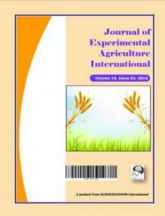

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Activities of Farmers in Rice Production in Awka North Local Government Area, Anambra State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author JCI designed the study, wrote the protocol and wrote the first draft of the manuscript. Author CJA managed the literature searches. Author ICU collected data and performed the statistical analysis under the supervision of author JCI. All authors read and approved the final manuscript.

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ABSTRACT

Nigeria is a heavy importer of rice and the rate of importation is increasing year by year at an alarming rate. This necessitates the need to ascertain activities of farmers in rice production and specifically in Akwa North Local Government Area, Anambra State, Nigeria. A multi-sage sampling technique was employed in selecting 90 rice farmers for the study. Interview schedule was used to collect data. Data collected were analyzed using percentage, mean score and factor analysis. The findings show that rice farmers used personal savings (75.6%) as capital for engagement in rice production while about 67% had no access to tractor hence 73.3% used hired labour in rice production. On average, the respondents owned 2.7 hectares of land but cultivated 1.7 hectares of this land with rice. They planted different varieties of rice seeds obtained from personal reserve

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(66.7%) and had no alternative water supply (83.3%). They practiced sole cropping (90%) and planted their seeds by broadcasting method (53.3%). NPK 20:10:10 was fertilizer that 60% of the farmers used in their rice farms and 61.1% processed rice immediately after harvest. Average output and yield from rice were 3.2 tonnes and 1.4 tonnes/hectare per year respectively. Soil fertility and biotic stress, farm-farmers related problems and economic related problems were extracted as constraints to rice production in the area. The study recommends that researchers that are involved in rice breeding should develop high yielding rice varieties while agricultural extension agents should transfer the innovations to farmers and ensure that farmers adopt them through follow up and feed-back exercises/visits to these farmers targeted at boosting output, yield and income from rice production.

Keywords: Agronomic practices; output; yield; constraints; rice.

1. INTRODUCTION

Nigeria is the most populous country in Africa, with a population of over 167 million people as at 2012 [1]. Its domestic economy is dominated by agriculture, which accounts for about 40% of the Gross Domestic Product (GDP) and engages two-thirds of the labour force [2]. The food sub-sector of Nigerian agriculture parades a large array of staple crops, made possible by the diversity of agro-ecological production systems. The major cereals are: sorghum, maize, millet, rice, and wheat. These are the commodities that are of considerable importance for food security, expenditures and incomes of households.

Of all the staple crops, rice (*Oryza sativa*) has risen to a position of preeminence and is the fastest growing commodity in Nigeria's food basket [3]. It is one of the most important healthy and staple foods [4] and influences the livelihoods and economies of several people. It can provide the country"s required food security minimum of 2,400 calories per person per year [5,6].

In Nigeria, rice consumption was 5 Metric Tonnes in 2010 and is expected to reach 36 Metric Tonnes by 2050 with 5.1% annual growth. An average Nigerian consumes 24.8 kg of rice per year, representing 9 per cent of annual calorie intake [7]. Due to its increasing contribution to the per capita calorie consumption of Nigerians, the demand for rice has been increasing at a much faster rate than its domestic production and more than in other African countries since mid 1970s [8]. [9] noted that rice is one of the crops where the gap between potential and actual production is wide.

As a response to the prevailing rice supply deficit situation in Nigeria, successive Nigerian governments intervened in the rice sector by coming up at various times with policies and programmes. However, the policies and programmes were observed not to have been consistent. These erratic policies reflect the dilemma of securing cheap rice for consumers and a fair price for the producers. Notwithstanding the various policy measures, domestic rice production has not increased sufficiently to meet the increased demand [10]. Research has shown that the demand for rice in Nigeria has been increasing at a much faster rate than domestic production, making the country to expend huge amount of foreign exchange on the importation of rice [8]. For example, imports of wheat, rice, fish and sugar alone cost Nigeria 1 trillion Naira (approximately 6 billion USD) in foreign exchange annually and the imports are growing at an alarming rate of 11 per cent per annum [11]. Resorting to importation is not the ultimate solution to improve rice sector rather identifying and addressing challenges and other relevant issues surrounding the sector. These factors mentioned above and more necessitated the need to investigate on the activities of farmers in rice production in Awka North Local Government Area (LGA) of Anambra State, Nigeria. Specifically, the study described production activities of the rice farmers; identified agronomic practices they used as well as constraining factors to rice production in the area.

