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FLOOD RECESSION FARMING IN BENUE RIVER BASIN: TOWARDS SUSTAINABLE UTILIZATION OF FLOOD WATER FOR SUSTAINED AGRICULTURAL PROUDUCTIVITY

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Abstract:

Flood is a common natural disaster, and its aftermath affects human livelihood. Globally, causality figures associated with floods has been increasing, especially in developing countries, due to weak flood coping mechanism. Engineering and non-engineering methods have been proposed to reduce the menace of floods on human settlements. Though, floods are destructive, flood water can be utilized in an all-year round farming especially in tropical region with distinct rainy and dry season. Flood recession farming is a non-engineering approach aimed at utilizing flood water for agricultural production. This study is aimed at analyzing socio-economic livelihood characteristics of flood recession farmers in Benue River basin; with a view of determining its contribution to household food security and employment generation. A combination of open-ended questionnaire, focus group discussions, field survey, remote sensing and geographic information systems (GIS) was utilized to achieve study aim. Evidence suggests that land availability remains a major constraint. However, it was also found that crop tolerance and market demands determine the type of crop grown. In conclusion, there is a huge potential for further development of flood based farming systems; considering the many areas that experience annual flooding in Nigeria.

1.1. INTRODUCTION

Flooding is the most common environmental hazard in Nigeria (Etuonovbe, 2011). All over the world and also in Africa people learned to deal with floods in the most effective way (Nederveen, 2012).Mostly on small-scale, farmers practice various methods to cope with the annually occurring floods and use them for their benefits.Floods occur in Nigeria in three main forms: coastal flooding, river flooding and urban flooding (Folorunsho and Awosika. 2001). In areas largely inhabited by people, there are both positive and negative environmental effects of

flooding (Ologunorisa, 2004).Most times, the negative effects of flood tend to overwhelm the positive impact of floods. Flood recession farming is one of the non-engineering, traditional approaches aimed at utilizing flood water for agricultural production by farmers. (Nederveen, 2012). There are several publications about flood related activities on floodplains in western Africa (Adams, 1993; Saarnak, 2003). However, little attention is given to flood based farming system. This study is therefore aimedatimproving the understanding of flood recession farming system and the influence of the hydrology of the lower river Benue catchment on the agricultural productivity. To achieve this aim, the area used for recession farming in the lower Benue river basin was measured, the food production potential of flood recession agriculture in the area of study was analyzed as well as the management of water, soil and field by the farmers, the influence of the hydrology of the area on the productivity of flood recession agriculture was also determined and finally the socio-economic implications of flood recession farming was discussed.

1.1.1 Flood Recession Farming

Flood recession farming is a form of flood-based agriculture. Flood-based agriculture can also include spate irrigation or other water management systems that guides or stores water for irrigation. Flood recession agriculture uses the residual moisture of seasonally flooded lands when the floods recede. This form of agriculture is not uniform, various adjustments and techniques have been developed to optimize the yields of the areas that are prone to annual flooding. There are, however, some general features that are typical for flood recession agriculture systems. The annual flood that comes in the rainy season brings fertile sediment from the upper catchment. The flooded areas are often gently sloped floodplains or margins of lakes or wetlands where these sediments can settle. Organic material in the sediment acts as a natural fertilizer. The recession farmers do not have to add fertilizers and plots are suitable for continuous cropping without fallowing. The sedimentation of fine-grained material allows the development of clayey soils that have high water retention capacities.

1.1.2 Agricultural uses of Flood

There are benefits of flooding despite its immediate ill effects. For farmers and those in the agricultural sector, it helps them in the long run by providing nutrients to the soil that were lacking. This makes the soil more fertile and increases agricultural production. Nutrients are also added to rivers and lakes, improving the health of fishes that can be consumed. There may be

relocation of fishes and organisms living in water bodies. This may improve the ecosystem. New predators and prey are introduced to areas, balancing the aquatic population.

