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## Economic Activities of Rice Production Practice and the Outcome in Southern Guinea Savanna of Nigeria

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## ABSTRACT

By means of a descriptive statistics and farm budgeting technique, economic activities of rice production practice in Southern Guinea Savanna of Nigeria was ascertained. Primary data were collected from cross-section of 360 paddy rice farmers drawn from 3 States in the Savanna zone of Nigeria using a structural questionnaire. The results of the findings showed that rice farmers used personal savings (75.6%) as capital for engagement in rice production while majority (67%) used family labour in rice production. On average, the respondents owned 2.6 hectares of land. Majority (76.0%) of the rice farmers were semi commercial. The farmers planted different varieties of rice seeds of improved and local and established their seeds by broadcasting method (51.0%). Urea was fertilizer that 81% of the farmers used in their rice farms. In terms of production practice engaged in by the farmers, 74% were on lowland, 21% on upland while 5% on irrigation practice. Rice farmers in Niger, Kogi and FCT showed variability in profit. Paddy rice farmers in Kogi State had the highest return (₦/ha 21,420.55) followed by Niger (₦/ha16,668.12) and FCT (₦/ha15,724.01). The study concluded by recommending among others that the district agricultural development office should create opportunities for paddy rice farmers that earn high returns to share their knowledge with those paddy rice farmers with lower returns and also involve them in fundamental farm management skills training.

**Keywords:** Production practice, Paddy rice, Profitability, Southern Guinea Savanna.

## Introduction

Before the Second World War, the *Oryza Glaberrima*, an African-derived red-grained rice variety, was the most widely planted rice variety in Nigeria.<sup>1</sup> With the outbreak of World War II and the resulting increased demand for food for fighting troops, Guyana varieties (of which BG 79 was the most frequently farmed) were introduced to rice producers (particularly exotic types) (Salako,). Since then, numerous Research Institutes in the country, particularly the National Cereals Research Institute (NCRI) Badeggi, has made significant progress in discovering and release of new rice varieties. Nigeria's total arable land area is thought to be 82 million hectares. Whereas the area suitable for paddy production is thought to be 4.6 million of which only 39% is currently utilized.<sup>2</sup> The nation is also fortunate to have 3.14 million hectares of undeveloped land that is suited for the production of irrigated rice, but only about 50,000 hectares is currently utilized.<sup>3</sup> In Nigeria, rice is primarily a cash crop raised for commercial purposes. As a result, in rice-producing areas, the enterprise employs over 80% of the population in diverse tasks throughout the production/distribution cycle, from cultivation to consumption.<sup>3</sup> For more than 10 years, The Nigerian rice industry has undergone some astounding changes. Both production and consumption increased during this time, but output did not keep pace with consumption, with rice imports filling the gap.<sup>4,5</sup>

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The Nigerian agriculture landscape is changing tremendously with increased government policies focusing at encouraging the private sector to increase rice production with the goal of improving food security. According to statistics, Nigerian rice production increased from 5.5 million tons in 2015 to 5.8 million tons in 2017. The Nigerian Central Bank's Anchor Borrowers Program, which possesses four million hectares of Fadama rice field and 12 million rice growers, is responsible for this commendable increase. Various efforts by many researchers like<sup>6</sup> among others had concentrated on activities of rice production while there has been less effort to systematically study the economic activities of rice production practice and its outcome to identify possible means to boost the production of the product. Economic activities of rice production practice and its outcome assessment and the changes that occur over time is an important policy tool for agricultural sector policy makers. Its relevance is underscored by the relationship between output expansion, and economic growth and general wellbeing of citizens. The Nigerian government has introduced some fiscal and monetary policies to reduce rice importation and to increase the nation's rice production but paddy rice output still remains low. Checking and balancing the challenges and other relevant issues surrounding rice economy is the only way to increase rice yields. In light of the aforementioned, it was necessary to determine the economic activities of rice production practice and the outcome in Southern Guinea Savanna ecological zone of Nigeria.

## Materials and Methods

The study region is Nigeria's Southern Guinea Savanna ecological zone, which is located between longitude 38° and 148° E and latitude 78° and 108° N. The savanna ecosystem is sometimes referred to as Nigeria's Corn Belt. The zone covers a large geographical area that includes the States of Kwara, Niger, Kogi, FCT, Taraba, Plateau, and Benue. Due to its short early growth season followed by a reasonably

long late season, strong solar radiation, and ideal temperature during the growing season, the Southern Guinea Savanna of Nigeria offers considerable potential for rice crop yield. The zone, however, is marked by changeable weather, fragile soils with little moisture holding ability, and drought susceptibility.<sup>7</sup>

#### Sampling Technique and Sample Size

Multi-stage sampling techniques were used to select the respondents. The first stage involved the purposive selection of Niger State, Kogi State and Federal Capital Territory (FCT) Abuja because of the higher prevalence of various rice production practices in these states. The second stage also involved purposive selection of Wushishi and Katcha Local Government Areas in Niger State; Yagba and Kogi Local Government Areas in Kogi State; Kwali and Abaji Area Council in FCT for its preponderance to the 3 systems of rice production practices. Stage three involved the purposive selection of two villages from each sampled Local Government Areas, summing up to 12 villages. The fourth stage involved random selection of respondents. Considering<sup>8</sup>, a sample of 10 to 30 percent is good enough to define the sample of the targeted population. The study used 58.1% of the population as its sample for research. 360 paddy rice farmers in total were sampled for the survey from the sampling frame. Therefore, the sampling was justified based on probability proportional size (p p s). It is the quotient between the size of the population and the size of the sample<sup>8</sup>.

$$N_h = \frac{N \cdot n}{n} \quad (1)$$

Where;

$n_h$  = the sample size to be determined

$n$  = the number of the targeted respondents

$N_h$  = total number of the population size

$N$  = targeted population

The sampling frames of rice producers was collected from the Agricultural Mechanization and farmers Development Authority, State ministry of agriculture, Village heads and farmers association, through a reconnaissance survey.

#### Data collection

Data were collected from primary sources through a well-structured questionnaire which was administered through personal interview. In this research, Pretesting of the questionnaire; measures to improve the validity of the recall data provided by the sampled households. Enumerators were given the chance to get training during pretesting on how to spot and handle reporting mistakes.

