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Multidimensional Approach to Mitigating Flood Risks and Impact: A Case Study of Rice Farming in Nigeria

Modupe Olufunmilayo Jimoh[1],Solomon Olakunle Bilewu[2],Adeniyi Saheed Aremu[2] , Habeeb Solihu[3*]

1. School of Engineering, University of Warwick, Coventry, United Kingdom. 2. Department of Water Resources and Environmental Engineering, University of Ilorin, P.O.Box 1515, Ilorin, Nigeria
3. Department of Civil Engineering, Faculty of Engineering and Technology, Kwara State University, P.M.B. 1530, Malete, Kwara State, Nigeria

Abstract

Rice farmers in the study area as elsewhere in some developing parts of the world have been negatively affected by floods annually. There have been several solutions, some suggested and others implemented to mitigate the effect of these floods on the farmers. Different initiatives have been undertaken by various stakeholders in the food production chain. Providing a multidimensional approach to highlighting these initiatives is essential to an effective and efficient resolution. The prospects and challenges of incorporating technology, capacity development, business and government support have been evaluated. The solutions proposed in this paper would bring economic benefits to the rice farmers, private companies, and government, leading to the attainment of Sustainable Development Goal (SDG) 2-Zero Hunger and the other 16 SDGs.

key words

Flooding

Multidimensional Approach

Nigeria

Rice Farming

Sustainable Development Goal 2

*To whom correspondence should be addressed:
solihu.habeeb@aait.edu.et

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1.Introduction

Nigeria is the most populous nation in Africa. In recent years, the nation has experienced rising incidents of major and nuisance flooding. The flood of 2012 was considered the worst flood in modern history in terms of the magnitude and spatial extent of the impact. It was followed by the 2017 and 2018 floods, both of historical proportions. The repeated devastation brought by the flooding prompts the Nigerian federal, state and local governments to seek remedies that would improve the systemic resilience of the communities. It is evident that the rainfall is very high as a result of factors such as climate change and some anthropogenic activities impacts; [1].

Agriculture is an important contributor to the wealth of a nation. As an example, agriculture contributed 25% to Nigeria's real GDP in 2018 which represents 75% of non-oil. However, disasters have been a bane to the growth of the sector, impacting agriculture beyond the short-term. Over the years, the sector has endured long-lasting and multi-pronged consequences such as loss of harvest and livestock, outbreaks of diseases, and destruction of rural infrastructure and irrigation systems" [2].

Between 2005 and 2015, floods are responsible for 20 percent of the cumulative production loss in crops and livestock in developing countries, amounting to just under USD 19.5 billion. The floods are often caused by incessant and heavy rainfall events due to climate change or the release of excess water from dams located. In 2012, Nigeria experienced the worst flooding in over forty years because of heavy rainfall that lasted several days. The incident affected 32 (of 36) states in the country with 24 considered severely affected.

Flooding is a phenomenon that sometimes has devastating effects on human livelihoods [3]. Asides land use land cover changes, poor governance, decaying infrastructure and lack of proper environmental planning and management, flooding is also exacerbated by climate change and inadequate preparedness, resulting to loss of life and properties, spread of diseases, deformed livelihoods, assets and infrastructure [3]. Thus, there has been rapid growth in the number of people killed or seriously impacted by flood disasters worldwide [4].

Also, flooding is the most widespread of all naturally-occurring hazards, which threaten society's human and economic development [5-6]. Flood can cause shortage of crops as a result of drowning and suffocation of crops on floodplains and meadows [7-8]; however, flooding can also be beneficial to the soils by making the soils more fertile by providing nutrients required for crop production [7].

Flooding has been noted as a major environmental hazard that has regularly affected more people than all other major disasters worldwide, only with the exception of epidemic diseases [9-11]. Thus, flood control plan could be structural and non-structural, and should be adopted which must include effective flood forecasting and warning system, flood plan zoning and restrictions of land use in areas of greater risk or relocation of existing structures [9,12].