According to Parker et al (2005) Flooding has both adverse and beneficial impacts. “In theory, flood warnings allow adverse impacts to be reduced and beneficial impacts to be increased”, in their model of flood forecasting warning and response system identified agricultural benefits as one of the benefits of flood.

Although flooding can be devastating to an unprepared community, it is a natural event with a purpose. Some of the benefits include:

- Floods distribute rich sediment and refresh streams.
- Floods allow rivers and streams to overflow their banks naturally, which can prevent more serious flooding downstream.
- Parks, open space and wetlands provide natural protection from flooding, allowing water to spread over a large area and cause little or no damage.
- Floods return nutrients to the land and contribute to the health of wetlands, which is good for flood recession farming. (Boulder FloodInfo.net, 2012)

Flood recession farming receives no controllable input other than land and labor and therefore has a very high net return to energy expenditures. **(**Saarnak 2003)

The output from the recession farming is very important to household subsistence since the general energy requirements of the households are far from covered by the irrigated farming. The recession agriculture would then support the household subsistence during months where other contributions to the household subsistence are limited.(Saarnak 2003).

In urban areas, flood plains along the rivers crossing cities and towns are used for car parking, recreational purpose and for sporting activities, but at rural areas, the flood plains are used for agricultural or others purpose. (Yuksel *et al,* 2011)

According to Saarnak (2003), a wise society, would reap the benefits of flooding and avoid many of the negatives if they would choose to build cities in ways that can accommodate flooding without trying to avoid it. Attempting to go against nature is almost certainly a losing prospect in the end.

2.1 Area of Study

This study focused on the lower part of the river Benue basin in area around Makurdi (Figure 1) and its environs. The geographical extent of the study area is 7^0 50^1 N 8^0 25^1 E and 7^0 35 N 8^0 40^1E. Makurdi is a suburban town (Figure 2), which trails the banks of the Benue River, one of the major rivers in Nigeria. It is divided into northern and southern sections by the river, which bordered on both banks by a floodplain of varying width. It is at an elevation of about 93 meters above sea level. It has a sub-humid tropical climate, characterized by a distinct dry season of about four months and by Southern Guinea Savanna vegetation. The rainy season occurs between April and November. The mean annual precipitation is about 1370 mm and has a bimodal pattern. The floodplain and its enclosed river are flanked by cretaceous sediment; the Makurdi sandstone in the South and the Keana sandstone in the North (Fagbami and Vegecatalan, 1985). The floodplain is filled with Quaternary heterogeneous sediments.

In the town, traditional dwellings blend haphazardly with modern residential and commercial buildings. With the town rapidly sprawling on both the sandstone uplands and the floodplain, there is a growing concern among farmers living within and at the periphery of the town, about the escalating loss of agricultural land to urban land. The Benue River basin is a rich agricultural region, full of rivers, and could be called the breadbasket of Nigeria. Some crops grown include potatoes, cassava, soya bean, guinea corn, flax, yams and beniseed. It also boasts of one of the longest stretches of river systems in the country with potential for a viable fishing industry, dry season farming through irrigation and for an inland water way. Fig 3 and 4 shows a typical farmland in Makurdi.

