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Comparative Analysis of Direct Seeded and Transplanted Rice Yields in Ebonyi State, Nigeria

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ABSTRACT: Comparative analysis of transplanted and direct seeded rice in Ebonyi State, Nigeria was studied using multi-stage, simple random and purposive sampling techniques with the aid of structured questionnaires for data collection. Data collected were analyzed using descriptive and inferential statistics. The result showed that, for both transplanted and direct seeded method, most of the farmers were males and that they were within productive age range. The result further showed that approximately, 98% and 94% of transplanted and direct seeded rice farmers had one form of education or the other with average family size of 7 and 5 persons per household respectively. Again, the average farm size of the respondents was 2.5 and 2 hectares for transplanted and direct seeded rice farmers with average annual income of ₦334, 000 and ₦315, 000 respectively. Similarly, the study revealed that the major factors that influence the adoption of direct seeding and transplanting method of growing rice were finance, land, labour, yield, cost of production, lodging, time of maturity, technical know-how, weed and pest infestation. The study further revealed that, the average yield per hectare for transplanted rice was 1.9tons and 1.6tons for direct seeded rice, indicating higher yield with transplanted rice. In similar way, there was a higher gross margin and profit of ₦132,850 and ₦81,550 under transplanted rice as against ₦119,850 and ₦69,250 for direct seeded rice respectively, meanwhile, return on investment was the same (1.34) for both direct seeded and transplanted rice. Transplanted and directed seed rice was profitable in the study area, and recommended government attention in Ebonyi state to boost rice production.

Keywords: Comparative, direct seeded, transplanted, rice, yield

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INTRODUCTION

Rice is the seed of the grass species *Oryza sativa* or *Oryza glaberrima.* Asa cereal grain, it is the most widely consumed staple food for a large part of the world especially in Asia and Africa. It is a food crop of world-wide importance and forms the foundation of the diet of over 3 billion people, constituting over half of the world's population (Cantral and Reeves, 2002). It is widely cultivated throughout the world and has become the second most important cereal in the world after wheat in terms of cultivation due to a recent decline in maize production (Jones, 2005). The crop is one of the world's three most produced grains alongside with wheat and maize (Oselebe, 2013). Rice is grown in more than 100 countries under wide range climatic conditions and it is particularly productive in tropical regions with abundant moisture. It is cultivated by countries which are well

situated in a region with low labour cost and high rainfall, as it is labour intensive and needs much water. It is rich in genetic diversity with thousands of varieties grown throughout the world and its economic importance related to agro-ecological adaptation, household food security, ceremonies, nutritional diversification, income generation and employment (Perez *et al.,* 1987).

Worldwide, rice is grown on 161 million hectares, with an annual production of about 678.7 million tons of paddy (FAO, 2009). Generally, the production regions of *O. sativa* lie between Latitudes 45°N and 30°S and cover the entire African continents. The extreme latitudes at which rice is cultivated arc situated in China at 50°N and in Australia at 35°S. Over 90% of the World's rice is grown in Asia. India has the largest area of Land under rice cultivation (42.2 million hectares) while China is the principal producer of rice (187.5 million tonnes) (Nwibo et al., 2009). Africa production level is 13 million tonnes and about 7 million hectares under rice cultivation accounts for only 2% of World rice production, Nigeria. Egypt and Madagascar are the biggest African producers with 3.2, 3.1 and 2.2 million tonnes per annum respectively (Nwibo et al., 2009).Farmers find rice more adaptable than a high input staple crop such as maize when there is declining soil fertility because of the huge array of varieties of rice, which they switch to in case of poor productivity. Since rice is a staple crop, famers seem to be willing to grow it all the time no matter the constraints they are facing (Selbut. 2003).According to Babafada (2003), rice is the fourth major cereal crop in Nigeria after sourgun, millet and maize items of output and cultivated land. Today, the crop is ranked first in Ebonyi State among other cereals. It is grown and consumed in all ecological zone of Ebonyi State (Ohaka *et al.,* 2013). Rice farmers choose varieties adapted to the region's length of growing season, soil, altitude and the depth of water in the fields. It is produced in wide range of location and under variety of climatic conditions, from the wettest areas in the world to the driest deserts. The crop constitutes one of the major crops produced in Nigeria.

The consumption of rice has changed from a ceremonial to a staple food in many Nigerian homes (Oselebe, *et al.,* 2013). The demand for rice has increased at a much faster rate in Ebonyi State and Nigeria in general than in other West African countries. For example, during the 1960's, Nigeria had the lowest per-capita annual consumption of rice in the sub-region, averaging 3 kg. Per-capita consumption levels grew significantly at 7.3% per annum, averaging 18 kg in the 1980's and 22 kg in 2005-2009. By 2008 it rose to 32 kg, with per capita consumption in the urban areas averaging 47 kg (Adejumo-Ayibiowu, 2010; Obasi, 2001). The constraints to rice production are varied, including low yield in farmer's field, poor water management, inadequate weed management/control, low adoption of new technologies e.g. high yielding varieties, low level of mechanization and investment, problem of pest and disease management, ageing farming population and the effects of climate change. Climate change through extreme temperatures, frequent flooding, drought and increased salinity of water supply used for irrigation in rice fields constitute factors that affect agriculture. Compared to other cereals, the ability of rice to tolerate drought is poor and thus drought is a limiting factor in rice production (Fukai *et al.,* 2003). The final rice cultivation system in the world is affected by water deficiency, low suitable land, and shortages of workers (Nguyen and Ferrero, 2006).