According to Felino [13], the factors that influence the occurrence of flood are anthropogenic in nature. As reported by World Meteorological Organization (2008), causal factors of floods include hydrological extremes and human factors. In addition, McGranahan [14] added that, economic activity and urban development which could lead to increased environmental pressure are the causes of floods. Thus, in general, climate change, irregular rainfall patterns, increase in storm frequency, and other forms of human, ecological and cultural diversities/factors increase the chances of the occurrence of flooding and its attendant hazards [9,12,15-19].

In addition, the volume of municipal solid waste (MSW) generated in Nigerian cities keep soaring as a result of increasing urban population and rapid urbanization than the ability of the authorities to provide the financial and technical resources to respond to this growth in terms of efficient and sufficient waste management systems [20-22].

Meanwhile, minimum temperature in the country has increased slightly faster than the maximum temperature, resulting in smaller temperature range. This warming of the environment is most significant between June and November each year [23-24]. Nigeria experiences dry and rainy seasons; however, too much heat can damage crops and vegetation and too much rainfall can produce widespread flooding and forced relocation [23]. Also, evidence shows that changes in weather conditions will continue to have a major impact on human life and ecosystems [23].

At the peak period of the flood (September to October 2012), a total of 95 Local Government Areas were flooded in 14 states which are within the ba-

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sins of the two main channels in the country, Rivers Niger and Benue. Over 1.9 million hectares of land was destroyed, reducing food production in the affected areas. Mitigating the impact of these occurrences on the affected farmers would support the attainment of several United Nations Sustainable Development Goals. The most connected is SDG 2 which seeks to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture and targets Zero Hunger. Similarly, SDG 13 encourages all to take urgent action to combat climate change and its impacts. Paying attention to the plight of these farmers is key to leaving no one behind.

Rice is a major staple food consumed across all geopolitical zones and socioeconomic classes in many parts of the world including Nigeria. Locally produced rice accounts for about 57% of the 6.7 million metric tonnes of consumption. This study, thus, focuses on rice farmers in the Kwara State of Nigeria as a case study. The State is situated in the transition zone between the rain forest and the savannah region of Nigeria and has sixteen (16) Local Government Areas with an estimated population of 3.54 million in 2020. A major setback to rice production in Nigeria has been the frequent flooding of lowlands and flood plains commonly cultivated for rice farming.

The farming communities most affected by the annual floods happen to be the major rice farming areas in Nigeria. In 2007, four hundred and fifty-eight (458) rice farms were submerged by flood in parts of Kwara State. The 2012 floods reduced rice production in the affected areas by 22.4%, leading to a supply deficit in locally produced rice. The Nigerian National Emergency Management Agency (NEMA) had reported that over 122,653 hectares (ha) of agricultural land were damaged in 2018. In particular, several farmlands in two local government areas of the state were reportedly washed away by the floods. It is however possible that a good number of these challenges may be mitigated by some form of social innovation measures.

AfriAlliance had defined social innovation measures as “tackling societal, water-related challenges arising from Climate Change by combining the technological and non-technological dimensions of innovation” [25]. The alliance postulates that a hybrid of existing solutions and innovations would be required to tackle water and climate-related challenges. The Alliance further places emphasis on the importance of technological solutions, capacity development, governance structure, and business roadmap as elements that make up a successful social innovation. For example, monitoring climate for early warning systems to prepare for extreme weather events in Africa would require the use of data collection apparatus, satellite technologies and online information and knowledge platforms [26].

Other solutions prescribed are capacity development in the use of digital technology, effective government financing to overcome the lack of data and infrastructures needed to monitor climate, and a business road map that allows solution providers and potential users to interact effectively. This work adopts the four AfriAlliance principles in detailing multidimensional sustainable solutions that will reduce the impact of flood incidences on rice farmers in a developing country like Nigeria.

Although several initiatives are being applied independently to tackle the effect of flooding, there is little emphasis on a multidimensional approach. This paper reviews the existing solutions and innovations being developed and applied to combat flooding challenges in rice farms, their direct impact on rice farming and the challenges with implementation. It attempts to highlight the advantages of combining the technical, educational, government and business initiatives to mitigate flood loss in crop production.