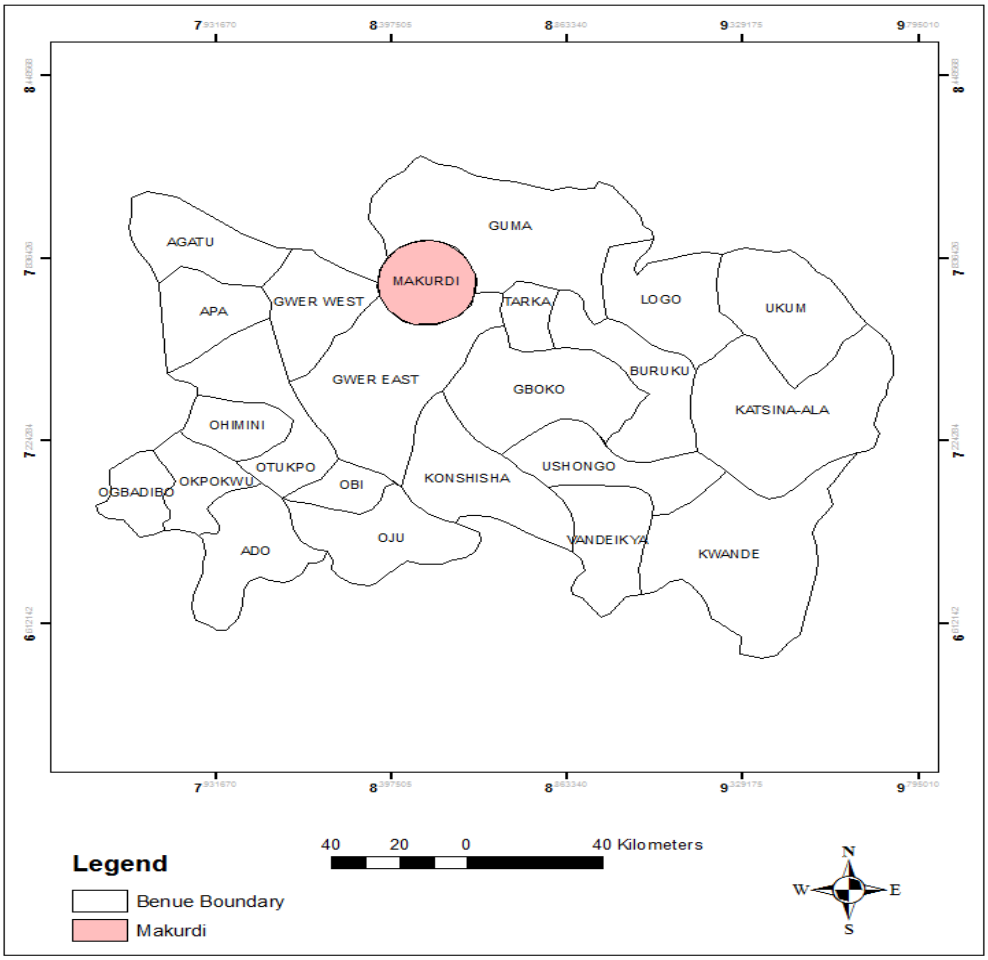

Figure 1. Map of Benue State showing the Study Area

Source: Benue, Geographical information system(GIS), 2020.

