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Research article

Assessment of the Viability of Irrigation Projects within the Sokoto Rima River Basin, Nigeria

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Abstract
Irrigation projects in Nigeria have been established to compliment rain fed agriculture by providing water for continuous cultivation of agricultural land during the dry season for national food security, self-sufficiency and to alleviate poverty among small scale farmers. The Sokoto-Rima River Basin irrigation project was one of the projects established in the 1980s by the Nigerian government to play these roles. This study carried out an assessment on the viability of irrigation projects in 2016/2017 irrigation season within the Sokoto Rima River Basin in specific areas which include: Middle Rima Valley (MR), Shagari (SHG), Zauro Polder (ZP), Jibiya (JBY), and Zobe (ZB). The data sets collected were transformed into descriptive statistics such as averages, percentages, charts and tables, in order to depict a brief information of the population under study. The findings revealed that about 89% of the farmers within the scheme practice irrigation farming and are resident; the number of farmers in the scheme is below the expected baseline (ranging from 97.3 to 30%) for all the schemes under study; under-utilized proposed irrigation area (average area cultivated in all the selected projects ranged between 30% and 40% of the total irrigation area); poor participation of active young people as average ages of farmers in all the schemes ranges between 45 and 51 years; single season irrigation farming is practiced more; ineffectiveness of extension services and water users association reduces the farmers' potentials; poor accessibility to farm inputs and credit facilities; high and varying land charges per hectare (ranged between ₦ 5,000 to ₦ 27,666) and irregular and inconsistent water charges which are supposed to be the funding source for sustainable irrigation projects were established. Although irrigation farming is profitable in the project area with the cost benefit ratio ranged between 36% to 182.3%, but other indicators shows that the viability of the project is limited as the irrigation project could not be self-sustaining due to under cultivation of the proposed irrigation land which is meant to generate revenue from land rent and water charges for its sustainability as one of the core objectives of the National Irrigation Policy (NIPS) to stabilize the public irrigation sector and transfer operation and maintenance (O&M) to the beneficiaries/private sector and government to consolidate existing investments in the basin and rehabilitate those schemes found to be viable. It is therefore recommended that government should rehabilitate those schemes found not to be viable by taking full control of the irrigation farm lands, harmonize charges in the schemes, encourage multiple season irrigation and also encourage youth to participate in farming through the provision of loan/credit facilities.

Keywords: Farmers; irrigation farm lands; irrigation projects; irrigation season; land and water; Sokoto Rima River Basin

Introduction

Numerous studies have ascertained that earlier irrigation schemes, established by missionaries in the 1930s, achieved well in terms of agricultural performance, financial and economic viability (Sishuta, 2005; Van Averbeke *et al.*, 2011).

Irrigation projects have been successful in allowing farmers to obtain a certain amount of wealth, " substantially more than dryland farmers, perhaps more than employees of white farmers, and similar to levels enjoyed by urban workers" (Mburu and Massimo, 2005; Visser and Ferrer, 2015). This suggests that farmers in irrigation schemes as long back as the 1930s were earning higher incomes than dryland farmers. The schemes helped in reducing the rural to urban migration by offering the rural population another source of employment and income (Satterthwaite *et al.,* 2010; Ajaero and Onokala, 2013). A lot of financial resources have been devoted into various irrigation projects so as to increase the farm area, and improve crop yield (Levidow *et al.*, 2014; Bjornlund *et al.,* 2017). Large-scale irrigation involves construction of dams, irrigation canals, drainage and other irrigation facilities in order to irrigate huge area of land for agricultural development (Le Moigne *et al.,* 1992).

Contemporary irrigation schemes are frequently required to meet certain objectives as may be set out from the beginning of the project. In order to realize these objectives effectively, management of the completed projects are needed in addition to good engineering designs and construction (Muhammad, 1991; Evans and Sadler, 2008). Large-scale Irrigation Projects (LSIPs) were introduced in Nigeria to make best use of the available resources in order to boost agricultural production (Ogunjimi and Adekalu, 2002). These projects are managed by the River Basin Development Authorities (RBDAs). One of the earliest RBDAs is the Sokoto Rima River Basin Development Authority (SRRBDA, 1992) established in 1973 (SRRBDA, 2013). The SRRBDA covers Sokoto, Katsina, Kebbi and Zamfara States as shown in Figure 1. Many large-scale irrigation projects were created under the SRRBDA, which include Jibiya Irrigation Project (JIP), Bakalori Irrigation Project, Zauro Polder, Wurno Irrigation Project and Goronyo (Falalia) Irrigation Project (SRRBDA, 1991).

Jibiya irrigation project is one of Nigeria's large-scale irrigation projects, which is aimed at boosting agricultural productivity of the country. The objective is to improve living standard of the people, through the creation of job opportunities, food production and increased income (SRRBDA). Irrigation farming has increased in Nigeria, in the recent times and this could be attributed to the increased awareness from the different Fadama projects across the country funded by the Federal Government and State Governments in collaboration with the World Bank in many instance (Nkonya *et al.,* 2009). The Federal Government of Nigeria through the activities of the Federal Ministry of Water Resources and in collaboration with development agencies and bilateral organizations has invested widely in the Irrigation sub sector in the whole country. This is done as a measure to balance between rainfed and irrigated agricultural production in Nigeria (Olagunju, 2007; Idris *et al.,* 2010; Oladimeji, 2017).

Irrigated agriculture can contribute to poverty reduction through improved food security, job creation and income generation with an overall objective of improving economic and environmental performance by raising general irrigation productivity in all public and private initiatives (Hussain *et al.,* 2004; Pingali, 2012; Moyo *et al.,* 2015). Additionally, to improve water services to all irrigation farmers and work toward full operation and maintenance (O & M) cost recovery from the users, improving and sustaining irrigation efficiencies at all schemes and providing extension services and ease the provision of inputs and the marketing of outputs (Faruqee and Hussain, 1997; Ngigi, 2002; Perret and Touchain, 2002; Easter and Liu, 2005; Backeberg *et al.,* 2013; Bell *et al.,* 2016).

Irrigation farming is a profitable venture, because it is capable of alleviating poverty among farming households. Hence irrigation farming could have been an effective tool used to achieve the MDG of reducing poverty and hunger by the end of 2015 (Oriola, 2009). In an effort to manage the nation's surface water resources, the Nigeria government over the years has established 12 River Basin Development Authorities, among which is the Sokoto Rima River Basin Development Authority with the responsibility of developing infrastructure for irrigation and increasing agricultural production and undertaking rural development activities in systems with a command area above 2,000 ha (Yahaya, 2002; Lee, 2005; Abdullahi *et al.,* 2014). However, the sector's performance has not had the anticipated impact on national food productivity, food security, employment opportunities and economic growth (Timmer, 2005; Ferroni and Zhou, 2017; Dorward, 2013; Nesheim *et al.,* 2015). Farmers lack adequate start-up capital and are frequently faced with irregular fuel supply, frequent pump breakdowns.

The majority of farmers are illiterate and lack basic knowledge of water requirement, irrigation scheduling, and skills in maintaining and operating the pumps (Ogunjimi and Adekalu, 2002; Ojo, 2011; Lempériere *et al.,* 2014). This affects the yield of crops as the crops are either over- or under-irrigated, leading to wastage of the little available water (Fanadzo *et al.,* 2010). Erosion is a severe problem during the rainy season and coupled with continuous use of land, low fertility results (Ogunjimi and Adekalu, 2002; Pimentel and Burgess, 2013; Wolka, 2014).

This could be as a result of other factors ranging from poor to lack of maintenance of the irrigation infrastructure, incomplete development of the secondary canals and installation of facilities and poor management of the various schemes (Jahan and McCleery, 2005; de Silva *et al.,* 2014; Mdemu *et al.,* 2017).The constraints to irrigation project were identified as marketing problem, infrastructure inadequacies, and unstable input and output prices (Wu *et al.,* 2019; Olukunle, 2013; Wudil *et al.,* 2021). Exploratory factor analysis of the perceived constraints affecting rice farmers of kano river irrigation (KRIP) kano state, Nigeria. *International Journal of Agricultural Extension, 9*(3), 485-492.). From the above findings, the viability of the irrigation projects across the country becomes questionable. This study will be assessing the viability of irrigation projects in five (5) of the irrigation projects within the Sokoto Rima River Basin Authority and they include; Zobe, Zauro Polder, Shagari and Middle Rima Valley (Goronyo) irrigation projects respectively.

The Sokoto-Rima River basin is located at north-western part of Nigeria and it covers four (4) states (i.e. Sokoto, Kebbi, Katsina and Zamfara), that have ninety-two (92) local government areas for administrative purpose as shown in Figure 2. This makes the rivers and streams within the basin to be the important source of surface water to the people living in those states. It has a population of more than 15 million according to 2006 census (Abdullahi *et al.,* 2014).

Since the establishment of the Sokoto Rima River Basin in 1967 as a means of ensuring food security as well as improving the standard of living of the rural populace. Several studies have been carried out within the basin but not much has been done in assessing the socio-economic impact and to better understand the viability of the projects within the Sokoto Rima River Basin. So many concerns were raised about the viability of the irrigation schemes, such as: Are irrigation schemes financially viable? Are the schemes sustainable? Are these projects not inducing a financial burden on the government as far as operation and maintenance is concerned? What major peculiar factors affecting these projects? Are the farmers benefiting from the project as to meet up with National Irrigation Policy Strategy of poverty alleviation? The viability of irrigation projects under the Sokoto-Rima River Basin was undertaken to assess the present situation of Sokoto-Rima River Basin and to evaluate the present irrigation status of the farmers, including their socio-economic and financial status.

