

STAKEHOLDERS CONFLICT AND INFRASTRUCTURAL DECAY IN NIGERIAN IRRIGATION SCHEMES: A REVIEW

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ABSTRACT

The contribution of irrigation in Nigerian agriculture has been significant, especially in the northern part of the country where many of the population are farmers. However, irrigated agriculture in Nigeria has been affected by several problems, including stakeholder conflicts and infrastructural decay. Despite the significance of stakeholders' conflicts and infrastructural decay on the management of irrigation schemes, information on the extent to which these problems hampered the success of irrigation schemes in Nigeria had been sporadic. Herein, we reviewed the impact of stakeholders' conflict and infrastructural decay in Nigerian irrigation scheme and proffer some perspectives on the way forward. Reviewed literature revealed that misunderstandings between the stakeholders often lead to frequent contestations and conflict of interests among the agency staff, water users, herdsman, and neighbouring communities. Several factors are found to influence stakeholders' conflicts, which include: water sharing rules, irrigation technologies, water charges, policy alterations, socio-economic status of farmers, level of education and awareness, water managers' competence and expertise, and access to information and extension services. The problem of infrastructural decay has been mostly associated with mismanagement and lack of farmers' participation in the operation and maintenance, which they perceived as not their responsibility. Inconsistency in government policies and lack of continuity also play a vital role in abandoning ongoing irrigation rehabilitation projects. The review concluded by offering some perspectives on the way forward to address these problems. These include creating farmer-agency staff joint management, revitalization and expansion of infrastructures, and strengthening the concept of Participatory Irrigation Management (PIM) through intensifying sensitization and awareness campaign programs. It is envisaged that implementing these strategies will ensure the effective and sustainable utilization of Nigerian irrigation schemes.

Keywords: *Irrigation management, Participatory irrigation; Farmers; Stakeholders; Sustainability.*

1 INTRODUCTION

The need to produce adequate food to feed the teeming population of the world necessitates the establishment of irrigation schemes in different countries globally. Irrigation provides the opportunity for food production year-round by providing the necessary water for dry-season farming. In addition, irrigation becomes necessary where rain-fed agriculture is threatened with poor yield or destruction as a result of drought or erratic rainfall [1]. In many countries, irrigation has contributed to the attainment of food self-sufficiency through the reduction of uncertainties associated with rain-fed agriculture and ensuring that food can be produced to the required quantity throughout the year [2]. In Nigeria, formal irrigation schemes were launched around 1970s to augment rain-fed agriculture and to ensure food security in the country, with eleven (11) river basins set up to provide water resources for the irrigation, among other uses [3]. Irrigation schemes are common in the northern part of the country, where there is a convergence of extensive farming activities and insufficient rainfall. Irrigation activities in Nigeria range from small scale irrigation systems (usually by small scale Fadama farmers) to large scale irrigation schemes owned by the government [4]. The contribution of irrigation as a complementary means of food production cannot be overemphasized and involves a great number of rural people during the traditionally idle period of the long dry season [5]. Irrigation enhances the potentiality of growing economically important cash crops such as onion, tomato, pepper, maize, and wheat during the dry season. Hence, irrigated agriculture is a critical component that can ensure

Nigeria's food self-sufficiency [2, 6]. Irrigated agriculture, like many other institutions in Nigeria, is hindered by many factors, including technical, social, economic, and political problems [7]. Agriculture also continues to suffer from the inertia associated with policies and programmes intervention and reformation that pervaded Nigeria [8]. Irrigation schemes are made up of two components, the structural components such as the reservoirs, canals, drainages, and gates, and the human components, including the Water Users Association (WUAs), water engineers, individual farmers, researchers, and the governmental and non-government authorities [9]. However, designs and management of irrigation schemes in Nigeria have paid more attention to the physical structures (hard) than human structures (soft), thereby creating a wide gap between the stakeholders that leads to conflicts and decay of the irrigation infrastructure [7]. [2] opined that besides being technically sound, irrigation designs have to also be realistic by considering the social and institutional aspects, as well as practical considerations such as access-road conditions, night-shift work, and motivation of low-pay staff members. However, several socio-economic factors determine the success or failure of an irrigation scheme [10]. Factors such as gender, marital status, educational status, method of land acquisition, source of capital, water structures, source of labour, method of land preparation, varieties of the crop planted, source of planting materials, access to implements and availability of input crops cultivated, all play important roles in irrigation system management [11]. These influence the participation of farmers (water users) in decision making and implementation of various activities that assure the success of irrigation schemes [12]. The irrigation schemes in Nigeria have since been under dilapidated conditions and keep deteriorating at an alarming rate. Most of the infrastructures are no longer operating in normal condition, which diminishes their contribution to agricultural production in Nigeria. In many irrigation schemes, for example, the structures such as the main canal, secondary canals, and even the tertiary and drainages have been destroyed [13]. In the Lake Chad for instance, due to the issue of insurgency irrigation activities have been abandoned. Similarly, the Upper Niger River Basin Development has many developed reservoirs laying down idle without developing the operational structures such as the water conveyance systems, leaving the reservoirs susceptible to siltation. To revive the Nigerian irrigation schemes and ensure their sustainability, it is necessary to understand the existing problems hindering their effectiveness. While there have been several studies on Nigerian irrigation schemes, information on the implications of stakeholders' conflict and infrastructural decay has been sporadic, and a review on these aspects is yet to be presented. The aim of this work is therefore to provide a critical review of the stakeholders' conflict and infrastructural decay and their impact on Nigerian irrigation scheme and offer perspectives towards having an effective and sustainable irrigation system in the country. This review is timely considering the recent efforts to revive agricultural production in the country, with irrigation expected to play a key role in achieving that. The work will therefore be useful to the range of stakeholders involved in Nigerian irrigation scheme.

