IMPROVED INPUT COMBINATION STRATEGY FOR INCREASED PRODUCTIVITY AND PROFITABILITY OF RICE PRODUCTION IN EBONYI STATE, NIGERIA

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ABSTRACT

Ebonyi state is a major rice producing area, where the bulk of rice consumed in Nigeria is produced. Rice production in the area has always fallen short of the demand owing particularly to low rice crop yields in this area. Low rice productivity is ascribed primarily to soil fertility constraints and inefficient use of production resources. In order to address these problems, a farmer participatory research was conducted in 2009 and 2010 rainy seasons at the major rice producing areas of Ebonyi state. The aim was to introduce a new input combination package, compare it with the local production practices and use the result to tackle the rice productivity problem of the area. The new package comprised improved varieties of lowland rice, inorganic fertilizer, herbicide and planting technique, whereas the local production practices involved the landrace varieties and the traditional methods of rice production. A multi-stage (purposive and random) sampling technique was used to draw a total of 240 farmer participants for the study. The data collected included grain yield, cost and return on rice production. The pooled data for the two years were compared using descriptive statistics and inferential statistics. The results showed that average grain yield for FARO 44 was 6.44 tonnes per hectare (t/ha), FARO 52 was 7.25 t/ha under the new package. The mean grain yield for the FARO varieties was 7.03 t/ha. The average grain yield for the land race variety was 2.53 t/ha, under the local production practices. The mean cost of production per hectare using the new package was ₦151, 400.00 compared to ₦153, 050 using the local production practices. At the farm-gate price of ₦55.00 per kilogram of rice grains, the net revenue from 1 hectare for the new package was ₦ 68,600 whereas the local production practices gave net revenue of -₦ 35,600. It was concluded that the new input combination package led to a higher grain yield, lower cost and was more profitable compared to the local production practices for rice production. Farmers are encouraged to adopt the improved package of production practices.

Key Words: Input combination, rice production, productivity and profitability

INTRODUCTION

Rice is widely cultivated as a major crop in the tropical and sub- tropical regions of the African continent. In Nigeria, rice is not only important as food but serves as a source of raw materials for agro-allied industries (Chinyelu, 1999). Rice is a crop that is grown nation- wide and in all agro-ecological zones in Nigeria from the Sahel to the coastal swamps. Rice was widely regarded in Nigeria as superior staple food, which until recently, was mainly consumed by city dwellers, the middle and higher income earners, and on occasions such as Christmas, marriages and naming ceremonies by the peasants.

Unfortunately, rice production in Nigeria has always fallen short of its demand in spite of huge investments in its productions; and in spite of the production resources in Nigeria. Self-sufficiency in rice production and availability in the diet of average Nigerians are yet to be achieved (Agwangwa, 2004; Goni *et al*., 2007). The major reasons for decline in rice production was attributed to; insufficient use of resources, unfocused

government policies, lack of agro-chemicals, lack of improved seeds, low soil fertility and high cost of labour among others (Okuneye, 2001; Akimbola, 2002; Ohajianya, and Onyenweaku, 2002; Awoke and Okorji, 2003; and Goni *et al*., 2007). Also, Agricultural production in Nigeria is labour intensive and more than 90 per cent of the rice producers are small- scale farmers cultivating one to two hectares, utilizing unpaid family labour as a major source of farm labour supply (Olayide and Atobattele, 1980).There is also gap in knowledge between varieties of rice in the area resulting to low productivity in rice production. The combined effect of resources as explanatory variables in swamp rice production is still unknown to them. The rice farmers cultivate rice without reliable information on investment criteria and resource use efficiency.

The farmers therefore need to be guided on what level of input combination that would ensure optimum profit. Spencer (2002) revealed that resource-poor farmers must be assisted to rise beyond subsistence to increase their incomes through more efficient use of resources. According to Ali and Flinn (1989), opportunities for developing and adopting better technologies provide a possible solution for raising productivity and improve efficiency. Farmers in Nigeria need improved varieties of rice to increase yield. In Nigeria, Olagoke (1991), showed that irrigated rice farms had the highest yield of 2.19 tons /ha followed by swamp rice (1.96 tons/ha) and then upland rice (1.17 tons/ha). However, NCRI (1988) reported that yields of 2.5—8.0 tons/ha could be realised with high levels of fertilizer, improved cultivars and varieties, optimum plant population, weed control and crop protection measures.

METHODOLOGY

Location: The study area covered the major rice growing areas across Ebonyi state. The state is situated within latitude 7^0 30^1 E and longitude 5^0 40^1 N southEast Nigeria. The state has two distinct vegetation belts. The north and central portions have derived Guinea savannah while the south has forest belt. The soil is hydromophic, shallow in depth, with an impervious layer of parent material made of shale. The rainfall regime is bimodal, with peaks in July and September. The temperature ranges between 24^0 and 28^0. Annual rainfall ranges between 1500 mm and 2000 mm, while humidity averages 85% during the rainy season. The soil is acidic, noted for high temperature, and high bulk density.