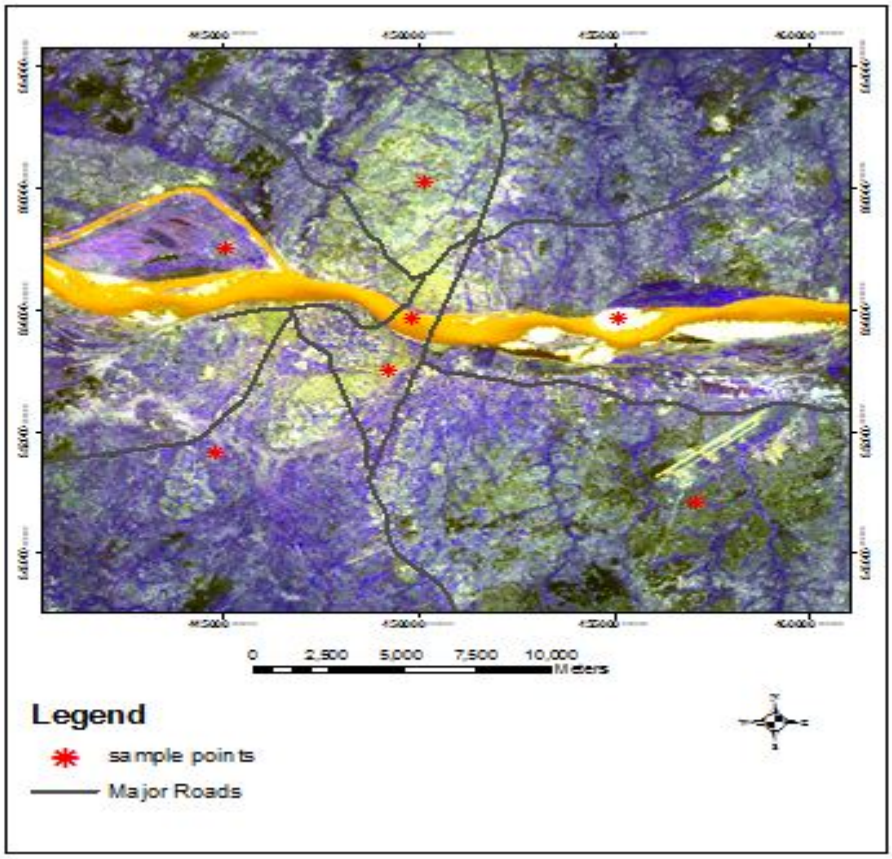

Figure 2. Satellite Imagery of Study Area

Source: Author's Fieldwork, 2020.

Figure 3. River Benue and surrounding farmland

Source: Author's Fieldwork,2020.

Figure 4. Makurdi Flood Plain

Source: Author's Fieldwork, 2020.

3.1 METHODOLOGY

The data were basically from primary and secondary sources.The primary sources included direct measurement of coordinates from the field with the aid of the global positioning system and questionnaire administration.This involved formal and informal method. The formal method was through administration of questionnaires directly to the farmers 40 questionnaires were administered and distributed to the farmers who have been practicing recession farming at least in the last 20 years. Various questions were asked about Socio-Economic characteristics, area of farmland, food production, hydrology and soil.

Satellite imageries were collected from Center for Remote sensing, Ministry of Lands and Survey and internet.An area of 52202.10 hectare (Ha) covering the lower part of the river Benue basin was obtained from the National Centre for Remote Sensing (NCRS) Jos for this project. The choice of this area was because it covered the urban city of Makurdi which is annually flooded, the flood plains and the adjoining uplands captures a large population of the recession farmers.Secondary data about agricultural productivity over 10 years, hydrological data and meteorological data have been collected from different institutions at different administrative levels.

Due to the nature of the data collected for this research, the research adopted purposive and random sampling techniques. This means that information were directed and obtained from the

farmers who have practiced recession farming for a minimum of 20 years and who can give reliable information relevant to the study.40 of the farmers were randomly selected from different parts of the river basin along the River Benue bank, this include Wadata, Wurukum, Northbank, Mbatol sand island, Fidi. The approach to this study is basically designed to evaluate the flood recession farming in river Benue basin with focus on Makurdi. The methods used are based on Geographical Information System, Remote Sensing and Statistical analysis. The study did not cover the entire river basin because of the cost and time required for the study; however the region covered gives a good representation of the entire River Benue basin.

4.1 RESULTS AND DISCUSSIONS

4.1.1 Size of Flood Plain in the Benue River Basin.

From the Landuse land cover classification, the estimated area of the farmland in the study area is about 8842.62 Ha, about 4000 Ha of the farmland accounted for the flood recession farming. About 1.5km around the Benue River is usually inundated. The entire region is not efficiently used for recession farming as some other human activities like settlements; block industries compete with the farming activities thereby underutilizing the agricultural potential of the area. Figure 5 and 6 shows the landuse/ landcover classification of the study area. The study revealed that the farmers either cultivate in the flood water, the seasonally inundated land or the elevated land close to the flooded (dry flood plain) region depending on the tolerance of the crop against flood. From the study, about 70% of the farmers cultivate their crops in the seasonally inundated area of the flood plain and 75% of them claim that the seasonally inundated region has the highest yield hence the choice of the region. Figure 7 shows the graphical representation of the areas used for flood farming in the Benue River basin.