2 DEVELOPMENT OF IRRIGATION SCHEMES IN NIGERIA

During the oil boom of the 1970s, an investment programme in support of public irrigation was launched [14]. Public irrigation in the Nigerian context means schemes run either by River Basin Development Authorities (RBDAs) or by the States under Agricultural Development Projects (ADPs) [15]. The programme included the construction of large dams and pumping stations, especially in the drier northern part of the country [16]. By 1990, 162 dams had been constructed with a total storage capacity sufficient to irrigate 725 000 ha. Many of these dams, however, were built with little or no infrastructure and the sites chosen do not always have sufficient irrigable areas [17]. The schemes that were developed have not been brought into production fully or they have been implemented with inappropriate infrastructure. By 2004, only about 20% of the area planned for public irrigation was developed [14]. However, 32% of the developed area were being irrigated. According to [15]. Problems such as poor utilization and utmost decay in public irrigation infrastructures were as a result of the combinations of the followings; i) Poor strategic policy for irrigation sub-sector development; ii) Attention was not duly given to management structures; iii) A paucity of funding and cost recovery by the government; iv) High capital and operating cost which become proceeds of embezzlement; v) Lack of farm support services; vi) Low level of financial viability and project ownership acceptability [15]. These, and many other problems, have led to the serious deterioration of irrigation facilities over the years. Therefore, urgent and swift interventions are needed to avert the total collapse of the irrigation

infrastructure. Food security is therefore threatened by the current dilapidation of these structures. Irrigation potential estimates in Nigeria vary from 1.5 to 3.2 million ha. The latest estimate gives a total of about 2.1 million ha, of which about 1.6 million from surface water and 0.5 million ha from groundwater. The country is divided into 6 zones: North-East, North-West, North-Central, South-West, South-East, and South-South, which is consistent with the main drainage basins of the country [10]. Nigeria is a member of two regional authorities dealing with water resources management: the Niger Basin Authority and the Lake Chad Basin Commission [3, 5]. The highest national water resources policy formulating body is the National Council for Water Resources (NCWR), chaired by the Federal Ministry of Water Resources. It is structured under the Departments of Irrigation and Drainage and promotes the development of irrigated agriculture through River Basin Development Authorities (RBDA) as shown in Figure 1 [7]. The Federal Ministry of Agriculture and Rural Development is involved in irrigation development through the Agricultural Development Projects (ADPs). ADPs promote farmer-owned and-managed irrigation and provide extension services to farmers on public irrigation schemes, and are assisted by the Federal Agricultural Coordinating Unit. In some states, Ministries of Water Resources have been created and federal competences of the Ministry of Agriculture and Rural Development in irrigation have been transferred to them [18, 19]. The irrigation schemes were created under the river basins, the River Basin Development Decree was promulgated in 1976 to establish eleven River Basin Development Authorities (RBDAs) (Decree 25 of 1976) [7, 20]. The aim was to boost the economic potentials of the existing water bodies in those river basins, particularly irrigation and fishery, hydroelectric power generation, and domestic water supply. The objective of the programme was later extended to other areas most important to production and rural infrastructural development. Problems such as poor coordination and intensive political interference have continued to hinder the success of the RBDAs. In addition, substantial public funds were wasted to streamline the sizes and functions of RBDAs through the disposal of their non-water assets.



Figure 1. River Basins in Nigeria [7]

The major irrigation schemes in Nigeria use a surface irrigation system that is fully controlled by the government, with other stakeholders having a little role to play in the operation and maintenance of the systems [7]. Although there have been efforts to develop the culture of participatory irrigation management, the situation remains largely the same. The farmers, being the central stakeholder, pay

little attention to the management of the irrigation schemes infrastructure, as long as the water flows. However, infrastructural decay constitutes a major drawback in the sustainability of the irrigation schemes. It creates wastage of water resources and rendering those downstream in acute shortage of water. When the controls are faulty or damaged, it results in uncontrollable water flow in the field, leading to inundation and drainage problems. Inundation and poor drainage could lead to salt buildup within the field, discharges of methane gas from the field as a result of the activities of anaerobic bacteria, and poor plant growth due to poor aeration in the soil.

3 THE ROLE OF STAKEHOLDERS IN THE MANAGEMENT OF IRRIGATION SCHEMES

Irrigation scheme management involves the coordination of the water sources, water conveyance infrastructures, water allocation rules, and teamwork by all stakeholders to equitably, efficiently, and sustainably share water among farmers. Irrigation scheme stakeholders, including public agencies, private institutions, national and international organisations, civil societies, water users' associations and traditional leaders are the custodian of the scheme [21]. They had a collective responsibility to manage the irrigation scheme under the agreed rules. In Nigeria, irrigation schemes are managed using a semi-autonomy approach by subdividing it along the lines of one Water User Association (WUA) per distribution canal such that a WUA consists of 10 to 25 farmers. Some of the responsibilities of WUA include operation and maintenance (O&M) of the infrastructures and adherence to water scheduling and sharing rules [11]. A scheme management committee (SMC) is typically formed, which consists of at least one member from each WUA and then acts as the interface between the WUAs and River Basin Development Authority (RBDA) or other authorities [22]. Nigeria is known to have a poor culture of maintenance, particularly in public irrigation schemes, as it has been revealed that small-scale individual farming schemes are successful [22]. Hence, creating a self-organised management strategy that co-opted all parties is essential [23]. Therefore, the success of irrigated agriculture in Nigeria, or anywhere in the world, is not only related to water availability or vast arable land [24] but also effective water sharing policy and continuous infrastructural maintenance through stakeholder participation and engagement [11]. Participatory is the act of involving all stakeholders in the procedural and decision-making processes, which improve management through transparency, accountability, public-private collaboration, and partnership [23, 25]. According to [21], engaging stakeholders in water planning and management dialogues is not an option, but a necessity. A mechanism for checking if all parties are involved or not needs to be put in place. To check whether all the stakeholders are involved in policy development and management, there is a need to answer the following ethical questions: Who participates in the decision-making process? Are participants active? Are their views considered in formulating policies? Is there respect for the socio-cultural, traditional, and religious beliefs of indigenous communities? [26]. The focus of water management is increasingly shifting from the command and control to decentralize and user-oriented approaches. Water governance literature reveals that stakeholders' engagement is an integral part of sound water governance [27]. Stakeholders' engagement and active participation have since been recognized as an important component of sustainable water management, ranging from planning, development, and operations to consumption [28, 29, 30]. Such user-oriented approaches are designed to place more emphasis on stakeholder participation through the creation of local organisations [31]. Involving traditional leaders and community-based associations also offers a significant and important role in dealing with unethical human activities [32]. These approaches enable water stakeholders to feel and see themselves as agents of change, which can improve the performance of the water management sector, including irrigation schemes. Therefore, such approaches, in which representatives of water users and managers decide to actively participate in tackling the challenges facing water management sectors, are necessary [33]. From the irrigation water management perspective, the concepts of Participatory Irrigation Management (PIM) and Irrigation Management Transfer (IMT) were introduced and have been used as an avenue for co-opting water users in the management of irrigation schemes. The PIM is defined as the involvement of irrigation users in all managerial aspects of the irrigation scheme. Whereas the IMT is defined as the transfer of responsibility and authority for irrigation scheme management from governmental organizations to water users associations or other non-governmental private entities [34]. In Nigeria, there were several attempts to initiate, develop, and formalize participatory and stakeholder engagement-based irrigation scheme management. Traditionally, groups of farmers typically from one