2. Method of study

This study relies on information available in journals articles, government documents, print and online sources and site visits to assess the potential and possible extent of flooding of some rice farms in the rice-growing plains located along the banks of the Niger River (Latitude 9° 2’ 59.86”N, Longitude 5° 9’ 51.70”E) in Kwara State of Nigeria (Figure 1) and proffer a multi-faceted approach to mitigating its effect. Keywords used for online search included rice farming, rice farm flooding, drought-resistant species, and planting technologies. The initial search returned over 53,000 relevant documents and web pages.

Elements retrieved from the returned search included dominant cultivated crop, technologies, hydraulic and irrigation structures, extension services, farmers technology and business literacy levels, governance structures and funding. Further search within the documents was carried out to highlight the cases that relate to both Kwara State

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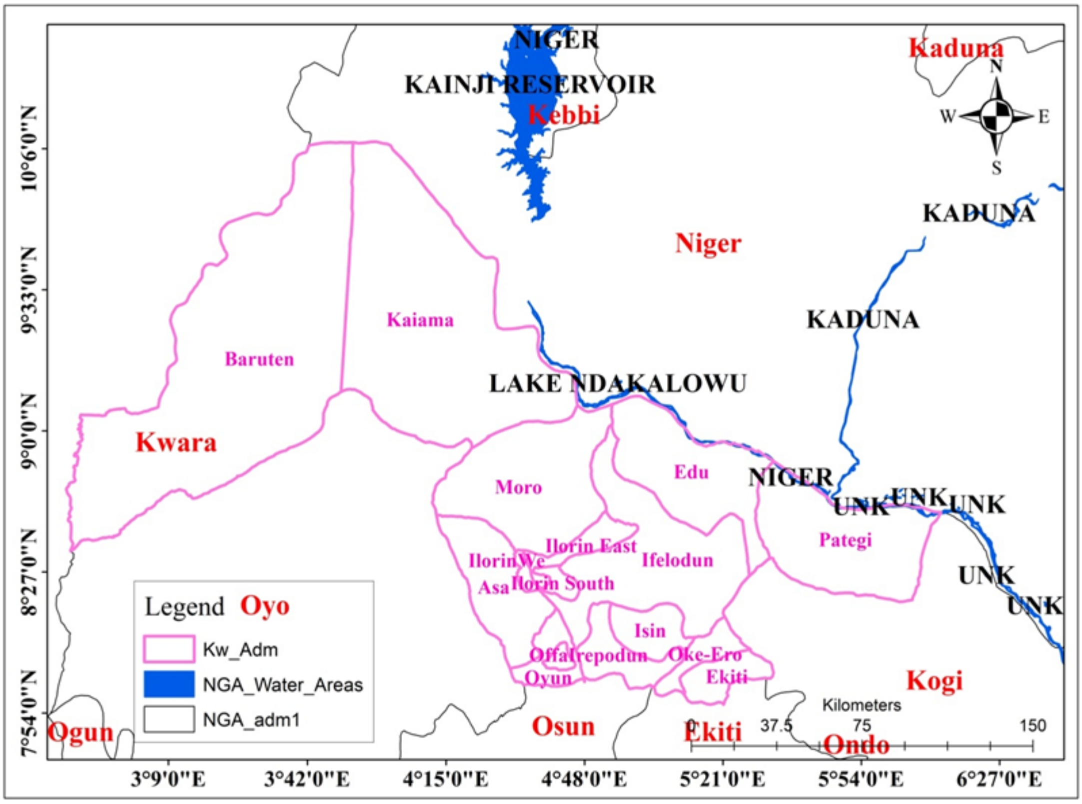

Figure 1: Study area location map

and Nigeria. Extensive site works was also carried out to primary data and elicit first-hand information from the farmers on the severity and frequency of the challenges they face. All available information sources were reviewed and a total of 25 sources were used in this paper.

3. Multi dimension approach to mitigating rice farm flood risks

3.1. Engineering and technology

The applications of Engineering and Technology solutions are essential in mitigating floods. These solutions range from those that can be applied by the farmers to those that require interventions from the government or development agencies. For farmers in the study area, flooding incidents are often caused when the Niger River (572 km in length) overflows its bank during peak flows or sudden releases from two large hydropower Dams upstream. A reduction in the frequency of rivers flooding their banks can be achieved by dredging which is the removal of sediments from the sides and bottom of a river.