#### Data analysis

In order to summarize the data, descriptive statistics were used. Like frequency, percentage, mean score, chart among others, and Farm Budgeting Techniques

#### Farm Budgeting Techniques

*a) Gross margin analysis:* This is the contrast between the gross farm income (GFI) and the Total Variables Costs (TVC) of production. Gross margin analysis assumes that the fixed cost items are shared amongst the enterprises. It shows what each enterprise contributing to overall farm profit<sup>9</sup> is observed that it is a useful planning tool in situation where fixed costs are negligible as the case of small scale subsistence agriculture. This model was used to accomplish objective (iii) of this study. The model is mathematically expressed as:

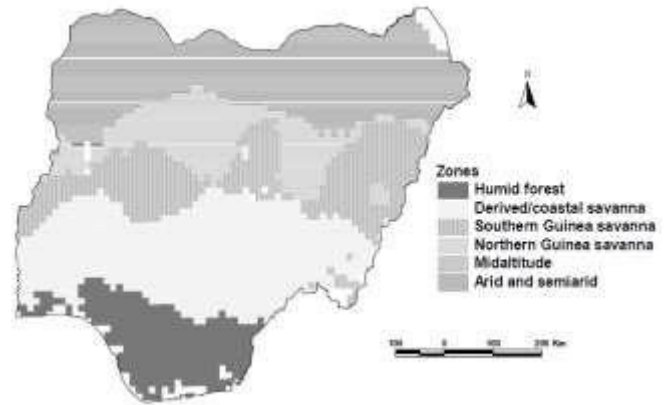
$$GM = GFI - TVC \quad (1)$$

Where:

GM = Gross Margin (₦/ha)

GFI = Gross Farm Income (N/ha)

TVC = Total Variable cost (total sum expenses that varies directly with level of production, e.g cost of seeds, fertilizer, labour, among others (N/ha)



**Figure 1:** Map of Nigeria showing savanna zones

#### (b) Net Farm Income:

This is the difference between the Gross margin and the total fixed costs. It is algebraically presented as;

$$NFI = GM - TFC \quad (2)$$

Where:

NFI = Net farm Income,

GM = Gross Margin (₦/ha)

TFC = Total Fixed Cost

$$NFI = GFI - TVC - TFC$$

$$\sum \sum$$

Where:

$P_j$ =unit price of  $j^{\text{th}}$  output,  $Q_j$ =quantity of  $j^{\text{th}}$  output,  $P_k$ =unit price of  $K^{\text{th}}$  input,  $Q_k$ =quantity of  $K^{\text{th}}$  input,  $\sum$ =summation sign, TFC= total fixed cost.

(C) Profitability Index

(D) Benefit Cost Ratio

(E) Rate of Return on Investment

NFI/TVC

GFI/TVC

NFI/TC

## Results and Discussion

### Production Activities of the Respondents

#### Sources of labour

The types of labor used in agricultural production in Africa can be broadly classified into three categories: family labour, exchange labour and hired labour. Table 1 revealed that on the average about 67.0% of the rice farm households employed the services of family labor, constituting their wives and children. 22.0% of the rice farm household employed both family and non-family labour while only about 11.0% of the farms did not make use of family labor. The result thus, confirmed that the use of family labor was the norm and a major input in agricultural production and a contributor to higher productivity in the absence of intensive application of farm mechanization. The result showed that all the sample areas used family labour almost at the same proportion. In term of using both family and non-family labour, FCT had higher value of 23% in utilization of family and hired labour. The result thus, confirmed that the use of family labor was one of the major inputs in rice cultivation across the study areas.

#### Credit for farm operation

Finance is the sole of paddy rice cultivation business. Farm loans obtained by paddy rice farm households were used to purchase farm inputs. Accordingly, the households were asked to indicate whether they have access to loans, the amount, the source, interest rate, duration and the interest accruing. The results of the survey in Table 2 uncovered that 37% of the farm households were able to obtain credits from different source, while 63% were unable to get access to credit.

**Table 1:** Sample Population and Sample size

| State | LGA        | Villages | Samples Frame | Sample Size           |
|-------|------------|----------|---------------|-----------------------|
| NIGER | BORGU      | SWASHI   | 208           | <del>x</del> 360 = 36 |
|       |            | SAMINAKA | 170           | x 360 = 29            |
|       |            | SWASHI   | 208           | <del>x</del> 360 = 36 |
|       | KATCHA     | KATCHA   | 238           | <del>x</del> 360 = 41 |
|       |            | BADEGGI  | 242           | x 360 = 42            |
|       |            | OMI      | 198           | <del>x</del> 360 = 34 |
| KOGI  | YAGBA WEST | EJIBA    | 220           | x 360 = 37            |
|       | KOGI       | GIRYAN   | 250           | <del>x</del> 360 = 43 |
|       |            | PANDA    | 180           | x 360 = 31            |
| FCT   | KWALI      | DABI     | 85            | — x 360 = 15          |
|       |            | GADABIU  | 109           | x 360 = 19            |
|       |            | YABA     | 100           | <del>x</del> 360 = 17 |
|       | ABAJI      | PANDAGI  | 90            | x 360 = 16            |
| 3     | 6          | 12       | 2090          | 360                   |

**Table 2:** Distribution of labour used by the respondents

| Use of Labour             | Niger (n=148) |         | Kogi (n=145) |         | FCT (n=67) |         | Total (N 360) |         |
|---------------------------|---------------|---------|--------------|---------|------------|---------|---------------|---------|
|                           | Frequency     | Percent | Frequency    | Percent | Frequency  | Percent | Frequency     | Percent |
| Use Family labour only    | 99            | 67      | 97           | 67      | 45         | 67      | 241           | 67      |
| Family/ non family labour | 34            | 22      | 31           | 22      | 15         | 23      | 80            | 22      |
| Do not use Family Labour  | 15            | 11      | 17           | 11      | 7          | 10      | 39            | 11      |
| Total                     | 148           | 100     | 145          | 100     | 67         | 100     | 360           | 100     |

Source: field survey (2020)

During the survey, the interviewer sought for the reasons why the farmers were unable to have access to credit from any of the sources. The results showed that more than half of the respondents expressed difficulty to access credits as a major reason for not being able to obtain credit. Others sighted non-availability of credit locally as a major reason, while only marginal number expressed the reason of high cost of borrowing as a major hindrance. Credit were available to exactly 28% of the paddy rice farmers in Niger State and FCT but in Kogi State 49% of the respondents received credit to boost paddy rice production.