hydraulic unit or irrigation block are formed to manage a portion of the irrigation scheme, formally known as Water Users' associations - WUAs [35]. The mandate of WUAs is to safeguard and ensure efficient and effective sharing and utilization of the limited water through the maintenance of irrigation infrastructures as well as in the decision-making process. Although the ideas and laws enacted to govern WUAs are tailored towards the improvement of irrigation schemes, many attempts at WUA formation and development are reported to have failed due to disparities and the dynamic nature of the social, economic and political background of irrigation communities and other situational factors [1]. In Nigeria, many self-organized groups of farmers and other water users are formed by the communities close to larger water bodies like Lake Chad and large and medium scale reservoirs such as Tiga and Watari dams. A larger proportion of farmers in these groups were reported to have paid more attention to their farming activities than the management and maintenance of irrigation infrastructures outside their plots [11]. These, among other reasons, further deteriorated the performance of many irrigation schemes in Country. In some few irrigation schemes, such as Watari Irrigation Project (WIP), Barwa-Minjibir Irrigation Scheme, Kano, and Kpong Irrigation Project in Niger Delta Basin Development Authority (NDBDA), some proportion of farmers especially those at downstream had to abandon their farm plots due to poor water distribution [35, 36, 37, 38]. In some schemes, farmers are left on their own without a proper guide on how, and when to irrigate [35]. To curtail these problems, a research programme to promote Agency-Farmer Joint Management was formed in 1995 by the Centre de Cooperation International En Research Agronomique pour le Development (CIRAD), the National Agricultural Extension and Research Liaison Services (NAERLS) and the Hadejia Jama'are River Basin Development Authority (HJRBDA). This programme led to the establishment of a WUAs unit in the Hadejia Valley Irrigation Project (HVIP). Despite the successes recorded such as farmers' involvement, the programme had several limitations as a result of political interference and inter-village differences within the associations, which led to the conflict of interest and retardation of the WUAs development process [11]. Moreover, according to a report on the Review of Public Irrigation Sector in Nigeria (ROPISIN) conducted in 2004, there were very few irrigation schemes with effective and functional WUAs. The report further ascertained that even if WUAs exist, they rarely have any prescribed and formal constitution, rather, they are mostly guided by tradition and culture. Also, unreliable and inequitable irrigation water supply, indiscipline and fraudulent activities in the use of water have become the norm among farmers [39]. These, among other problems, persisted and rendered the sustainability of irrigated agriculture in Nigeria in jeopardy. Hence, urgent action is required to reduce or stop such undesirable occurrences thereby improving the performance of irrigation schemes in Nigeria.

4 STAKEHOLDERS CONFLICT AND EFFECT ON MANAGEMENT OF IRRIGATION SCHEMES

Irrigation water management comprised public irrigation agencies, national and international organisations, civil societies, WUAs, religious and traditional leaders. Thus, the management of a given water sector such as an irrigation scheme is a collective responsibility of these water custodians under the agreed rules. The agents of public agencies include the minister of water resources, directors of various directories, water operators, engineers, and other technical, security, and administrative staff. The non-governmental organizations may include multinational agencies (United Nations, World Bank etc), international and national water organisations, WUAs, traditional and religious leaders [40]. Issues related to how the water custodians are structured, what belongs to who (property right), licensing bureaucracies, allocation rules, and the means of sharing information can result in a conflict of interest [41, 42]. Governmental or public water management agencies have been reported to allegedly accuse water users to lack of enthusiasm for minimising unlawful activities related to water use and considered as one of the major problems affecting the water sector. However, many stakeholders considered the low implementation and ineffectiveness in enforcing water laws and other situational factors related to water users and infrastructures as the main cause of these problems [43, 44]. There is also a lack of consistent awareness campaign to enlighten farmers to understand that irrigation scheme management activities are also their responsibility. Moreover, majority of the farmers perceived that irrigation scheme management is the sole responsibility of the government and it shall be free of charge [6]. In Nigeria, many stakeholders are involved in the management of irrigation schemes, including farmers and agency staff. But there are several problems associated with such farmers-agency irrigation