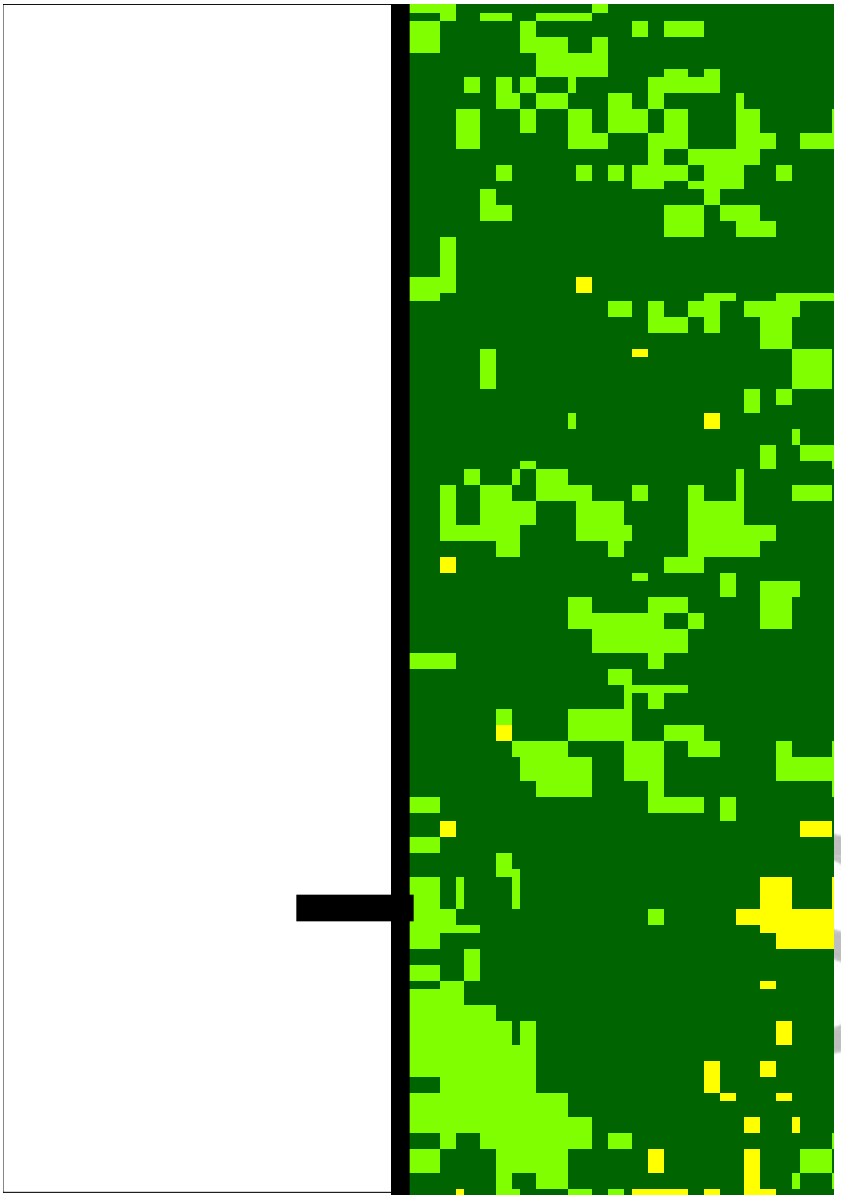

Figure 5. Land Use Land Cover Map of Makurdi

Source: Author's Fieldwork, 2020.

