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ASSESSMENT OF SOME SELECTED UPLAND RICE VARIETIES PERFORMANCE IN MANCHOK DISTRICT, KAURA LOCAL GOVERNMENT AREA, KADUNA STATE.

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ABSTRACT

Rice (Oryza sativa L.) is one of the major cereal crops worldwide and is the staple food for millions of people in Nigeria. It is consumed across all geopolitical zones and socioeconomic classes. The demand for rice as the most cherished food outweighs the local production in the country. Thus, this study set out to assess the performance of some selected upland rice (Oryza sativa L.) varieties in Manchok District, Kaura Local Government Area, Kaduna State. The aim of this study was to determine which of the selected rice variety that thrive best in the study area which can effectively bust food production and ensure food security given the Tropical Ferruginous soils of the study area. A portion of land with uniform soil characteristic was prepared and partitioned into small plots of 10 x 10m in two rows to reduce incidence of soil micro –variation. Five varieties (FARO 40 (NERICA 8); FARO 45; FARO 49 (NERICA 8 or Jan naira); FARO 55 (NERICA 1 or white jollof) and FARO 58 (NERICA 7)) were planted and monitored. Equal treatment of NPK fertilizer, herbicides and other inputs were applied uniformly. The results showed that FARO 45, FARO 55 and FARO 58 matured earlier <95days of planting, while FARO 40, FARO 49 matured >120 days from planting. The results indicates that the improved varieties give higher yields than the older varieties (i.e. faro 55 and 58 gives higher yields than faro 40, 45 and 49). The study recommends government intervention in terms of provision of fertilizers at subsidized rates and donors from Non - Governmental Organizations to assist farmers with farm inputs such as fertilizers to boost food production.
Awareness is needed on the types of upland rice that gives higher yields (Faro 55, 58), this knowledge is practically lacking for many farmers in the study are.

Keywords: *Rice (Oryza sativa L.), Production, Varieties, Soil Type, Food Security.*

BACKGROUND OF THE STUDY

Rice (Oryza sativa L.) is one of the major cereal crops worldwide and is the staple food for millions of people in Nigeria. It is consumed across all geopolitical zones and socioeconomic classes. Rice is grown under a range of agroclimatic conditions. Rice production has increased significantly in Nigeria in recent years, with the country now one of the largest producers and consumers of rice in Africa (Jonah, et al., 2023; Bin, et al., 2023). However, there are still challenges in the production of rice in Nigeria, including limited access to high-yielding and disease-resistant varieties, poor agronomic practices, climate variability, and environmental stresses (Jonah, et al., 2023 Somado, et al., 2008). Consequently, the demand for rice in Nigeria has quadrupled, thereby, far exceeds production levels. As a result, rice imports keep growing at a fast rate, as local rice production has been mainly under upland conditions and primitive agronomic practices, with farmers clearing new forest lands every year (Somado, et al., 2008). Phenotypic variations in rice genotypes play a crucial role in rice improvement and are essential for developing high-yielding varieties.

New Rice for Africa (NERICA), is a genetic material derived from the successful crossing of the two species of cultivated rice, the African rice (Oryza glaberrima Steud.) and the Asian rice (Oryza sativa L.), to produce a progeny that combines the best traits of both parents: high yields from the Asian parent and tolerance of the African parent to harsh environments (Pramod, et al., 2009). This improved genotype (NERICA) is a new type of upland rice that perfectly adapts to the rain-fed upland ecology in sub-Saharan Africa (SSA), where smallholder farmers lack the means to irrigate and apply chemical fertilizers. However, NERICA genotypes also respond even better than traditional genotypes to higher inputs ((Somado, et al., 2008). On the other hand, Liberian Agriculture Company (LAC) variety, otherwise known as LAC 23 is the best upland local variety in Liberia, which was developed by International Rice Research Institute (IRRI) scientists in the late 70s through varietal selection at the LAC. The name of the variety was named after the selection site. It is adapted to multiple local agro-ecologies and is late maturing (140 - 150 days to maturity) (Pramod, et al., 2009; Amoatey, et al., 2016). Rice consumption is increasing rapidly in Nigeria because of the shift in consumer preference towards rice, increasing population growth, increased income levels, and rapid urbanization. However, rice production falls short of demand; the country depends heavily on rice importation of over 3 million tonnes annually, equivalent to over US$480 million in scarce foreign exchange.