#### *Farm Land Owned, Land Area under Rice Cultivation and Farming Objective*

##### *Land tenure system*

The relevance of land tenure system in agriculture efficiency is well documented. The amount of rights, types, and nature of access that a farmer may have are thought to depend on the land tenure system, which has an impact on how that farmer uses the land to improve household well-being. In essence, land tenure refers to the right on land and the resources in it<sup>10</sup>. Result in Table 4 confirmed that about 43.3% of the of paddy rice farms were situated on traditional inherited land. Similarly, about 15.3% of the farms were situated on rented land and subsequently attracts rent, which has implication on the cost of production. Communal, borrowed and purchase recorded 35.0%, 3.3% 3.1% respectively. Specifically, the results showed similarity in Niger and Kogi States but differed substantially in FCT. For example, in FCT, about 59.0% of the paddy rice farms were situated in owned land, while about 34% were located on rented land. This result concurred the finding of Onumadu *et al.*,<sup>11</sup> in their study “Resource use efficiency in

arable crop production in Oyi Local Government Area of Anambra State, Nigeria”.

##### *Land Area under Rice Cultivation*

In the short-run, land was the constant input in all the samples. In terms of scale of farm operations, the Paddy rice farms that were reported having land scale between 0.1ha to 0.4ha were classified as small-scale farms. Similarly, the paddy rice farms that had farm scale between 0.5ha to 9.90ha were classified as Medium while those paddy rice farmers who had farm scale between 10ha and above were classified as large-scale farming operations. Result in Table 5 revealed that in all the sampled States in terms of scale of farm operations, about 57.0% of the paddy rice farms were reported cultivating less than 0.5ha and were classified as small-scale farms. Similarly, 36.0% (0.5 to 9.90 ha) and 7.0% (10 ha and above) of the paddy rice farms were classified as medium and large-scale farming operations respectively. The average paddy rice farm size (land per farm) was 2.6 ha while the median farm size was 2.5 ha thus, confirming the finding that majority of the Nigerian paddy rice farms were operating with small rice farms.<sup>12</sup> This could suggest that small farm sizes may be as a result of the type of land tenure system practice in rural communities; where family land is divided among all the family members. Niger State paddy rice producers had less small farm when compared to Kogi State and FCT with values of 73.0 and 57% respectively.

##### *Objective of rice production*

The results of the survey in table 6 indicated the key objective of paddy rice production in the study area.

**Table 3:** Distribution of respondents' credit for farm operation

| Items                              | Niger   | Kogi    | FCT    | Total   |
|------------------------------------|---------|---------|--------|---------|
|                                    | (n=148) | (n=145) | (n=67) | (N=360) |
| <b>Access to Credit (%)</b>        |         |         |        |         |
| Access to credit                   | 9.0     | 12.0    | 16.0   | 37.0    |
| No-access to credit                | 30.0    | 20.0    | 10.0   | 96.0    |
| <b>Source of credit (%)</b>        |         |         |        |         |
| Friends/Relations                  | 6.0     | 7.0     | 6.0    | 19.0    |
| Community Bank                     | 0.0     | 0.0     | 0.0    | 0.0     |
| Nigeria Agricultural Bank          | 3.0     | 2.0     | 5.0    | 10.0    |
| Deposit Money Banks                | 0.0     | 0.0     | 0.0    | 0.0     |
| State Governments                  | 0.0     | 0.0     | 0.0    | 0.0     |
| Local Governments                  | 0.0     | 3.0     | 5.0    | 8.0     |
| Total                              | 9.0     | 12.0    | 16.0   | 37.0    |
| <b>Reason no-access to credit</b>  |         |         |        |         |
| Difficulty to access credits       | 25.0    | 20.0    | 12.0   | 56.0    |
| Non-availability of credit locally | 16.0    | 13.0    | 10.0   | 39.0    |
| Other reasons                      | 2.0     | 1.0     | 1.0    | 4.0     |
| Total                              | 43.0    | 34.0    | 23.0   | 100     |

Source: field survey (2020) data.

Majority of the rice farmers were described as semi commercial as an average of 75.0% of the respondents reported producing rice to provide enough for consumption by members of households and sell the surplus produced in the local market. However, about 19.0% of paddy rice farmers were involved in rice production mainly for commercial purpose, while 5.0% were engaged in rice production for subsistence purpose. There were no remarkable differences in percentage of farmers that reported commercial semi commercial and subsistence objective in study area. On State wise basis, FCT paddy rice producers were into commercial rice production (82%) more than Niger ((75%) and Kogi (75%) States.

*Varieties of rice grown and their source*

The use of high yielding and certified rice seed varieties are necessary conditions that could have positive impact on the paddy rice farm households. Therefore, in this study the rice seed variety was categorized into two groups namely improved and traditional varieties. Eleven major rice seed varieties planted by the paddy rice farm households were identified during the research work. Table 7 shows the rice seed varieties planted comprised 6 improved varieties and 5 traditional varieties. Some of the improved seed varieties were also found to have different categories. For example, FARRO and NERICA varieties were the improved varieties that have subcategories. All of the seed varieties have growing periods of between 3 to 4 months. Most of the seed varieties were for lowland production and many were of the long grain type. The research also found out that about 19% of the paddy rice producers in the study area cultivated a mixture of two to four varieties of paddy rice seeds.

**Table 4:** Distribution of respondents by acquisition of land used

| Land acquisition Variable | Niger (n=148) |         | Kogi (n=145) |         | FCT (n=67) |         | Total (N= 360) |         |
|---------------------------|---------------|---------|--------------|---------|------------|---------|----------------|---------|
|                           | Frequency     | Percent | Frequency    | Percent | Frequency  | Percent | Frequency      | Percent |
| Inherited                 | 115           | 78      | 113          | 78      | 39         | 59      | 267            | 74      |
| Purchase                  | 5             | 3       | 4            | 3       | 2          | 3       | 11             | 3       |
| Rented                    | 21            | 15      | 21           | 15      | 23         | 34      | 65             | 19      |
| community land            | 2             | 1       | 2            | 1       | 1          | 1       | 5              | 1       |
| Borrowed                  | 5             | 3       | 5            | 3       | 2          | 3       | 12             | 3       |
| Total                     | 148           | 100     | 145          | 100     | 67         | 100     | 360            | 100     |

Source: field survey (2020) data.