Experimental Design: A multistage purposive randomised sampling technique was employed in the study. For the purpose of selection of the experimental locations, the state was demarcated into three agricultural zones. Two local governments out of four per zone were chosen, giving a total of six local governments. Four major rice producing communities were selected per local government, giving a total of 24 farm communities. Ten rice farmers were randomly selected per community, giving a total of 240 participating farmers. Data for the analysis was generated from field survey involving the 240 farmers and researchers field experiments using improved production package. All data obtained were scaled up to 1 hectare as the standard unit of measurement for analytical purposes.

Treatments: The treatments comprised of a new input combination package and farmers local production practices. The new production package included improved rice varieties, herbicide and line planting, whereas the local production practices involved the landrace varieties and traditional cultural practices for rice production in the area.

Layout and Treatment application: The Agronomic study was conducted in the farmers' fields. The plots for the new package were laid alongsides the participating farmer's field in each experimental site. A land area of 0.5 hectare each, for the new varieties and the farmers plot respectively were used in each location. An alley, of 1m wide was maintained between the two plots in each location. Glyphosate at the rate of 5 litres per hectare equivalent was used to kill the vegetation on the new package plots, two weeks before transplanting, while, the vegetation on the farmers field was cleared manually with matchet. The improved varieties were transplanted in rows, 20 cm apart and 20 cm between plants, while the landrace verities were transplanted randomly without consideration to planting space. For the fertilizer component of the new

package, equivalent of 100 kg of urea ,and 200 kg of N P K 15: 15: 15 per hectare were applied to appropriate plots, while the farmers applied a varied denominations and rates of fertilizers, where available. For the improved package, half the rate of the urea was applied basally, 4 days before transplanting, while the remaining two thirds was applied alongside the N P K, by side placement, 4 weeks after transplanting.

Cultural practices: The rice nurseries were made on beds established near the farms. The nurseries were established in May in the forest belt, and in June in the derived guinea savannah belt. The zero tillage method was used for the rice production.

Yield Determination: The grain yield was determined from a total of ten, 10 x 10 cm plots in each plot. The plots were randomly marked in each plot, the rice panicles harvested and heaped separately. The panicles were threshed, winnowed and the grains dried to 14 % moisture content. The mean weight of the grain harvests from each plot was calculated and the average for the ten plots converted to tons per hectare.

Data Analysis: The data collected were analysed using descriptive and inferential statistics. Specifically, the analytical tools used include mean, coefficient of variation and t-test.

RESULTS AND DISCUSSION

Rice Crop Productivity: The results of the statistical analysis indicated that there was significantly higher rice grain yield when the new production package was applied, compared to the local production practices (Table 1). The mean grain yield of FARO 52 was 7.25 t/ha, representing 4.72 t/ha significantly higher grain yield (t-test at 1% level of significance) compared to mean grain yield of 2.53 t/ha of the farmers best under the local production practices. The FARO 44 variety also had the mean yield of 6.44 t/ha, representing 3.91t/ha significantly higher grain yield (t-test at 1% level of significance) than the farmers' best under the local production practices. The average of the FARO varieties was 7.03 t/ha which showed 4.5 t/ha significantly higher grain yield (t-test at 1% level of) compared to the yield of the farmers best. The variability in the yield of FARO 52 among the experiments was 55%, which for FARO 44 was 42%, whereas the variability in the yield of the farmers' varieties was 92%. This showed that the FARO varieties were more adaptable to variations among the soils of the area, particularly the inherent soil constraints of the study area. The soils of the area had been reported to suffer low soil fertility, resulting from its low organic matter content, low level of exchangeable bases and cation exchange capacity, buffer capacity and soil physical constraints including high bulk density, compaction and high soil temperature (FDALR, 1985; Enwezor *et al.,* 1990; Ogbodo, 2004)

There were no significant differences in grain yield among the two improved rice varieties under the improved production package. The implication of the comparable grain yield is that both varieties had comparable adaptability to the inherent poor soil conditions, and the improved soil productivity owing to the benefit of the new production package. Both had equal responses to the effect of effective weed management, improved soil nutrient availability, and adequate feeding area. These situations culminated in enhanced crop productivity. The combination of varietals disparity, poor production management, and weed interference, lower fertilizer application, restricted feeding area, and shading effect culminated in reduced crop productivity under the local production process.

Table 1: Rice Grain Yields

Variables	Yield (t/ha)	Variation Index	Coefficient of variation
FARO 44	6.44	0.42	42%
FARO 52	7.25	0.55	55%
Landrace	2.53	0.36	36%
Demo plot (mean)	7.03	0.76	76%
Farmers plot (mean)	2.53	0.92	92%

Costs and Returns in Rice Production: The costs and returns were evaluated to determine the profitability of rice production using the new production technology package and farmers' indigenous practices. Results obtained are presented in Tables 2, 3 and 4.