management, including the overlapping authority and responsibility, in addition to conflicting interests between them. Such farmers-agency irrigation management has yielded both positive and negative impacts on the performance of irrigation schemes. Some of the positive impacts include collective responsibility and participation in the operation and maintenance of irrigation infrastructures and reporting illegal breaking of canals to siphon water and other unlawful activities to the relevant authority. However, stakeholder collaborations have led to frequent contestation and conflict of interests between agency staff, group of water users, civil societies, traditional leaders, herdsmen, and the entire neighbouring community [45]. Several factors have been found to influence stakeholders' conflicts of interest in irrigation scheme management. These include government new policies and/or policy alterations, introducing new irrigation technologies to the farmers, market forces, environmental concerns, demographic factors, institutional factors, and water delivery systems. Others include social status, educational level, farming experience, membership to organizations, access to information, and extension services [6]. Irrigation stakeholders' conflict is a term usually used to describe disputes and differences among water stakeholders over access to water for their agricultural production. Among the groups involved in water conflicts in irrigation schemes, the main conflicts are usually between groups of farmers, farmers and herdsmen, as well as farmers, and government officials [46]. Although water-sharing processes and rules have been formalized and insisted on national policies and water laws in Nigeria, they are not so effective in the management of such water stakeholders' conflicts. Several studies have shown the occurrences of water stakeholders' conflicts in irrigation schemes in Nigeria. Some of the pioneered conflicts are due to the dominance of powerful irrigators who control the upstream plots at the detriment of the less powerful farmers situated downstream [47]. Many farmers commonly perceived that water managers are more concern with the collection of water charges than doing their work, which led to the farmers having little respect for the water managers [48]. A report on the analysis and management of natural resource conflict in Northern and Central Nigeria identified some major areas of conflict in irrigation catchments, which include farmers and pastoralists, fisheries and hunters opposed to both pastoralists and farmers, and between large-scale farmers and indigenous landowners. Other conflicts comprised native communities opposed to industrial enterprises (e.g. mining) and the development of large infrastructural projects such as dams [12]. A study to examine the economic impacts of farmer-herdsmen conflicts in Bauchi State, Nigeria, revealed that farmers experienced higher losses of more than 10 times than the pastoralists. In conclusion, farmer-herdsmen conflicts and confrontations have had negative effects on not only the economy of the families involved but also at the national level in terms of huge resources lost [49]. Another study revealed that over 85% of the farmers at the Lower Niger River Basin Development Authority (LNRBDA) in Kwara State, Nigeria, complained bitterly about poor response to their needs by the irrigation authority [50]. This, among other reasons, including poor water allocation strategy, led to severe confrontations between the farmers and the water managers in the basin. Water users-managers conflict has recently occurred at the Kano River Irrigation Project (KRIP). Water managers have been found to give more emphasis to allocating water to downstream users as well as environmental flows and groundwater recharge, whereas upstream farmers oppose this policy [51, 52]. There were several studies on the conflicts between groups of farmers, farmers and herdsmen and farmers and the government officials, which have been reportedly linked to the poor performance of irrigation schemes in Nigeria [53, 54, 55]. Several underlying problems typically lead to such stakeholders' conflicts. For example, decentralized water users due to poor sensitization and facilitation of farmers to form self-organized groups (WUAs). Lack of annual workshops and seminars to train farmers on how to manage irrigation infrastructures and to understand that participation in the maintenance of irrigation infrastructures is their responsibility. Lack of routine awareness and enlightenment campaigns on how farmers can resolve conflict among themselves, between farmers and pastoralists and between farmers and water managers. Negligence to train farmers on how to properly use limited water resources and understand when and how much to irrigate their farm plots and pay water dues to agency staff among other positive responses from farmers [6, 56]. Besides, most of the large dam irrigation projects do not improve the water supply to the adjacent farming areas (project-affected communities), and the majority of the beneficiaries are the downstream farmers where the government irrigation scheme is located [57].

5 The Problem of Infrastructural Decay

The success of any irrigation scheme depends, among others, on the infrastructures that are necessary for water supply and distribution. Thus, the decay of such infrastructure is always a threat to the effectiveness and sustainability of irrigation schemes. Infrastructural decay can be a result of ageing, mismanagement and sometimes, poor construction. In Nigeria, the decay of irrigation infrastructures is mostly associated with mismanagement. Irrigation infrastructures are built to last for decades, however, proper water usage and management of structures is paramount for the structures to reach its life span. Managing these infrastructures requires substantial funding, which the country has not been able to maintain consistently. Politics has also played a vital role, where a change in government often results in the discontinuity of ongoing projects. Another major cause of this problem is that the end-users (farmers) are mostly not conversant with irrigation technologies, which can be regarded as necessary for proper management and utilization of the water. NEDECO's 1974 report had also emphasized the farmers' technical-know-how on irrigation systems [58]. Another short report on the proper management needed in the Kano system outlined that: *"Farmers should be fully conversant with irrigation technologies and cultivating irrigated crops. Inputs such as fertilizers, insecticides, agricultural machinery, and credit facilities should be made available. Marketing of agricultural production should be organized"* [58]. In large scale irrigation schemes, the main components are the farmers and the irrigation agencies such as the River Basin Development Authorities. The agencies are responsible for the operational, maintenance, and management of large-scale irrigation projects. Other responsibilities include resolving conflict among the farmers, resettlement of the affected farmers, rural development programmes and provision of agro-support services such as land preparation, seeds, fertilizers, chemicals, and assistance in marketing produce. It is the complete co-operation between all categories of people concerned that determines the success of an irrigation project. It has been found in many countries that the sustainability of the irrigation system without the appropriate participation of the farmers has been very difficult [5]. The feeling of superior-subordinate between the agency personnel and farmers needs to be changed. The agency personnel should change their attitude in describing the farmers as obstinate, ignorant, uncooperative, and traditional. The agency personnel should take the farmer as an important source of system management. In this context, therefore, the farmers also have to change their attitude of describing the agency personnel as exploiters, uncooperative, and stubborn (Haruna, 2004). These will surely contribute tremendously to the success of any irrigation scheme. Public irrigation infrastructural developments in Nigeria began in the 1970s, with the 3 pilot schemes (Bakalori, Kano and Chad basin) sought after the occurrence of 1970-75 droughts. Thereafter, the government made a huge investment in dams, though the corresponding irrigation infrastructure was not developed at that time. This was followed by the development of small-scale farmer-based irrigation systems in Fadama areas for dry season farming by the provision of irrigation pumps and tube-wells through Agricultural Development Projects (ADPs) and the National Fadama Development Project (NFDP) from 1993 onwards [59]. Today, the public irrigation sector in Nigeria accounts for 13% of the irrigated area and an estimated 0.25% of the total agricultural area [15]. There is an appreciable success, with over 325,106 ha of land been equipped for irrigation across the country [7]. However, these huge government investments have continuously deteriorated over time due to poor management, among other things. Infrastructure, a key for any solid economic growth remains a serious limiting factor in all the sectors of the national economy. Many studies have indicated the weak infrastructural foundation to accelerate economic growth, especially in agriculture. A number of studies have reported the status of the state irrigation infrastructures across the country. A report on the environmental and social impact assessment for the Hadejia Jama'are River Sub-Basin by Transforming Irrigation Management in Nigeria has clearly shown, for example, that, there is extensive decay of the irrigation infrastructures and many rehabilitation measures including replacements, repairs and upgrades of some important parts of the structures, were suggested.

