges and implementation plans of the policy framework (Ojong and Anam, 2018).

Furthermore, in 2014, Nigeria government partnered with Food and Agriculture Organization to finalize the 2006 draft of the National Irrigation and Drainage Policy and Strategy (NIPD) which is expected to provide the essential framework that will guide the sustainable irrigation development, create an enabling environment, and stimulate private sector investment in irrigation development.

CHALLENGES OF THE IRRIGATION SYSTEM IN NIGERIA

The performance of agricultural use of irrigation water in sub-Sahara Africa, as compared to Asia, has been characterized by inefficiency and poor management (Nwa, 2003). However, Nigeria irrigation system has recently started receiving due attention and there is an

Tables 5. Comparing fund availability for Kampe-Omi and Tada-Shonga irrigation schemes (2004-2010).

Farming season	Kampe-Omi				Tada-Shonga			
	Land area irrigated (ha)	Fund required ($)	Fund released ($)	% of fund released	Land area irrigated (ha)	Fund required ($)	Fund released ($)	% of fund released
2004/2005	85	4054.05	1790.54	44.16	28	10135.14	N.A	N.A
2005/2006	70	3513.51	1824.32	51.92	28	11486.49	N.A	N.A
2006/2007	105	4054.05	1756.76	43.33	12	5405.41	3378.38	62.5
2007/2008	94	3716.22	1418.92	38.18	15	18457.25	8108.11	43.93
2008/2009	100	4256.76	1689.19	39.68	40	38496.96	16891.89	43.87
2009/2010	92	3378.38	1560.81	46.20	38	37155.41	N.A	N.A

Source: Oriola and Alabi (2014) (with modification) *$1 equivalent to ₦148 (exchange rate), N.A means Not available.

observed facelift in its development. Nevertheless, there are still underline challenges that need to be adequately addressed in other to meet up with its developmental objectives such as contributing substantially to the national economy, and rural development.

Firstly, Nigeria irrigation development has been faced with inconsistent and unstable policies and inappropriate legal framework over the years. Water and agriculture are regarded as separate entities under different ministries (Ugalahi, 2016). These have made the two to have different independent policies formulation. Federal Ministry of water resourcesS (FMWR) is saddled with the policy formulation for irrigation development in Nigeria. However, the Federal Ministry of Agriculture and Rural Development (FMARD), State Irrigation Departments, and River Basin Development Authorities (RBDAs) have variant duties regarding the irrigation development in Nigeria. Rather than complementing one another to ensure sustainability of water resourcesS for agriculture and consumption in Nigeria, the Ministries and the respective agencies have resulted to a competition among one another which resulted to a fragmented and conflicting approach to irrigation development in the country (Goldface-Irokalibe, 2008, World Bank, 2014). Notwithstanding the unstable policies witnessed in the past, the current government's agricultural transformation agenda and the finalization of the National irrigation and drainage policy and strategy are expected to set things right in the future especially in terms of appropriate framework and policy stability (FMARD, 2011).

Secondly, the funding constraint and farmers' attitudes and awareness towards irrigation systems of crop production. For a successful irrigation scheme, apart from the provision of irrigation infrastructures, there are other required inputs such as operating irrigation equipment, operation and maintenance of irrigation infrastructures, and technical expertise, which government has been responsible for their provision. But, all these are either inadequately provided or are not provided at all. According to Oriola and Alabi (2014), two of the Nigeria irrigation schemes, Kampe-Omi and Tada-Shonga, under Lower Niger River Basin Development Authority, received less than fifty percent of the funds required for their operations between 2004 and 2010 while the status of irrigation equipment is presented in Table 5. Comparatively, more funds were available for Tada-Shonga irrigation scheme than in Kampe-Omi irrigation scheme (Table 5). Furthermore, Tada-Shonga irrigation scheme enjoyed more irrigation equipment than the Kampe-Omi irrigation scheme (Table 6). However, more land is under irrigation in Kampe-Omi compared to Tada-Shonga irrigation scheme. Moreover, the percentage of the funds released compared to what was required did not reflect on the size of the land under irrigation. Oravee (2015) reported that the challenges of inadequate funding of the river basins can be traced back to 1989 which was instrumental to discontinuing of direct involvement in farming activities by some of the River Basins and Rural Development Authorities and consequently leading to the ineffectiveness of the scheme. In conclusion, the attitudes and interests of the participating farmers have a larger role to play when it comes to Nigeria irrigation farming. The government and its agencies in charge of the irrigation systems need to be proactive in discharging their duties and correspondingly provide a platform to encourage and sensitize the farmers on the need to engage in irrigation farming rather than on only rainfed.

In addition, the farmers are not interested in the operation and maintenance of the large-scale irrigation facilities. Adekunle et al. (2015) found out that poor knowledge of irrigation techniques among the farmers was one of the factors affecting their participation in large-scale irrigation scheme. Those that manage to participate are not equipped with the requisite knowledge for the operations and maintenance of the facilities. This problem is one of the current challenges being faced by the large-scale irrigation scheme in Nigeria. The participating farmers see the facilities as government properties which should be maintained by the government. These do not only make the equipment short-lived but have also resulted in the abandonment of irrigation scheme due to lack of irrigation equipment and

Table 6. Status of irrigation equipment in Kampe-omi and Tada-Shonga irrigation schemes.