This serves for flood control and straightening of the channel for navigation purposes. The removal of the sediments opens up more depth within the river thereby providing additional capacity for the river to retain water during heavy rainfall. The Nigerian Government awarded a project to dredge the River in 2009, and the project was completed in 2014. A follow-up dredging maintenance project was flagged off in 2017.

This process means that the navigation path is cleared, speeding up the flow of water along the river channel and reducing the chances of flooding over the banks. Although there are several established advantages to dredging, there are also risks involved to downstream communities as well as river habitats. It is advised that dredging should be considered within a range of tools for flood management rather than a standalone solution.

Dykes (also referred to as levees or floodwalls) can also be used to control flood events. An example is a current effort to protect rice farms in Shonga, Kwara State that lies in the flood plain of the Niger River. A 32 km long protective dyke was built around the area, to reduce the impact of flooding on the farming communities in the flood plains. The project also included 10 km of a drainage canal network and a drainage pump station. These additional items drain off excess water within the farmlands.

An innovative irrigation system properly operated would encourage farmers to plant their rice at a time that would guarantee harvest before the coming of the floods. Availability of irrigation sys-

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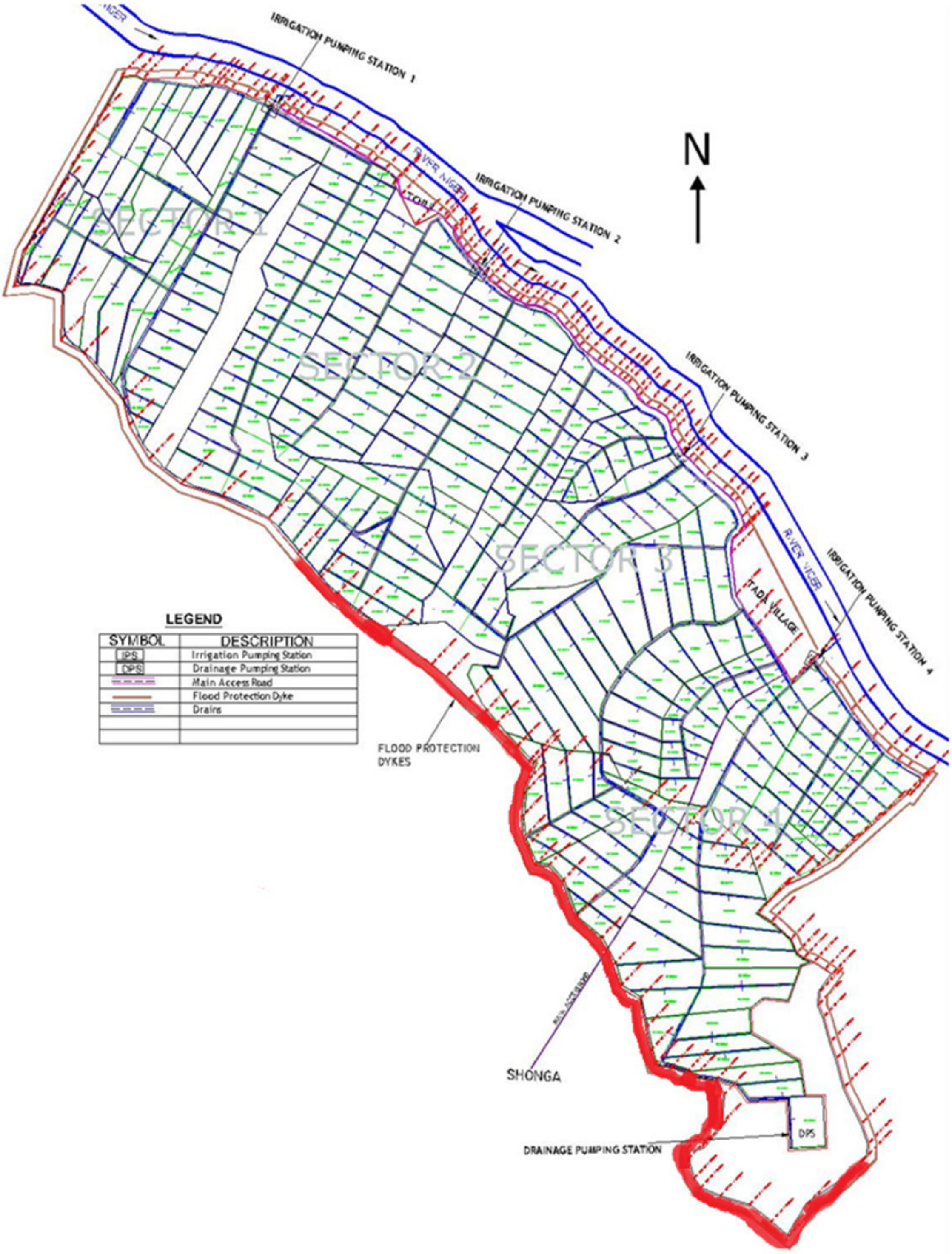