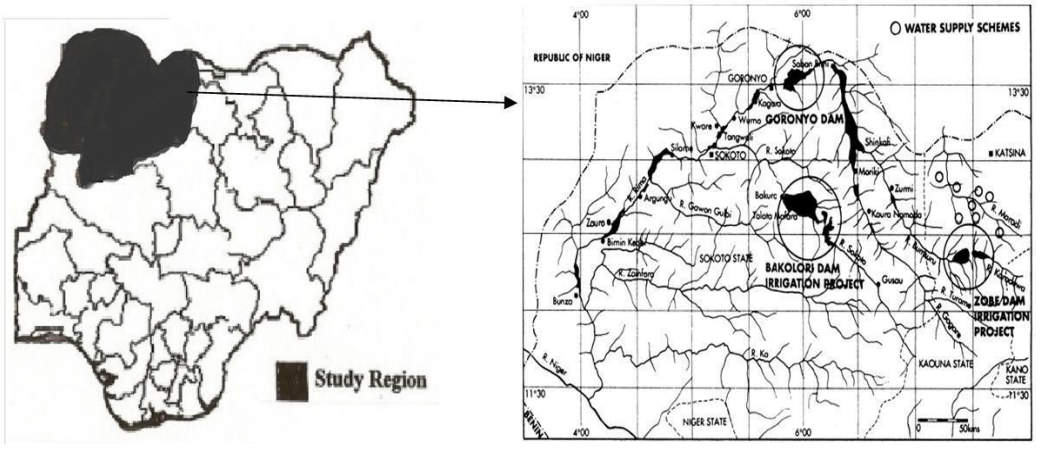


Figure 1. Sokoto-Rima River Basins in Nigeria (Source: Abdullahi *et al.,* 2014)

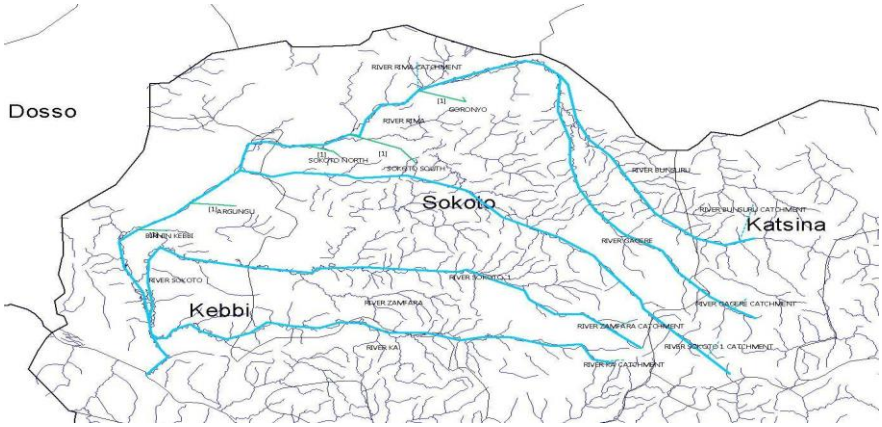


Figure 2. The Schematic View of Sources of Water of the Dams in the Study Area (Source: Abdullahi *et al.*, 2014).

Table 1. Population Census of the States in Sokoto Rima River Basin

States	Population Census 2006, Total Population	Projected Population 2023	Land size Km^2
Katsina	5,801,584	9,300,382	24,971.22
Kebbi	3,256,541	5,001,610	37727.97
Sokoto	3,702,676	6,163,187	33,776.89
Zamfara	3,278,873	5,517,793	35,170.63

(Source: National Bureau of Statistics (NBS), 2020)

METHODOLOGY

Physical Features of the Study Area

The Sokoto basin falls within the hottest parts of Nigeria and is located on latitude 10˚04'N and longitude 4^0 - $8^0$14'E is the most northern region of Nigeria bordering the Sahara Desert. This Sahelian State which is surrounded by sandy Savanna and isolated hills have over 6.2 million projected populations (NBS, 2020). Throughout the year the average maximum is 36 ºC and average daily minimum is 21 ºC. Rainfall is generally low. The average annual rainfall for 35 years is about 470 mm. Much of the rain falls between the months of May to September, while the rainless months are October to April. Evaporation is high ranging from 80 mm in July to about 210 mm in April to May. It is dominated by the North-East Trade wind (Harmattan) blowing Sahara dust over the land when dusts hang in the air. Northern Nigeria receives the least amount of rainfall in Nigeria because of its hinterland location and being the transition zone between humid tropical Africa and arid Sahara (Ekpoh and Nsa, 2011; Adegboyega *et al.*, 2016). The Sahel is particularly sensitive to changes in the African monsoon, which are modulated by changes in solar radiation and Sea surface temperatures in the southern Pacific called El Nino. The Sahel has experienced numerous dry episodes in the past (Adegboyega *et al.*, 2016).

A monthly average evaporation ranges of about 140 mm represent 30 % of monthly average precipitation into the catchment. The hottest months of April to May are periods of highest evaporation. Relative humidity is low most of the year and only increases during the wet seasons of June to September. The vegetation is typically Sudan savannah and is characterized by stunted and thorny shrubs, invariably of the acacia species (Abdullahi *et al.*, 2014).

Table 2. Land use and land Cover of the Sokoto Rima River Basin

Category	Area in Km^2	Percentage (%)
Forest land/wood land	2,755	2
Grass land	46,615	35
Agricultural land	69,520	53
Wet land	970	0.74
Bare land	10,330	7.8555
Water area	1,400	1.06
Urban land	10	0.007
Grand Total	**131,600**	**100**

(Source: Abdullahi *et al.*, 2014)

Sampling Technique and Data Collection

Data used for the study were collected from field survey of 141 farmers using a convenient non-random sampling technique, where the respondents were interviewed as they turned up at a particular location or at the point where the researchers met them in their farms. Out of 141 respondents, the distribution of respondents is as follows, 10 % (Zobe), 0 % (Sabke), 35 % (Jibiya), 7 % (Zauro Polder), 20 % (Shagari) and 28 % (Middle Rima Valley). This is done based on the level of activities going on as at the time of visit.

Data were collected with the aid of structured questionnaire designed to provide information on socio-economic characteristics such as age, family size, farm size, household size and farming experience; irrigation variables include access to water, method of abstraction of water, average area of land cultivated and regularity of irrigation water supply; economic viability of irrigation activities such fixed costs, rental value of land, variable costs (i.e. cost of seed, fertilizer, chemical and labour). Income as used in the analysis and the discussion sections of this paper are the net income from the sales of farm produce harvested from irrigated farms which is obtained by subtracting total cost from total revenue. The questionnaires were subjected to a check list designed for project managers.

Data Analysis

The data sets were converted to descriptive statistics such as tables, averages, percentage and charts using Microsoft Office Excel 365 version, Microsoft.com. In order to give brief background information about the socioeconomic characteristics of the population under study. Cost benefit of producing in the different schemes were estimated using appropriate formula.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

From the in Figure 3, presentation about 89 % of farmers practice dry season irrigation farming and are resident in the towns and villages where the projects are located.

$$\text{\% Cost Benefit} = \frac{\text{Cost}}{\text{Benefit}} \quad (1)$$

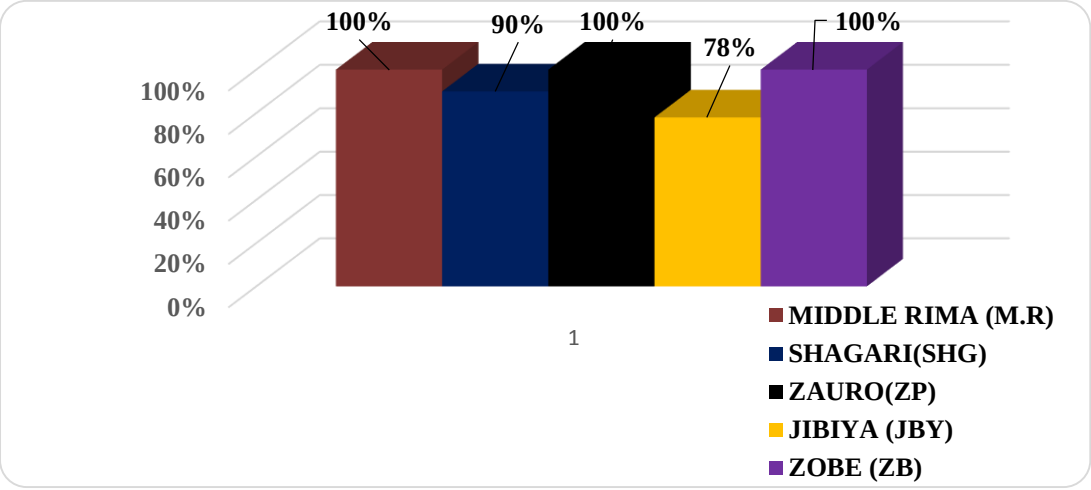


Figure 3: Shows Resident Irrigation Farmers

The benefit of this is that efficiency in the projects will lead to increased involvement of locals in irrigation farming which will invariably lead to engagement in gainful farming activities.