Historically, rice is believed to have originated from South-East Asia (*Oryza sativa*) and Africa (*O. glaberrima*) with some of the rice producing countries being China, Burma, India, Indonesia, Japan, United States, Spain, Italy and Brazil, before its spread to Africa (Dong et al., 2004). Although, the original parental varieties of rice are native to South-East Asia and certain parts of Africa, centuries of trade and exportation have made it common place in many cultures worldwide (IRRI, 2008). Two varieties of rice have been mainly cultivated in Nigeria: the African rice *(Oryza glaberrima)* and the Asian rice (*Oryza sativa).* In recent times, however, new rice varieties have also been introduced including the West African Rice Development Association's (WARDA) hybrid rice varieties referred to as New Rice for Africa (NERICA), which are inter-specific hybrids between the African and Asian rice. According to Jones (2005), the African rice *O. glaberrima* originated from the wild rice (*O. barthii*) some 3500 years ago and its offspring domesticated probably in the inland delta area of Nigeria from where it spread through the upper Niger valley to the rest of West Africa. African rice is cultivated as field crop and a paddy crop. For the Niger Benue trough, Sokoto Rima and Chad Basin, rice has been in cultivation long enough for a rice culture to evolve going as far back as 1500 BC (Imolehim and Wada, 2000). Consequently, local rice farmers in Ebonyi have long adopted the Asian rice and some local names given to such rice varieties based on their quality attribute and/or the person that introduced such varieties. As such, two or more local rice varieties in various localities may actually be of the same cultivar.

Remarkable deepwater varieties of *Oryza, glaberrima* exist which are specific to the unusual flood conditions that occur in the inland Niger Delta, the Sokoto-Rima valley and other flood plains of the extreme north of Nigeria. *Oryza glaberrima*is known by different local names as "hakorinmontol" in Plateau /Nasarawa area, Jatau (red) throughout Hausa land and the Chad Basin and osikapa throughout Igbo area. The ecological adaptation of the two species may be more important from the point of view of human selection. An estimated

25 percent of Nigeria's rice is under rain-fed low land cultivation, the ecology to contribute between 43 and 45 percent of national rice production (Imolehim and Wada, 2000) and (Singh *et al*., 2007).The lowland ecology comprises of the shallow Fadama and deep Fadama. A distinguishing feature of this system is that the soil must be covered completely by water at some stage in the growth cycle (Moormann and Juo, 2010). Excessive flooding, iron toxicity and lack of water control structure have been the bane of lowland swamp rice production in Ebonyi State particularly in the Abakaliki area (Nwaobiala, 2010). Farmers in Ebonyi State have interesting farming system whereby giant mounds are made at the onset of rains and yams planted at the top of the mound and groundnut at the base. With the early rains, groundnut is harvested and the mound ploughed and puddled by hoeing and crop residue incorporated into the soil. This helps in increasing the fertility of the soil as groundnut possesses root noodles that add nitrogen to the soil. At this time, the fields are flooded and rice is transplanted or sown directly to the field. Although this system suffices, there can be total crop failure in a year when the cross river overflows its banks (Imolehim and Wada, 2000). Total crop failure in this case means low production which affects the chemical composition and agronomic characters of rice. Total crop failure also leads to reduction in the grain quality and the organoleptic properties of the lowland rice. The production of rice represents 38.89 % of total cereal production in Nigeria and presently, global rice production stands at 596.5 million tons from 155 million hectares (ha) in 2009. However, rice is grown virtually in all the agro-ecological zones (AEZ) of the country (Akaude, 2001) with different varieties possessing adaptation traits for each of the ecological zones (Sanni *et al.,* 2005).

There are basically two methods of planting rice which include; Transplanting and Direct seeding. Transplanting is the most common method of rice planting in Nigeria. Here the seeds are grown in a nursery and pulled and transferred into puddle and leveled fields 15 to 30 days after seeding. The seedling can either be transplanted manually or by mechanical method. Manual transplanting does not require machine and it is most suitable in areas with surplus labour and for small scale farmers. Mechanically, rice can be transplanted using machines in a much organized and large scale farms. Seedling can be raised in a wet, dry or modified nursery, depending on the growing environment. Transplanting ensures a uniform plant stand and gives the rice crop a head start over emerging weed. In transplanting, seedlings are established even if the field is not leveled adequately and has varying water levels. Transplanting can be done manually in the following ways; the seedlings are pulled out at the average of 15 to 30 days after seeding from nursery and transplanted into the main field. In some places depending on the farmer's choice, transplanting can be done between 15-20 days of nursery seeding. The seedlings are transplanted as soon as possible after pulling from the nursery into puddle and leveled field as delay will lead to slow revival and rapid growth after transplanting. However, this method is hampered by some factors such as the tediousness, time consuming, uniform plant spacing and density especially in random transplanting method and risk of inadequate rainfall.