6 PERSPECTIVES ON THE WAY FORWARD FOR NIGERIAN IRRIGATION SCHEMES

Recently, there are growing efforts by the Nigerian government to promote agricultural production towards the diversification of its economy [7]. While agriculture could provide sustainable contributions to the Country's GDP, necessary frameworks must be developed to ensure that sustainable

infrastructure is incorporated in the operation of the irrigation systems. Although irrigation is necessary for sustainable agricultural production in Nigeria, it is evident that many challenges have hindered the effective utilization of Nigerian irrigation schemes. Thus, it is necessary to address these challenges to ensure the sustainable utilization of Nigerian irrigation schemes. The following sections present some perspectives to address these challenges:

6.1 Effective and holistic management framework

Currently, there are no clear and effective frameworks for managing and utilizing Nigerian irrigation schemes. While the objectives of setting up these irrigation schemes were spelt out, the necessary strategies to achieve these objectives are lacking. Consequently, most of the irrigation schemes are underutilized, making their contributions to Nigerian agricultural development less significant. Therefore, there is a need to have holistic frameworks where the roles of all the stakeholders are clearly defined and synergized. Such frameworks should also cover the technical and socio-economic aspects of the irrigation schemes and how these can be carefully managed for the sustainability of the irrigation scheme.

6.2 Revitalization and expansion of infrastructure

While many irrigation schemes have been established over the years, they are not fully utilized due to myriads of problems, including infrastructural decay. With the rising population and the government's deliberate policy to curb food importation, it is necessary to revitalize and expand the existing irrigation infrastructure to ensure sustainable food production. The capacity of the existing irrigation schemes must be enhanced while necessary efforts must be put towards developing new schemes across the country.

6.3 Strengthening the participatory framework/approach

There is insufficient farmer participation in many aspects of irrigation projects in Nigeria. Farmers, as the end-users, are involved in the last stage of irrigation, where they utilize the water. However, they have little or no input in the preceding stages, which are usually technically-oriented and formulated without regard to the existing farming systems and other socio-economic aspects. This has resulted in irrigation systems that are capital-intensive, focus on the hardware, and neglect agricultural production and institutional weaknesses. For the sustainability of the irrigation system, farmers must be recognized as important stakeholders that should participate in all the stages of the irrigation system. A clear framework of participatory irrigation, where farmers are recognized as important stakeholders, should be formulated. This will require a major shift from the conventional technically-oriented approach to a more sustainable participatory approach, where farmers are the prime stakeholders.

6.4 Deliberate policies and interventions

As highlighted earlier, the lack of strong institutional frameworks and deliberate interventions are among the major challenges of irrigation schemes in Nigeria. For example, while Nigerian irrigation schemes are under the purview of the Federal Ministry of Water Resources, the Federal Ministry of Agriculture and Rural Development coordinates agricultural activities in the country. This often leads to poor coordination and management since the ministries may have different priorities and approaches. For sustainable irrigation schemes and agricultural production, there is a need for both ministries to synergize in coming up with implementable policies and interventions.

6.5 Enhancing the capacity of stakeholders/WUAs

There is a strong need to enhance the capacity of farmers, who are the central stakeholders, in irrigation systems and technologies. Currently, the majority of Nigerian farmers do not have the requisite knowledge to manage or participate in modern irrigation systems. This is a challenge considering the need to adopt sustainable and modern irrigation technologies to ensure abundant food production in the face of changing climate and dwindling water resources. The farmers needed to be trained and retrained periodically on operations and maintenance of modern technological irrigation systems and practices with the collaboration of the Water Users Association (WUA). This will give the

WUA a sense of belonging and ownership for the maintenance and sustainability of the irrigation systems.

7 CONCLUSION

This study reviewed stakeholders' conflict and infrastructural decay in Nigerian irrigation schemes. Some of the major problems identified are the poor synergy between the key stakeholders, inadequate sensitization of farmers and the agency staff on roles and responsibilities in the schemes, and poor management of infrastructures. Nearly five decades after initiating some of the formal irrigation schemes in the country, the lack of consistent expansion plans, coupled with a decline in the operation and maintenance of irrigation infrastructure, has led to the continuous decay of the facilities. The infrastructural decay could also be attributed to the poor institutional framework to safeguard policies that will protect the system. The political instability that brings about disruption in policies has also affected the irrigation schemes. The roles of stakeholders in irrigation scheme have not been spelt out in most cases, which gives room for farmers to disclaim their responsibilities and treat the schemes as belonging to government alone in terms of operation and maintenance. This view creates a serious rift between the water managers and the other water users, which not only brings disharmony between stakeholders but also leads to conflicts. The review then proffered a way forward to address the problems of stakeholders' conflicts and infrastructural decay in the Nigerian irrigation schemes, which include; effective and holistic framework, revitalization and expansion of infrastructure, strengthening the participatory framework/approach, deliberate policies and interventions formulations and enhancing the capacity of stakeholders/WUAs. It is expected that adopting some of these perspectives would enhance the effectiveness of the Nigerian irrigation scheme, particularly at this point where the country focuses on boosting its agriculture production.