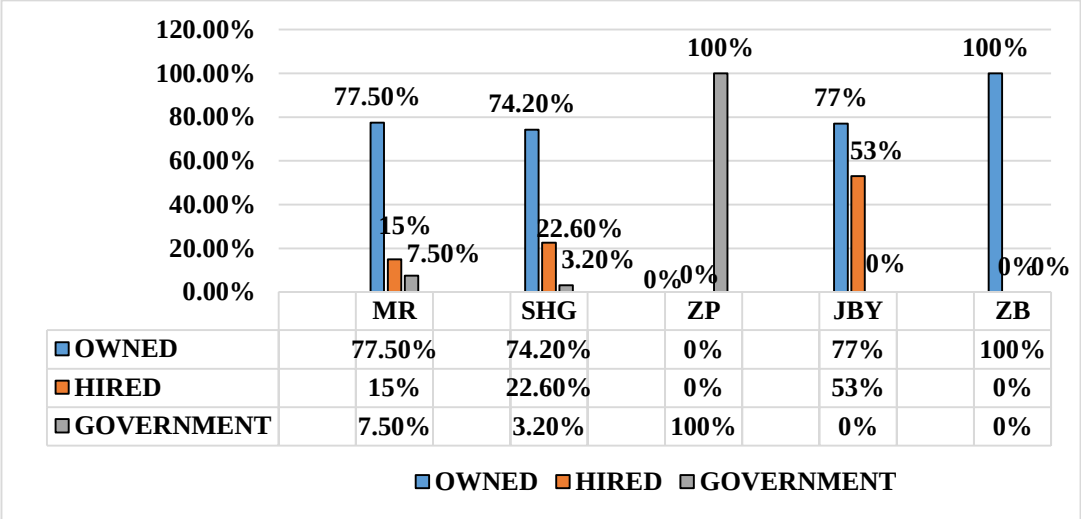


Figure 4: Shown is the type of ownership of land predominant in the project areas i.e. land ownership

Figure 4 shows that land ownership is mostly of individual ownership, except for Zauro Polder where the farm land is completely owned by the government. This form of ownership within the irrigation area account for the occurrence and re-occurrence of land fragmentation in the project area as many of the land have gone through inheritance sharing and, in some areas, the land is used for residential buildings. The effect of this fragmentation has resulted to poor farming system as mono cropping can hardly be practiced in areas where a single crop would have been best grown. In many instances, it leads to reduction in the total cultivated hectares as many residential buildings are commonly found in the project area as in the case of Jibiya irrigation project.

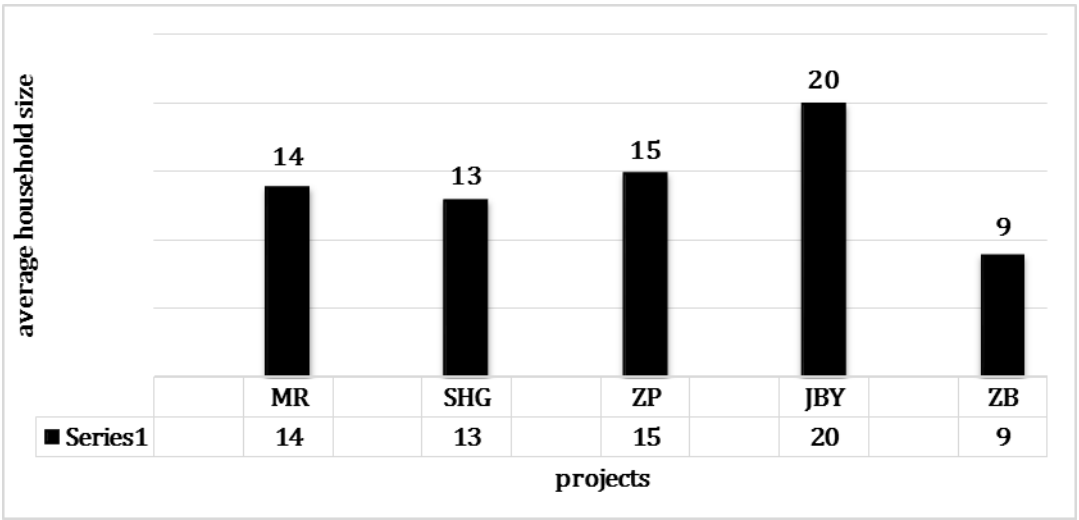


Figure 5: Shown is the average number of people living in household in the project area i.e. household size

Figure 5 explains the average household size. The household size ranges from 9 to 20. From the result, the household have enough people to provide a reasonable proportion of the farm labour required, with Jibya having the highest value of 20 persons per household.

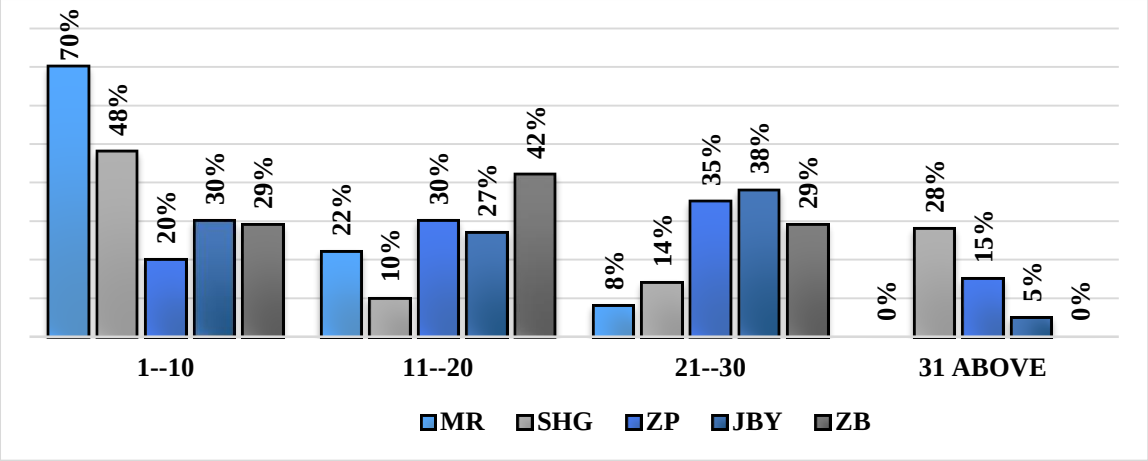


Figure 6: Shown is the duration for which the farmers have been into farming i.e. years of experience

From Figure 6, the majority of the farmers are into irrigation farming for about less than 10 years. When comparing the years of experience in irrigation farming against the average ages of the farmers, the result shows that the farmers went into farming in their late 30 s and early 40 s. The interpretation and implication this is that the farmers were not engaged in active farming and they may not actively take irrigation farming as main occupation due to their age. The present situation of the schemes has not encouraged the young farmers.

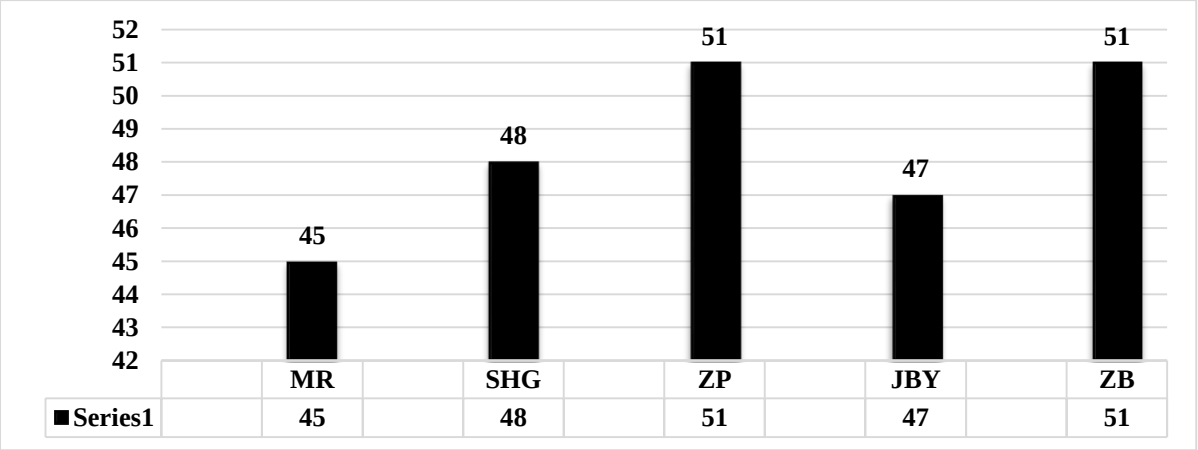


Figure 7: Shown is the average ages of farmers that participate in farming activities in the project areas i.e. active age range into farming

From Figure 7, the average ages of the farmers in all the schemes ranges between 45 and 51 years. This shows that the younger adults are not mostly involved in farming activities as obtained from the respondents. Most of the non-farmer adults are into trading, rendering of hired labour and commuting. From the Figure 4, the present farmers are in their middle-ages and thus may have limited input in terms of labour and other resources. The level of willingness to take risk will be low for fear of potential loss more than the young farmers. Also, the areas to be cultivated will be affected. The younger the farmers, the more areas they are likely to cultivate.