The Nigeria agricultural landscape is changing, with increased government policies aimed at stimulating private sector involvement and boosting local production (Kamai, et al., 2020). The efforts are starting to show results, as Nigeria's rice production rose from 3.7 million metric tonnes in 2017 to 4.0 million metric tonnes in 2018. For the record, the major rice producing states in Northern Nigeria are Kebbi, Borno, Kano, and Kaduna. Currently, most of the farmers producing rice rely on traditional technology with low use of improved input technologies. It is important for farmers to adopt improved varieties and have a good knowledge of rice agronomy to increase rice production and productivity in the various states in Nigeria.
Emphasis on the promotion of improved rice production technologies gained a fresh momentum following the recent policy of rice import restriction. Also, it warranted a need to equip extension agents with up-to-date information on crop production practices (Kamai, et al., 2020).Although, there have been several phenotypic rice studies in Nigeria (Salleh et al., 2022; Abubakar and Daji, 2022) there is a gap in the knowledge of rice performance in the geographical area of Manchok, Kaura Local Government Area (LGA) of Kaduna State. This study was conducted to enable farmers identify, appreciate, and cultivate an upland rice variety with the heighst output to ensure food security in the study area. The aim of the study is to assess the suitability of some selected upland rice varieties in Manchok, Kaura LGA under the given existing soil type in the study area that gives higher yields. A research hypothesis was postulated to provide decision on whether there is no significance difference in rice yields by different upland rice varieties due to soil type.

The choice of Manchok in Kaura LGA was informed by the high population of rice farmers which makes the area an agrarian community. The climatic condition favours the cultivation of rice in the LGA. This study will considerably improve the farmers' understanding of different varieties of upland rice performances in the study area. The findings and recommendations of this research will go a long way to assist the rice farmers in understanding the climatic characteristics of the study area and identify the best variety that would be suitable for the soils of the area.

LITERATURE REVIEW

Conceptual Issues

Upland rice production accounts for about 20% of the total rice produced in Nigeria. With the development of New Rice for Africa (NERICA) for upland production systems, several farmers have shown interest in growing upland rice. Unfortunately, these farmers do not have a ready source of information on upland rice production (West Africa Rice Development Association, 2015). Several studies have been conducted in Nigeria and in similar agro ecological zones to evaluate the phenotypic variations of rice genotypes. A study by Abubakar and Daji (2022) evaluated the yield potential of local and improved rice varieties in Gombe State and found significant variations in reproductive traits such as number of panicles/plants, number of seeds/plant and days to 50% flowering. A study conducted by Chukwu, et al., (2022) investigated the performance of different rice genotypes in Malaysia a similar agro ecological zone to Nigeria. They found variations among rice lines; approximately 50% of the lines produced yields of 5 t/ha or more. Salleh, et al., (2022) reported significant variations in plant height, number of tillers per plant, panicle length, and grain yield among the genotypes.

Between 1985–1989, fourteen additional high-yields, blast – resistant varieties, including six upland and three lowland varieties were released (Table 1). In 1990 more eleven rice varieties consisting eight upland and three shallow swamp varieties were released to Nigerian farmers (Table 2).

Table 1. Recommended rice varieties in Nigeria, 1985 - 1989

Cultiva: Old name	New name	Year of Released	Duration (days)	Plant height cm	Grain type	Yield Potential (tonne/ha)	Reaction to blast
Upland rice ecosystem							
FARO 38	IRAT133	1986	100-105	100-110	C	1.5-3.5	R
FARO 39	IRAT144	1986	100-105	95-105	C	1.5-3.5	R
FARO 40	FAROX229	1986	115-120	115-120	M	1.5-3.5	R
FARO 41	IRAT 170	1986	115-120	80-90	M	1.5-3.5	MR
FARO 42	ART 12	1986	115-120	110-115		1.5-3.5	MR
FARO 43	ITA 128	1986	115-120	110-115		1.5-3.5	MR
Irrigated rice ecosystem							
FARO 30	FAROX 228-2-1 -1	1986	110-115	120-125	M	3.0-6.5	MR
FARO 31	FAROX 228-3-1-1	1986	110-115	120-125	M	3.0-6.5	MR
FARO 32		1986	110-115	110-120	M	3.0-6.5	MR
FARO 33	FAROX 228-4-1 -1	1986	110-115	120-115	L	3.0-6.5	MR
FARO 34	FAROX 233-1-1-1	1986	105-115	115-120	L	3.0-6.5	MR
FARO 35		1986	120-135	125-135	M	3.0-6.5	MR
FARO 36	FAROX 239-2-1 -1	1986	120-135	125-130	M	3.0-6.5	MR
FARO 37	ITA-212	1986	125-140	127-130	L	3.0-6.0	MR

L = long grain, M = medium grain, C = short grain, R = resistant, MR = moderately resistant,

