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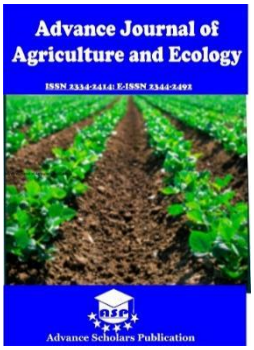

EFFICIENCY OF OUTGROWER SEED PRODUCTION IN NORTHWEST AND NORTHCENTRAL NIGERIA

C. G. Aguiyi, U.S. Mohammed; C. O. Adebayo and A. Ogaji
Department of Agricultural Economics and Farm Management, Federal University of Technology, Minna, Nigeria
**Corresponding author E-mail and Phone number: abdullahibashiru70@gmail.com +234 8184349634*

Keywords: Financial; Viability; Outgrower; Seed; and Production

Abstract: *The study was conducted to assess financial viability of outgrower seed production in Northwest and North-central, Nigeria. Multi-stage sampling technique was used to select 394 respondents for the study. Structured questionnaire complemented with interview schedule was employed to collect primary data. Data collected were analysed using farm stochastic frontier model. The results showed that seed out-growers in North-central (1.1208) and North-west (1.5029) are operating with increasing returns to scale while farm size, fertilizer and agrochemicals positively influence the technical efficiency of farmers. However, quantity of seed used by farmers had inverse relationship with technical efficiency. More so, amount received as credit, numbers of extension contacts and membership of cooperative decreases technical inefficiency. These services can help farmers make informed decisions, enhancing productivity and consequently, profitability.*

Introduction

NASC (2018) describes that the seed industry includes all domestic and foreign seed companies, community-based seed producers, other local seed entrepreneurs, and agro-dealers that engage in the production and/or marketing of quality seed. Over the years, seed companies adopted out-grower schemes to increase their production towards meeting the market demands for improved seeds. The Out-grower schemes can be described as a form of contract farming where the seed companies supply the raw material for the seed production (foundation seeds, breeding lines for hybrid seeds), provide technical assistance, credit, and input services, and then repurchase the seeds at the end of the season under some form of predefined contractual arrangements (Veettil *et al.,* 2021).

The United Nations Conference on Trade and Development (UNCTAD), in 2009 noted that contract farming has become a potentially viable model for coordinating production and ensuring higher-quality, safer food and lower production and marketing costs for producers in developing

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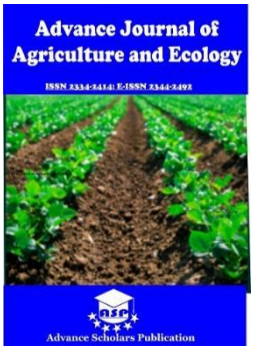

countries (UNCTAD), 2009). Out-grower schemes have gained prominence as a business model that can benefit both smallholders and investors. Such schemes can improve smallholders' access to markets, finance, infrastructure, and improved growing techniques; can enhance investors' access to land, labor, and quality produce; and can improve investor-community relations (World Bank 2018).

Abdulai and Al-Hassan (2016) broadly described out-grower schemes as an institutional arrangement between farmers and businesses to produce and transact agricultural commodities at predetermined prices and conditions. Similarly, Food and Agriculture Organization (FAO) (2018) illustrated that at the heart of contract farming and out-grower schemes lies an agreement between farmers (producers) and buyers: both agree in advance on the terms and conditions for the production and marketing of farm products. These conditions usually specify the price to be paid to the farmer, the quantity and quality of the product demanded by the buyer, and the period for delivery to buyers. Rohrbach *et al.* (2019) noted that many farmers do not have access to commercially processed seeds that can be bought at a nearby retail outlet and many released varieties have never been widely disseminated. Inadequate access to improved seeds by farmers is a major cause of low yield for most major crops. However, it has also been noted that most seed access problems are due to seed company's inability to meet the market demand for improved seed and the issues of ineffective seed supply chain management that makes it difficult to deliver quality improved seeds to farmers to enable them to increase their productivity (Ajuka *et al.,* 2021). According to NASC (2018), the Nigeria's total national seed requirements for major crops, including maize and rice, stood at 413,417.64 metric tons (MT) in 2017, however, only half of this demand is met. Seed companies engage the service of out-grower to augment the gap in what is produced from their seed production fields. Also, there is limited documented evidence to show whether seed companies in the study area provide their contracting farmers with access to inputs, whether the extension services and inputs given under the schemes can improve the input use efficiency of the out-growers. It was based on the foregoing the study was conducted to determine technical efficiencies of the out-grower seed production system