2. MATERIALS AND METHODS

The population of the study included all rice farmers in the LGA. A multi-sage sampling method was employed in selecting respondents. The first stage involved the purposive selection of three towns (Ebenebe, Amanuke and Achalla) from the nine (9) towns in the LGA, due to their high level of production in rice enterprise. The second stage involved simple random selection of 3 villages from each of the three towns giving

a total of nine villages for the study. The third stage involved simple random sampling of 10 rice farmers from each of the nine villages making a total of 90 rice farmers for the study. Interview schedule that contained information based on the specific objectives of the study was used to elicit information from the respondents.

The farmers (respondents) were asked to indicate their sources of labour, capital, access to tractor services, their farm size, etc. in order to assess respondents' production activities. Respondents were also requested to answer relevant questions pertaining to the agronomic practices they employ in their rice farm e.g. variety grown, cropping pattern used, method of land preparation, fertilizer application, weeding, harvesting, type of tools used etc. Constraints to rice production were ascertained using a modified four point Likert type scale with responses as; to a great extent (4), to a moderate extent (3), to a little extent (2) and to no extent (1) with a mean of 2.5. Data generated were further subjected to factor analysis while varimax rotation with Kaiser normalization [12] was used to extract the perceived constraints into three factor components. (Variables with loadings less than 0.40 were dropped and those that loaded in more than a factor were discarded [13]). Frequency, percentage, mean score and factor analysis were used for data analysis.

3. RESULTS AND DISCUSSION

3.1 Production Activities of the Respondents

3.1.1 Sources of labour

Table 1 reveals that majority of the respondents (73.3%) used hired labour while the rest (36.7%) used family labour in their farm enterprise. In this era of ageing farmers and migration of youth to urban centers in search of white collar jobs, use of hired labour in agriculture especially in rice production that is labour intensive becomes inevitable. On the other hand, use of hired labour increases cost of production leaving farmers especially peasant/subsistent farmers with little or no income.

3.1.2 Source of capital

Majority (75.6%) of the respondents sourced their capital from their personal savings, 23.3% sourced from friends and family members while 10% sourced from the banks and financial institutions. Most of the respondents may have relied mostly on their personal savings as source of capital probably because of the high interest rate charged by the banks and other financial institutions and lack/ inability of the farmers to provide collateral in order to source the fund from these institutions. However, funds from informal sources especially when they are small may not allow an entrepreneur like farmer to boost his enterprise to the level he/she wants.

3.1.3 Access to tractor services

Findings on the access to tractors revealed that majority (66.7%) of the respondents did not have access to tractor services while the rest (33.3%) had access to tractor services. This may mean that most of the farmers may not have the capabilities to cultivate large hectares of land due to limitation associated with labour. Also, [14] noted that an average peasant farmer in Nigeria owns less than two hectares that is barely enough to produce what is needed to feed the family. Using tractor or other machines for agriculture in this relatively small size of land may not be economical.

3.2 Farm Land Owned and Cultivated with Rice

Entries in Table 1 revealed that a higher proportion (48.9%) of the respondents owned a farm land within the range of 1-2.9 hectares, 17.8% had less than one hectare of farm land, 15.6% owned between 3-4.9 hectares while 13.3% owned farm land ranging from 5-6.9 hectares. The average farm size of the respondents was 2.7 hectares. This finding is consistent with [15] who reported that the major occupation in the area was farming with land holding ranging from 2-3 hectares per household on the average. The table also shows that majority (62.2%) of the respondents cultivated rice on 1-2.9 hectares of land, 18.9% of them cultivated in less than I hectare while16.7% cultivated on 3-4.9 hectares of farm land. On average, the respondents cultivated 1.7 hectares of land with rice. The findings tend to suggest that the respondents did not cultivate the entire land they owned with rice. Lack of labour, production of other staple/arable crops, rearing of livestock, practices of bush fallow, shifting cultivation/ land rotation among others may be responsible for this.