**Table 5:** Distribution of respondents by Land Area for Rice Cultivation

| Variable              | Niger (n=148) |         | Kogi (n=145) |         | FCT (n=67) |         | Total (N=360) |         |
|-----------------------|---------------|---------|--------------|---------|------------|---------|---------------|---------|
|                       | Frequency     | Percent | Frequency    | Percent | Frequency  | Percent | Frequency     | Percent |
| Land area used        |               |         |              |         |            |         |               |         |
| Small (0.1-0.4 ha)    | 81            | 53      | 79           | 50      | 42         | 59      | 204           | 57      |
| Medium (0.5-9.90)     | 50            | 37      | 60           | 37      | 20         | 36      | 130           | 36      |
| Large (10.00 & above) | 16            | 10      | 7            | 13      | 5          | 5       | 24            | 7       |
| Total                 | 148           | 100     | 145          | 100     | 67         | 100     | 360           | 100     |
| Mean                  | 2.6           |         |              |         |            |         |               |         |
| Median                | 2.5           |         |              |         |            |         |               |         |

**Table 6:** Distribution of respondents by objective of rice production

| Objective of rice production | Niger (n=148) |         | Kogi (n=145) |         | FCT (n=67) |         | Total (N 360) |         |
|------------------------------|---------------|---------|--------------|---------|------------|---------|---------------|---------|
|                              | Frequency     | Percent | Frequency    | Percent | Frequency  | Percent | Frequency     | Percent |
| Commercial                   | 29            | 20      | 29           | 20      | 10         | 15      | 68            | 19      |
| Semi-commercial              | 111           | 75      | 108          | 75      | 55         | 82      | 274           | 76      |
| Subsistence                  | 8             | 5       | 8            | 5       | 2          | 3       | 18            | 5       |
| Total                        | 148           | 100     | 145          | 100     | 67         | 100     | 360           | 100     |

Source: field survey (2020)

In some cases, the paddy rice producers combined during planting season both the improved and traditional varieties in their farms.

Thus, about 85.0% of the paddy rice producers in Kogi State, 80% in FCT and 72% in Niger State planted the widely accepted improved FARO rice seed varieties (mainly FARO 15, 44, 47, 55, 57, Dan China, 2PC and Willey) alone or together with other improved and traditional varieties. In the study area only 17.0% in Kogi and FCT used the NERICA varieties or combined with other improved and traditional varieties, while Niger State had 14%. The common traditional variety used by the paddy rice producers in Niger State was the Badegi rice seed as approximately 18%. Jamila was the most commonest among the traditional rice planted in FCT with 18% while the commonest traditional rice varieties among Kogi paddy rice producers was Alura with about 7% of the farms using it during the growing season.

#### *Years of involvement with rice production practice*

Result in Table 9 indicates that the average years of farming practice among the paddy rice farmer was 9.6 and 51.1% of the respondents had the experience of 1-3 years into rice production practice. This is so because of the increased realization of the crops potentials in putting smiles on the faces of its producers in the study area. This connotes that there is high prospect of increased production of the crop in the future. The result also showed that all the production practice in the sampled areas is getting more ground in the study area.

#### *Cropping patterns and associated activities of rice cultivation engaged by respondents*

Paddy rice production in the States studied consisted of a timed series of activities. Land preparation, crop establishment by planting and transplanting, weed management, insect management, fertilizer application, bird control, and harvest and post-harvest management are among the primary tasks in paddy rice production in Nigeria, according to <sup>13</sup>the timing of these processes, however, varies depending on the production practices and states. Figure 2 shows the cropping patterns of production methods and farming activities in the analyzed states by type of production practice. Land preparation for upland production practice begins in early January and lasts until May, taking advantage of the early rains for the timely establishment of the rice crop. Land preparation in lowland rice fields, on the other hand, begins in April and ends in June. Land preparation begins in October and ends in November in the irrigated practice. In most production procedures, seeding or crop establishment by one of the following methods, namely direct seeding, broadcasting, or transplanting of seedlings, begins at different periods. While it occurs in upland rice fields during the commencement of the rains between March and May, it occurs in lowland rice fields between April and June, and in irrigated practices between November and December. Weeding occurs between May and July, and pest management begins in May and ends in June in upland practices. Lowland practices and irrigated practices, on the other hand, the activities are active between June and September and December and February. The harvest and post-harvest management in the upland rice practice starts in August and lasts till December but in the lowland practice it takes place between November and December. In the irrigated method it begins in February and ends in March.

In the analysis of the production practice of rice farmers in the study areas, the following procedures were undertaken. Firstly, various production patterns were evaluated in terms of lowland, upland and irrigated practice. Secondly factors influencing these decisions were looked into as well as reasons driving these intentions were examined. Also, the income generations as per production methods used were examined to know the profitability of each production practices. Table 9 indicated the various farming practice that were taken by the rice farmers in the study areas. Results revealed that farming practices include Low land 245 (68.6%), Upland 97 (26.4%) and irrigated 18 (5.0%) (Table 4.2.1). The data analysis further revealed that irrigation facilities were near absence in the study area as such most of the farmers have relied on rain fed cultivation. This result suggests that technology that will promote lowland farming practice will be welcome as more rice farmers will benefit immensely. The result also revealed that Niger State had highest spread of lowland practices (82%) followed by Kogi (68%) then FCT (67%). Kogi State had highest

percentage of spread of upland practices (27%) followed by FCT (22%) while Niger State had 20% spread.