The second rice establishment method is direct seeding. This is the method where seeds are sown directly into the main field without raising them through nursery (Reddy *et al.,* 2011). It is the spreading of seeds in fields before or immediately after rainfall. This method does not require raising and transplanting of seedlings from nursery. The seeds are directly sown into the main field by spreading manually or with the help of a tractor and attached implements at a depth of 2-3 cm. Direct seeding method requires less water and labour and hence lower cultivation cost with comparatively equal grain yields and the crop matures in less duration. Nevertheless, weed growth is high in direct seeded rice and farmers always spend much to control these weeds. Moreover, the crop comes to an early harvest. This method of seeding has been practiced for more than 20 years in addition to transplanting in the state.

Rice is an increasingly important crop in Nigeria. It is relatively easy to produce and grown for sale and home consumption. Rice is adaptable to a broad range of climatic, edaphic and cultural conditions. About 90% of the world's rice is produced in tropical and semi-tropical areas by peasant farmers in low income countries (UNDP, 2008). The domestic demand/consumption of rice has exceeded the local production. To meet the increase in demand, there was increase in importation of milled rice to bridge the gap between domestic demand and supply which afterward affects our economy. There are various methods of growing rice which can address these problems but their adoption is constrained by lack of information package in appropriate formats and poor communication channel. Ahmadu (2011) stated that the goal of increased productivity can be achieved by stabling agencies that will teach farmers on the best method of rice growing and how to practice them.

Despite the efforts by several governments and non-governmental agencies in Nigeria to achieve rice sufficiency, a wide gap continues to exist between domestic rice supply and demand in the country. The insufficiency in rice production in Nigeria has been attributed to low yield. Specifically, rice yield dropped from about 1.5 tons per hectare in 1997 to 1.01 tons per hectare in 2010 (FAO, 2004). As a result of divergence in supply and demand gap, imported rice has continued to be source to supplement domestic production. The rice import bill for Nigeria, which was N123.61 million in 1980

was projected to rise to N9.72 billion in year 2000 (FOS, 2008). This did not only drain the nation's foreign exchange reserves but almost virtually crippled the domestic rice industry. In Nigeria, the diverse rice production condition cover three major ecologies of rain-fed upland, rain-fed low land and irrigated lowland (Nwibo and Alimba, 2013). Presently, Nigerian rice sub-sector is dominated by weak and inefficient producer-market linkages due to poor infrastructure including lack of improved processing facilities, low rice productivity, poor post-harvest handling and storage, expensive and poor access to inputs (high quality seed, fertilizing and crop protection products), inadequate market information, lack of transparency among players, low capacity to meet quality standards, and limited efficiency distribution networks.

This has declined the rice productivity and low income for the rice farmers in Nigeria, especially in Ebonyi State. In Ebonyi State, it has resulted to massive loss of manpower through the abandonment of the farmers and the migration of rural youths to cities in search of white collar jobs (Nwaobiala, 2010).

There has been an increase in rice production in recent years against the low production experienced in the previous years in Ebonyi State. But despite this, population and demand for the grain have been on increase higher than the level of production soil fertility has decreased because of shorter fallow period which has not been compensated for by use of fertilizer or organic manure (Obinne, 2001). There has been a fluctuation in the yields of crop over the years. This has resulted in food shortages in rice needs in the country leading to much importation of rice into the country. Ebonyi State in 2016 banned the sale of foreign rice within the state.

This is to ensure the patronage of local rice (Abakaliki rice). Though the production of rice in the state has increased, the increase has not reflected on the adequacy of the product within the state. Therefore, there is need to determine the appropriate planting method to adopt to ensure that this product (rice) is available at all time in all part of the state to ensure that the poor masses have access to them.

In order to effectively address the problems, the study sought to provide answers to the following questions; what are the socio-economic characteristics of rice farmers who cultivated rice under direct seeded and transplanted methods? What are the factors that influence the adoption of direct seeded and transplanted rice in the study area? What are the yield differences of direct seeded and transplanted rice in the study area? What are the cost and return of direct seeded and transplanted rice? What is the effect of socio-economic characteristics of rice famers on the adoption of direct seeded and transplanted rice?

What are the problems associated with direct seeded and transplanted rice in the study area?

METHODOLOGY

The study area is Ebonyi State, Nigeria. The State share boundary with Benue State to the North, Enugu State to the West, Imo and Abia States to the south and Cross River State to the East. The main crops produced in the States are rice, yam, palm, maize, groundnut, plantain, banana, cassava melon, sugarcane, beans, fruits and vegetables. Fishing is also carried out in Afikpo. The State is blessed with mineral resources such as lead, limestone, zinc and marble. The State has a landmass of approximately 5,932 square kilometers lying between latitude 7^0 3N, and longitude 50^0 40^0N and 6^0 45^0N, with population of about 2.1 million people (NPC, 2006) of which 85 percent reside in rural areas. In the industrial sector, the state has several food processing factories including rice mills, quarry factories, a fertilizer blending plant, one of Nigeria's largest poultries (Nkaliki poultry farm), baking industries and many others (Figure 1). The study adopted a combination of multistage, simple random and purposive sampling techniques in the selection of the respondents.