Irrigation Viability Variables

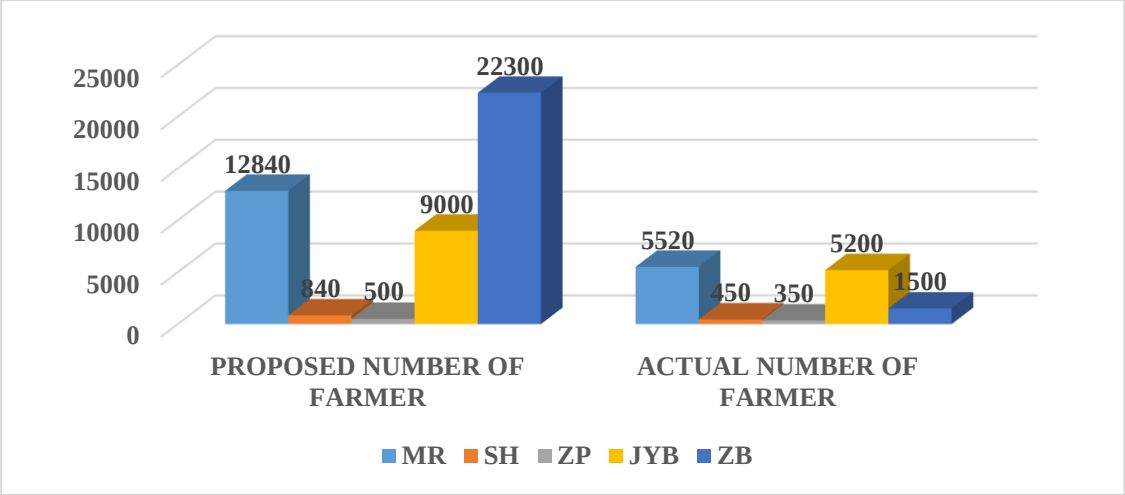


Figure 8: Shows Proposed Number of Farmers for Schemes/Actual Number of Farmers (Source: Interaction with Irrigation Project Managers - this study)

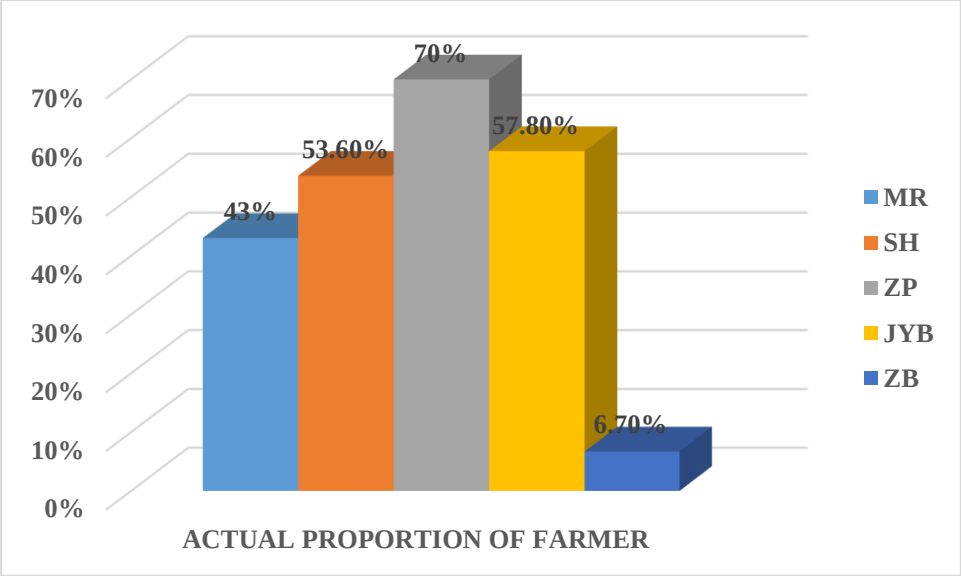


Figure 9: Actual proportion of farmers in irrigation projects

The number of farmers targeted is below the expected baseline for all the schemes under study. Presently, the proportion of farmers in MR, SHG, ZP JYB and ZB irrigation projects are 43, 53.6, 70, 57.8 and 6.75% respectively. Comparison the proportion of land actually cultivated and the actual number of farmers in Figure 11, some farmers are like to cultivate land that is less than half a hectare which is most likely to focus on the traditional subsistence farming targeting the family need rather producing for commercial purpose.

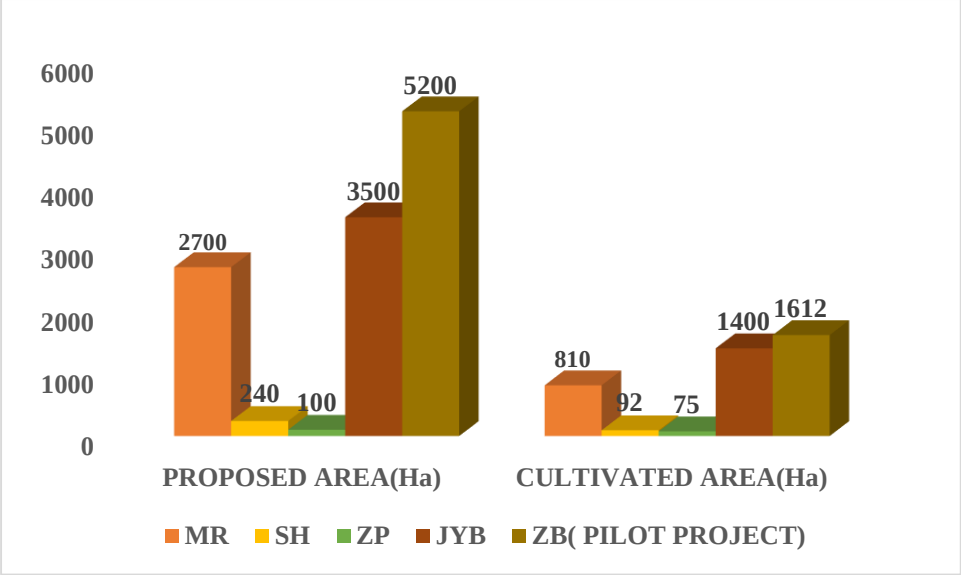


Figure 10: Shows proposed area/actual area under cultivation (ha) (Source: National Water Resources Master Plan Report, 1994); interaction with irrigation project managers - this study)

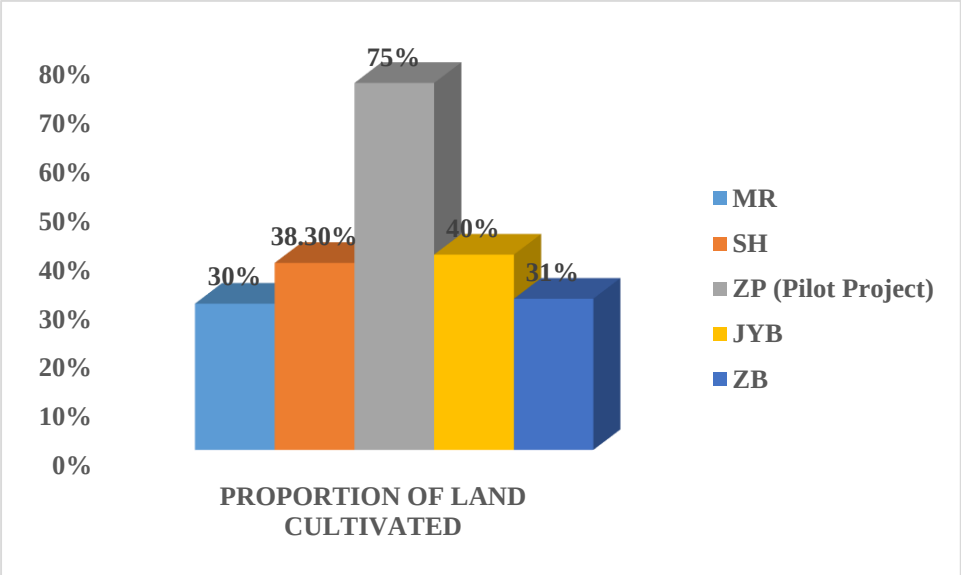


Figure 11: Showed the actual proportion of land cultivated

The total number hectares of land cultivated in the scheme are between 30 and 40 % which is obviously under cultivated. Except for Zauro polder scheme which is a pilot project with only 100 hectares of land of which about 75 % is cultivated only and the other 25 % percent have been taken over by sand deposit which result from urban drainage that was channeled through the irrigation area.