#### *Adoption of Good Agronomic Practices (GAP)*

Chukwujekwu *et al.*,<sup>14</sup> identified Good Agronomic Practices (GAP) for paddy rice production to be land selection, seed selection from certified agro-dealer timely fertilizer application, use of smart weather reader, sport fertilizer application, weeding/pest control, appropriate agro-chemical application, packing, bagging and proper storage among others. The use of proper land preparation, weeding, planting and harvesting methods are worthy indicators of good agricultural practices. Results indicated that 52% of the paddy rice producers prepare their land using chemical supplemented with Manual preparation, 33% used manual preparation, 7% use chemical preparation while 8% applied mechanized method of land preparation. Weeding was not mechanized as an average of 91.5% of farmers did it manually while 8.5% used chemical method. Transplanting as the method of planting recorded the lowest (49%) of farmers used it while broadcasting and direct seeding recorded the highest (61%). Harvesting was investigated on the basis of either doing it manually or using labour saving technologies. Variations in use of harvesting methods existed across the study areas. Majority (98%) applied manual method of harvesting while only 2% of the rice farmers mechanized their harvesting. The field work also found that only 15% of the paddy rice farm households were able to harvest rice output two times in a year and none for three harvests but 84% harvested only once for all (Table 4.1.18). Based on the sampled areas report, Kogi State had 31% of respondents that harvested their rice farm twice while Niger and FCT 7% each.

#### *Fertilizer Input Management and Sources of Procurement*

Not all farmers in the study areas applied chemical fertilizer for rice production. For those rice producers that were able to get access to fertilizer they deploy it for use on their rice, 19% of the paddy rice producers used NPK while 81% used Urea. In addition, majority of the farmers (87.0%) in the study areas applied chemical fertilizer twice during the cropping season, while only 13.0% applied it once. The major source of chemical fertilizer procurement was through government ADPs in the study areas. Precisely, 82.0% of the farmers procured chemical fertilizer from the government, while 17.0% of the paddy rice farm households purchased from the marketing agency (Table 10). The result also revealed that the paddy rice farmers in FCT were able to obtain fertilizer from government selling points than those paddy rice producers in Niger and Kogi States.

#### *Herbicide Input Management and Sources of Procurement*

Herbicide is also a major chemical input in paddy rice production, which is used for weed control by rice farm households. The use of agrochemical has been observed to be on the increase in the study areas. This is because of the scarcity and increasing wage rate of farm labour requirement for weeding. It is expected that application of agrochemicals increases output level. The results from the survey showed that approximately 86.0% of the rice farm households in the study area made use of herbicides to control weed in the rice fields. Contrary to the application of chemical fertilizer, about 64.0% of the rice farm households applied herbicide twice during the cropping season, while 32.0% applied once. The findings also showed that the rice farm households in Niger State were more cautious in the use of chemical herbicides as approximately 28.0% of the rice farmers applied herbicides once, compared to 23.0% for Kogi State and 15% for FCT.

#### *Profitability of rice production in the three samples*

Due to the existing differences in profit margin, farm income and cost of production the analysis of the profitability of paddy rice production across the three States became very important measure to be considered in this study. An evaluation of the survey results of rice production profit in Niger State revealed that the gross margin realized by the farmers under the lowland rice farmers was ₦67560.1; upland rice producers was ₦56036.7 whereas an irrigated rice producer was ₦78390.3 per hectare of land cultivated. Computed gross margin for an appraisal of the rice production profit in Kogi State showed that the sampled lowland rice farmers earned ₦93684.3;

**Table 7:** Rice seed varieties used by paddy rice farm household in the study area

| NIGER              |                     |                        | KOGI                    |                     |                        | FCT                     |                     |                        |                         |
|--------------------|---------------------|------------------------|-------------------------|---------------------|------------------------|-------------------------|---------------------|------------------------|-------------------------|
| Variabe            | Production practice | % of farm used variety | Growing period in month | Production practice | % of farm used variety | Growing period in month | Production practice | % of farm used variety | Growing period in month |
| <b>Improved</b>    |                     |                        |                         |                     |                        |                         |                     |                        |                         |
| FARO Variety       | Lowland             | 72                     | 3,0                     | Lowland             | 85                     | 3,0                     | Lowland             | 80                     | 3,0                     |
| NERICA Variety     | Lowland             | 14                     | 3,0                     | Lowland             | 17                     | 3,0                     | Lowland             | 17                     | 3,0                     |
| Jalloy rice        | Lowland             | 0,3                    | 4,0                     | Lowland             | 0,3                    | 4,0                     | Lowland             | 0,3                    | 4,0                     |
| BW                 | Lowland             | 0,7                    | 4,0                     | Lowland             | 0,7                    | 4,0                     | Lowland             | 0,3                    | 4,0                     |
| Oga                | Lowland             | 0,3                    | 4,0                     | Lowland             | 0,3                    | 4,0                     | Lowland             | 0,1                    | 4,0                     |
| AIC                | Upland              | 1,3                    | 4,0                     | Upland              | 1,3                    | 4,0                     | Opland              | 1,0                    | 4,0                     |
| <b>Traditional</b> |                     |                        |                         |                     |                        |                         |                     |                        |                         |
| Badegi             | Lowland             | 18                     | 4,0                     | Lowland             | 0,7                    | 4,0                     | Lowland             | 7,0                    | 4,0                     |
| Alura              | Lowland             | 0,7                    | 4,0                     | Lowland             | 7,0                    | 4,0                     | Lowland             | 0,7                    | 4,0                     |
| Jamila             | Upland              | 3,0                    | 4,0                     | Upland              | 3,0                    | 4,0                     |                     | 18                     | 4,0                     |
| Paper              | Lowland             | 0,3                    | 4,0                     | Lowland             | 0,7                    | 4,0                     | Lowland             | 0,5                    | 4,0                     |
| Masaga             | Lowland             | 1,7                    | 4,0                     | Lowland             | 1,7                    | 4,0                     | Lowland             | 1,7                    | 4,0                     |

Source: field survey (2020)

**Table 8:** Distribution of respondents by years of involvement with rice production practices

| Years of farming practice             | Niger(n=148) |            |               | Kogi (n=145) |            |              | FCT (n=67) |           |              |
|---------------------------------------|--------------|------------|---------------|--------------|------------|--------------|------------|-----------|--------------|
|                                       | Lowland (%)  | Upland (%) | Irrigated (%) | Lowland (%)  | Upland (%) | Irrigated(%) | Lowland(%) | Upland(%) | Irrigated(%) |
| 1-3                                   | 32           | 17         | 3             | 34           | 19         | 4            | 42         | 14        | 3            |
| 4-6                                   | 20           | 6          | 1             | 19           | 6          | 1            | 18         | 6         | 1            |
| 7-9                                   | 13           | 3          | 0             | 11           | 1          | 0            | 6          | 3         | 0            |
| 10 and above Average farming practice | 5            | 1          | 0             | 5            | 1          | 0            | 6          | 1         | 0            |
|                                       | 9.6          |            |               |              |            |              |            |           |              |