Equipment	Kampe-Omi			Tada-Shonga		
	Number	Condition	Remark	Number	Condition	Remark
Tractor	6	Good	Not adequate	6	Good	Not adequate
Excavator	1	Good	Not adequate	1	Good	Not adequate
Load loader	1	Good	Not adequate	1	Good	Not adequate
Pale loader	1	Good	Not adequate	1	Good	Not adequate
Grader	1	Good	Not adequate	1	Good	Not adequate
Bulldozer	1	Good	Not adequate	1	Good	Not adequate
Planter	-	None	Not adequate	1	Good	Not adequate
Boom sprayer	-	None	Not adequate	2	Good	Good
Duty vehicle	-	None	Not adequate	2	1 Good	1 for Repair
Motorcycle	-	None	Not adequate	2	1 Good	1 for Repair
Irrigation pump	-	None	Not adequate	4	2 Good	2 for Repair

Not Adequate = NA; No = Number; Source: Oriola and Alabi (2014).

infrastructure to make use of. There has been limited stakeholders' participation as well as inadequate attention to operation and maintenance of irrigation systems. Also, farmers see other agricultural inputs and services such as fertilizers, tractors, harvesters, as more important than agricultural water. They tend to seek more government interventions on these agricultural inputs more than the provision of agricultural water through irrigation facilities.

Moreover, the use of technology in large-scale irrigation systems for agricultural operations including land clearing, land leveling, and excavation of soil for the construction of canals and drains tends to destroy small-scale farming systems and render most of the practicing farmers homeless (Yahaya, 2002). Anyebe (2015) opined that the Sokoto Rima River Basin Development Authority has failed in one of its objectives of flood prevention and control which has resulted in loss of agricultural farmlands and displacement of farmers. Similarly, rice plantation of about 3,200 ha under Tada-Shonga irrigation scheme, one of the schemes under Lower Niger River Basin Development Authority, was inundated by the flood. The current challenge of incessant flooding is a threat to large-scale irrigation farming system to ensuring food security and rural development. However, the farmers, which are the benefits of the irrigation facilities, are not involved in planning and construction of large-scale irrigation systems. Most of their views and concerns in terms of agricultural productivity, relocation, and settlement plans are left unaddressed (Yahaya, 2002). This made most of them abandon the facilities after the completion. The level of awareness of the farmers regarding the large scale-scale irrigation systems is very low in Nigeria.

Furthermore, overestimation of construction cost, high overhead and management cost, inaccurate irrigation cost/benefit analysis, and technical and management problems are some of the factors considered by Carsell (1997), limiting the development of irrigation system in Nigeria. This was corroborated by FAO report in its review that the average cost of large-scale irrigation development in Nigeria with an estimated per capita income of $1000, is estimated at $15000 per ha in 1993 with the annual operation and maintenance cost varying between $50 per ha for gravity systems and up to $800 per ha for sprinkler irrigation system (FAO, 1997).

FUTURE IRRIGATION DEVELOPMENT PROSPECTS

The agricultural sector has been projected as an alternative to the future economic sustainability of the country (Omorogbe et al., 2014). However, its developmental plan cannot be achieved without addressing the challenges being faced by the irrigation systems. water resourcess development for irrigation plays a key role in agricultural and economic growth (Mugagga and Nabaasa, 2016). Since agriculture and irrigation are intertwined, especially in a country like Nigeria where there is a wide spatial-temporal variation of rainfall across the country (Akande et al., 2017; Bibi et al., 2014), every plan towards agricultural development must also be extended to irrigation system development. It is on this premise we reviewed the future prospects of irrigation development in Nigeria under the population growth, resources availability, and government policy.

With the unabated population growth, the dire need to meet the growing food demand and the nutritional requirement of the population require bringing more land under cultivation. Consequently, the opportunities for future irrigation water development as the rainfed agriculture cannot sustain the production of growing food demand (Cosmas et al., 2010; Olayide et al., 2016). According to Takeshima and Adesugba (2015), the average population growth in Nigeria between 1961 and 2013 was 2.6% with continuous growth in agricultural

Table 7. SWOT analysis of the review outcomes.