Stage I: The first stage involved the purposive selection of six (6) Local Government Areas out of the thirteen Local Government areas in the state. The choice for purposive sampling was based on the Local Government Areas that have a high level of rice production in the State.

Stage II: The second stage involved the purposive selection of four (4) autonomous communities from each of the selected six (6) Local Government Areas to give twenty four (24) communities.

Stage III: This stage involved the random selection of five (5) villages from each of the selected communities to give one hundred and twenty (120) villages.

Stage IV: Finally, one (1) transplanted and one (1) direct seeded rice farmers were selected from each of the selected villages to give a total of two hundred and forty (240) respondents used for this study.

Note 1, 120 farmers were those involved in direct seeded and other 120 were those who practice transplanted rice planting method.

Note 2, the sample frame was drawn from FADAMA contact rice farmers in Ebonyi State.

Data were collected with the aid of a well-structured questionnaire which was complemented with direct

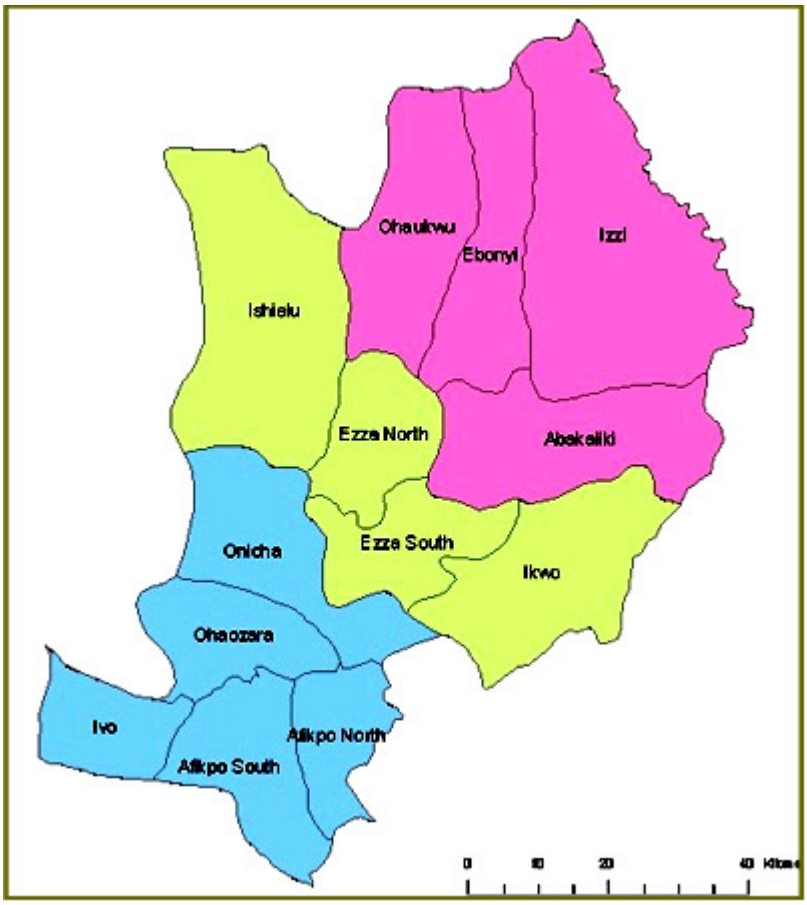

Figure 1: Map of Ebonyi State

interview for those that were illiterate and unable to fill the questionnaires. Some data especially quantity of rice yield were collected by direct measurement in the field and by farmers' memory recall on the quantity harvested.

Data were analyzed using different analytical tools to such as descriptive statistics (frequency tables and percentages) were used to achieve objective I and II, objective III was analyzed using gross margin (GM) analysis, and objective IV was analyzed using principal component factor analysis.

Factor analysis was used to analyze the factors that influenced the farmers' adoption of transplanting or direct seeding rice planting method and constraints associated with rice farming generally. In the analysis of factors, the Principal Component Analysis (PCA) or factor loading was used as used by Kothari (2004). The Principal Component Analysis is built on the assumption that: the error terms (e_i) are independent of one another, such that $\sum(e_i) = 0$, and $Var(e_i) = \delta_i^2$, thus, each $e_i$is an outcome of a random draw with replacement from a population of e_i values having means of zero (0) and certain variance δ_i^2.

The observable factors F_i are independent of one another and the error term, and such that $\sum(F_i) = 0$ and Vari $(F_i) = 1$. Therefore, each observable variable or factor Y_i, is linear function of independent factors, F_i and error term (e_i). Using the assumptions of PCA, factor isolation was based on Kaiser's rule of thumb of 0.4 variable values as a minimum loading weight for isolating a factor as being positive to the attribute in question. Quantitatively:

$$Y_i = \alpha_{i0}+\alpha_{i1}F_1 + \alpha_{i2}F_2 + \alpha_{i3}F_3 \ldots + \alpha_{in}F_n+e_i \quad (1)$$

Where;α_i = parameter or loading. Thus, a_1- α_n is the loading of the variable Y_i on factor F_n.