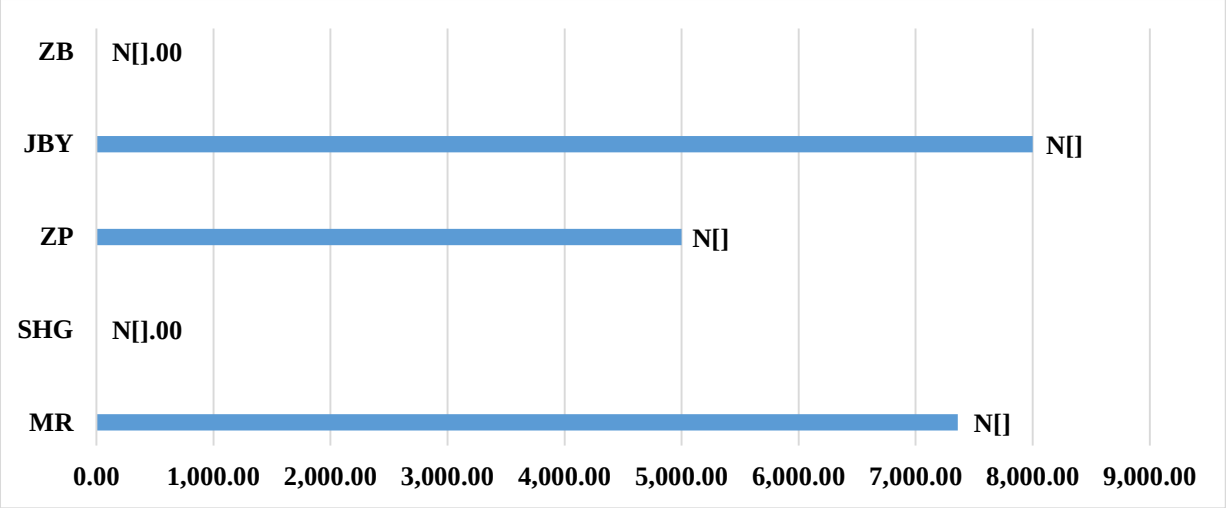


Figure 12: Shows average amount charged for irrigation water in (₦)/Ha

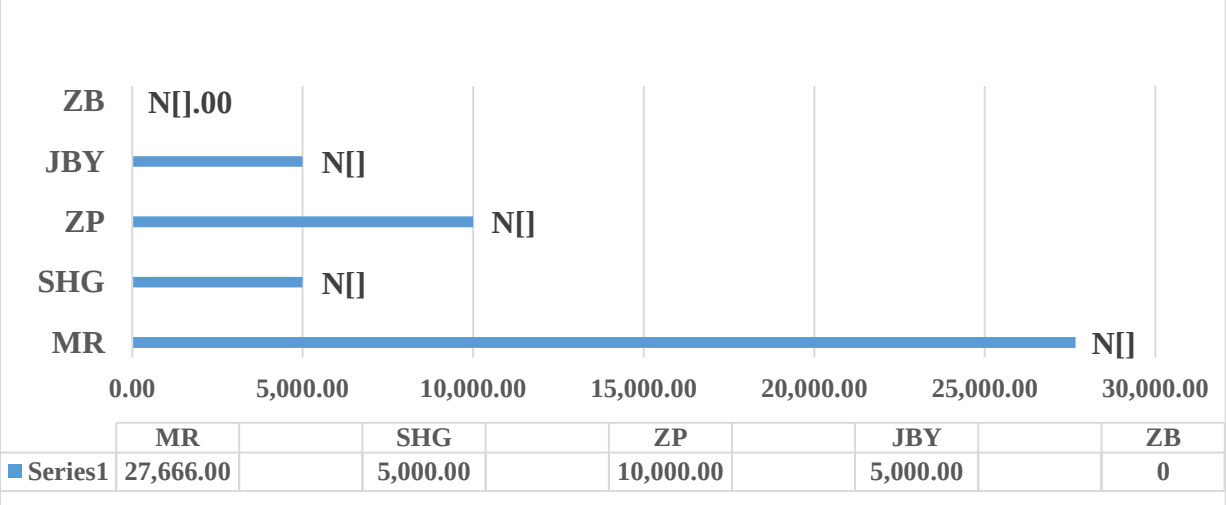
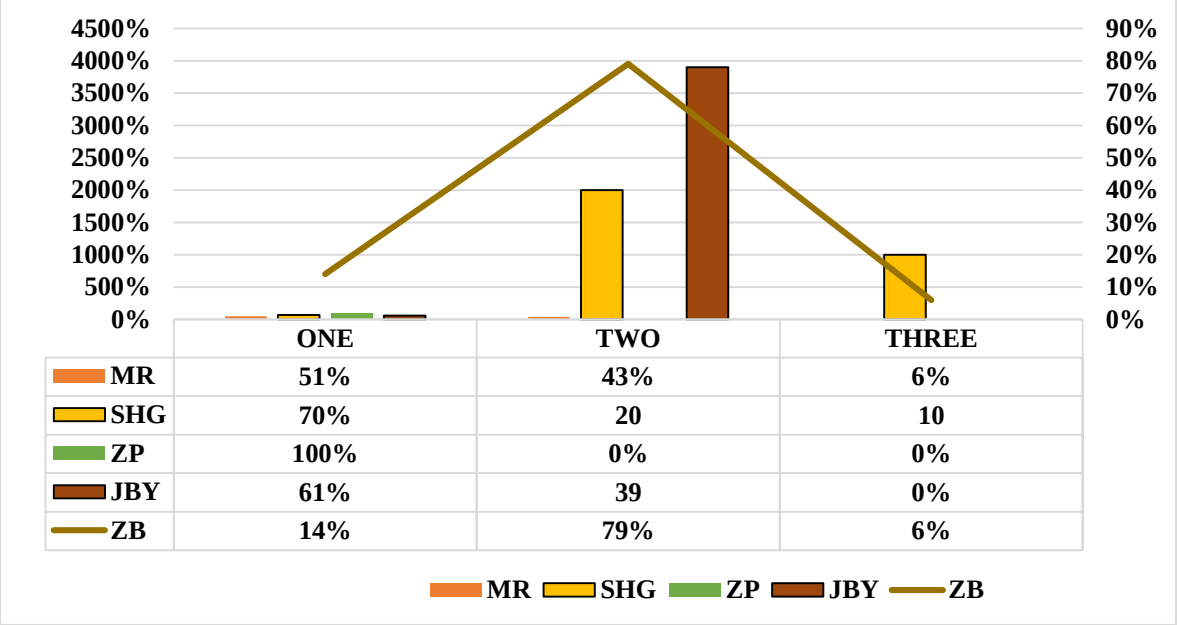


Figure 13: Average amount charged in (₦)/Ha

The only medium that the irrigation projects are expected to be self-sustaining is through charges collected from irrigation water and land rent under the irrigation area. From Figures 12 and 13, the average amount charged for irrigation water per hectare ranges from N5000 to N8000 which is relatively on the high side. In Zobe and Shagari schemes, there is no charges for irrigation. Non-payment for irrigation water as it is the case in Zobe is a deviation from long term goal of the project where the federal government is to gradually withdraw its funding and allow the scheme to raise self-sustaining revenue for its maintenance. This will tend to increase the period of financial burden and dependence on the government.

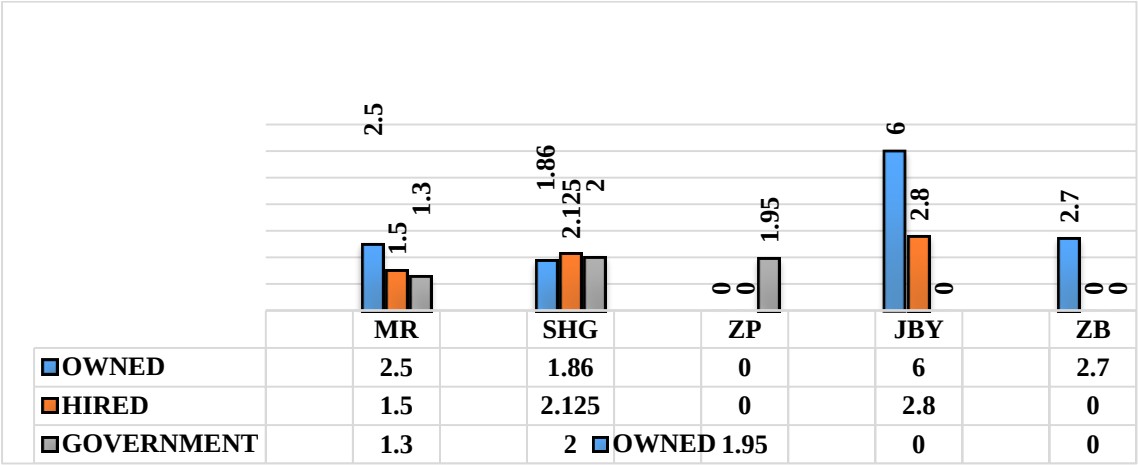
Also, average cost of land rent is as low N5000/ha in Zobe and Gibiya while in Middle Rima Valley, it is as high as N27000/ha. Although the later is relatively high for young farmers who are to be encouraged into farming. In Zobe, there is no charge for irrigation land use. This implies that the scheme may not be able to generate the needed fund to sustain its self at the event of withdrawal of government funding.



	ONE	TWO	THREE
MR	51%	43%	6%
SHG	70%	20	10
ZP	100%	0%	0%
JBY	61%	39	0%
ZB	14%	79%	6%

Figure 14: Shown is the number of time(s) or seasons at which the farmers in the project areas engaged in irrigation farming in a year

The practice of two or more irrigation seasons per irrigation year was only observed in Shagari and Jibiya Irrigation Projects as depicted in Figure 14. The Farmers in Shagari were able to embark on multiple irrigation seasons because they provide the water by themselves through tube wells. However, the inability of other projects to engage in multiple irrigation seasons could be due to irregular and/or late release of water to the farmers which ultimately will not give way for multiple irrigation reason.



	MR	SHG	ZP	JBY	ZB
OWNED	2.5	1.86	0	6	2.7
HIRED	1.5	2.125	0	2.8	0
GOVERNMENT	1.3	2	1.95	0	0

Figure 15: Shown is the average area of land in hectare cultivated by individual farmers in all the project areas, which is a function of the type of ownership found in each of the project sites

The average area of land cultivated by the farmers in respect of ownership in all the studied areas is shown in Figure 6. Most of the project had average area of cultivation ranging between 1.3 and 6.0 hectares. More of the cultivated areas cultivated are individually owned as the case are in Middle Rima Valley, Jibiya and Zobe irrigation schemes. This to a great extent have the tendency of affecting the cropping pattern of the farmers within the scheme as the farmers are to use their property as they wish and cultivate whatever crop they wish to grow, which will not encourage commercial production.