Source: field survey (2020) data

| Production Systems | Activity               | Month |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|--------------------|------------------------|-------|------|------|------|-----|------|------|------|-------|------|------|------|-----|------|------|
|                    |                        | Jan   | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan | Feb. | Mar. |
| Upland             | Land Preparation       |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Planting of rice seeds |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Weeding                |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Pest Mgt               |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Fertilizer             |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Bird Control           |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Harvest                |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
| Lowland            | Land Preparation       |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Crop Establishment     |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Weeding                |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Pest Mgt               |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Fertilizer             |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Bird Control           |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Harvest                |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
| Irrigated          | Land Preparation       |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Crop Establishment     |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Weeding                |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Fertilizer             |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Bird Control           |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |
|                    | Harvest                |       |      |      |      |     |      |      |      |       |      |      |      |     |      |      |

Figure 2: Cropping patterns and associated activities of paddy rice production.

Table 9: Distribution of the production methods engaged by respondents

| Production practice | Niger (n=148) |         | Kogi (n=145) |         | FCT (n=67) |         | Total (360) |         |
|---------------------|---------------|---------|--------------|---------|------------|---------|-------------|---------|
|                     | Frequency     | Percent | Frequency    | Percent | Frequency  | Percent | Frequency   | Percent |
| Upland              | 20            | 13      | 39           | 27      | 15         | 22      | 75          | 21      |
| Lowland             | 121           | 82      | 99           | 68      | 46         | 67      | 269         | 74      |
| Irrigated           | 7             | 5       | 7            | 5       | 6          | 3       | 17          | 5       |
| Total               | 148           | 100     | 145          | 100     | 67         | 100     | 360         | 100     |

Source: Field Survey, 2020.

Table 10: Adoption of Good Agronomic Practices (GAP)

| Variable                        | Niger (n=148) |         | Kogi (n=145) |         | FCT (n=67) |         | Total (N=300) |         |
|---------------------------------|---------------|---------|--------------|---------|------------|---------|---------------|---------|
|                                 | Frequency     | Percent | Frequency    | Percent | Frequency  | Percent | Frequency     | Percent |
| <b>Land preparation methods</b> |               |         |              |         |            |         |               |         |
| Manual land preparation         | 10            | 7       | 10           | 7       | 5          | 7       | 25            | 7       |
| Chemical land preparation       | 49            | 33      | 48           | 33      | 22         | 33      | 119           | 33      |
| Chemical/Manual preparation     | 77            | 52      | 75           | 52      | 35         | 52      | 187           | 52      |
| Mechanized preparation          | 12            | 8       | 12           | 8       | 5          | 7       | 29            | 8       |
| Total                           | 148           | 100     | 145          | 100     | 67         | 100     | 360           | 100     |
| <b>Weeding methods</b>          |               |         |              |         |            |         |               |         |
| Manual weeding                  | 40            | 27      | 39           | 27      | 18         | 27      | 97            | 27      |
| Chemical weeding                | 108           | 73      | 106          | 73      | 49         | 73      | 263           | 73      |
| Manual/chemical weeding         | 0             | 0       | 0            | 0       | 0          | 0       | 0             | 0       |
| Mechanized weeding              | 0             | 0       | 0            | 0       | 0          | 0       | 0             | 0       |
| Total                           | 148           | 100     | 145          | 100     | 67         | 100     | 360           | 100     |
| <b>Planting methods</b>         |               |         |              |         |            |         |               |         |
| Transplanting                   | 72            | 48      | 71           | 49      | 33         | 49      | 176           | 49      |
| Broadcasting/direct seeding     | 76            | 52      | 74           | 51      | 34         | 51      | 184           | 51      |

|                           |     |     |     |     |    |     |     |     |
|---------------------------|-----|-----|-----|-----|----|-----|-----|-----|
| Total                     | 148 | 100 | 145 | 100 | 67 | 100 | 360 | 100 |
| <b>Harvesting methods</b> |     |     |     |     |    |     |     |     |
| Manual harvesting         | 145 | 98  | 142 | 98  | 66 | 99  | 353 | 98  |
| Mechanized harvesting     | 3   | 2   | 3   | 2   | 1  | 1   | 7   | 3   |
| Total                     | 148 | 100 | 145 | 100 | 67 | 100 | 360 | 100 |
| <b>Number of harvest</b>  |     |     |     |     |    |     |     |     |
| One harvest per season    | 138 | 93  | 100 | 69  | 62 | 93  | 300 | 83  |
| Two harvests per season   | 10  | 7   | 45  | 31  | 5  | 7   | 60  | 17  |
| Three harvests per season | 0   | 0   | 0   | 0   | 0  | 0   | 0   | 0   |
| Total                     | 148 | 100 | 145 | 100 | 67 | 100 | 360 | 100 |

Source: field survey (2020)