Figure 2: Plan for Shonga Farm flood and irrigation intervention

tems would also encourage upland cropping for rice rather than the lowlands/flood plains. For the Shonga farms under reference (Figure 2), the irrigation system consists of pumping stations for the direct abstraction of water from the Niger River, a network of canals for water supply and disposal of the excess and control structures to service some 3200 ha of rice farms. The advantage of irrigation schemes is that irrespective of the amount of rainfall, farmers are guaranteed water for their crops.

Also, rice farming seasons can be changed from the flood risk seasons to the safer months of the year. A study showed that shifting irrigated rice farming to the dry season by farmers in the Senegal River Valley has a projected probability of 89% more yields. The challenge for irrigation schemes is that power supply for the abstraction of water for irrigated agriculture can be expensive and subsequently uneconomical for crop production during the dry season. The provision of an economic or

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renewable source of energy is essential for the effective implementation of the scheme.

The introduction of drought and/or flood-resistant rice varieties and specified planting technologies will be a good mitigation measure in disaster or climate-challenged areas. Globally, technologies have been developed for planting flood and drought-resistant rice varieties. For example, flood-tolerant rice varieties have been planted successfully in some Southeast Asian countries, such as the Philippines, Lao PDR, Indonesia, and Southern Viet Nam. The study highlighted that improved rice varieties with the SUB1 gene survive losses to flood much more than traditional rice varieties. Of interest is the introduction of new rice varieties in lowland paddy fields as part of the project consolidating capacities for Disaster Risk Reduction (DRR) in Agriculture in South East Asia[27}.

The program aimed to reduce losses by farmers in cases of prolonged floods. The new varieties were combined with specific planting technologies for maximum efficiency. When compared to existing practices, the new concept resulted in a Cumulative Net Benefit of 109 % and 149 % in flood and non-hazard conditions respectively. In Nigeria, more than 67 rice varieties exist. In 2017, the National Varietal Release Committee (NVRC) of the National Centre for Genetic Resources and Biotechnology in Ibadan, Nigeria released three new varieties of rice [28].

These varieties, named FARO 66, 67, and 68, are high-yielding and flood-resistant varieties. It has been shown that under submergence, FARO 66 can yield about 80 times higher than its parent FARO 52, while FARO 67 can yield at least 10 times higher than its parent FARO 60. Unfortunately, the lack of adequate access by rice farmers to these varieties has resulted in their low uptake.. Planting these new rice varieties and following their prescribed planting technologies would reduce the loss to floods while significantly increasing the income generation capacity of rice farmers.

It is critical to stress those farmers and farmer organizations must carefully heed flood warnings and professional advice. Mobile phone-based technologies can be advanced for this purpose. Farmers can have access to mobile applications that are connected to the meteorological office such that information on flood forecasts can be easily assessed. GIS tools can be used to identify flooded locations and estimate affected farmlands. This baseline information is necessary for emergency planning and post-flood management of agricultural systems.

Data integration and analysis results from the tools can be incorporated into Nigerian National Development Plan to ensure preparedness in the face of increasing climate change and variability. Progress in applicable mobile technologies was achieved in 2013 by the development of a free Android application named RiceAdvice by AfricaRice. The application provides farm-specific recommendations on rice management practices to farmers. It was piloted in Nigeria and 12 other Saharan African countries. An increased yield of 0.5 tonnes per hectare has been attributed to its use in Nigeria. A critical requirement for mitigating against the effects of floods in rice farms is the need for water control and soil management. This led to the development of smart valley technology.