Y_i = dependent variables, F_i = independent Variables

Gross margin is the gross income from an enterprise less the variable costs incurred in achieving production. It is the estimate of the income and costs associated with activities in a farm business. In calculating gross margin, the cost of goods or products sold is subtracted from the

price of the item sold. In this study, GM was used to determine the cost and return of transplanted and direct seeded rice in the study are. The formula for gross margin is written thus;

GM = TR – TVC (2)

Where; GM = Gross Margin, TR = Total Revenue, TVC = Total Variable Cost.

While the farmers' profit was calculated by gross margin less the total fixed cost.

Profit =GM – TFC (3)

Where; GM = gross margin, TFC = total fixed cost

However, return on investment is calculated as: $\frac{TR}{TC}$ (4)

RESULTS AND DISCUSSION

The results of data analysis based on the specific objectives of this study were presented under the following headings: socioeconomic characteristics of transplanted and direct seeded rice farmers in the study area, factors that influence the adoption of transplanted and direct seeded method of growing rice, rice yields difference of transplanted and direct seeded rice, costs and returns of transplanted and direct seeded rice planting methods, effects of socioeconomic characteristic of transplanted and direct seeded rice farmers on their adoption of transplanted or direct seeded method of planting rice and constraints to transplanted and direct seeded rice planting methods in the study area.

Socioeconomic Characteristics of Transplanted and Direct Seed Rice farmers in Ebonyi state

The result of the socioeconomic characteristics of rice farmers in Ebonyi State was presented in (Table 1). The result showed that majority of the transplanted (76.7%) and direct seeded (87.8%) rice farmers were males. This study was in agreement with Adebayo *et al*., (2008) who stated that majority of rice farmer in Nigeria are males, quoting Misari, (2002) who revealed that greatest numbers of rice farmers are males which had a great significant influence on rice output in Nigeria. The result also revealed that the average age of rice farmers in the state was 37 years for transplanted rice and 41 years for direct seeded rice farmers. This result agreed with Olukosi and Erhabor (2005), that the age of rice farmers the active productive age. Furthermore, greater number in Ogun state were less than (50) years which was within (69.2%) of transplanted rice farmers and 80.8% of the direct seeded rice farmers were married.

This finding was in agreement with Sharma and Datta (2010) who inferred that most of the rice farmers in India were married which contributed significantly to their level of rice production.

Furthermore, Oyewole *et al.,* (2010) reported that most rice farmers in Bunkere Local Government Area of Kano State Nigeria were married.

Most of the rice farmers in the state have one form of education or the other. Majority of the surveyed transplanted and direct seeded rice farmers (48.3%) had secondary school education. The finding was consistent with Ojuokaiye (2001) who revealed that education is an essential socioeconomic factor that influences the level of rice production in Nigeria because of its effect on the awareness, perception, reception and quick adoption of innovation that can increase productivity. The mean household size of the transplanted rice farmers was 4 while that of direct seeded rice farmers was 6. This is in agreement with the findings of Chima (2015) who reported that the average household size of rice farmers in Enugu state was less than 10 persons. Large family size is assumed as an indicator of labour availability in the family. Also, the mean annual income of the transplanted rice farmers was three hundred and thirty four thousand naira (₦334, 000), while that of direct seeded rice farmers was three hundred and fifty six thousand naira (356,000). This finding was in accordance with Igboji *et al.,* (2015) who asserted that annual income of rice farmer in Ebonyi State was very low, hence low rice production in the state. Low annual income is a constraint that associated with rice farming and as such, high cost of fertilizer, pest and cost of labour and transportation and lack of improved varieties. However, the finding of this study was not in agreement with Ohaka *et al* (2013) who reported a high annual income of rice farmers in Bekwara L.G.A of Cross River State.

Greater number of transplanted rice farmers (53.3%) had a farm size of between 3 – 4 hectares and (47.5%) for direct seeded rice farmers, while 25.0% and 40.8% of transplanted and direct seeded rice farmers had a farm size of <2 and ≥ 5ha respectively. Moreover, the average farm size of the farmers was 2.5hacters transplanted rice farmers and 2hacters for transplanted rice farmers. This conforms to the findings of Igboji et al., (2015) who reported that the average rice farm size range between 2.5 – 3ha in Ebonyi State. This implies that most of the farmers had a small farm size which is an impediment to agricultural mechanization. The result indicated that most of transplanted rice farmers (71.7%) had farming experience of five years and above while that of direct seeded rice farmers was (67.5%). 15.8% and (29.2%) had between 3–4years experience respectively.

This result conformed to the findings of Nwobiala (2014), who reported that most of the rice farmers in Ebonyi state had spent between 10 – 20 years in the

Table 1: Distribution of rice farmers according to their socioeconomic characteristics.