**Table 11:** Distribution of respondents fertilizer Input Management and Sources of Procurement

| Use of Fertilizer                        | Niger (n=148) |         | Kogi (n=145) |         | FCT (n=67) |         | Total (N360) |         |
|--|---------------|---------|--------------|---------|------------|---------|--------------|---------|
|  | Frequency     | Percent | Frequency    | Percent | Frequency  | Percent | Frequency    | Percent |
| Yes                                      | 108           | 72      | 106          | 72      | 49         | 73      | 263          | 73      |
| No                                       | 40            | 28      | 39           | 28      | 18         | 27      | 97           | 27      |
| Total                                    | 148           | 100     | 145          | 100     | 67         | 100     | 360          | 100     |
| <b>Type of fertilizer used</b>           |               |         |              |         |            |         |              |         |
| NPK                                      | 45            | 31      | 44           | 31      | 21         | 31      | 110          | 31      |
| Urea                                     | 84            | 57      | 83           | 57      | 38         | 57      | 205          | 57      |
| Organic                                  | 19            | 12      | 18           | 12      | 8          | 12      | 45           | 12      |
| Total                                    | 148           | 100     | 145          | 100     | 67         | 100     | 360          | 100     |
| <b>Number of fertilizer</b>              |               |         |              |         |            |         |              |         |
| <b>Applica</b>                           |               |         |              |         |            |         |              |         |
| Once tion                                | 62            | 41      | 59           | 40      | 27         | 40      | 148          | 41      |
| Twice                                    | 86            | 59      | 86           | 60      | 40         | 60      | 212          | 59      |
| Total                                    | 148           | 100     | 145          | 100     | 67         | 100     | 360          | 100     |
| <b>Sources of fertilizer procurement</b> |               |         |              |         |            |         |              |         |
| Government                               | 79            | 53      | 78           | 53      | 36         | 54      | 193          | 54      |
| Market                                   | 56            | 38      | 55           | 38      | 26         | 40      | 137          | 38      |
| Others                                   | 13            | 9       | 12           | 9       | 5          | 6       | 30           | 8       |
| Total                                    | 148           | 100     | 145          | 100     | 67         | 100     | 360          | 100     |
| <b>Fertilizer Accessibility</b>          |               |         |              |         |            |         |              |         |
| <b>Time</b>                              |               |         |              |         |            |         |              |         |
| Appropriate time                         | 65            | 44      | 64           | 45      | 29         | 43      | 158          | 44      |
| Late time                                | 83            | 56      | 81           | 55      | 38         | 57      | 202          | 56      |
| Total                                    | 148           | 100     | 145          | 100     | 67         | 100     | 360          | 100     |

Source: field survey (2020)

upland rice farmers recorded a gross margin of ₦78254.7 whereas irrigated rice producers was ₦97949.5 per hectare of land cultivated. The survey results from FCT in terms of gross margin also showed that farmers under the lowland rice farmers earned ₦89664.73; upland rice producers earned ₦90654.4 whereas irrigated rice producers earned ₦101826.4 per hectare of land cultivated. This shows that the irrigated rice production practice earn more profit than the other practices in the study area. There is need for further study to ascertain the causes of the differences.

#### *Other profit indicators*

Table 13 showed that the average rate of return realized per hectare was 1.3 which implies that for every Naira invested, ₦1.3k was realized per hectare of rice production in the study area. Meaning that rice production was profitable and worthy of investing in the study area. This study is in line with Mark.<sup>15</sup> The average profitability index was 2.1 indicating that the present value of future cash flows from the investment is more than the initial investment by 2.1 thereby indicating that it will earn profits. The result also showed the average benefit cost ratio was 1.1, indicating that the farm is expected to deliver a positive net present value to the investor. The average capital turn-over was 1.7, indicating the potential profit the farm can bring with given fund for a day-to-day operation.



**Table 12:** Distribution of respondents herbicide input management and sources of procurement

| Variables                              | Niger (n=148) |         | Kogi (n=145) |         | FCT (n=67) |         | Total (N=360) |         |
|--|---------------|---------|--------------|---------|------------|---------|---------------|---------|
|  | Frequency     | Percent | Frequency    | Percent | Frequency  | Percent | Frequency     | Percent |
| <b>Use of herbicide</b>                |               |         |              |         |            |         |               |         |
| Yes                                    | 123           | 81      | 130          | 89      | 55         | 82      | 308           | 86      |
| No                                     | 25            | 19      | 15           | 11      | 12         | 18      | 62            | 14      |
| Total                                  | 148           | 100     | 145          | 100     | 67         | 100     | 360           | 100     |
| <b>Number of herbicide Application</b> |               |         |              |         |            |         |               |         |
| Once                                   | 35            | 28      | 15           | 12      | 45         | 15      | 95            | 32      |
| Twice                                  | 80            | 66      | 98           | 82      | 9          | 80      | 187           | 64      |
| Trice                                  | 7             | 5       | 6            | 11      | 0          | 5       | 13            | 4       |
| Total                                  | 122           | 100     | 119          | 100     | 57         | 100     | 298           | 100     |
| <b>Sources of procure herbicide</b>    |               |         |              |         |            |         |               |         |
| Government                             | 37            | 31      | 36           | 19      | 15         | 25      | 88            | 30      |
| Market                                 | 83            | 69      | 81           | 81      | 46         | 75      | 210           | 70      |
| Total                                  | 120           | 100     | 117          | 100     | 61         | 100     | 298           | 100     |

Source: field survey (2020)