Strengths	Weaknesses
1. Resources availability There are abundant water resources, arable land, and rural population that can drive the irrigation development (Aidi et al., 2016, Arokoyo, 2012.	1. Farmers' awareness and participation. The level of utilization of the irrigation system is very low compared to the existing irrigation facilities (Yahya, 2002).
2. Policy framework. Government acknowledgment to support irrigation development (Olajide et al., 2012). Provision of resettlement framework for transforming irrigation systems in Nigeria (Elufioye, 2017).	2. Technical know-how and knowledge capacity The farmers' inadequate technical knowledge of the operations and maintenance of irrigation systems limits the extent of irrigation development (Adekunle et al., 2015).
3. Irrigation infrastructure and financial support. The existing irrigation development can transform an irrigation system in Nigeria (Takeshima and Yamauchi, 2012, FMWR, 2017). Financial supports under the Transformation Irrigation Management enhances the improvement of the existing irrigation development and stimulates private sector investment (World Bank, 2014).	3. Irrigation infrastructure and financial support. The exorbitant cost of construction and maintenance of large-scale irrigation systems limits the development of irrigation development in the country (Carsell, 1997; FAO, 1997).
Opportunities	**Threats**
1. The productivity of irrigation systems Irrigation development enhances the productivity of the agricultural land and improves yield (Takeshima and Adeshugba, 2015).	1. Policy framework. The sustainability of the existing framework and political commitment are not guaranteed due to the past failed policies (Ugalahi et al., 2016).
2. Resources availability The land and water resources s are currently underutilize (Lowder et al., 2016; Omorogbe et al., 2014). There is potential for future development of the irrigation systems (Olayide et al., 2016; Cosmas et al., 2010).	2. Management of irrigation scheme The incessant flooding of some of the large-scale irrigation schemes hinders the goals of irrigation development (Anyebe, 2015).
3. Policy framework There is a policy framework that encourages the irrigation development through private sector participation (Arigor et al., 2015; Ogundele, 2007).	3. Operations and maintenance of irrigation systems. Late release of fund and inadequate running costs significantly affect the productivity of most the irrigation schemes (Oravee, 2015)

population at 1.4% which was higher than most of the countries in Asia and South American. This implies that there will be more pressure on the food demand and also on the expansion of irrigated agriculture in the future (NINCID, 2015). Ugalahi et al. (2015) reported that about 2 million irrigated land is required to produce 11 million tonnes of rice demand by 2025 to feed the Nigerian population. Nevertheless, the available resources for agricultural and irrigation development are still underutilized including land, water resourcesS, and other agricultural inputs (Mallam et al., 2014). The essential needs, however, are the sustainable irrigation development to meet the future demand for food production (NINCID, 2015).

Currently, the total arable land in the country is estimated at about 34.6 million ha, however, only 40% is under cultivation out of which less than 5% is irrigated (Lowder et al., 2016; Omorogbe et al., 2014). Notwithstanding the abundant land and water resourcesS, the availability of land for crop production is under threat due to recently increased conflict of the resource among the farmers and the herders in some selected agro-ecological zones of the country (Dimelu et al., 2017). The productivity of the available land can be enhanced through irrigation systems and other agricultural inputs including fertilizers (Takeshima and Adesugba, 2015). Furthermore, Cosmas et al. (2010) and Xie et al. (2017) are of the opinion that more land can be cultivated by engaging in small-scale irrigation scheme. The potential of future expansion of small-scale irrigation system under baseline conditions was estimated at 1 and 0,65 million ha for dry and rainy seasons, respectively (Xie et al., 2017). The development of small-scale irrigation system will not only improve the performance of the agriculture sector in terms of food production but also allow the participation of private sectors in the development of future irrigation systems. The involvement of private sector investment in future irrigation development is imperative and requires appropriate agricultural policies (Table 7).

On this account, the recent government policy towards increased importation tariff and an outright ban on

importation of some staple food like rice has started bringing development to the country's irrigation system as more stakeholders including private sectors and youths are now interested in irrigated agriculture (Arigor et al., 2015; Ogundele, 2007). One of the examples is Kampe-Omi dam project under the Lower Niger River Basin which has been underutilized after the construction. This is now targetted by the Kogi State Government in collaboration with private sectors for massive production of rice. More lands are now under cultivation for food and fiber productions, however, optimum productions cannot be achieved through rainfed practice alone without additional water through irrigation systems. The irrigation development in Nigeria will continue to receive attention now, and in the future, as there will need to increase food production to feed the unabated growing population in the country.

CONCLUSION

This study reviewed the Nigerian irrigation systems development on the basis of historical backgrounds, current conditions of development, challenges, and the future development prospects. There are diverse points of view on the underline problems of the irrigation development in Nigeria. A sizeable number of the authors are of the opinion that investment on large-scale irrigation systems has been resulted in costly failures because of their under-utilization and cases of abandonment when compared to the success recorded in small-scale irrigation system across the country. All the authors agreed that with the appropriate policy framework, political commitment, institutional reform, and sensitization of farmers on the operation and management of the modern irrigation technology. Nigeria irrigation will meet up with its developmental plan on the national economy and rural development.

However, irrigation development in Nigeria, whether small or large-scale, offers some benefits, which also comes with some challenges. Already, considerable amounts of private and public funds have been invested in both large and small-scale irrigation development. Investment in irrigation development should not be an issue of debate but rather on how to improve the performances of various irrigation schemes across the country by addressing the various challenges encountered. Generally, the government is now aware of the significant role of irrigation development and its efficient utilization of food security and economic growth. The confidence of other stakeholders' participation in modern irrigation development and its sustainability also needs to be enhanced. Agriculture needs to be seen as a serious business by both the government and the farmers. Hence, there should be a performance index which must be effectively pursued for each irrigation scheme across the country by the government, non-government organization, and private investors. Specifically, the roles of individual actors in the development of irrigation systems across the country should be well defined and as such should be evaluated from time to time accordingly.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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