RESEARCH METHODOLOGY

The study was conducted in selected States within the North West and North Central geopolitical zones of Nigeria. The North Central States are Benue, Kogi, Kwara, Nasarawa, Niger, Plateau, and the Federal Capital Territory (FCT). These States extend roughly from latitude 60°50'N to 90°30'N of the Equator and longitude 70°30'E to 100°00'E of the Prime Meridian. The area has a projected population of 22,325,056 million people at 2.5 percent population growth

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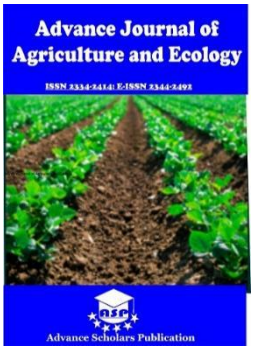

rate (National Population Commission (NPC), (2020)

Sampling Technique and Sample Size

A multistage sampling technique was used to select the respondents (out-growers) for the study. The first stage involved a purposive selection of the two geopolitical zones based on the significant number of registered seed companies in the zones. As of November 2019, there are 314 registered seed companies in the National Agricultural Seed Council (NASC) database, of which, 199 are located in the selected zones. The second stage involved the purposive selection of 2 States from each zone based on the significant presence of seed companies and seed production activities. The States selected are Niger and FCT for the North-central zone while Kaduna and Kano States were selected for the Northwest zones.

Methods of Data Collection

Primary data were used for this study; the primary data were collected using structured questionnaires complimented with interview schedules. The collected data were analysed using stochastic frontier model.

Stochastic frontier model

The Stochastic Frontier Model was used to achieve objective of the study. The stochastic function model for the seed producers is specified as follows:

$Y = f(Xa; \beta)\, e\varepsilon$ (1)

Where Y = output, X = vector of input, β = vector of parameter; e = error term; ε is the stochastic disturbance term consisting of two independent elements "V" and "U". Both U and V are independent of each other. Hence ε = U+V. However, the general empirical model to be used in the analysis of the technical efficiency is specified as:

$$LnY_i = \beta_0 + \beta_{1i}LnX_1 + \beta_{2i}LnX_2 + \beta_{3i}LnX_3 + \beta_{4i}LnX_4 + \beta_{5i}LnX_5 + \beta_{6i}LnX_6 + \beta_{7i}LnX_7 + V_1\text{-}U_1 \quad (2)$$

Where:

Y_i = quantity of i^{th} seed produced per out-growers (grain equivalent)

X_1 = Farm size for i^{th} seed out-growers (ha)

X_2 = Labour used to produce i^{th} seed (man-days)

X_3 = Quantity of i^{th} foundation seed used (grain equivalent)

X_4 = Quantity of fertilizer used to produce i^{th} seed (kg)

X_5 = Agrochemical used in producing i^{th} seed (litres)

$B_1 - \beta_7$ = Parameters estimates

V_i = Normal random errors assumed to be independently and identically distributed, having N (0, δ^2) and U_i = Non-negative (zero mean and constant variance) random variables called technical inefficiency effect associated with technical efficiency of the i^{th} farmer U_{ij}'s are the technical inefficiency effects which are assumed to be independent of V_{ij}'s such that U_{ij}'s is the non-negative truncation (at zero) of the normal distribution with U_i and variance δ^2 v. where U_i is defined as:

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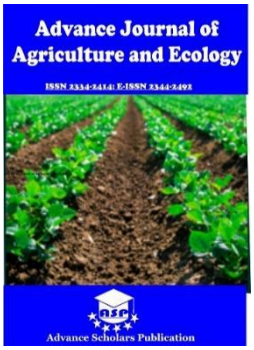

$-U_i = \beta_0 + \beta_{1i}LnZ_1 + \beta_{2i}LnZ_2 + \beta_{3i}LnZ_3 + \beta_{4i}LnZ_4 + \beta_{5i}LnZ_5 + \beta_{6i}LnZ_6 + \beta_{7i}LnZ_7 + \beta_{8i}LnZ_8 + \beta_{9i}LnZ_9 + \beta_{10i}LnZ_{10} + \beta_{11i}LnZ_{11} + \beta_{12i}LnZ_{12} + ... + V_1-U_1$ (3)

$-U_i$ = Technical inefficiency of the seed out-growers output

Z_1 = Age of the seed out-growers (Number of years)

Z_2 = Years of experience in out-grower schemes (Number of years)

Z_3 = Gender of (1 = male, 0 = female)

Z_4= Proximity to research institutions (km)

Z_5= Amount spent on seed treatment to produce i^{th} seed (₦)

Z_6= Value of inputs provided (₦)

Z_7= Value of credit (₦)

Z_8= Number of extension contacts (Number)

X_9= Number of training (Number)

Z_{10}= Number of years spent in formal educational (Number)

Z_{11}=Membership of cooperative (1=Yes and 0=No)

Z_{12}= Formal contract (1=Yes and 0=No)