The Smart Valley approach had been applied on45,000 ha of rice farms in Nigeria as of 2018. The technology has also been adopted in some rice planting regions of Benin, Togo, Burkina Faso, Liberia, Sierra Leone. Smart valley technology follows a step-wise procedure focusing on design, layout and construction of low-cost water control infrastructure after a careful selection procedure paying attention to both socio-economic and biophysical factors and making extensive use of farmer knowledge. The technology comes in handy to mitigate flooding in lowlands by combining technical and non-technical elements. The adoption of Smart-valley technology in Benin increased the rice yield by 0.9 t/ha and the farmers' net income by US$ 267/ha.

Table 1 shows selected interventions that have been adopted to mitigate climatic challenges to rice farming. Although climate change could reduce rice yield by 37%, RICE reported that a 121% increase in yield is possible if African farmers adapt to climate change by changing varieties, sowing dates and the number of crops per year.

3.2. Education and capacity development

The London-based Overseas Development Institute reported that between 2001 and 2002, the Monthly Technical Review Meeting (MTRM) that took place between researchers and extension agents in the rice farming sector did not include farmers. The resultant effect is that the effectiveness of training programmes is often perceived differently by the Government and the Farmers.

Effective education and capacity development

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Table 1: Selected Proven Interventions for Sustainable Rice Farming

Location	Project	Area of Influence	Agency/ Program	Impact	Year
Nigeria	RiceAdvice	Technology, Knowledge and Capacity Development	AfricaRice	549 kg/ha (15%) increase in yield. 20% increase in income.	2019
Nigeria	Drought-tolerant rice variety (DTRV)	Improved Rice Varieties	AfricaRice	570 kg/ha (24%) increase in yield	2019
Africa	National Rice Development Strategies (NRDS)	Policy framework and Government Interventions	Coalition for African Rice Development (CARD)	0.29 t/ha (27%) increase in yield	2008-2018
Eastern India	10% increase in the genetic contribution of IRG accession	Improved Rice Varieties	International Rice Genebank (IRG)	27% increase in yield	2015 wet season
Mekong River Delta, Vietnam	Salt-tolerant rice varieties (STRVs)	Improved Rice Varieties	Consortium for Unfavourable Rice Environment (CURE)	19 million USD in value added	2017/18 Dong Xuan season
Benin	“smart-valley approach	Technology and Innovation	AfricaRice	0.9 t/ha increased yield	2010 till date
Madagascar	Field days	Knowledge and Capacity Development	Agricultural Research Centre for International Development (CIRAD)	300 farmers trained	Not specified
Brazil	Implementing Improved technology for farm management	Technology, Knowledge and Capacity Development	The Latin American Fund for Irrigated Rice (FLAR) and Rio Grande Do Sul State Rice Institute (IRGA)	19% increase in yield 25% reduction in production cost	2016-2019 (3 planting sessions)
Philippines, India, Colombia, Senegal and Cote d’Ivoire	Drone-based high-throughput phenotyping (HTP)	Technology for Climatic resilience	International Rice Research Institute (IRRI), International Centre for Tropical Agriculture (CIAT), AfricaRice	Adaptation to climatic change	2019
China, Myanmar, Thailand, Vietnam, Indonesia, and Sri Lanka	Closing Rice Yield Gaps in Asia by best management practices	Technology, Knowledge and Capacity Development	International Rice Research Institute (IRRI)	Increased rice yield by 11-20%	2016-2018
Nepal	Use of mini tillers	Engineering and Technology	Farmers and Nepal Agricultural Machinery Entrepreneurs Association (NAMEA)	Additional 1,110 kg/ha	2017

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initiatives are crucial for farmers to embrace innovations and strategies in mitigating the effect of floods on their rice farms. Capacity building must include educating farmers on climate change and its effect, planting flood-resistant or flood-tolerant varieties of rice, new planting technologies, finance, insurance, and disaster management.