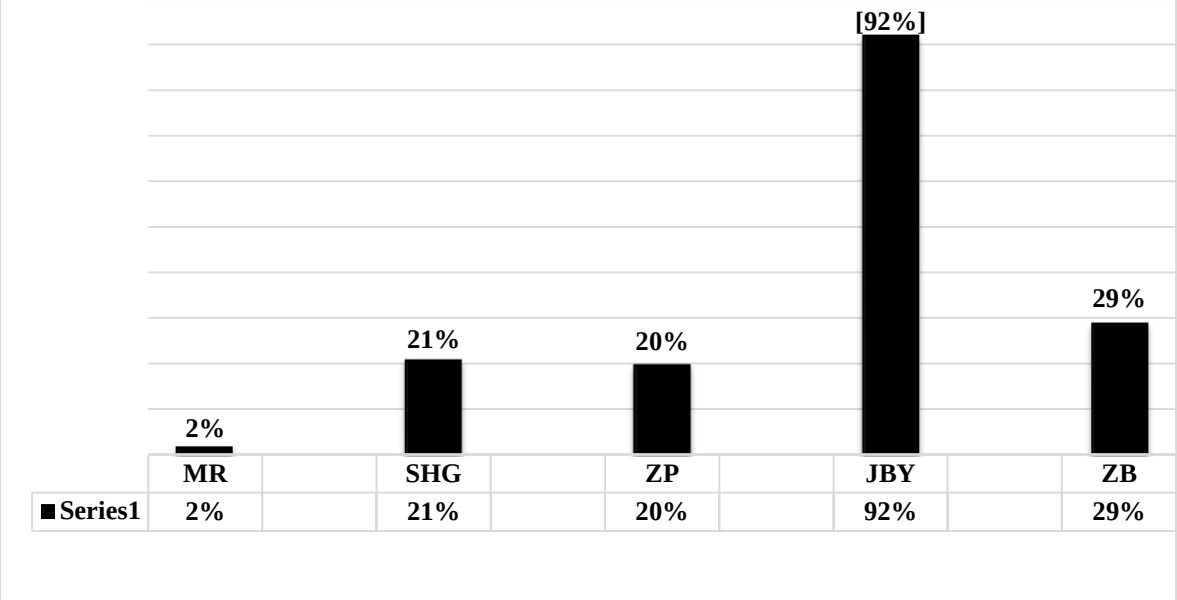


Figure 16: Shown is the water supply frequency in all the project areas i.e. Irregularity of water supply to farmers

Irregular or late release of irrigation water was observed to be the major problem faced by the farmers in all the projects except Middle Rima Valley as presented in Figure 16. Jibiya Project had a more peculiar case. In Jibiya project, 92 % of the respondents had no access to regular irrigation water supply during the irrigation seasons under study. According to farmers interviewed, the pumping machines are bad. This have the tendency of affecting the area of irrigation land cultivated within the schemes and the number of irrigation seasons being cultivated per year.

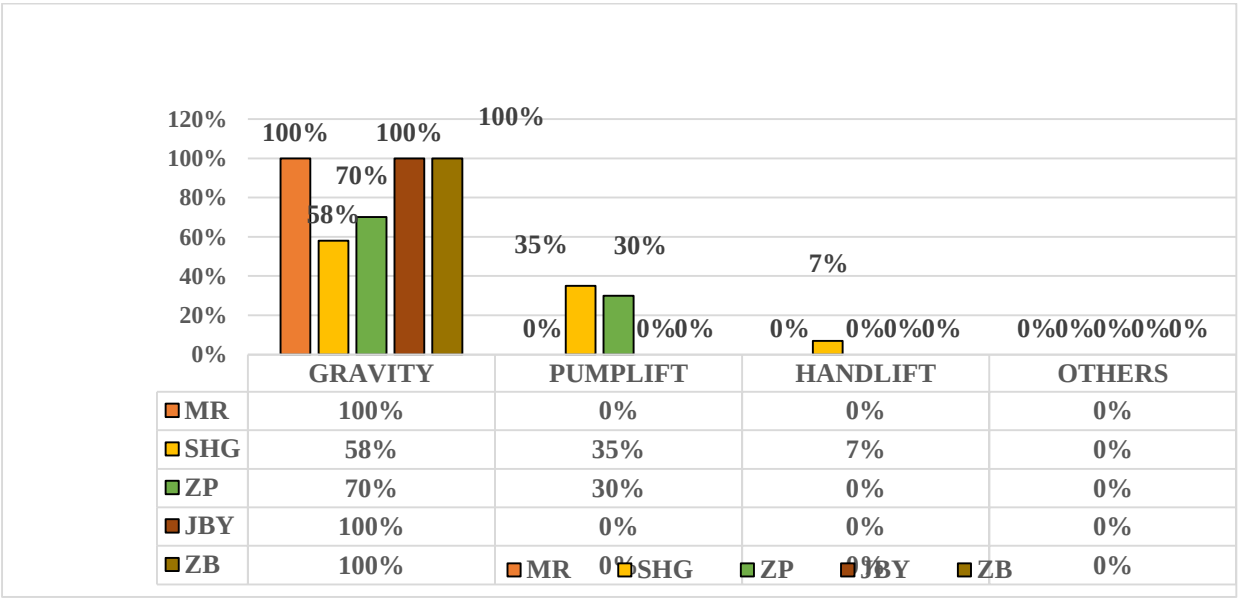


Figure 17: Shown is the common method of water abstraction in all the project areas

Water abstraction method is presented in Figure 17. In Shagari irrigation projects 35 % of the farmers do abstract water using pump lift from the canals to their farm land at a reasonable distance and this result to increase in the cost of inputs, such as fuel and maintenance of pumps.

Cost Variables

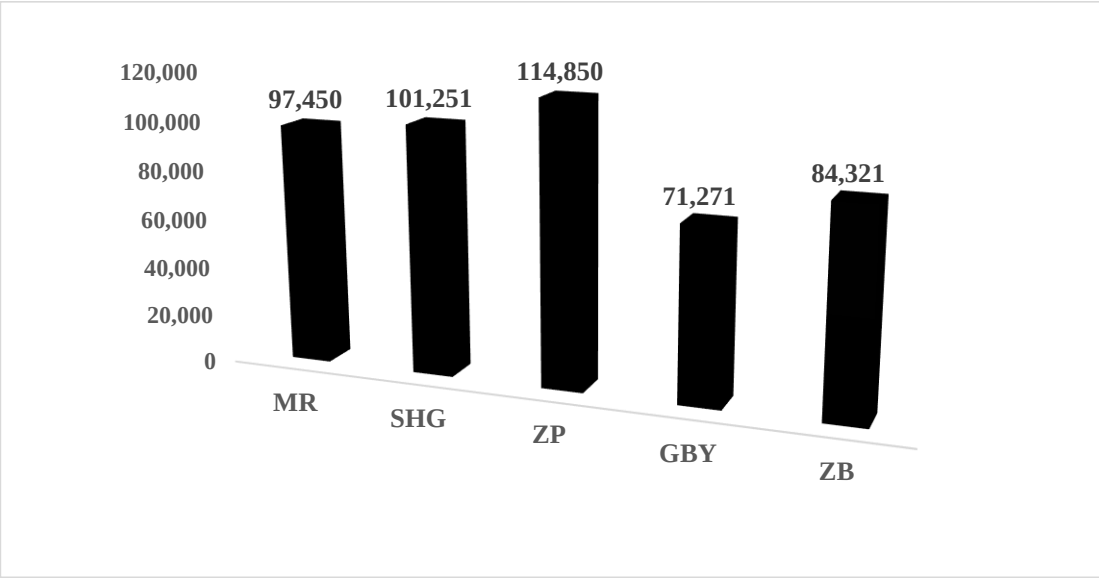


Figure 18: Average cost of inputs (seeds, fertilizer and chemical) used per hectare (₦)

From figure 18, the average cost of inputs in Middle Rima Valley, Shagari and Zauro Polder are ₦97, 450, ₦101, 251 and ₦114, 850 though those of Jibiya and Zobe Irrigation projects are less. It is expected that the average cost of production per hectare will increase when labour cost is added to the figure above. This could be traced to the challenge the farmers face in the area of input supply as indicated in Figures 22, 23 and 24 below.

Table 3: Cost of Farm Labour/Man Day (₦)

Irrigation Projects	Clearing	Planting	Weeding	Harvesting	Processing	Total Cost
MR	770	696	346	817	660	3289
SHG	665	560	677	593	546	3041
ZB	600	500	550	500	450	2600
JBY	625	500	600	600	400	2725
ZP	750	500	500	700	600	3050
Average Cost	682	551.2	534.6	642	531.2	

Average cost of farm labour in man day in the different irrigation project ranges from ₦ 531.2 to ₦ 682. MR having the highest total cost of ₦ 3289 and the least, ZB with a value of ₦ 3050.

From the presentation in Figure 19, all the irrigation projects have positive value which indicates that irrigation farming within the scheme on the average is profitable. Middle Rima Valley and Shagari Irrigation Projects have cost benefit ratios at 36 % and 38.23 %. Showing that the cost of production in the scheme is relatively lower in comparison to that of Zauro Polder, Jibiya and Zobe irrigation projects where the ratio ratios are above 50 %. An indication that a higher cost of production is obtained in these areas which may be attributed to regular use of fuel for pumping machines and maintenance as some of the farmers make use of tube wells as well as lifting the water from the main canals through a distance to their farm land; hence, the variability in the cost of labour, water charges and land rent.

Economic Benefit of the Farmers

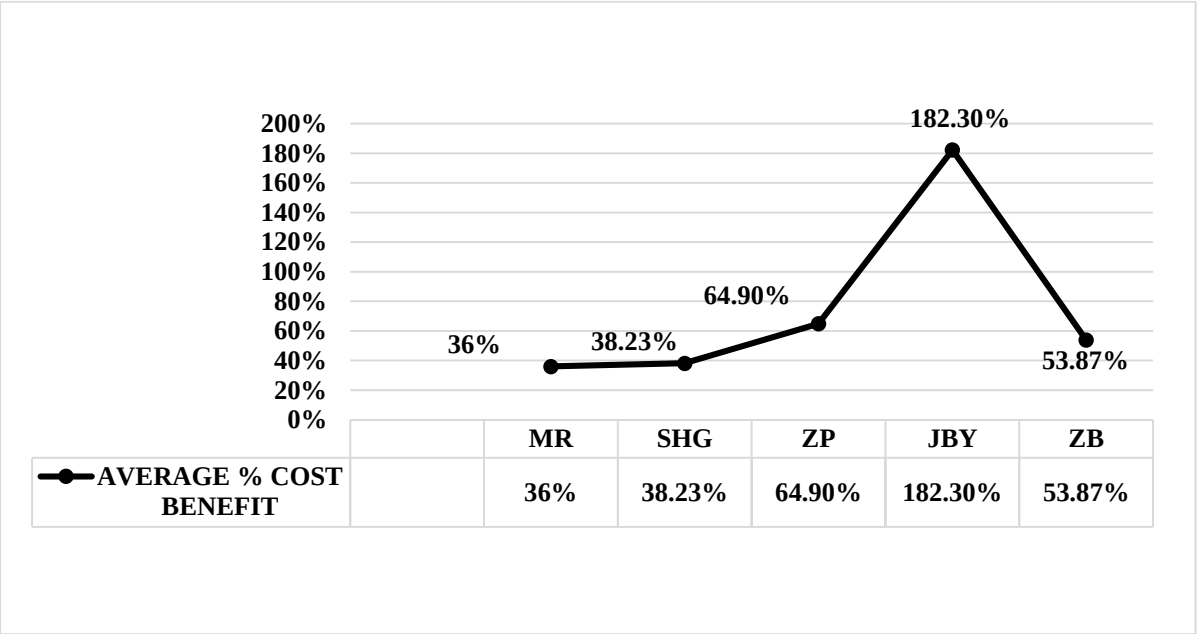


Figure 19: The average cost benefit ratio for the schemes to measure profitability of the projects