3.2.1 Yield of rice

Table 1 further indicates that about 56% of the respondents obtained rice yield of 1-1.9 tonnes/hectare (t/ha), 23.3% obtained less than 1 t/ha while the rest (21.1%) obtained between 2-2.9 t/ha in a year. The average rice yield of the respondents was 1.4 t/ha per year. This average yield (1.4 t/ha) is very low when compared with 3.0 t/ha in places like Cote d' Ivoire and Senegal [16] and that of the world average yield of 3.84 t/ha [17]. This signifies the need to strategize measures in order to boost rice production in the area and in the country at large.

4. AGRONOMIC PRACTICES OF THE FARMERS

4.1 Pre-planting and Planting Operations

4.1.1 Varieties of rice grown and their sources

Table 2 shows that about 34% of the respondents cultivated rice variety called MARZ, 31.1% grew R-Box, 17.8% grew FARO-45, 15.6% grew 1416 and 13.3% grew a variety called BJ. The table further shows that majority (66.7%) of these farmers obtained these varieties from preserved seeds of previous harvest, 27.8% got/bought from the market (seed dealers), 4.4% obtained from research institutes while the rest (2.2%) obtained from extension agents. This finding suggests that most of the respondents did not source or grow new improved varieties from reliable sources like research institute, ministry of agriculture rather used or planted seed from previous harvest which may be one of the reasons for low yield (Table 1). In line with this finding, [17] reported that the low productivity on farmers' field is due to several constraints including poor seed management. Thus, [18] recommended that farmers should consult the nearest agricultural office or seed companies for certified seeds of recommended varieties in their areas.

4.1.2 Water management

Table 2 revealed that majority (83.3%) of the respondents did not make use of any alternative water supply apart from rainfall while the rest (16.7%) resorted to alternative water supply to augment for the water requirement in their rice farm. Those that used alternative water sourced it from river (11.1%), ponds (3.4%) and dams (2.2%). Rice is a water loving plant and about 3,000 to 5,000 litres of water are required to produce a kilogram of rice grain. Wherever irrigation facility is available, water should be applied during critical growth stages like tillering, panicle initiation, panicle emergence and grain filling stage to get maximum yield [19]. In corroboration, [20] stated that irrigated system (alternative water supply) has the highest yields (3.7 t/ha) in rice production. Unfortunately, most of these rice farmers did not provide irrigation or alternative water supply to their rice farms. Which may be another factor that contributed to low yield in rice production in the area (Table 1).

4.1.3 Cropping pattern

Table 2 also showed that majority (90%) of the respondents engaged in mono- cropping (planting rice alone) while the remaining (10%) planted rice with other crops. Field observations showed that they intercropped rice with groundnut, soybeans, cocoyam and other crops. Intercropping rice with legumes could help reduce weed problems, improve soil fertility and enhance farm income.

4.2 Method of Land Clearing

Table 2 indicated that (58.9%) of the respondents used hand tools like hoe; cutlass etc. in clearing their land, 26.6% used herbicides while the rest (6.7%) used mechanized equipment like bulldozer and tractor coupled implements to clear their lands for rice farming. Most of these farmers practice what may be termed "hoe technology". [21] stressed that hoe technology makes use of tools and implements that rely on human muscles. Relying on this type of technology may mean that farmers cannot cultivate much land because of the limit of human power [14].