	Transplanting Method			Direct Seeding Method		
Variables	**Frequency**	**Percentage**	**Mean**	**Frequency**	**Percentage**	**Mean**
Sex						
Male	92	76.7		105	87.5	
Female	28	23.3		15	12.5	
Age:						
≤ 20	2	1.7		7	5.8	
21 – 30	25	20.8		28	23.3	
31 – 40	58	48.3	37	35	29.2	41
>40	35	29.2		50	41.7	
Marital status						
Single	22	18.3		12	10.0	
Married	83	69.2		97	80.8	
Divorced	7	5.8		3	2.5	
Widowed	9	7.50		8	6.7	
Level of education						
Non formal education	3	2.5		9	7.5	
Primary education	18	15		31	25.8	
Secondary education	58	48.3		61	508	
NCE/B. Sc	41	34.2		19	15.3	
Family Size						
≤ 2	20	1.7		22	18.3	
3 – 5	62	51.7	7	44	36.7	5
≥ 6	38	31.7		54	45.0	
Annual income						
≤ 100, 000	21	17.5		26	21.7	
101, 000 – 300,000	31	25.8	334, 000	32	26.7	315, 000
301, 000 – 500, 000	40	33.3		48	40.0	
>500, 000	28	23.3		14	11.7	
Farm Size						
1 – 2	26	21.7		49	40.8	
3 – 4	64	53.3	2.5	57	47.5	2
≥ 5	30	25.0		14	11.7	
Farming Experience						
≤ 2	15	12.5		4	3.3	
3 – 4	19	15.8	12	35	29.2	9
≥ 5	86	71.7		81	67.5	
Member of farmers association:						
Member	77	64.2		84	70	
Non member	43	35.8		36	30	

Source: Field Survey, 2017

Table 2: Distribution of the Rice Farmers Based on Yield per Hectare for Transplanted and Direct Seeded Rice.

	Transplanted Rice			Direct Seeded Rice		
Category	**Frequency**	**Percentage**	**Mean**	**Frequency**	**Percentage**	**Mean**
≤ 200	0	0		0	0	
201 – 300	2	1.7		0	0	
301 – 400	4	3.3		6	5	
401 – 500	1	0.8		3	2.5	
501 - 600	8	6.7	1900kg	3	2.5	1600kg
601 – 700	2	1.7		7	5.8	
701 – 800	7	5.8		12	10	
801 - 900	11	9.2		5	4.2	
901– 1000	21	17.5		27	22.5	
>1000	64	53.3		57	47.5	

Source: Field Survey, 2017

system. Experience, they say, is the best teacher. Meanwhile, 64.2% of transplanted rice farmers do not belong to any farmers association while 70% of direct seeded rice farmers also did not belong to any farmers association.

Membership of farmers association is identified to be a strong determinant to the adoption of new technology in rice farming (Oboh and Ineye, 2011).

Results of Yield Difference between Transplanted and Direct Seeded Method of Rice Production in the area

The result of frequency distribution of rice yield difference of direct seeding and transplanting method of planting rice was presented in (Table 2). The result showed that there was a yield difference between transplanted and

Table 3: Distribution of the Respondents Based on Cost and Returns for Transplanted and Direct seeded Rice Method.

		Transplanted Rice			Direct Seeded Rice		
	Items	**Quantity**	**Cost/Unit (₦)**	**TC/TR(₦)**	**Quantity**	**Cost/Unit (₦)**	**TC/TR (₦)**
A	**Variable Cost**						
	Rice Seed	2bags(50kg)	8,500	17,000	2bags (50kg)	8,500	17, 000
	Herbicide	8litres	1,300	10,400	10litres	1,300	13,000
	Fertilizer	6bags(50kg)	8,000	48,000	4bags(50kg)	8,000	32,000
	Pesticide	3litres	1,150	3,450	3litres	1,200	3,600
	Land preparation (nursery)	4MD	1,500	6,000	-	-	-
	Land preparation (swamp)	13MD	2,000	26,000	-	-	-
	Land preparation(direct seeding)	-	-	-	8MD	2,000	16,000
	Planting (transplanting)	17MD	1,500	25,000	-	-	-
	Planting (direct seeding)	-	-	-	13MD	1,500	19,500
	Pesticide application	2MD	1,000	2000	2MD	1,000	2,000
	Fertilizer application	4MD	1,200	4,800	3MD	1,000	3,000
	Weeding(pre-emergence herbicide)	4MD	1,500	6,000	5MD	1,500	7,500
	Weeding(post-emergence herbicide)	2	1,500	3,000	3MD	1,500	4,500
	Harvesting	15	1,100	16,500	11	1,300	14,300
	Transportation	LS	-	17,000	LS	-	14,650
	Miscellaneous	LS	-	5,000	LS	-	5,000
	Total variable Cost (TVC)			190,150			152,050
B	**Fixed Cost**						
	Land Renting	1ha	30, 000	30, 000	1ha	30, 000	30, 000
	Hoe	2	3000	6000	2	3000	6000
	Cutlass	1	1500	1500	1	1500	1500
	Wheel barrow	1	10, 000	10, 000	1	10,000	10,000
	50kg bags	38	100	3800	32	100	3200
	Total Fixed Cost (TFC)			51,300			50,700
	Total Cost (TC) = TVC+TFC			241,450			202,750
C	**Revenue**	38bags	8,500	323, 000	32	8,500	272, 000
	Gross Margin(GM)= TR-TVC			132,850			119,950
	Profit = TR - TC			81,550			69,250
	Return to Investment =			1.34			1.34

Source: Field Survey 2017

direct seeded rice. While transplanted rice had average yield of 1900kg which was equivalent to 1.9 tons, direct seeded rice recorded 1600kg which was equivalent to 1.6 tons of rice per hectare. These indicate a yield difference of 0.3tons in favour of transplanted rice against direct seeded rice. This study is in agreement with the findings of Nwalieji (2016) who reported that transplanted rice yielded higher than broadcasted rice in Anambra state, Nigeria. According to Bakar et al., (2000) there was a significant different in the grain yield of transplanted and direct seed rice in India. In a similar way, Kundu *et al.* (2013) and Balasubramanian and Hill (2002) both opined that there were higher grain yield in transplanted rice than direct seeded rice in South Asia. However, this study was not in agreement with Mujammad *et al.* (2015) who stated that there was higher grain yield in direct seeded rice than transplanted rice, though the different was not significant. Fabusoro *et al.* (2010) attributed high grain yield on transplanted rice to appropriate spacing, stating that the number of panicles per plant and yield increase with increase in spacing of transplanted rice.