Peculiar factors affecting the Projects

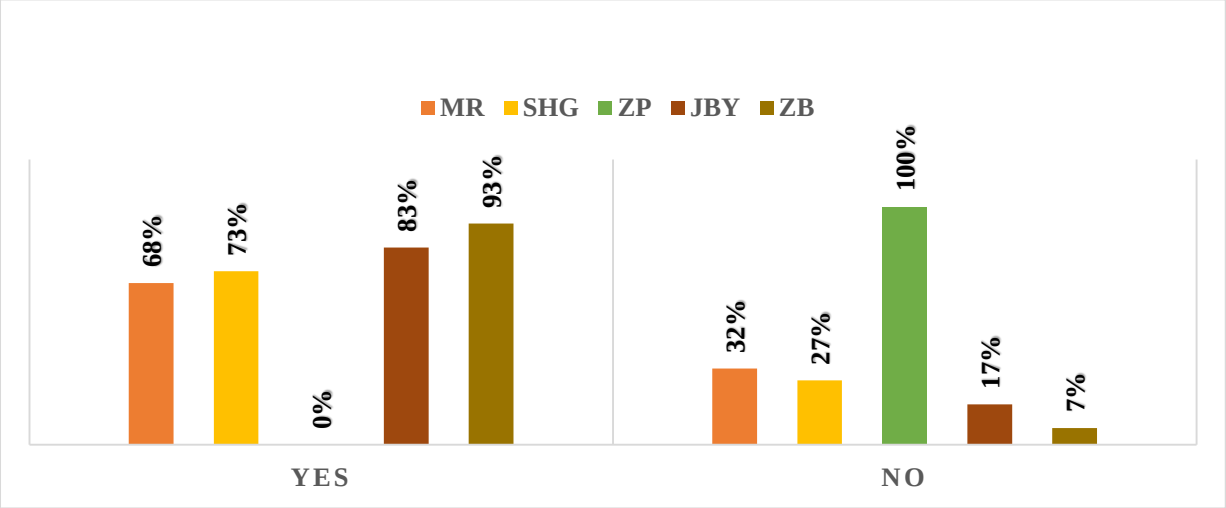


Figure 20: Shows membership of water users association

In all the Projects or Schemes, there exist Water Users Associations (WUAs). The basic purpose of forming WUA where members pool resources together for self-support and addition of value to products is not the case in all the schemes. There was zero response of the farmers, on the issue of obtaining material or financial support from both commercial banks and the Government due to ineffective WUAs. This implies that the farmers in the schemes do not have access to loans or credit facilities from financial institutions.

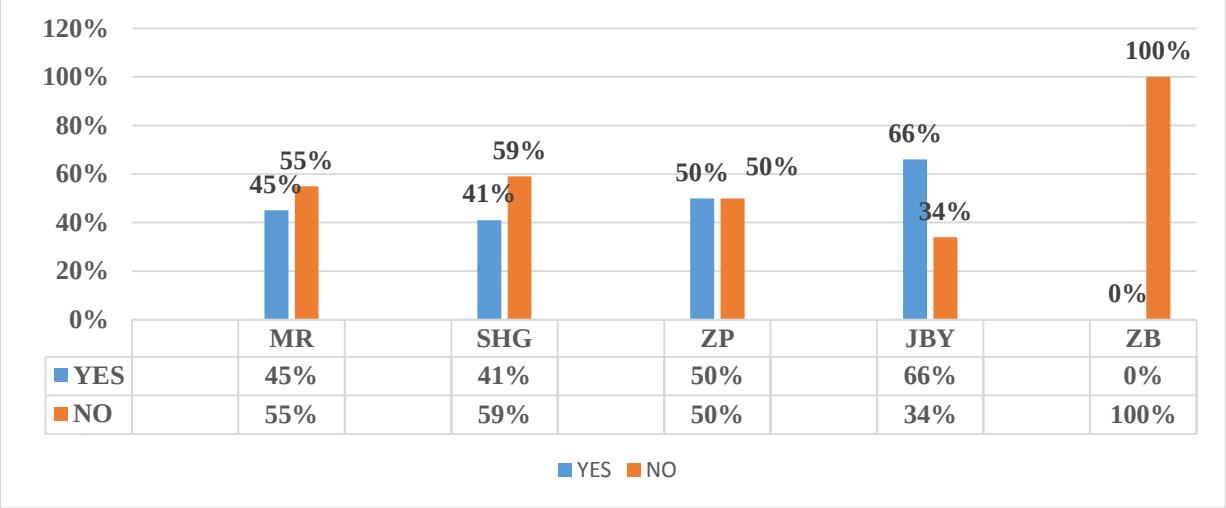


Figure 21: Shows extension worker visit to farmers

From Figure 21, a high proportion of the farmers do not have contact with extension agent. The Projects do not have trained Agricultural Extension personnel. Their idea of extension personnel is those that release water for irrigation and such visits are highly irregular. In the case of ZB, 100 % of the farmers do not have contact with extension agents and these farmers therefore rely on their local technique in handling farming related issues (cropping pattern, pests and diseases control etc.)

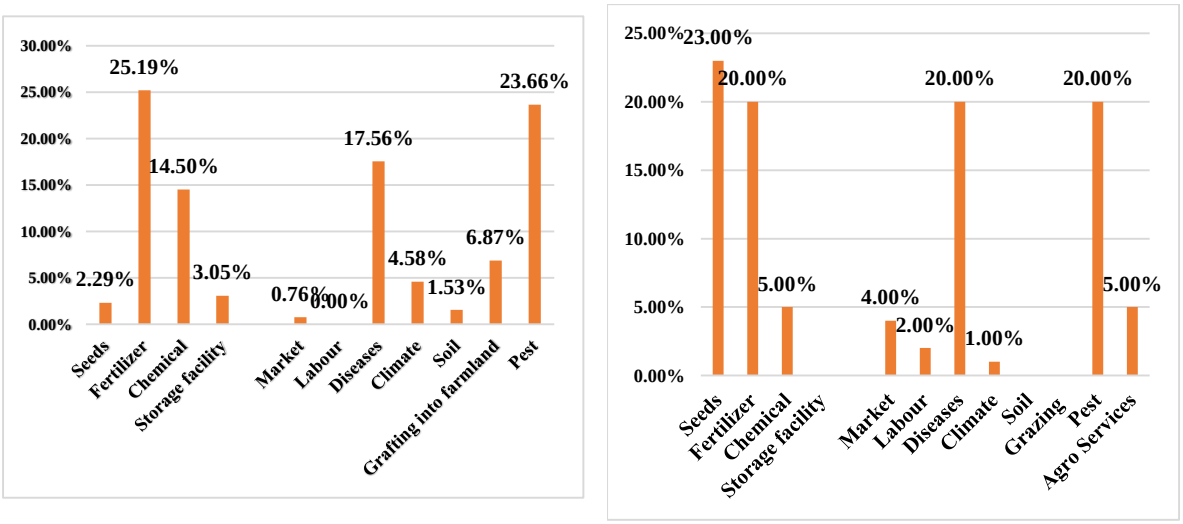


Figure 22: Constraints faced by farmers in Middle Rima Valley and Shagari Irrigation Project in their magnitude

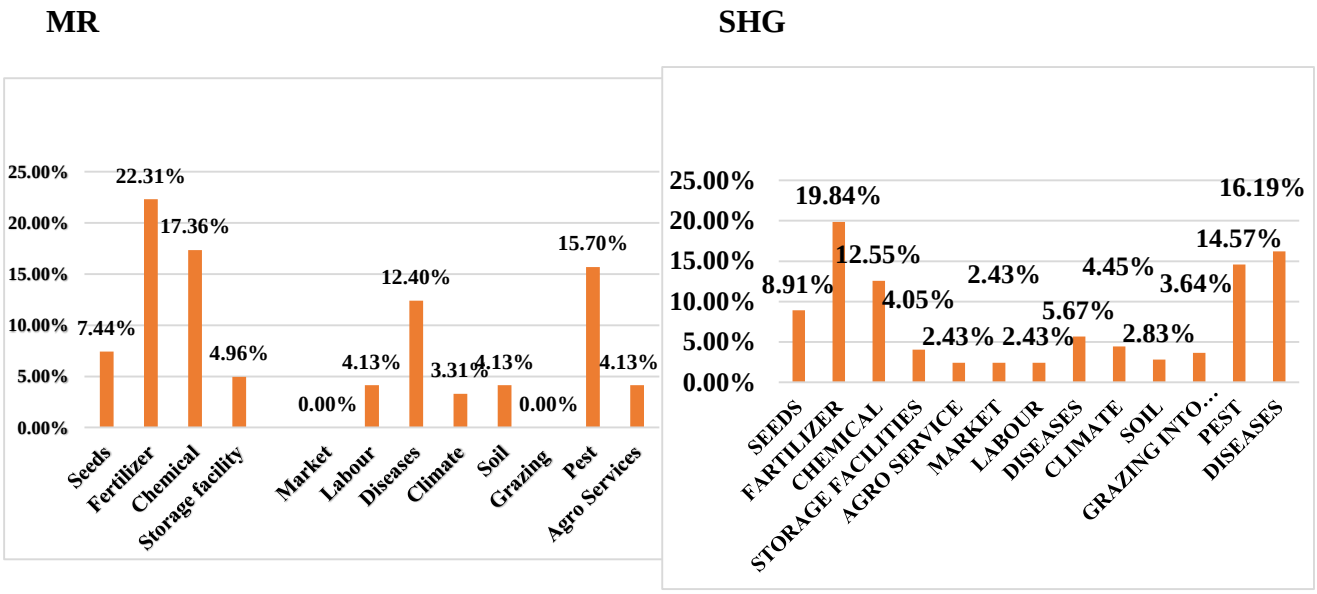


Figure 23: Constraints faced by farmers in Zauro Polder and Jibiya Irrigation Project in their magnitude