In 2003, the Nigerian government's assessment through the Monthly Technical Review Meeting (MTRM) by National Cereals Research Institute (NCRI) reported that for Kwara state, there was effective technology transfer to tackle problems of rice maturity and disease. Recently, it was reported that in the 4-dominant rice-producing states (Oyo, Ekiti, Kwara and Ebonyi) in Nigeria about 35.8% of farmers were not aware of the existence of improved varieties. According to the study, as of 2018, only 5% of farmers planted the latest improved rice varieties mainly due to lack of awareness of its availability, access to the new varieties and the lack of support services for its adoption. Also, an assessment of farmers in two northern states in Nigeria (Nasarawa and Kano) showed an adoption rate of 14.53%.

The study suggested that households that had access to information and knowledge had higher readiness to adopt new technologies than those that did not. Assessment of rice farmers in the study area in 2018 showed that the level of education of the rice farmer, past losses due to flooding, the farmers' savings, and awareness programs by private and public entities had a positive influence on the farmers' adaptation strategy. It was also reported that private grain companies have been supportive of the capacity development of rice farmers in Kwara state through awareness programmes and access to improved seeds. These companies stand to gain reduced costs in grain procurement as opposed to importation. They also have a stake in the quality of the rice grains being produced by their farmers.

Learning through Community-based groups should be encouraged as disaster management is most effective at the community level. Several studies have indicated positive outcomes of community-based approaches in the management of disasters worldwide. Adopters of new varieties of rice are often members of farming associations or cooperatives. The Kwara State Rice Farmers Association (RIFAN) serves as a focal group for its members. In addition to this focal group, the Lower Niger River Basin Development Authority (LNRBDA) created a Water Users Association (WUA). LNRBDA support both RIFAN and WUA with training on how to get increased outputs from seedlings, conflict management, and resolutions between different farming groups.

In 2017 over 40,000 pieces of advice were generated by RiceAdvice to farmers. Results showed that the impact of RiceAdvice was consistently positive with approximately 80% of the users attributing its impact to increased yield, increased income and reduced use of fertilizer. The deployment of Smart-valleys lowland technologies relies on training and capacity development of technicians and farmers. The plan for each community is locally developed using the knowledge of the farmers about the lands. Afterwards, the farmers are taught to interpret the plans and transpose them unto the lowland.

Some of the other activities involved in the process are the digging of canals and the construction of small protective structures against erosion in flood-prone areas. The advantage of the introduction of the scheme is that the developments are cheap and sustainable because they are developed and constructed by the farmers themselves. In addition, there is increased human capacity development, increased yield and better disaster risk management. A sustainable approach to capacity development could be achieved through the incorporation of flood management practices into curriculums of relevant faculties within universities and training institutes. The knowledge acquired can then be trickled down to farmers through extension officers and farm technicians.

3.3. Governance and institutions

There are several government agencies connected to the rice farming sector, some are the Central Bank of Nigeria (finance), Ministry of Agriculture, River Basin Development Authorities, Agricultural Development Projects, and Research Institutes. Sustainable progress can only be achieved by building and strengthening cross-institutional partnerships, shared responsibility, and information flow among all relevant national, regional, and state institutions [2].

Proper funding of research institutes would result in the development of local capacity and low-cost indigenous technologies with a resultant effect of fewer losses and increased profit margins. This would enhance the capacity needed for damage and loss assessment which would ultimately lead to better-informed policy, action, preparedness,

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and resilience in the rice farming sector. For example, in 2019 the Kwara State government launched media campaigns because of forecasts from the meteorological agencies.

The media campaigns warned, appealed, and put riverine communities in Kwara Central and Kwara North on red alert, encouraging them to relocate to safer locations in a bid to avert loss of lives, farmlands, and property to flooding. In addition, the LNRBDA provides training, extension services and infrastructure support to rice farmers in the form of tube wells and farming tools.

The government-guaranteed access to affordable credit and compensation is essential for the development of rice farming as well as mitigating the effect of floods. Huge successes were recorded by the interventions of the Central Bank of Nigeria (CBN) in rice production in several states under its Anchor Borrower Programme (ABP). Four hundred and fifty-eight (458) rice farmers in Kwara state benefitted from the program in 2017 but unfortunately, their farms were flooded, eroding the gains of the initiative for that year.