Cost and Return on Transplanted and Direct Seeded Rice Method of Rice Production in Ebonyi State

To compare the cost and return of transplanted and direct seeded rice farmers in the study area, the profitability was measured using gross margin (GM) analysis. To achieve this, the average operating input, labour cost and revenue per hectare of the two methods of planting rice in the study area were ascertained. 50kg bag was used as a yardstick for the measurement of quantity of rice produced. Table 3 showed a gross margin analysis of one hectare (1ha) of rice farmers in the study area for transplanted and direct seeded rice farmers. Table 3 revealed that total cost of production was ₦241, 450 and ₦202, 750 for transplanted and direct seeded rice respectively. This implies that rice farmers incur lesser cost in rice production by using direct seeding method of planting than transplanting method. This agreed with Ajah and Ajah (2014) who stated that the cost of producing rice through broadcasting was less than transplanting in Anambra State, Nigeria. The results further revealed that the average total revenue from paddy sale per hectare for transplanted and direct seeded rice was ₦323, 850 and ₦272, 000 respectively. This implied that rice farmers realized higher income using transplanting rice method than direct seeding method. This is in line with Muhammad *et al.,* (2015) who reported that income generated by transplanted rice farmers was significantly higher than that of direct seed rice in Pakistan. The result also indicated that the gross margin of transplanted and direct seeded rice farmers was ₦132,850 and ₦119,150 respectively, implying that rice farmers' gross income was higher in transplanting method than direct seeding method. This study conformed to the finding of Nwalieji (2016) who stated that transplanted rice farmer in Anambra

Table 4: Factor Analysis on Constraints to Transplanted and Direct Seeded Rice Farming.

		Transplanted Rice Method			Direct Seeded Rice Method		
S/N	**Constraints**	**Factor-I Economic**	**Factor II Institutional**	**Factor III Technical**	**Factor-I Economic**	**Factor II Technical**	**Factor III Institutional**
I	high land fragmentation	- 0.464	0.911	-0.166	0.002	0.102	0.864
II	Poor knowledge	-0.167	-0.241	0.744	-0.098	0.883	0.061
III	lack of finance	0.890	0.275	-0.209	0.590	0.168	-0.128
IV	inconsistent weather/climate	-0.056	0.932	0.642	-0.080	-0.037	0.899
V	poor yield	0.697	0.358	0.260	0.771	0.539	0.044
VI	excessive lodging	0.158	0.028	0.893	0.844	-0.109	0.601
VII	poor access to loan	0.957	0.007	0.091	0.647	0.558	-0.015
VIII	Early/late time of maturity	0.301	0.224	0.429	0.368	-0.313	0.611
IX	poor fertilizer utilization	-0.074	0.104	0.043	0.118	0.604	0.229
X	high cost of production	0.953	0.021	0.079	0.410	-0.229	-0.003
XI	high weed infestation	0.361	0.196	0.092	0.478	0.373	0.119
XII	poor extension service	-0.074	0.974	0.043	0.235	0.042	0.812
XIII	Low water availability	0.262	0.857	0.605	0.307	-0.069	0.691
XIV	high pest infestation	0.917	0.025	0.086	0.634	0.313	-0.209

Source: Field Survey, 2017

State and Ebonyi State had greater profit than broadcasted rice farmers. In line with this study also, Nguyen and Ferrero (2006) stated that transplanted rice farmer in Asia earns more income than direct seeded rice farmers. Further analysis showed that return to investment was approximately the same (1.34) for both transplanted and direct seeded rice farmers (Table 3). This implies that for every one naira invested in rice production, the farmer realizes ₦1.34 implying that there is no difference in return to investment of the farmers using either transplanting or direct seeding techniques in rice production.

Constraints to Transplanted and Direct Seeded Rice Farming in the Study area

Under economic constraints; the identified economic factor that constrained transplanted and direct seeded rice farmers in the study area were lack of finance (0.890) and (0.590) respectively, implied that the rate of financial problem was greater in transplanted rice than direct seeded rice (Table 4). This finding is in agreement with Olatomide and Omowumi (2015), who stated that lack of finance constitutes critical obstacle in agribusiness investment in Lagos State. Poor yield (0.697) and (0.771) respectively. This implied that low yield of rice posse serious barrier to both direct seeded and transplanted rice farmers in the study area, though the problem is more in direct seeded rice (Table 4). In similar findings, Djomo *et al.,* (2016) reported low yield as major constraint in adopting and practicing direct seeded rice method in West Region of Cameroon. The quantity of rice paddy determines the profitability of the business. Lack of access to loan (0.957) and (0.647) respectively. This study is in conformity with Dauda *et al.,* (2009) who asserted that the major factor that inhibits agricultural activities was poor access to credit.