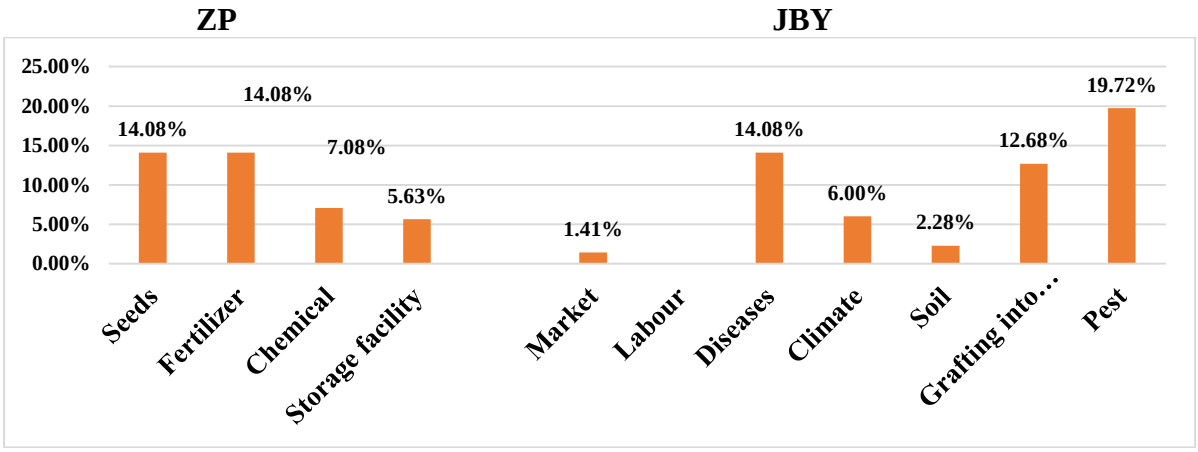


Figure 24: Constraints faced by farmers in Zobe Irrigation Project in their magnitude

ZB

The following Figures 22, 23 and 24 above show the proportionate response of farmers to the constraints in the different irrigation schemes. The basic farm inputs such as seed, fertilizer and chemical are seen to pose serious constraints in terms of availability and cost. From all the constraints, fertilizer and chemical inputs had 25.19 and 14.05 (39.24) in MR and 22.31; 17.3 (39.61) in SHG; and 19.8 and 12.55 (32.35) in JBY. In ZP and ZB seeds and fertilizer constraints were rated 23, 20 (43) and 14.08, 14.08 (24.16%) respectively. The presence of this basic input constraint will no doubt to a great extent increase the farmers' cost of production the area.

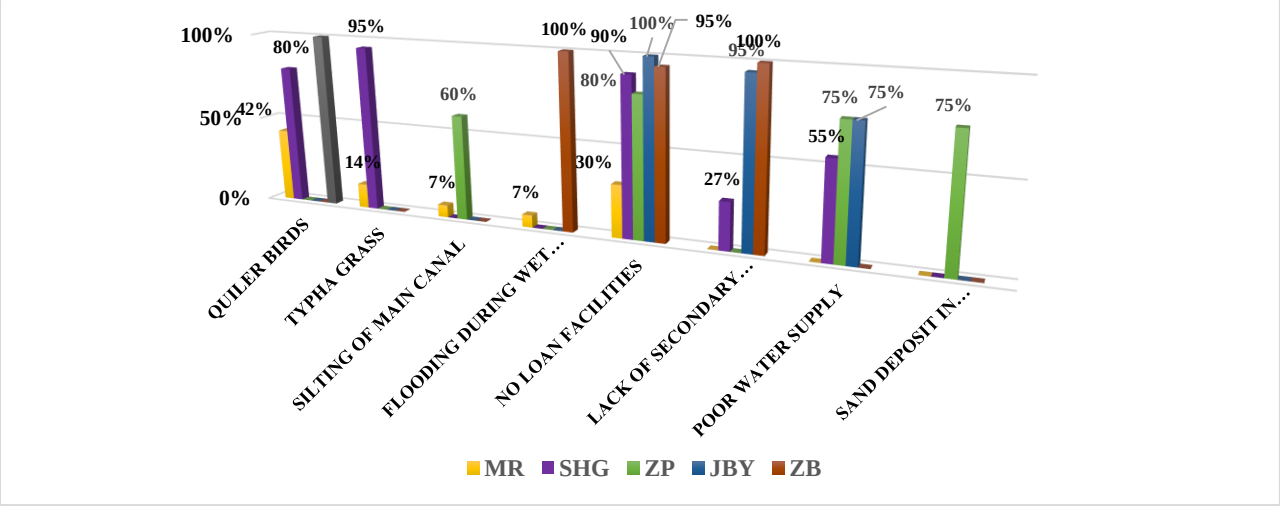


Figure 25: Show specific challenges facing each scheme as perceived by the farmers

From Figures 25 above, the respondents identified other constraints affecting the irrigation farming as presence Quiler birds and Typha Grass in Middle Rima Valley and Shagari Irrigation Projects, Silted Main Canals in Zauro Polder and Middle Rima Valley irrigation projects, Flooding in Middle Rima Valley, lack of loan facilities in all the irrigation schemes, lack of developed secondary canals in Shagari Irrigation Project; irregular and late release of water to farmers in Zauro Polder, Jibiya and Shagari irrigation Projects and heavy sand deposits in Zauro Polder Irrigation Project. Sediments deposits have been noticed in Sabke dam where irrigation water is meant to be stored, with grasses seen growing in the middle of the dam; high deposit of sand sediment in Zauro Polder irrigation area that has claimed about 25 % of the irrigation area as reported by the project manager. Jibiya and Zauro Polder Irrigation scheme have obsolete and faulty pumping machines and insufficient electricity power resulting to the inability of the scheme to supply water to upstream farmers. Typha grass invasion was highly noticed in Shagari Irrigation Project claiming more than 25% of the land area as reported by the project manager.

In most schemes, aging farmers have been observed to be the irrigation farmers and this is a great disadvantage to the irrigation farming in the schemes and most of the schemes are not fully developed as water collected in the dams is not utilized.

Conclusion

Irrigation projects within the Sokoto Rima River Basin has the potentials to operate optimally in that the farmers operate above their input cost level and this is an indication that farming activities within the basin is profitable. Despite all profit margins, the project did not meet some specific goals of the government because the results show that;

1. Most of the farmers operate within the peasant scale farming with smaller hectare.
2. Land in the project areas are mostly owed by individual farmer which allows for inheritance and the result of which is continuous fragmentation and also used for other purpose other than irrigation farming i.e. building of residential quarters in the project areas.
3. Most of the farmers cultivate one irrigation season annually, while there is the potential to cultivate the land up to three seasons annually as practiced in Jibiya. See Figure 14.
4. Most of the farmers did not embrace irrigation farming early enough because majority spent less than ten years in the practice. Meaning that they were between 30 and 40 years when they venture into the practice.
5. It was confirmed from the analysis, that irrigation area is under-utilized between 30 % and 46 %. Charges for irrigation water varies within the basin, with some as high as N10, 000/Ha and others as low as N2, 000/Ha. The cost of hiring irrigation land also varies and ranges between N1, 000/Ha and N55, 000/Ha.

6. The release of water is not always regular and timely in most of the schemes as most farmers complain of water supply not being regular owing to a number of factors such as obsolete pumping machines, inefficient water distribution method i.e. pumping water instead of allowing it to flow by gravity, and lack of secondary or distribution canals.

The viability of Irrigation projects within the Sokoto Rima River Basins have been identified to be having some challenges; with peculiarities in some areas, while in other areas they are similar. Therefore, the following recommendations are given as measures to improve and sustain its viability:

1. Government should consolidate existing investments in the basin and rehabilitate those schemes found to be viable (and with preference for gravity irrigation, farmer management and cash cropping).
2. Government should take full control of the irrigation farm land in the project areas, so as to prevent the sale of land and building of residential quarters on lands meant for irrigation practice.
3. A standard hacterage should be scaled out to farmers willing to practice irrigation farming in other to produce crops for commercial purpose.
4. There is the need to harmonize charges in the irrigation schemes within the basin and accountability should be upheld in the schemes as funds raised are used to meet one of the National Irrigation Policy and Strategy for Nigeria (NIPS) objectives, which is to stabilize the public irrigation sector and transfer O & M to the beneficiaries/private sector.
5. Farmers should be encouraged to grow in more than one irrigation season throughout the basin in order to increase annual production and to attain the required self-sufficiency.
6. Young people should be encouraged to go into irrigation farming at early age by providing the needed loan/credit facilities.

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