The Nigerian Agricultural Insurance Corporation (NAIC) as part of its functions provides a premium subsidy of up to 50%, chargeable on selected crop and livestock insurance policies; insurance coverage of equipment, assets and other properties which form part of the total farm investments, and general risks coverage. NAIC assured stakeholders of their willingness to pay appropriate compensation to insured farmers whose farmlands were affected by the 2018 floods. The government must extend a mandatory cover to farmers, as the 2018 payment was strictly for farmers insured under NAIC policies.

The government can also use tax incentives to encourage businesses to support capacity development and technology adoption by rice farmers. The partnership between government, institutions and development agencies is crucial towards a sustainable mitigation project. The National Fadama Development Programme (NFDP) is agriculture in lowlands and flood plain initiative with financial support from the World Bank Group. The project is community-based which means that in the case of rice farming, the coordinators needed to collaborate with the State chairman of the Rice Farmers Association (RIFAN).

The collaboration results in empowerment, skill and capacity development and income generation. It has been successful in most states of Nigeria, with Phase I and II of the project resulting in an increase of rural farmer's income by 63%. The NFDP phase III is ongoing and its objective is to improve the incomes of farmers, reduce rural poverty, increase food security, and contribute to the development of SDGs. A similar partnership has been developed between the African Development Bank and AfricaRice towards the development of the 'Continental Investment Plan for accelerating Rice Self-Sufficiency in Africa' which would support African countries in attaining rice self-sufficiency. These partnerships would accelerate development, strengthen government initiatives, and foster support for rice farmers.

3.4. Challenges, peculiarities and benefits implementations in Nigeria

As reported, about 80 percent of Nigeria's population depends on rain-fed agriculture and fishing as their primary occupation [29-30]. Unpredictable rainfall variation, heat stress and drought, stemming from climate change, can adversely affect the food production system and result in food shortages [29-32]. Poor responses to resource shortages could result in more hunger [33].

The rising risk of flooding traces its cause to a plethora of natural and anthropogenic factors. There are indications that the frequency and intensity of flood producing storms have been on the rise in a warming climate. Meanwhile, economic expansion has drastically altered the land surface and waterways that have not been fully accounted for in floodplain delineation and design of conveyance structures. Also contributing to the extensive flood losses is a lack of effective warning and response mechanisms. Many developing nations are behind many of the industrialized nations is forecast and warning capabilities, warning dissemination and response mechanisms, platforms for information sharing and coordination among organizations and communities.

Although there have been recognitions that such developments are unsustainable, thus far, efforts undertaken to address the rising flood risk have not gone far enough. This is partly due to the complex, multi-facet nature of the issue. Government agencies are constrained by budget limitations and are strained by short-term relief and restoration efforts that often take priority. Meanwhile, many affected communities are aware of the risk but are not sufficiently informed to determine the proper actions to reduce risk exposure.

This lack of awareness, when combined with poverty, community inertia, and the lack of financial wherewithal, result in a continuation of status quo that have proven detrimental to the resilience of the communities. Also to note is that the flooding and its aftermath may have also served to intensify the outmigration of citizens, which, in turn, may serve to destabilize the economy and further reduces the resources of government agencies to invest.

4. Conclusion

Appropriate policy formulation, implementation, and support for rice farmers would increase the rice production capacity of Kwara state and Nigeria. It is believed that at full production capacity, Nigeria would be self-sufficient in rice production for its over 200 million people and be able to export. Increased yields from the adoption of improved rice varieties would result in farmer's sufficiency, job creation, improved economy, increase in tax generation, and foreign exchange earnings.

Government efforts towards promoting the adoption of modern technologies should be paired with support services such as training, extension programs, credit, and market access for effectiveness. Collaborations between impact and development agencies such as the World Bank Group, African Development Bank, Food and Agriculture Organization of the United Nations, and the Nigerian Government for improved farming and rice production are essential. This would result in positive strides towards attaining Sustainable Development Goal 2- End hunger, achieve food security and improved nutrition and promote sustainable agriculture, which is connected to the other 16 SDGs.

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