4.2.1 Method of planting

Entries in Table 2 showed that 53.3% of the respondents planted rice through broadcasting of the seeds directly into the main field, 21.1% broadcasted in a nursery and later transplanted to the main field, 13.4% of the respondents planted their rice directly by dibbling into the main field while 12.2% planted their seeds using drilling method (the use of machines to plant which is usually employed on a large hectare of land). Broadcasting method used by most of these rice farmers helps to reduce labour/ cost of transplanting, waist breaking task of dibbling in the field and cost of hiring drilling machine. [22]

noted that broadcasting is used in area where labour is expensive while [23] and [20] noted that nursery practices and dibbling reduces seed waste as opposed to broadcasting but they require much labour. Farmers should be encouraged to adopt dibbling method instead of broadcasting in order to ensure/maintain adequate sowing depth, plant population, spacing and optimum/maximum output and yield.

4.3 Post Planting Operation of the Respondents

4.3.1 Thinning

Table 3 showed that majority (87.8%) of the respondents did not practice thinning while the rest (12.2%) thinned their rice farm. Most of the respondents did not practice thinning which is the removal of extra seedlings from a stand on their rice farm probably because according to [22], closer spacing of rice seeds will help to smother weeds and suppress tilling while wider spacing encourages tilling and more weed incidence.

4.3.2 Mulching

Table 3 also showed that about 97% of the respondents did not mulch while the rest (3.3%) mulched their rice farm. Mulching is an activity that involves use of green/vegetable matter to cover the top layer of soil in order to discourage weed growth or/and conserve water in the soil. Field observation showed that the majority cultivated on heavy clay soil because of their high water retaining capacity hence may not need mulch.

4.3.3 Fertilizer/manure application

Entries in Table 3 revealed that the majority (60%) of the respondent used NPK 20:10:10 to enrich their rice farm, 31.1% used urea, 18.9% used poultry dung manure, 6.7% applied piggery manure while 1.1% did not use any kind of fertilizer/manure to enrich rice farm. Field observation showe that farmers preferred use of inorganic manure as indicated by 91.1% of the respondents. This might be because of its

Table 1. Production activities of the respondents

Parameter	Frequency	Percentage (%)	Mean (M)
Source of labour*			
Family labour	33	36.7	
Hired labour	66	73.3	
Source of Capital*			
Personal savings	68	75.6	
Family and friends	21	23.3	
Financial institution	9	10	
Tractor Services			
No access	60	66.7	
Access	60	33.3	
Total Farm Size (ha)			
Less than 1	16	17.8	
1-2.9	44	48.9	2.7
3 -4.9	14	15.6	
5-6.9	12	13.3	
7 and above	4	4.4	
Share of rice in total cropped area (ha)			
Less than 1	17	18.9	
1-2.9	56	62.2	1.7
3-4.9	15	16.7	
5 and above	2	2.2	
Rice yield (T/Ha)			
Less than 1	21	23.3	
1-1.9	50	55.6	1.4
2-2.9	19	21.1	

** Multiple responses*

Table 2. Pre-planting and planting operations of the respondents

Pre-planting and planting operations	Frequency	Percentage (%)
Varieties*		
BJ	13	13.3
MARZ	31	34.4
FARO 45	16	17.8
1415	14	15.6
R Box	28	31.1
Source of Seed*		
Personal reserve/stored seed	60	66.7
Market	25	27.8
Research institute	4	4.4
Extension Agent	2	2.2
Alternative water supply		
Yes	15	16.7
No	75	83.3
Sources of alternative water supply		
None	75	83.3
River	10	11.1
Dams	2	2.2
Ponds	3	3.4
Cropping patterns		
Sole	81	90
Mixed	9	10
Method of land clearing*		
Herbicides	23	25.6
Mechanized equipments	15	16.7
Hand tools	53	58.9
Planting method		
Broadcasting	48	53.3
Dibbling/direct sowing	11	12.2
Drilling	12	13.4
Transplanting from nursery to the main field	19	21.1

**Multiple responses*

efficient supply of required nutrient to the soil unlike the organic fertilizers. Further, [19] noted that application of fertilizer in correct dose and amount are the prerequisites for getting optimum response in growth and management of pest and diseases in crops.

4.3.4 Weed management

Data in Table 3 further revealed that majority (63.3%) of the respondents weeded their rice farm manually by using hand tools and by hand picking. Also, 38.9% of the respondents used herbicides, while 16.7% used mechanized equipment during weeding. This result is in agreement with the work of [19] that noted that in North East India hand weeding is mostly practiced, but, in the absence of manpower, herbicides are been used.