Source: Ayolade (1991) in Imolehin and Wada, (2000)

Table 2. Recommended rice varieties in Nigeria, 1990 – 2000

New Name	Old Name	Ecology	Days of maturity	Plant height (cm)	Yield range tonnes/ha	Grain shape	Amylase content	Result to blast	Year of release
FARO 44	SIPI692033	Shallow swamp	110-120	95	4.0-6.0	Long	26.0	R	1992
FARO 45	ITA257	Upland	100	100	2.0-3.0	Medium	17.4	R	1992
FARO 46	ITA15 0	Upland	105	110	2.0-3.5	Medium	22.5	R	1992
FARO 47	ITA11	Upland	115	105	2.0-4.0	Long	10.5	R	1992
FARO 48	ITA301	Upland	128	100	2.5-4.0	Medium	16.4	R	1992
FARO 49	ITA315	Upland	120	100	2.0-4.5	Medium	16.2	R	1992
FARO 50	ITA230	Shallow SwSwamp	125	100	4.0-6.5	Medium	28.0	R	1992
FARO 51		swamp	130	100	4.0-6.0	Long	---	R	1997

Source: Imolehin, 2000

More so, in order to achieve the objective of people's demand on rice, fifty-one rice varieties have been bred from 1990-2000 to suit the various ecological zones of the country- rain fed uplands, flooded plains and irrigated plains. These varieties have properties that satisfy different consumer preferences in terms of grain type, swelling capacity, amylase content, protein and cooking time (Imolehin and Wada, 2000). Despite the fifty-one rice varieties released for farmers in Nigeria, the National Cereals Research Institute (NCRI) in collaboration with National Seed Service (NSS) identified varieties preferred by farmers in Nigeria (Longtau, 2003). The adoption of FARO 44 by different States in Nigeria is expected to be high compared to other rice varieties. Rice grows in all the agro ecological zones as diverse as the Sahel of Borno State and the coastal swamps of the southwest and south-south (Longtau, 2003). According to Damola, (2010), rice growing environment in Nigeria are usually classified into five rice ecosystems: rain-fed lowland which accounts for 47% of total rice production area, rain-fed upland (30%), irrigated lowland including large-scale irrigation schemes and small-scale irrigation schemes account for 16% of total rice area, deep water (5%) and mangrove swamp accounting for less than 1% of total rice area.

Imolehin and Wada, (2000) show the possible land area for rice production in Nigeria to be 4.6 million and 4.9 million hectare, and the areas includes five different ecologies such as; upland, inland or shallow swamp ecology, irrigated rice ecology, deep water or floating rice ecology and idal(mangrove) swamp ecologies. These ecologies cannot be the same in terms of hydrology and water control. The type of rice plants that are grown are different for each ecology. Plant bred for the irrigated land for instance cannot be grown in the uplands or flood plain and deep-water environment (Pingali et al., 1997). In all, rice ecologies are bred for a specific zone. Therefore, the modern FARO 44 high yielding varieties that outshined the other varieties were developed for the irrigated and the favorable rain fed lowlands.

Different studies for individual countries and on the global scale also found that recent trends have decreased different crops as observed among the top three rice - producing nations, witnessing very low yield growth rates (Gleeson, 2012). China, India and Indonesia are witnessing rice yield increases of only 0.7 %, 1.0%, and 0.4 % improvement per year. China, India, and the U. S., the top three wheat producers, similarly witness yield increases by 1.7 %, 1.1%, and 0.8 % per year, respectively. At these rates (Gleeson, 2012) found that yield driven production growth in India and China could result in nearly unchanged per capita rice harvests but decline steeply in Indonesia. Gleeson (2012) also noted that maize, rice, or wheat yield improvement rates are below the 2.4 % doubling rate in many smaller crop producing nations. Unfortunately, a high percentage of total calories consumed in these countries are from these four crops. This is particularly true for maize throughout much of Africa (especially in Kenya, Zambia, Zimbabwe), Central America (especially in Guatemala, Nicaragua, Panama), and parts of Asia (Nepal, Georgia).

Spencer, et. al., (2006) evaluated the adoption of NERICA and other improved upland rice varieties following varietal promotion activities in Nigeria. The survey was undertaken in two states in Nigeria (Ekiti and Kaduna) in local government areas (LGA) where WARDA and partner organisations have been promoting NERICA (new rice for Africa) and other upland rice varieties with funding provided by the Gatsby Foundation and the Rockefeller Foundation. The purpose of the survey was to investigate farmers' adoption of these varieties, both in villages where varieties had been promoted through participatory varietal selection (PVS) activities and in nearby villages which had not been involved in such activities (termed 'near-PVS' villages). The study also developed and tested methods for possible use in subsequent wider studies of varietal adoption in Nigeria.