**Table13:** Profitability of rice production in the Study Area

| Components for Rice Production | Niger (n=148) |           |           | Kogi (n=145)  |          |           | FCT (n=67)    |          |           |
|--------------------------------|---------------|-----------|-----------|---------------|----------|-----------|---------------|----------|-----------|
|                                | Profitability |           |           | Profitability |          |           | Profitability |          |           |
|                                | Lowland       | Upland    | Irrigated | Lowland       | Upland   | Irrigated | Lowland       | Upland   | Irrigated |
| land preparation               | 22,999.18     | 20,560.40 | 23,956.20 | 28,475        | 23,634.1 | 10,824    | 29,717        | 27,750   | 24994.06  |
| Planting                       | 981.60        | 520.80    | 851.20    | 2,500         | 1,722    | 1,400     | 2,880         | 4,537.8  | 3021      |
| Weeding                        | 12,830.80     | 12,777.00 | 13,750.70 | 11,107.5      | 14,915   | 12,734    | 15,735.5      | 16,417   | 15995     |
| Fertilizer application         | 248.60        | 353.00    | 292.50    | 559           | 354      | 405       | 1,850.67      | 1,373    | 1396.06   |
| Processing                     | 1,976.20      | 1,788.60  | 2,652.70  | 2,112         | 1,822    | 2,001     | 1,110         | 1,617    | 1720.22   |
| Transportation                 | 1,093.00      | 461.78    | 672.20    | 2,900         | 1,799    | 1,670     | 1,001.56      | 2186     | 1510.66   |
| Fertilizer                     | 5,873.10      | 4,450.90  | 3,841.80  | 6,900.9       | 4,965    | 9,584.5   | 14,273.27     | 12127    | 14309.97  |
| Seed                           | 6,719.82      | 7,289.39  | 7,166.96  | 8,080         | 4,200    | 4,093     | 7,101         | 10,489   | 9,126.04  |
| Herbicide pesticide            | 12,014.00     | 1439.80   | 11,569.82 | 14,267.5      | 18,255   | 11,652.5  | 1,418         | 4178     | 5677.05   |
| Total Variable Cost            | 922.60        | 669.60    | 775.20    | 6,547         | 1,986    | 10,952.5  | 9,597.37      | 5463     | 4926.53   |
| Cutlass                        | 65,658.9      | 50642.27  | 65348.78  | 83,448.9      | 73,652.5 | 65316.5   | 83684.37      | 86137.8  | 73549.56  |
| Hoe                            | 422.30        | 183.00    | 612.55    | 570.02        | 460.14   | 480       | 335.04        | 338.30   | 388.07    |
| Basket                         | 741.80        | 399.70    | 773.35    | 961.11        | 500      | 120       | 2,189.56      | 1531.90  | 1782.29   |
| Sickle                         | 75.40         | 62.85     | 57.50     | 520           | 198.19   | 310.15    | 294           | 477      | 357.01    |
| Bucket                         | 505.90        | 50.45     | 84.52     | 460.21        | 360.09   | 277,31    | 381.72        | 329      | 313       |
| Tarpaulin                      | 269.82        | 43.05     | 38,75     | 205.42        | 430      | 410.44    | 413.85        | 510      | 398       |
| Knapsack sprayer               | 200.46        | 190.76    | 400.70    | 630           | 377.23   | 454       | 981.72        | 124.40   | 571.63    |
| Tractor                        | 461.00        | 400.00    | 446.00    | 4200.13       | 3790     | 4090      | 413.45        | 400      | 4181..32  |
| T F C Depreciated()            | 10,018.50     | 10,780.00 | 10,908.00 | 13,201        | 12,000   | 12,820.07 | 13,962        | 14147    | 12798     |
| Total costs                    | 12,695.18     | 12,109.81 | 13,321.3  | 20747.89      | 15704.65 | 18961.97  | 18285.78      | 17857.6  | 20789     |
| farm income (₦)                | 78,364.08     | 62,752.08 | 78,670.08 | 104196.79     | 89357.15 | 84274.34  | 101970.05     | 103995.4 | 94338.56  |
| Gross margin (₦/ha)            | 133219.0      | 106679.0  | 143739.1  | 177133.2      | 151907.2 | 163266    | 173349.1      | 176792.2 | 175376    |
| Net farm income (₦/ha)         | 67560.1       | 56036.7   | 78390.3   | 93684.3       | 78254.7  | 97949.5   | 89664.73      | 90654.4  | 101826.4  |
|                                | 54854.9       | 43926.9   | 65069.0   | 72936.41      | 62550.1  | 78991.7   | 71379.05      | 72796.8  | 81037.4   |

**Table14:** Other Profitability indicators of rice production in the Study Area

| Components for Rice Production | Niger (n=148) |        |           | Kogi (n=145)  |        |           | FCT (n=67)    |        |           |
|--------------------------------|---------------|--------|-----------|---------------|--------|-----------|---------------|--------|-----------|
|                                | Profitability |        |           | Profitability |        |           | Profitability |        |           |
| Cost Components                | Lowland       | Upland | Irrigated | Lowland       | Upland | Irrigated | Lowland       | Upland | Irrigated |
| Benefit cost ratio             | 2.0           | 2.1    | 2.2       | 2.1           | 2.0    | 2.4       | 2.1           | 2.1    | 2.3       |
| Profitability Index            | 1.0           | 1.0    | 1.0       | 1.1           | 1.1    | 1.2       | 1.1           | 1.1    | 1.1       |
| Rate of Return                 | 1.3           | 1.4    | 1.2       | 1.4           | 1.4    | 1.1       | 1.4           | 1.4    | 1.2       |
| Capital Turn Over              | 1.8           | 1.7    | 1.8       | 1.6           | 1.7    | 1.9       | 1.7           | 1.7    | 1.1       |
| Mean BCR                       | 2.1           |        |           |               |        |           |               |        |           |
| Mean PI                        | 1.1           |        |           |               |        |           |               |        |           |
| Mean RR                        | 1.3           |        |           |               |        |           |               |        |           |
| Mean CTO                       | 1.7           |        |           |               |        |           |               |        |           |

### Conclusion and Recommendation

In this research, it was established that rice cultivation was the main occupation of majority of sampled households as well as the major important activity amongst all daily activities; hence, policy that will improve subsistence farming particularly rice farming in which majority derived their livelihood should be emphasized by the government. Furthermore, ownership of important farm assets for rice cultivation was low in all the samples, while majorities of the farmers were unable to obtain credits during the cropping season. The studies showed that majority of the heads of rice farm households were male. A large number of the farmers owned storage facilities but were mainly traditional storage facilities. Irrigation facilities were almost absent in the sampled areas as such most of the farmers relied on rain fed cultivation. In this circumstance, most of the paddy farmers in the samples harvested rice during the season only once. The results further showed that the paddy rice farm households grew both improved rice seeds but more of the traditional rice seeds. The study identified various farming patterns that were taken by the rice farmers in the study areas. Results revealed that farming patterns include Low land, Upland and irrigated. Rice farmers in Niger, Kogi and FCT showed variability in profit. Paddy rice farmers in Kogi State had the highest return followed by Niger and FCT.

In light of this assessment, the study suggested that farmers' involvement in fundamental farm management skills training is necessary to help boost rice production in the study area. Evidence also showed that membership of cooperative societies by paddy rice farm households was low. The paddy rice farmers in the sample areas were found to be small holders and also relied substantially on family labor. Hence, policy that will improve subsistence farming particularly rice farming in which majority derived their livelihood should be emphasized by the government. The study examined various funding sources that are available for rice farmers in the study areas, results revealed that personal savings constituted the highest. Hence, policy to encourage savings need to be encourage among rice farmers as their sweat could influence farming operation outcomes. Rice farming in Kogi State was more profitable in the study area. There is the need for the district agricultural development office to create opportunities for paddy rice farmers that are proficient to share their experience with those paddy rice farmers with lower proficiency. The study found out that those categories of farmers who practice irrigated farming made more gains than other rice production systems, but were on a small scale. Policy that will encourage farmers to participate more in rice irrigation farming should be emphasized.

### Conflict of Interest

The authors declare no conflict of interest.

### Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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