The Table also showed that higher proportion (48.9%) of the respondents weeded their rice farm three times while 34.4% weeded twice per planting season. Thus, this majority (83.3%) that weeded their rice farm for about two to three times per planting season did this in accordance with [18] that recommended that rice should be weeded 2 to 3 times.

4.3.5 Harvesting, processing and storage

Majority (80%) of the respondents harvested rice manually; 13.3% harvested both manually and mechanically (use of machines) while 6.7% harvested with only machines (Table 3).

The table also indicated that majority (61.1%) of the respondents processed their produce immediately after harvest while the rest (38.9%)

stored their produce for processing in future. This finding tends to suggest that the respondents were focused on minimizing food waste along the supply chain by their acts of processing and storing of their harvested crops for future processing. According to FAO, about 1.3 billion tons per year or one-third of the edible food produced for human consumption is wasted along the food supply chain [24]. Reduction of wasted food will help to feed the increasing population, decrease negative environmental impacts and improve resource efficiency and productivity.

4.4 Constraints to Rice Production

Entries in Table 4 revealed constraints to rice production as perceived by the respondents. These constraints were grouped into three basic component factors which include: problems associated with soil fertility and biotic stress; problems associated with farm-famer status and economic related problems. Variables that loaded under factor I (soil fertility and biotic stress) were: weeding problem (0.785), rodent attack (0.783), high incidence of pests and diseases (0.775), low soil fertility (0.692) and insufficient organic manure (0.685). Problems related to soil infertility and plant protection measures are among the most significant factors causing decrease in the yield of rice production. Pests and diseases as organisms that can cause stress to crops, affect them and have serious impact on the economic output of a farm [25]. The author further stated that farmers should vary their prevention and treatment methods depending on the crops they grow and the pests or diseases they are susceptible to, as they affect crops differently. Field sanitation and proper weed management are some of the measures that can reduce insect and pest problems in rice.

Table 3. Post planting operations of the respondents

Post planting operations	Frequency	Percentage (%)
Thinning		
Yes	11	12.2
No	79	87.8
Mulching		
Yes	3	3.3
No	87	96.7
Type of fertilizer/manure*		
NPK 20:10:10	54	60
Urea	28	31.1
Piggery	6	6.7
Poultry	17	18.9
None	1	1.1
Method of weeding*		
Manual (hand tools)	57	63.3
Herbicides	35	38.9
Mechanized equipments (Rotary paddy weeder, e.g. Cono weeder or Japanese paddy weeder)	15	16.7
Number of weeding*		
None	3	3.3
1	5	5.6
2	31	34.4
3	44	48.9
4	7	7.8
Harvesting method		
Manual	72	80.0
Mechanized	6	6.7
Both	12	13.3
Processing and storage		
Process immediately after harvesting	55	61.1
Store for future use	35	38.9