The study shows that there are substantial processes of change in varietal cultivation among sampled farmers. These can be considered in terms of the proportion of upland rice farmers growing these varieties, and the proportion of upland rice cultivation under these varieties.
Considerable uptake of NERICA1 is observed (30% of farmers in Ekiti are estimated to have cultivated NERICA1 in 2005, and 42% and 19% respectively in PVS and near-PVS villages in Kaduna). These uptake rates are higher than have reported in other West Africa studies. Adoption of NERICA1 appears to have continued during 2004 and 2005 despite a scaling down of PVS activities in these years. Adoption of NERICA2 is observed only in Kaduna (with 14% and 9% of farmers growing NERICA 2 in PVS and near-PVS villages respectively). WAB189, another variety promoted by WARDA, is found extensively in both
states in LGAs where WARDA and its partners have been working, and its cultivation appears to have increased regularly over the last three years, so that by the 2005 season there were 46%, 36% and 23% of upland rice growing farmers cultivating WAB189 in Ekiti and in Kaduna PVS and near-PVS villages respectively. ITA150 is the most common variety cultivated in Ekiti (cultivated by around 60% of farmers), but is less common in Kaduna where there is some evidence of its popularity and cultivation being in decline. Cultivation of ITA321, the fifth main upland rice variety that has been promoted by WARDA, is not common.

Udemezue and Agwu (2018) examined improved rice varieties, production technologies and processing constraints in Nigeria. Secondary data approach was employed for the study. The results showed that the consumption rate of rice importation from 1980s to the present is relatively high compare to the production growth in Nigeria. Rice demand-supply gap scenario has been an existing trend that would be persistent if proper cares are not taken to salvage the situation. Hence, there would be continuous importation of rice to stop the demand-supply gap and this could as well be detrimental to the Nigerian economy. The modern FARO 44 high yielding varieties outshined the other varieties in Nigeria. The study recommended that: Research must be encouraged in order to improve rice production technologies significantly in a way that the rate of growth will match the needed self- sufficiency in domestic rice production just to reduce the amount of money spent in rice imports. Use of improved rice varieties should be encouraged and educated to farmers through the aids of extension workers, workshop on rice production management should be organized frequently to foster and rekindle the spirit of the farmers on rice production.

Edu and Oluka (2022) examined the effects of Sawah technology on the growth and yield performance of NERICA Rice varieties in the south-east Nigeria. Field experiment research was conducted to determine the effects of Sawah Technology on NERICA rice production from April to December 2020 during the rainy season at two different locations, namely, Ishieke and Imeoha Nkerefi in Ebonyi State and Enugu State respectively, both in the south-east of Nigeria. Six NERICA rice varieties: Sipi692033, WITA 4, NERICA 34, NERICA 1, NERICA 7 and NERICA 19 were used for the study on two Sawah fields and two non-Sawah fields measured 0.3ha each. Research data, namely: height, width, panicle length, grain number, and grain weight were collected starting from nursery to maturity of the rice. The study revealed that Sipi692033 has the highest yield of 5 tons/ha under Sawah Technology condition. The findings of the study show that the panicle length, grain number per panicle, weight of 1000 grains, and yield (ton/ha) were higher by 55.56 %, 50.00 %, 39.41 %, and 87.50 % respectively in the Sawah field relative to the non-Sawah field. The study concludes that FARO 55 generates the least height of seedling, while FARO 52 has the highest seedling height at the nursery stage in South-East Nigeria. Sawah Technology enhances rice growth in South-East Nigeria. Sawah Technology promotes NERICA panicle length yield performance. The number of grains per panicle, 1000 grain weight and tons per hectare increase with the application of Sawah Technology. Sipi692033 variety has the highest yield under Sawah Technology condition in South East Nigeria. Sawah Technology produces 50 % rice yield above what the non-Sawah Technology field offers.