The results showed that total costs of production (TC) were ₦151, 400 and ₦153, 050 for the demonstration plots and farmers' plots respectively. These produced corresponding total revenues (TR) of ₦220, 000 and ₦188, 650 for the demonstration and farmers' plots respectively. Thus, the total revenue from the new package was higher than that from the farmers' indigenous system by ₦31, 350. The difference in the total revenues here is attributed to the difference in mean yields of the two production technology combinations which was 4.5 t/ha. The test of difference of two means using t-test also shows that this observed difference was statistically significant at 1% level of significance.

Table2. Costs of Production under Farmers Practice

Item	Unit	Quantity	Unit Price(₦)	Cost(₦)
Land	Ha	1	12,00	12,000
Seed	Kg	50	140.00	7,000
Clearing	Mandays	20	800	16,000
Nursery Preparation	persons	3	400	1,200
Transplanting	Mandays	32	800	25,600
Fertilizer	Bags	4	5,700	22,800
Fertilizer application	Mandays	4	800	3,200
First weeding	Mandays	20	800	16,000
Second weeding	Mandays	10	800	8,000
Bird scaring	Persons	3	5000	15,000
Harvesting &threshing	Mandays	20	1,000	20,000
Bagging/bag stock	Tonnes	2.5	2,500	6,250
Total				153,050

Table3. Costs of Production under the New Package

Item	Unit	Quantity	Unit Price(₦)	Cost(₦)
Land	Ha	1	12,000	12,000
Seed	Kg	50	140.00	7,000
Glyphosate	Litre	5	850	4000
Propanil	Litre	4	500	2000
2-4D	Litre	1	400	400
Spraying Glyphosate	Mandays	7	800	5600
Nursery preparation	Persons	3	400	1,200
Transplanting	Mandays	32	800	25,600
Urea	Bags	2	5,750	11,500
N p k	Bags	4	5,700	22,800
Applying N P K	Mandays	4	800	3,200
Applying Urea	Mandays	2	800	1,600
Spraying Propanil/24D	Ha	1	2000	2000
Bird Scaring	persons	3	5,000	15,000
Harvesting/Threshing	Mandays	20	1,000	20,000
Bagging/Bag stock	Tonne	7	2,500	17,500
Total				**151,400**

An assessment of the cost outlays shows that the inputs that contributed significantly to the total cost of production under the new production package were the agro-chemicals which had an aggregate value of

₦27, 100 representing 18% of the total cost. These include the cost of land clearing and weed control using chemical method. Similarly, labour for land clearing and weeding under the farmers' indigenous system amounted to ₦40, 000 representing 26% of the total cost of production. According to Akpokodje *et al*. (2001), weed control constitutes the largest share of average total costs in rice production in Nigeria after land preparation.

The respective net revenues (NR) from the new package and farmers' indigenous system were ₦68, 600 and ₦35, 600 respectively showing a mean difference of ₦33, 000. The test of difference between the mean shows that the net revenue from the demonstration plots was significantly higher than that of the farmers. This implies that rice production using the new production technology package was more profitable than that of the farmers' production system. Also, the average cost of production for the demonstration plot was ₦21, 536/ton while that of the farmers was ₦60, 494/ton showing a difference of N38, 958. This shows that there was more efficient utilization of resources under the new input combination system than in the farmers' indigenous production system.

However on a general note, the average yields recorded in both the demonstration plots and the farmers' plots were significant improvement when compared to findings by Olagoke (1991), that the highest average rice yields per hectare for irrigated, swamp and upland fields in Uzo-Uwani in the same southeast Nigeria was 1.95 tons/ha. Obviously, there have been significant improvements in the land-area yield of rice due to technological improvements and introduction of high-yielding rice varieties. This has translated to reduced average costs of production and enhanced revenue as well as increased level of profitability. Moreover, the adoption of agro-chemicals in enhancing the soil and weed control leads to reduced drudgery in rice production as well as increased profit margin. As such there is need to intensify efforts at getting the farmers in the study area adopt fully the available improved input technology packages in their rice production towards greater productivity.

Table 4: Cost and Returns for Rice Production

Variable	Demo Plot	Farmers Plot
Cost	151,400	153,050
Gross income	220,000	188,650
Net income	68,600	35,600

CONCLUSION

The study demonstrated the great disparity in grain yield and income from two rice production processes. The new production package enhanced the soil fertility and improved crop productivity compared to the local indigenous rice production practices. The two improved (FARO) varieties were more adaptable to the inherent soil conditions, with superior grain yield per hectare compared to the farmers' landrace varieties. The lower total production cost, higher grain yield and net revenue of the new production package, makes it more attractive. It was concluded that the new production package be adopted by the farmers in the state, as a means of increasing their rice grain yield output, and reducing the glaring shortfall in rice production and supply in Nigeria.

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