** Multiple responses*

Table 4. Constraints to rice production

Perceived constraints	Factor 1	Factor 2	Factor 3
Scarcity of land planting	-0.244	0.243	0.495
Low soil fertility	**0.692**	0.015	0.039
Poor access road for transportation	-0.188	0.385	0.428
Lack of technical knowledge in the use of improved technology	-0.121	0.382	0.367
Lack/High cost of improved varieties	0.431	-0.087	0.323
Lack/High cost of inorganic fertilizer	0.023	0.171	0.336
Lack/Insufficient organic manure	**0.685**	0.270	-0.037
High cost/unavailability of agro-chemicals	0.179	-0.049	0.238
High cost/unavailability of other equipment e.g. farming implements, machines etc.	0.054	0.121	0.464
High cost/unavailability of labour to carry out the essential farming activities	0.309	-0.014	0.518
Labourious nature of rice production	0.345	0.010	0.562
Ineffective extension service/poor extension agent-famer's contact	0.095	**0.419**	0.258
High cost of processing	-0.486	0.442	0.294
Lack of finance/high interest rate on loan boost production	-0.203	0.029	**0.666**
Difficulties in obtaining credit facilities	-0.240	0.108	**0.662**
Lack of collateral required to collect loan	-0.130	-0.031	**0.601**
Problems associated with the importation of rice.	-0.427	0.490	-0.089
Rodents attack	**0.783**	**-**0.070	-0.196
Weeding problem	**0.785**	0.244	0.004
High incidence of pest and diseases infestation	**0.775**	0.158	0.102
Marketing problem	-0.275	**0.537**	0.061
Instability of the government policies	-0.563	0.524	-0.008
Low/poor interest in rice production	0.179	**0.458**	0.205
HIV/AIDS	0.243	**0.705**	0.070
Malaria	0.022	**0.814**	0.017
Other chronic disease	0.071	**0.779**	0.042
Climate change (e.g. shortage of rainfall, prolonged dry season etc.	0.492	0.318	-0.02
Poor/lack of other infrastructural facilities like school, Hospital, water etc.	0.002	**0.491**	-0.115
Lack of technology/innovation on rice production	-0.102	**0.425**	0.153

Extraction Method: Principal Component Analysis; Rotation method: Varimax with Kaiser Normalization
Factor 1: Soil fertility and biotic stress; Factor 2: Farm-farmers' status and Factor 3: Economic related problems

Malaria disease infection (0.814), other chronic disease (0.778), HIV/AIDS pandemic (0.705), marketing problems (0.537), poor/lack of other infrastructural facilities like school, hospital, water etc. (0.491), low interest in rice production (0.458), lack of technology/innovation on rice production (0.425) and ineffective extension service/poor extension agents-farmers' contact (0.491) were variables that loaded high under factor 2 (problems related to farm-famer status). Farmers' health status / manifestation of certain ailments like HIV/AIDS, malaria and other chronic diseases makes the farmers to be weak and unproductive and may result to decrease in his output and yield.

Under economic related problem (factors 3), lack of finance (0.666), difficulty in obtaining credit facilities (0.662), lack of collateral required to collect loan (0.601), scarcity of land for planting (0.495) and high cost of inorganic fertilizer (0.336) were variables that loaded high. Economic problems hinder the productivity of any enterprise including agriculture. This is because lack of fund or poverty hinders farmers from assessing agricultural inputs and utilization of

these inputs on time sensitive rice production/agricultural matters for enhanced yield and income.

5. CONCLUSION

Based on the findings, it was obvious that the area experienced poor yield in rice production (1.4 t/ha) probably because they sourced their seeds from previously cultivated cultivars stored by them, did not practice irrigation and most of the respondents did not have access to tractor services. The constraints facing farmers in rice production were grouped into three basic component factors which included: soil fertility and biotic stress; farm-famer status and economic related problems. The major soil fertility and biotic stress problems encountered by rice farmers were weeding problem, rodent attack, high incidence of pests and diseases, low soil fertility, and insufficient organic manure. The major farm-farmer status problems were Malaria disease infection, other chronic disease, HIV/AIDS and marketing problems. Lastly, economic related problems were lack of finance, difficulty in obtaining credit facilities, and lack of collateral required to collect loan.

6. RECOMMENDATIONS

1. The study therefore recommends that rice farmers should adopt irrigation farming as well as effective soil conservation and management practices like relaying rice with legumes after farming for a long period, plough rice residues into the soil as organic matters so as to maintain the soil nutrient status that will encourage improved output and productivity.
2. Researchers/research institutes that are involved in rice breeding should develop high yielding rice varieties with farmers' and consumers preferred characteristics for appearance, time of maturity, taste among others. Agricultural extension agents should transfer the innovations to farmers and ensure that farmers adopt them through follow up and feed-back exercises/visits to these farmers. This will help to boost output, yield and income from rice production.
3. Government and Non Governmental Organisations should assist rice farmers in addressing their production challenges for example disease infection by providing hospitals with qualified personnel and necessary facilities so as to handle health challenges of these farmers. Improved health status of these famers will surely culminates into increased productivity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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