REFERENCES

1. Aarnoudse, E., Closas, A. and Lefore, N. (2018). Water User Associations: A Review of Approaches and Alternative Management Options for Sub-Saharan Africa - Colombo, Sri Lanka: *International Water Management Institute (IWMI). IWMI Paper No. 180*, pp. 1-77. <https://doi.org/10.5337/2018.210>.
2. Nweze, N. (2016). Failure of Public Infrastructure Projects in Nigeria: Causes, Effects and Solutions. *Texila International Journal of Management*, vol. 2, no. 2, pp. 33-43. <https://doi.org/10.21522/tijmg.2015.02.02.art004>.
3. Walker, W.E., Loucks, D.P. and Carr, G. (2015). Social Responses to Water Management Decisions. *Environmental Processes*, vol. 2, no. 3, pp. 485-509. <https://doi.org/10.1007/s40710-015-0083-5>.
4. Worako, A.W.W. (2015). International Journal of Water Resources and Environmental Engineering Irrigation system in Israel: A review. *International Journal of Water Resources and Environmental Engineering*, vol. 7, no. 3, pp. 29-37. <https://doi.org/10.5897/IJWREE2014>.
5. Bashir, A. and Kyung-Sook, C. (2018). A review of the evaluation of irrigation practice in Nigeria: Past, present and future prospects. *African Journal of Agricultural Research*, vol. 13, no. 40, pp. 2087-2097. <https://doi.org/10.5897/ajar2018.13403>
6. Haruna, S.K. (2004). Socio-economic Factors Affecting Farmers Participation in Large Scale Irrigation Scheme Management in Kano River Irrigation Project (KRIP) Phase 1 *Unpublished MSc. Theses Department of Agricultural Economics and Rural Sociology ABU Zaria*, pp. 1-131.
7. Federal Ministry of Water Resources (2016). *A final draft of the National Water Policy* Federal Ministry of Water Resources Nigeria (Issue February). <http://wsssrp.org/wp-content/uploads/2017/10/Water-Resources-Policy.pdf>. pp. 1-62.
8. Iwuchukwu, J.C. and Igbokwe E.M. (2016). Lessons from Agricultural Policies and Programmes in Nigeria. *Journal of Law, Policy and Globalization*, vol. 5, pp. 12-22.

9. Shanono, N.J. and Ndiritu, J. (2019). Development of reservoir operation socio-hydrological simulation model to assess the impact of human behaviour on reservoir performance. 10th NAHS International Conference at UDU, Sokoto, State, Nigeria. in *10th NAHS International Conference on 21st – 24th October 2019 at UDU, Sokoto, State, Nigeria*, pp. 124–133.
10. Bassey, C.O., Ayara, N., Kichuru, W. and Garba, M.P. (2016). 2016 Strategic Conflict Assessment of Nigeria. A consolidated Zonal Reports. Institute for Peace and Conflict Resolution (IPCR) Report of 2017, pp. 1-545
11. Haruna, S. K. (2015). Impact of Participatory Irrigation Management (PIM) on the Livelihood of Water Users in Kano River Irrigation Project (KRIP), Nigeria. *Unpublished PhD Thesis submitted to Faculty of Agriculture, Ahmadu Bello University, Zaria*. Retrieved from <http://kubanni.abu.edu.ng/jspui/handle/123456789/8363>. pp. 1-164.
12. Blench, R. and Dendo, M. (2005). Natural Resource Conflicts in North-Central Nigeria - A handbook and case study. <http://rogerblench.info/Development/Nigeria/Pastoralism/Nigeria%20Conflict%20Book.pdf>. pp. 1-57.
13. Le Meur, P.Y., Hochet, P., Shem, M. and Touré, O. (2006). Conflict over Access to Land and Water Resources within {Sub-Saharan} Dry Lands. *Underlying Factors, Conflict Dynamics and Settlement Processes*. Roma: *FAO/Lead Report, September*. <http://www.fao.org/fileadmin/templates/lead/pdf/tanzania/conflict.pdf>. pp. 1-108.
14. Jafary, F. (2016). Participatory Modelling Platform for Groundwater Irrigation Management With Local Farmers in Iran (*Kashan*) PhD Thesis submitted to University of Birmingham. pp. 1-371. <https://www.semanticscholar.org/paper/Participatory-modelling-platform-for-groundwater-in-Jafary/92bf83adc36b32df9aad45b82c132f56a2a2f9b7?p2df>.
15. Food and Agriculture Organization (2005). Water Report 29: *Irrigation in Africa Aquastat survey*. http://www.fao.org/nr/water/aquastat/countries_regions/NGA/NGA-CP_eng.pdf. pp. 1-14.
16. Harmancioglu, N.; Alpaslan, N. and Boelee, E. (2001). Irrigation, health and environment: a review of literature from Turkey. In *IWMI Working Paper 006*. pp. 1-66. <https://doi.org/10.3910/2009.141>.
17. Di Baldassarre, G., Sivapalan, M., Rusca, M., Cudennec, C., Garcia, M., Kreibich, H., Konar, M., Mondino, E., Mård, J., Pande, S., Sanderson, M. R., Tian, F., Viglione, A., Wei, J., Wei, Y., Yu, D. J., Srinivasan, V. and Blöschl, G. (2019). Socio-hydrology: Scientific Challenges in Addressing the Sustainable Development Goals. *Water Resources Research*, vol. 55, no. 8, pp. 6327–6355. <https://doi.org/10.1029/2018WR023901>.
18. Food and Agriculture Organization (1992). Crop Evapotranspiration (guidelines for computing crop water requirements) FAO, Water Resources, Development and Management Service Rome, Italy. Irrigation and Drainage Paper 56, pp. 1-300.
19. Japan International Cooperation Agency (1993). The study on the national water resources master plan. Federal Ministry of Agriculture, Water Resources and Rural Development, Nigeria. pp 1-57. <https://openjicareport.jica.go.jp/pdf/12146569.pdf>.
20. Ayoola, G.B. (2001). The Nigerian Grain Market and Industrial Utilization of Sorghum. A book of readings on Agricultural Development Policy and Administration in Nigeria. Ibadan, TMA Publishers, pp. 249-254.
21. Wheater, H.S. (2014). Water Security – science and management challenges. *Hydrological Sciences and Water Security: Past, Present, and Future*, vol. 366, pp. 23–30. <https://doi.org/10.5194/piahs-366-23-2015>.
22. Pete, J. (2005). Irrigation in Africa in figures - AQUASTAT Survey – 2005, FAO Water Report_29, pp. 1-11. <http://www.fao.org/nr/water/aquastat/countriesregions/africa/figurescontinent.pdf>.