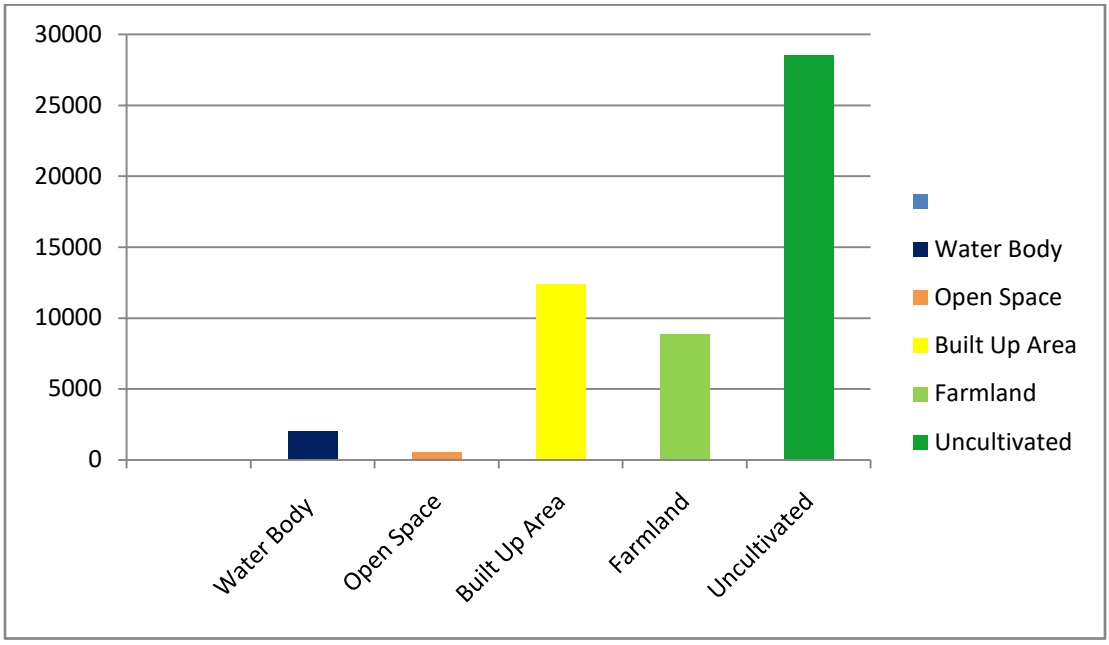

Figure 6. Land use / Land cover Area Distribution

Source: Author's Fieldwork, 2020.

The geographical extent of the study area is 7^0 50^1 N 8^0 25^1 E and 7^0 35 N 8^0 40^1E. Makurdi is a suburban town, which trails the banks of the Benue River, one of the major rivers in Nigeria. It is divided into northern and southern sections by the river, which bordered on both banks by a floodplain of varying width

The areas used for recession farming borders the famous river Benue which is the major source of water for the farmers; the farmers make use of the water to irrigate their farms when the soil moisture is not sufficient for the sustenance of the crops.

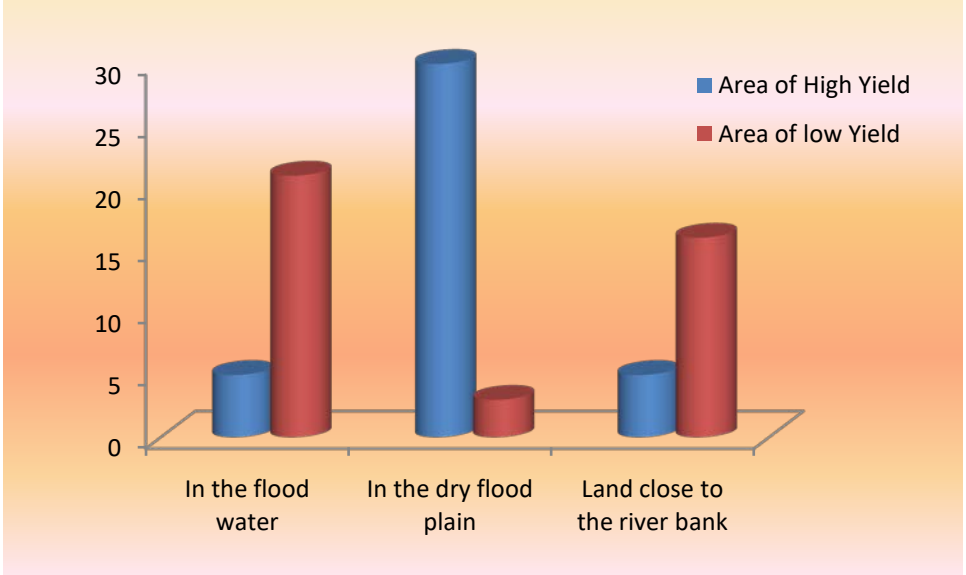

Figure 7. Different regions used for flood recession farming

Source: Author's Fieldwork, 2020.