Consequently, the uncertainty and risk associated with climate change/variability and crop yields could make farmers abandon farming or convert the farmlands to non-agricultural enterprise (Oluyole *et al.*, 2013).These negative developments, of course, would worsen the food insecurity in Nigeria. Therefore, Oyewole *et al.* (2014) have emphasised the need to enhance agricultural productivity, increase food production, meet the demands of growing populations, and ensure adequate access to food in Nigeria. Developing a reliable climate crop prediction system for estimating crop yields over Nigeria, will enhance agricultural production. Such a system can optimise agricultural productivity, improve crop management, and facilitate policy formulation on adaptation to future climate change.The main rice- producing states in Nigeria is; Benue, Ebonyi, Kaduna, Kano, Niger, Taraba and Borno. Other states include Enugu and Cross River (FAOSTAT, 2012). It is a staple food in the country and the most widely consumed, it is 3rd highest global food production, after sugarcane and maize. It is a cereal grain that grows in swampy areas, in regions with high rainfall but can still be grown in areas with little rainfall using water controlling terrace systems; it's sensitive and requires a lot of care and attention to grow well. Rice cultivation can be done by transplanting or direct seeding; the seeds are sprayed onto the soil after which it is ploughed into the soil by using a plough before cultivation, the rice seeds is soaked in water for 34 hours and allow drying for 24 hours after which it is ready for cultivation Okorie (2014). It takes about 120-200days after planting, depending on the areas and other factors for the grains to get ready for harvest; when it is ready, the grains falls off upon the stalk changing from green to golden-yellow. The water contained in the rice paddies can dry and evaporate before harvesting properly and let the rice ripen well. The rice is then harvested by cutting the stalk directly beneath the heads and the grains separated from the stalk by a mechanized thresher. Rice is one of carbohydrate- rich foods source in Nigeria and most African countries as well, and can be cooked in various ways and still be appetizing and nutritious, some of the delicacies include jollof rice, fried rice, coconut rice, ofada rice with stew, soup or sauce and in few cases as a rice pudding.

METHODOLOGY

The Study Area

The study area, Manchok is a big town in Kaura LGA, Kaduna State. It is located on Latitude 9°36′ 27″ North and Longitude 8°23′ 25″ East. The LGA is bounded in the northwest by Zango Kataf LGA, in the northeast; Kauru and Jema'a in the south and Plateau State to the east. The climate of the study area is classified as Tropical savannah climate (Aw), it has two distinct seasons; dry and wet season which are controlled by Inter-Tropical Discontinuity (ITD).The area is in the Sudan savannah which characteristically experiences the tropical wet-dry climate with about seven months of rainfall between April and October and five months of dry season from November to March. It has a mean annual rainfall of 2000-10000 mm, temperature of 24-27°C and relative humidity of 40-60% in January and 60- 80% in July (Dadah, et al. 2017). The dry season is between the months of November to March as a result of North-east trade winds and yields virtually no rains. Manchok has an average annual temperature of about 24.8°C, average yearly highs of about 28.6°C and lows of 18.8°C.

The town has zero rainfalls at the ends and beginnings of the year. It has a natural rain forest type of vegetation within the savannah. This is because of the location of the forest on the southwestern slope of the plateau. Manchok is on the windward side of the plateau thereby experiencing more rain than the surrounding environment. The vegetation is a mosaic of savannah and forest with forest occurring mainly in river and stream valleys, but also elsewhere due to high annual precipitation of more than 1,550 mm (Ezealor, 2002). The climate of the study area favours rice production.