Ln = sign for natural logarithm

$B_1 - \beta_6$ = Parameters estimates

RESULTS AND DISCUSSION

Technical efficiency of out-growers seed production

Table 1 present the results of technical efficiency of out-growers seed production in the study area. The estimated gamma (γ) values are 0.60524 for North-central and 0.5901 for North-west, indicating that 60.5% and 59% of the variation in production output among sampled farmers in these regions can be attributed to differences in technical efficiency. The sigma squared (σ^2) values are 0.0107 and 0.0109 for North-central and North-west, respectively, both statistically significant at the 1% level. These values confirm the model's accuracy in capturing the composite error term, validating the reliability of these efficiency estimates. The estimated returns to scale was 1.1208 in North-central and 1.5029 in North-west region, the findings indicate that farmers are operating under increasing returns to scale.

The results in Table 4.26 showed the coefficient of farm size (0.0790 and 0.0787) to be positively significant at 5% and 10% level of probability among the farmers in North-central and North-west region respectively, suggesting that larger farm sizes contribute to improved technical efficiency in seed production. As farm size increases, farmers benefit from economies of scale, potentially spreading fixed costs over a larger output and optimizing input use. This effect is particularly important in out-grower seed production, where efficient land use can enhance yields and meet production targets more effectively. The pooled result also showed a positive and significant relationship between farm size and output at 1% level of probability thus, indicating the relevance of size of land in commercial out-grower seed production. This finding corroborate with Karamyshev *et al.* (2018) and Ajibefun (2018) who reported that the size of farmland cultivated determines to a larger extent the level of output produced in crop production enterprise.

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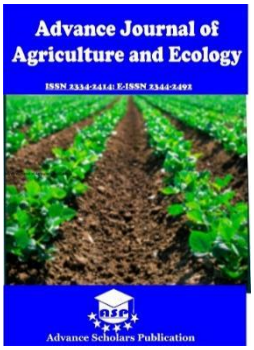

Table 1: Maximum likelihood estimates of technical efficiency of out-growers seed production North West

Variables	**North Central**	**North West**	**Pooled**
Cost factors	**Coefficient (Z-value)**	**Coefficient (Z-value)**	**Coefficient (Z-value)**
Farm size	0.0790(2.00**)	0.0787(2.01*)	0.0557(4.60***)
Labour used	0.0173(0.99)	-8.29e-08(-0.05)	0.0143(2.17**)
Quantity of seed	-0.0802 (-2.23**)	-0.0796(-2.25**)	-0.0173 (-9.40***)
Quantity of fertilizer	0.9068(5.86***)	0.9067(5.41***)	0.0116(0.22)
Quantity of agrochemicals	0.0125(0.27)	0.0703(2.02**)	-0.0947(-0.27)
Return to scale	1.1208	1.5029	0.7551
Age	1.5078 (4.71***)	1.4052 (4.60***)	0.5603 (1.48)
Years of experience	-2.4210 (-3.10***)	-2.1903 (-2.92***)	-0.8684 (-5.48***)
Proximity to research center	-0.0898 (-0.30)	0.0057 (0.03)	4.8759 (1.45)
Amount spent on seed treatment	-0.0153 (-0.25)	-0.0012 (-0.05)	-0.0514 (-2.30**)
Value of credit accessed	-0.0812 (-2.20**)	-0.0506 (-0.71)	-0.1371 (-4.50***)
Number of extension contact	-0.7802 (-3.80***)	-0.0639 (-2.01*)	-0.4253 (-3.55***)
Number of training received	-0.1054 (0.35)	-0.7281 (-3.67***)	-0.6709 (-4.10***)
Years in formal education	-0.1398 (-0.80)	-0.1306 (-0.45)	-0.0497 (-0.70)
Membership of cooperatives	-1.6025 (-2.80***)	-1.5961 (-2.90***)	-0.5256 (-2.25**)
Constant	7.0512(7.15***)	7.0463(7.47***)	7.1313(1.06)
Diagnostics statistics			
Number of observation	155	239	394
Prob >chi^2	0.0000***	0.0000***	0.0000***
Sigma	0.0107(3.91***)	0.0109((4.09***)	0.0154(4.03***)
Gamma	0.6054***	0.5901***	0.6083***

Source: Field survey, 2023

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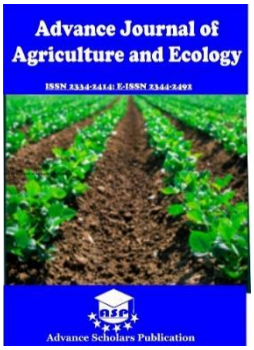