4.1.2 Coping with floods

The floods have become unpredictable over the last three years especially last year. Timing and size of the flood became different the years before. People reported flooding of the floodplain in the dry season, after rainfall events in the upper catchment in March to September. Siltation of the rivers and filling of the Lagkdo dam in Cameroon are thought to becauses of the change in the flood regime. Bad timing of the flood is considered to be a constraint of the area. There is a need for flood regulation. People would ideally have flood-protected land that they would irrigate with river water or ground water .At the same time people fear that when floodprotection will beinstalled,they wouldlose their fertile lands to the government.People that live in small villages on somewhat elevatedislands inside the floodplain experience another constraint. These people and their livestock have to move during the wet season when the floods inundated, to the most elevated parts of the flood plain. This moving in and out of the floodplain is considered very troublesome.

4.1.3 Productivities of Flood Recession Farming

The agricultural offices at Benue state does not have accurate data of the productivities from the flood recession farming; however from the information gathered from the few respondents shows that the main crops that are cultivated are rice, corn, tomatoes, garden egg, spinach and cassava in some cases. The higher elevated area is used for the cultivation ofyam, cassava and

rice.Some of the rice grows under flood recessionagriculture, but not all land where riceis grown inundates every year. It is not straight forward what part of the rice production was grown under flood recessionconditions.The vegetables; corn and garden egg are grown in the floodplains that are flooded annually. Farmers and agricultural experts in the River Benue flood plain confirmed this. There are certain plots along the river where small-scale irrigationist performed during the dry season.

Since most of the crops cultivated here are not collectively measured to determine the productivity, the researcher has used the productivity of the respondent for analyzing the productivity of flood recession farming. From table1 below, it reveals that 32% of the farmers measure their produce in baskets, 60% in bags and 7.5% accounted for others like trucks. 90% of the farmers produce about 50 bags/baskets in each farming season at minimum and about 100 bags/baskets at maximum yield.

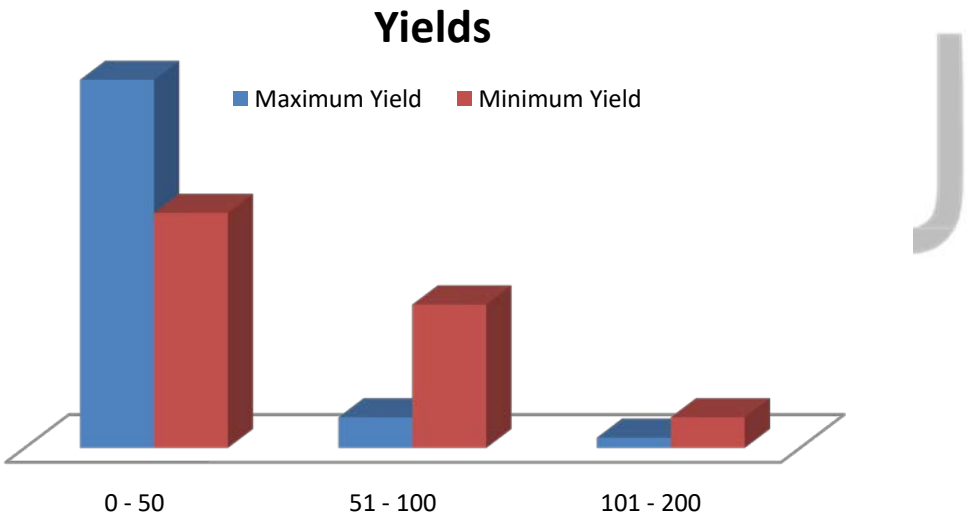

Figure. 8. Productivities of flood recession farmers in Benue River basin
Source: Author's Fieldwork, 2020.