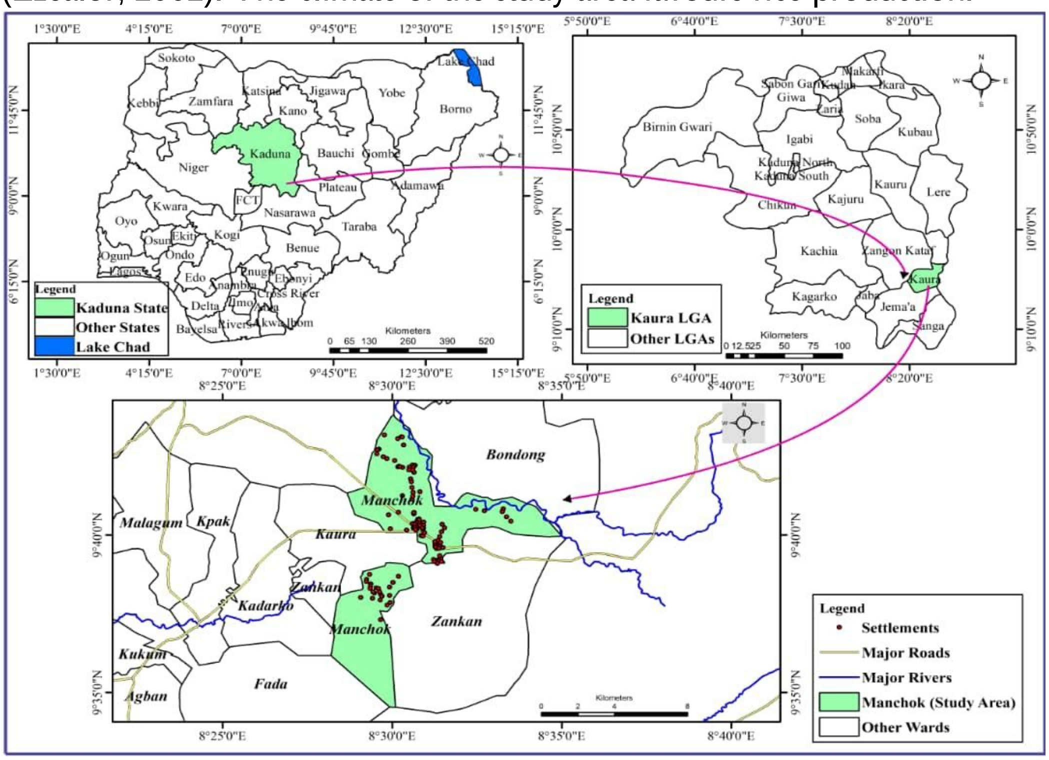


Figure:**1**. Kaura LGA Map Showing Study Area.
Source:Department of Geography and Environmental Management Federal University of Lafia.

Relief and Drainage

The relief comprises extensive tracts of almost undulating lightly dissected land, broken in places by group of rocky hills and inselbergs such as the Kagoro - Attakat hills. Much of the area lies between 400m - 600m above sea level (Ezra et al., 2017). The area is drained by two major rivers Kaduna and Gurara. Most streams found are seasonal in the sense that they dry up during the dry season. During the rainy season flooding occurs in the streams in the area which causes damage to most farm lands (Dodo, 2019). The soil of the area is ferruginous tropical soil from drifted and weathered basement complex with 32.1% of silt and clay. 0.5% cat ion infiltration rate with coarse and fine sand. They are zonal soils developed under climatic regimes with appreciable but seasonal rainfall (Oguntoyinbo, et al., 1983). They have distinct differentiated horizons with abundant of iron oxide with moderate nutrient holding capacity that support crop growth. The rivers in the area deposit some alluvial soils in the floodable region which provides additional fertility to the agricultural soils. Agriculture flourishes in the LGA with the presence of a large population of farmers occupied both during the dry and wet season (Mohammed et al. 2022). The rich alluvial soil favours the production of rice.

The vegetation of the study area is Guinea Savannah type characterised by shrubs, trees and grasses with presence of woodland found along valley bottoms. Types of trees found here are oil palm trees (*Elaeis guineensis*), locust bean (*parkia biggloboza*), shea butter trees (*butyrospermum*), mango (*magnifera indica*) with tussocky grass species. Due to anthropogenic influence such as felling of trees for fuel wood, clearing for cultivation, bush burning, grazing there is a decline in the vegetation resources in the area (Dodo, 2019).According to the 2006 census, Kaura has a population of 83,938 (NPC, 2009). This put the projected population of the LGA by 2023 at 222,579 using a growth rate of 3.0%.

Research Design

The research design is basically experimental in nature whereby the researcher sought to examine the performance of different rice varieties under the Tropical Ferruginous soil conditions of the study area.

Soil Preparation

Soil samples were first taken, random physical properties of the soil was conducted (soil P^H, soil texture, porosity and soil temperature). The

average P^H of the soil was found to be 6.8±0.1; with a texture of silt – loam highly weathered ferruginous red soil with moderate water retention capacity, which informed the use of NPK fertilizer to make up for any macro or micro – nutrient deficiencies.
Secondly, the soil was tilled and partitioned into beds of 10 x 10m as shown in figure 1. Subsequently, the planting of the five rice varieties was done and allowed to germinate under natural conditions.

Field Experiment

The study was conducted between May to October 2023. Field experiments were carried out during rainy season under rain – fed and uniform soil, same climatic conditions of Guinea Savannah in Manchok (9°36′ 27″ N - 8°23′ 25″ E). Five FARO varieties were used for this study: FARO 40 (NERICA 8); FARO 45; FARO 54; FARO 55 (NERICA 1) and FARO 58 (NERICA 7) were used for the study.