23. Rogers, K.H. and Luton, R. (2011). *Strategic Adaptive Management as a Framework for Implementing Integrated Water Resource Management in South Africa - A Report to the Water Research Commission*. Report number: K8/861, pp. 1-123. Retrieved from <file:///C:/Users/Wits-User/Downloads/SAM as a framework.pdf>.
24. Othman, M.K., Abubakar, S.Z., Murtala, G.B., Ibrahim, A. and Dayot, B. (2006). Problems and Prospects of Farmer Groups in Participatory Irrigation Management (PIM): Case study of Kano River Irrigation Project (KRIP). In *Proceeding of 7th International Conference of the Nigerian Institution of Agricultural Engineers (NIAE) Zaria, Nigeria*, pp. 269-271.
25. Chikozho, C. (2001). Towards Community-Based Natural Resources Management in the Water Sector: An Analysis of Legislative Changes made under the South African and Zimbabwean Water Reforms. pp. 1-17.
26. Jennings, B., Heltene, P. and Kintzele, K. (2009). Principles of Water Ethics. *Minding Nature*, (August 2019), pp. 25–28. Retrieved from http://www.humansandnature.org/filebin/pdf/minding_nature/August_2009_Principles_of_Water_Ethics.pdf
27. Akhmouch, A. and Clavreul, D. (2016). Stakeholder Engagement for Inclusive Water Governance: “Practicing What We Preach” with the OECD Water Governance Initiative. *Water*, vol. 8, no. 204, pp. 1-17. <https://doi.org/10.3390/w8050204>.
28. Global Water Partnership (2000). Integrated Water Resources Management: Technical Advisory Committee (TAC) Paper No. 4. *Water Science and Technology*, vol. 62, pp. 1-71. <https://doi.org/10.2166/wst.2010.262>.
29. Megdal, S., Eden, S. and Shamir, E. (2017). Water Governance, Stakeholder Engagement, and Sustainable Water Resources Management. *Water*, vol. 9, no. 3, pp. 1-7. <https://www.mdpi.com/2073-4441/9/3/190>.
30. Bartula, M., Lau, R. and Radojevi, U. (2017). Stakeholder analysis for supporting local water security planning in the Kingdom of Jordan. *Water Utility Journal*, vol. 15, pp. 3–13. Retrieved from http://www.ewra.net/wuj/pdf/WUJ_2017_15_01.pdf.
31. Dube, D. and Swatuk, L.A. (2001). Stakeholder participation in the new water management approach: a case study of the Save Catchment, Zimbabwe. In *2nd WARFSA/WaterNet Symposium: Integrated Water Resources Management: Theory, Practice, Cases; Cape Town, 30-31 October 2001*, pp. 32-42.
32. Summerill, C., Pollard, S.J.T. and Smith, J.A. (2010). The role of organizational culture and leadership in water safety plan implementation for improved risk management. *Science of the Total Environment*, vol. 408, no. 20, pp. 4319–4327. <https://doi.org/10.1016/j.scitotenv.2010.06.043>.
33. Choles, A.G., Govender, N. and Vlok, A. (2014). *Investigating Stakeholder Engagement Cycles and Identities Within Water Resource Management, Using Narrative Techniques*, WRC Report No. 2076/1/13. pp. 1-48.
34. Vuren, G. van, Papin, C. and El-Haouari, N. (2007). *Participatory Irrigation Management : comparing theory with practice a case study of the Beni Amir irrigation scheme in Morocco*. Paper Number: HAL Id: cirad-00188971, pp. 1-11. Retrieved from <http://hal.cirad.fr/cirad-00188971/document>.
35. Hallai, G. (2001). Evolving/Formation of Water Users’ Association for Effective Implementation of Participatory Irrigation Management in Public Sector Irrigation Schemes In A.O Lawal, R.A Jimoh and F.A Adeneji (Ed). In *Proceeding of National Workshop on Participatory Irrigation Management of Public Irrigation Schemes in Nigeria*. NAERLS, ABU Zaria Nigeria. pp. 105–113.
36. Shanono, N.J., Othman, M.K., Nasidi, N.M. and Isma’il, H. (2012). Evaluation of Soil and Water Quality of Watari Irrigation Project in Semi-Arid Region, Kano, Nigeria. In *Proceedings of the 33rd National Conference and Annual General Meeting of the Nigerian Institute of Agricultural Engineers (NIAE) Bauchi*. pp. 181-186.