Table 1: Measurements to determine productivity

Items	Variables	Frequency	Percent
Measurement of yield	Bags	13	60
	Baskets	24	32.5
	Others	3	7.5
	Total	**40**	**100**
Definition bad/good year	In yields	32	80
	In rainfall	8	20
	Total	**40**	**100**
number of baskets/bags/trucks at minimum	0 - 50	36	90
	51 - 100	3	7.5
	101 - 200	1	2.5
	Total	**40**	**100**
Number of baskets/bags/trucks at maximum	0 - 50	23	57.5
	51 - 100	14	35
	101 - 200	3	7.5
	Total	**40**	**100**
how much is a basket/bag/truck do you apply fertilizer	Above 1000 Naira	40	100
	Yes	28	70
	No	12	30
	Total	**40**	**100**
what kind of fertilizer	NPK	26	65
	Manure from dungs	3	7.5
	Total	29	72.5
	System	11	27.5
	Total	**40**	**100**
do you apply insecticides	Yes	18	45
	No	22	55
	Total	**40**	**100**
compare upland and lowland yield	Far More than	12	30
	Moderately more than	26	65
	Not more than	2	5
	Total	**40**	**100**

Source: Author's Fieldwork, 2020.

4.1.4 Potentials of Flood based Agriculture

The total area of flood recession agriculture in Africa is hard to estimate. There has been little attention to this form of agriculture, which is widespread, worldwide, on the African continent andalso in Nigeria.The practices are often performed on a small-scale. The area of existing wetlands, floodplains, or other seasonal inundated areas can give an indication of the potential of this form of agriculture. The number of wetlands shows that there is a huge potential for this form of agriculture. From the analysis it reveals that the productivity of the farmers is not too dependent on the hydrologic components of rain and evapotranspiration. This form of agriculture depends basically on water from the rivers and soil moisture.

The multiple regression test that the productivity of farmers is a function of the hydrology of the area (rainfall, evapotranspiration) shows that indeed a very high positive relationship exists between these variables with a coefficient of correlation of 0.977, implying that the higher the hydrology (rainfall and evapotranspiration, the higher the productivity will be and vice versa. The results also show that in recession farming, the hydrology variables are most significant for productivity as they contribute over 95% to the relationship. Surprisingly however, the independents variables are not statistically significant for both rainfall and evapotranspiration with respective Beta standardized coefficients of 0.689 and -0.599; P.0.194, 0.221 > 0.05 respectively. Hence, the decision is that the productivity of farmers is not a function of the hydrology of the area (rainfall, evapo transpiration). From the study, it shows that this form of agriculture can be independent on rainfall provided the water from the river can be depended upon. The utilization of seasonal wetland or floodplains when the flood retreat can therefore, be a good opportunity for agriculture.

5.0 CONCLUSION

Fieldwork in the lower River Benue catchment has provided insight into the methods of flood recession farming. Flood recession farming receives no controllable input other than land and labor and therefore has a very high net return to energy expenditures. The study however shows that the labor productivity and the net income from the input intensive irrigated farming system far exceed that of the traditional flood recession farming. When the focus is often on integrated water management plans, the utilization of seasonal wetlands or floodplains, as floods retreat can be a good opportunity for agriculture. In the wet season there is usually plenty of soil moisture retained in the soils of these fertile environments and without utilization this water reservoir

would likely evaporate and not be used at all. This form of agriculture only uses water that is available and no other users downstream will experience water shortages caused by this form of agriculture. The river discharges will not decrease significantly and this form of agriculture will not harm international agreements on river discharges across the border. The numerous varieties in the usage of water for different purposes in areas thatare floodedannually, brings insight in the optimal practices for certain environments. These different activities and practices dealing with annual floodwater showopportunities to enhance existing systems andtheirproductivity.These opportunities shouldbe explored.

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