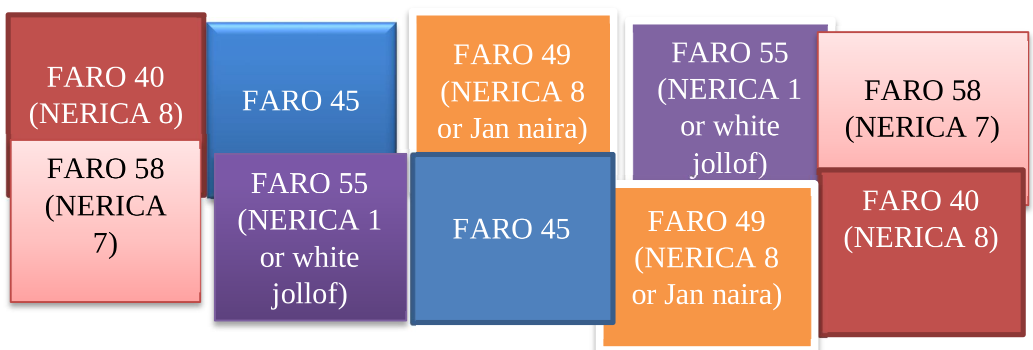


Figure 1: Arrangement of Cultivated Plots (10 x10m) with the Rice Varieties Planted

Data Analysis

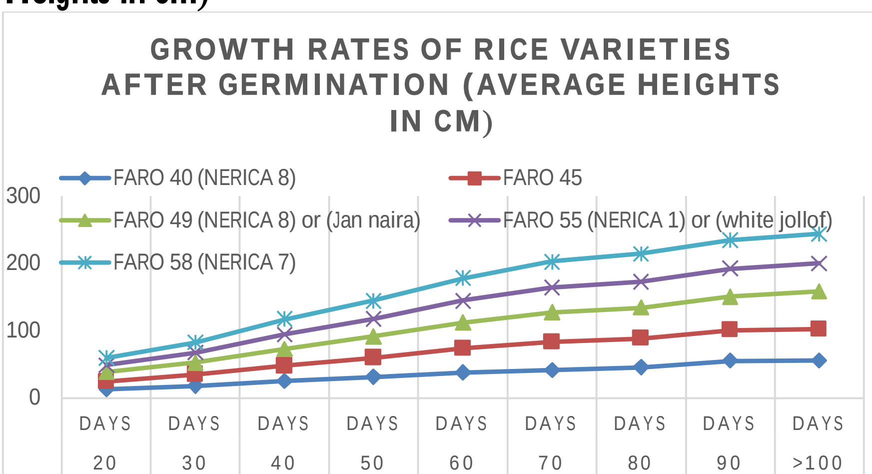
The data collected for this study was analyzed by means of the Statistical Package for Social Sciences (SPSS) software and presented with both descriptive and inferential statistics. Tables, frequencies were used for the data summaries while the inferential statistics was used to find the variation – analysis of variance in performance between the different rice species.

RESULTS PRESENTATION AND ANALYSIS

Data for performances of the different rice varieties from planting to harvesting are presented in the following tables.

Table 1: Growth Rates of Rice Varieties after Germination (Average Heights in cm)

s/no	Rice Variety	20 days	30 days	40 days	50 days	60 days	70 days	80 days	90 days	>100 days
1	FARO 40 (NERICA 8)	12.58	18.11	25.23	31.24	37.56	41.65	45.45	55.43	55.68
2	FARO 45	11.89	16.64	22.79	28.73	36.13	41.64	43.21	45.56	46.38
3	FARO 49 (NERICA 8) or (Jan naira)	14.53	17.67	24.86	31.77	38.21	43.67	45.23	49.78	56.41
4	FARO 55 (NERICA 1) or (white jollof)	9.78	14.56	21.37	25.63	32.49	36.82	38.57	41.23	41.22
5	FARO 58 (NERICA 7)	10.65	15.48	22.77	26.88	33.43	38.46	41.62	42.24	43.83



Source: Researcher's field work, 2024.

Figure 2: Growth Rates of the 5 varieties of rice (Oryza sativa L.)

The results of the growth rates of the different rice was taken from 20days after germination and was monitored until maturity as presented in Table 1 and figure 2. The more recent (improved varieties of Faro 49, Faro 55 and 58 grew taller than the older varieties (Faro 40 and 45). The implication of this observable improvements demonstrate man's efforts to boost food production to feed the fast growing population.

Table 2: Maturity Range for Various Rice Varieties (days)

s/no	**Rice Variety**	80-90days	90-100days	100-110days	110–120days	Standard Maturity Time
1	FARO 40 (NERICA 8)					115-120days
2	FARO 45					100days
3	FARO 49 (NERICA 8 or Jan naira)					120days
4	FARO 55 (NERICA 1 or white jollof)					75-100days
5	FARO 58 (NERICA 7)					75-100days

Source: Researcher's field work, 2024.