The study revealed that lack of access to loan is one of the major limitations of rice farmers in the study area using either transplanted or direct seeded rice planting method.

The study also showed high cost of production load 0.953 and 0.558 for transplanted and direct seeded planting method respectively. This implies that the cost the farmers incur in growing rice poses a major hindrance in their productivity and profitability using transplanting methods, while for direct seeded method, high cost of production seems not to be the major constraint. This was in-line with Thakur, (2013) who identified high cost of production to be an impediment in rice productivity in India. In the same way, Sharma, (2005) stated that cost are incurred in land, seed, fertilizer, agrochemicals and labour and hence considered by farmer as a major constraint that affect their profitability. Further analysis showed that high pest infestation as a constraint loaded 0.917 for transplanted rice and 0.634 for direct seeded rice. This implies that pest poses serious danger to both transplanting and direct seeding rice method, but mostly when using transplanting method. In conformity with this findings, Min *et al.,* (2011) asserted that incidence of pest attack can cause total loss of farm product. Adekunle *et al.* (2009) also perceived pest attack to be a factor that affects crop yield and farmers' profitability.

The identified constraints under technical factors were lack of knowledge and lodging. The result of this study revealed that lack of technical know-how loaded 0.744 and 0.883 for transplanted and direct seeded rice respectively. This means that technical knowledge causes more problem/hindrance using direct seeding rice planting methods. This finding is in total conformity with Alarima (2011) who stated that lack of technical knowledge hinder the effective production of rice using drilling and dibbling method of rice seeding. In addition Ajah and Ajah (2014) also identified lack of knowledge or

skill to constitute the factors that hinder profitability of rice production in cross River State. The findings of this study revealed that high lodging loaded high for both transplanting and direct seeding of rice method with the value of 0.601 and 0.893 respectively. This implied the excessive lodging poses more problems when rice is planted using direct seeding than when transplanted. Crop lodging is a condition under which plant stems at the base of the crop weakens to the point of no longer being able to support the weight of the upper part of the plants, causing it to fall in the field. In agreement with this study, Hayashi, et al. (2007) reported that lodging is one of the major problems faced by rice farmer in Ethiopia.

The perceived institutional factor that constrained transplanted and direct seeded rice farmer in the study area include: high land fragmentation, low water availability, poor extension service, untrusted weather/climate and low fertilizer utilization.

The study showed that high land fragmentation loaded 0.911 and 0.864 for transplanted and direct seeded rice respectively. This implies that low land availability issues poses great challenge to both transplanted and direct seeded rice. However, the lower loading of the factor on direct seeded rice method could be attributed to less demand of land for direct seeded rice as it requires lesser space for operation. According to Akande, (2001) Land fragmentation is one of the major problems and characteristics of Nigeria agriculture. This study confirms the finding of Alarima *et al.* (2011) who asserted that land acquisition and land tenure system is one of the constraints faced by Sawah rice production in Nigeria. In addition, Osanyinlusi and Adenegan (2016) also reported that cost of acquiring land and poor access to land reduce the productivity of rice farmers in Ekiti State.

The changes in crop production related to climate/weather variability will possibly have major influences on regional and global (Hoogenboom 2000). This study identified untrusted weather and climate to be one of the major setbacks that both transplanted and direct seeded rice farmers in the study area have in their rice production with the value of (0.932 and 0.899) respectively. The finding of this study is in line with Nwibo and Eze (2016) who reported that climate change was one of factors that affect farmers' productivity in Ebonyi State. Climate change can reduce crop yield thereby reducing their profit. Furthermore, the loaded values of lack of water as institutional constraint were 0.857 and 0.691 under transplanted and direct seeded rice farmers respectively. This implied that lack of water possess more trait to rice production through transplanting than as it is in direct seeding method. This agreed with the finding of Akinbile *et al.,* (2011) who reported that water is a major constraint on rice production in Malaysia. More so, poor extension service had been identified by this study to be an impediment to rice production using either transplanting or direct seeding rice planting with loaded value of 0.974 and 0.812 respectively. In agreement to these findings, Ajah and Ajah (2014) and Okam *et al.* (2016) both stated that lack of extension service reduce profitability of rice production in Nigeria.

Conclusion

Based on the findings of this study, the yield of rice using transplanting method is higher than that of direct seeding. It takes more finance to produce/grow rice through transplanting than in direct seeding method. Both transplanting and direct seeding methods of rice production are profitable.

Recommendation

Based on the findings of this study, the following policy recommendations were outlined;

1. Rice farmers should embrace the use of direct seeding since it is identified to be easier and cheap to practice and it has the same return to investment rate with transplanting method.
2. Farmers are advised to form cooperatives to enable them access loan from financial institutions and also to enjoy the current agricultural grant that the present government is offering to farmers.
3. Rice farming should not be left for rural farmers alone. It is advised that business men, politicians and civil servants in the state should invest in rice farming especially this time that government has introduced one man one hectare farming policy in Ebonyi State to ensure rice sufficiency.

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