37. Shanono, N.J., Nasidi, N.M., Zakari, M.D. and Bello, M.M. (2014). Assessment of Field Channels Performance at Watari Irrigation Project Kano, Nigeria. In *1st International Conference on Dryland, Center for Dryland Agriculture, Bayero University Kano, Nigeria. 8th – 12th December 2014*, pp. 144-150.
38. Nasidi, N.M., Shanono, N.J., Zakari, M.D., Ibrahim, A. and Bello, M.M. (2015). Reclaiming Salt-affected Soil for the Production of Tomato at Barwa-Minjibir Irrigation Scheme, Kano. In *International Conference on Green Engineering for Sustainable Development, IC-GESD 2015. Held at Bayero University, Kano Nigeria*, pp. 260 – 264.
39. Review of the Public Irrigation Sector in Nigeria (2004). *Review of the Public Irrigation Sector in Nigeria - Draft Status Report*, pp. 1-142. Retrieved from <ftp://ftp.fao.org/agl/aglw/ROPISIN/ROPISINreport.pdf>.
40. Jaspers, F.G.W. (2003). Institutional arrangements for integrated river basin management. *Water Policy*, vol. 5, no. 5, pp. 77–90. Retrieved from <http://www.environmental-expert.com/Files/5302/articles/5879/4.pdf>.
41. Dietrich, J. (2016). Scaling issues in the multi-criteria evaluation of combinations of measures for integrated river basin management. In *Proceedings of the International Association of Hydrological Sciences*, vol. 373, pp. 19–24. <https://doi.org/10.5194/piahs-373-19-2016>
42. Lopez-gunn, E., Stefano, L. De and Llamas, R. (2012). The role of ethics in water and food security: balancing utilitarian and intangible values. *Water Policy*, vol. 14, pp. 89–105. <https://doi.org/10.2166/wp.2012.008>.
43. Department of Water and Sanitation (2012). Water Reconciliation Strategy Study for the Large Bulk Water Supply Systems: Greater Bloemfontein Area, pp. 1-43. Retrieved from <https://www.dwa.gov.za/orange/Docs/Great Bloem Area/Preliminary Reconciliation Strategy.pdf>.
44. Muller, M. (2017). *Understanding the origins of Cape Town’s water crisis*: By Social Science Research Network (SSRN) in Civil Engineering Paper number: June, 2017, pp. 7-12. https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID2995937_code739318.pdf?abstractid=2995937&mirid=1.
45. Jumiaty, J., Fahmid, I. and Riwu, M. (2018). Stakeholder analysis in the management of irrigation in Kampili area. *Earth and Environmental Science*, vol. 158(June), pp. 1 – 5. <https://doi.org/10.1088/1755-1315/157/1/012069>.
46. Fundi, S.S. (2018). Water User’s Conflicts in Irrigation Schemes in Tanzania. *Journal of Public Administration and Governance*, vol. 8, no. 4, pp. 172–186. <https://doi.org/10.5296/jpag.v8i4.13965>.
47. Aiyedun, E.A. (1991). Irrigated Agriculture in Nigeria: Problems and Prospects. *African Journal of Agricultural Science*, vol. 18, no. 1, pp. 91 - 106.
48. Ogunwale, S.A., Maurya, P.R. and Owonubi, J.J. (1991). Farmers’ Views on the Management of Irrigation Schemes in Nigeria - *Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria*. pp. 10-19.
49. Sulaiman, A. and Ja’afar-Furo, M.R. (2010). Economic Effects of Farmers-grazier Conflicts in Nigeria: A Case Study of Bauchi State. *Trends in Agricultural Economics*, vol. 3, no. 3, pp. 147–157.
50. Adekunle, O.A., Oladipo, F.O. and Busari, I.Z. (2015). Factors Affecting Farmers’ Participation in Irrigation Schemes of the Lower Niger River Basin and Rural Development Authority, Kwara State, Nigeria. *S. Afr. J. Agric. Ext.*, vol. 43, no. 2, pp. 42–51. <https://doi.org/http://dx.doi.org/10.17159/2413-3221/2015/v43n2a353>.
51. Ahmad, M.T., Haie, N., Yen, H. and Tuqan, N.A.S. (2018). Sufficiency of a Water Use System: The Case of Kano River Irrigation Project, Nigeria. *International Journal of Civil Engineering*, vol. 16, no. 8, pp. 929–939. <https://doi.org/10.1007/s40999-017-0235-2>.

52. Shanono, N.J. and Ndiritu, J. (2020). A conceptual framework for assessing the impact of human behaviour on water resource systems performance. *Alger. J. Eng.*, vol. 2, no. 2. pp. 35–44. <http://dx.doi.org/10.5281/zenodo.3903787>.
53. Takeshima, H. and Adesugba, M. (2015). *Irrigation Potential in Nigeria: Some Perspectives Based on Factor Endowments, Tropical Nature, and Patterns in Favorable Areas*. IFPRI Discussion Paper 01399, pp. 1-48. <https://doi.org/10.13140/RG.2.1.2612.2400>.
54. Muhammed, I., Ismaila, A.B. and Bibi, U.M. (2015). An assessment of farmer-pastoralist conflict in Nigeria using GIS. *International Journal of Engineering Science Invention*, vol. 4, no. 7, pp. 23–33.
55. Anyoha, N., Chikaire, J.U., Ogueri, E.I., Utazi, C.O. and Godson-Ibeji, C.C. (2018). Perceived Effects of Resource-Use Conflicts on Rural Women Farmers in South-east Agro-Ecological Zone of Nigeria. *Current Investigations in Agriculture and Current Research*, vol. 3, no. 4, pp. 387–393. <https://doi.org/10.32474/CIACR.2018.03.000166>.
56. Abubakar, S. (2009). Participatory Irrigation Management Concept, Goals, Principle and Processes: Adaptation and Application in Nigeria’s Irrigation projects. In *Proceeding of Zonal Workshops held at Baden-Baden, Benin city and Lake Chad RBDA, Maiduguri, Nigeria February and March*, pp. 20–28.
57. Bliss, F. (2001). Conflicts Between the Traditional Usage of Water for Irrigation and Drinking Purposes and “Modern” Development. *Journal of Agriculture in the Tropics and Subtropics*, vol. 102, pp. 59–74. Retrieved from <https://jarts.info/index.php/jats/article/download/1406/588>.
58. Ertsen, M. (2014). Controlling the farmer: colonial and post-colonial irrigation interventions in Africa. *The Journal for Transdisciplinary Research in Southern Africa*, vol. 4, no. 1, pp. 209-236. <https://doi.org/10.4102/td.v4i1.167>.
59. Food and Agriculture Organization, (2016). National irrigation and drainage Policy and Strategy. Report of March 2015, pp. 1-59. <http://extwprlegs1.fao.org/docs/pdf/nig181432.pdf>.