The results of maturity times of the 5 rice varieties are presented in Table 2. The results showed early maturity of Faro 45, 55 and 58. Faro 49 takes longer period before maturity and thrived best in relatively wetter environments compared to Faro 45, 55 and 58. Faro 40 also takes longer period (115 – 120) before maturity been an older variety and also needs wetter environments to give maximum yields.

Table 3: Yields/Hectare Obtained after Harvest

s/no	Rice Variety	Experimental Quantity (t/ha)	Average Experimental Quantity (t/ha)	Actual Quantity Harvested (t/ha)
1	FARO 40 (NERICA 8)	1.5 – 3.5	2.50	2.18
2	FARO 45	2.0 - 3.0	2.50	2.06
3	FARO 49 (NERICA 8 or Jan naira)	2.0 – 4.5	3.25	3.12
4	FARO 55 (NERICA 1 or white jollof)	4.0 – 6.0	5.00	3.24
5	FARO 58 (NERICA 7)	5.0 – 7.0	6.00	4.28

Source: Researcher's field work, 2024.

The results of yields of individual rice variety is presented in Table 3. The results indicates that the improved varieties give higher yields than the older varieties (i.e. faro 55 and 58 gives higher yields than faro 40, 45 and 49).

Table 4: Regression Analysis of Yields (Experimental and Actual Yields)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.936[a]	.876	.834	.36797

a. Predictors: (Constant), experimentalyield
b. Dependent Variable: actualyields

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.857	1	2.857	21.102	.019[b]
	Residual	.406	3	.135		
	Total	3.264	4			

a. Dependent Variable: actualyields
b. Predictors: (Constant), experimentalyield

The results from data analysis using regression between experimental and actual yields are presented in Table 4. The results showed that there is a significant difference ($p = .019$) between yields obtained in the study area compared to the experimental yields. This differences may arise as a result of variation in soil preparation, fertilizers and other inputs used between the experimental and what this research did.

Similarly, a paired sample T – test was conducted to compared results obtained from the regression analysis, the results obtained is hereby presented in Table 5. The result obtained is similar to that obtained in Table 4

Table 5: T-TEST PAIRS=experimentalyield WITH actualyields (PAIRED)

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	experimentalyield	3.8500	5	1.57718	.70534
	actualyields	2.9760	5	.90326	.40395

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	experimentalyield & actualyields	5	.936	.019

The results from the paired samples correlation have a p – value (.019) which is also significant indicating that the actual yields significantly varies with the experimental yields.

DISCUSSION

Upland rice production accounts for about 20% of the total rice produced in Nigeria. With the development of New Rice for Africa (NERICA) for upland production systems, several farmers have engaged in rice cultivation at the subsistent levels. Unfortunately, these farmers do not have a ready source of information on upland rice production (West Africa Rice Development Association, 2015). Since Rice (Oryza sativa L.) is one of the major cereal crops worldwide and is the staple food for millions of people in Nigeria and it is consumed across all geopolitical zones and socioeconomic classes, there is still knowledge gap in terms of varieties that gives higher yields in the study area as rightly observed by Udemezue and Agwu (2018).

A performance study conducted by Chukwu, et al., (2022) on different rice genotypes in Malaysia a similar agro ecological zone to Nigeria. They found variations among rice lines; approximately 50% of the lines produced yields of 5 t/ha or more. Salleh, et al., (2022) reported significant variations in plant height, number of tillers per plant, panicle length, and grain yield among the genotypes. However, this study concentrated on actual yields and with better fertilizer application and adequate rainfall higher yields are attainable.

CONCLUSION

This study set out to assess the performance of some selected upland rice (Oryza sativa L.) varieties in Manchok District, Kaura Local Government Area, Kaduna State, with the aim of determining which of the selected rice variety that can thrive best in the study area which effectively can bust food production and ensure food security in the study area. Conclusively, rice grows well in this area and higher production can be boosted given maximum attention, availability of good fertilizers for application, and provision of improved seed varieties.

RECOMMENDATION

Based on the findings made from this study. The following recommendations are made which if effectively carried out can boost rice production in the study area and any other area within this ecological zone;

i. Most of the farmers in this study area lack the finances to purchase and apply the recommended amounts of fertilizers needed on their farms which is a major challenge to boosting food production. Therefore, the study recommends government intervention in terms of provision of fertilizers at subsidized rates and donors from Non - Governmental Organizations to assist farmers with farm inputs such as fertilizers to boost food production.

ii. Awareness is needed on the types of upland rice that gives higher yields (Faro 55, 58), this knowledge is practically lacking for many farmers in the study are. Therefore farmers in the study area have to sensitize on species selection for their planting in the study area.

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