However, the coefficient of quantity of seed used by farmers in North-central (-0.0802) and North-west (-0.0796) were negatively significant at (5%) level of probability respectively, suggesting an inverse relationship between seed quantity and technical efficiency in these regions. This implies that an increase in the quantity of seed used may not necessarily enhance productivity; instead, it could lead to inefficiencies. The pooled result showed similar negative and significant relationship in quantity of seed and the outputs derived. This findings may be due to the over utilization of seeds from the relatively good number of seed companies involved in out-grower seed farming. Excessive seed use can lead to overcrowding, increased competition for resources such as nutrients and water and reduced plant growth and productivity. This reflects the principle of diminishing returns, where beyond a certain point, adding more seeds does not proportionally increase output and may even reduce overall. This finding disagrees with the result of Karamyshev *et al.* (2018) who revealed that using large quantity of seeds on fertile soils positively affects the technical efficiency of commercial wheat production in sub-Saharan Africa. Also, Goodhue and Simon (2016) reported that a large percentage of rural farmers in central agricultural zone of Nigeria had benefitted and participated actively from out-growers seed production companies and association thus, increasing yield in cereal crop production.

Further, the coefficient of fertilizer (0.9068 and 0.9067) was positively significant at 1% level of probability among farmers in North-central and North-west region respectively. This implies that a unit increased in the quantity of fertilizer used make likely led to an increase in the output produced when other variables are held constant. Also, the coefficient of agrochemicals (0.0703) was positively significant at 5% level of probability among the farmers in North-west region. Indicating that a unit increase in the litres of agrochemicals used by the farmers leads to 7.0%, increase in the outputs produced as agrochemicals helps in crop protection and minimize loss due to insect pest infestation. This outcome indicates a rational production decision where factors of production are translated into output. This finding is in agreement with Bellemare and Bloem (2018) who revealed that coefficients of labour and fertilizer were positive and significant at 1% level of probability.

The coefficient of age of the farmers was positively significant at 1% level of probability among the farmers in North-central and North-west region respectively. This implies that an increase in the age of the farmers tend to increase the technical inefficiency of the farmers. Older farmers may have difficulty adopting new technologies or innovative farming practices due to a lack of familiarity or reluctance to change established methods. Additionally, the physical

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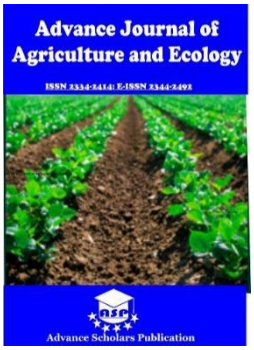

demands of farming may become more challenging as age progresses, reducing the farmer's capacity to manage farm activities effectively. This is similar to the study of Goodhue and Simon (2016) who reported age had inverse relation with technical efficiency.

Furthermore, the coefficient of years of experience was negatively significant at 1% level of probability among the farmers in North-central, North-west region and the pooled respectively. This implies that as farmers gain more experience in seed production, the probability of technical inefficiency decreases. This suggests that more experienced farmers are better at managing their resources and farm operations efficiently. This result corroborates with the findings of Cromwell, (2016) who reported that farming experience had direct relationship with technical efficiency

More so, the coefficient value of credit received was negative and significant at 5% level of probability among the farmers in North-central region and 1% in the pooled sample. This implies that access to credit is associated with a reduction in technical inefficiency in seed production. In other words, farmers who received credit were more likely to operate more efficiently in their seed production activities. The availability of credit provides farmers with the financial resources needed to invest in essential inputs such as fertilizers, better seeds and equipment, which enhance their productivity. This result is in consonance to the findings of Abdullahi (2019) who reported that access to credit is major predictor of technical efficiency among seed farmers in Nigeria.

Also, the coefficient of number of extension contact was negative and significant at 1% and 10% level of probability among the farmers in North-central and North-west region respectively. This indicates that an increase in the frequency of extension contacts is associated with a reduction in technical inefficiency. This implies that farmers who received more extension services tended to be more efficient in their seed production practices. Extension services provide farmers with crucial information on improved farming techniques, pest control, soil management and other aspects that enhance productivity. This finding is in line with Nwosu *et al.* (2021) who revealed that increased extension services to farmers tend to decrease technical inefficiency in rice production among farming household of northern Nigeria.

Likewise, membership of cooperatives was negative and significant at 1% level of probability among out-growers in North-central and North-west region respectively. This implies that an increase in farmers' membership of cooperative society leads to decrease in technical inefficiency of the farmers. This suggests that cooperative membership helps improve farmers' technical efficiency in seed production. By joining cooperatives, farmers gain access to collective resources, shared knowledge, and better bargaining power for inputs. This result is in

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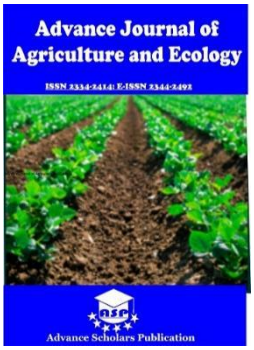

consonance to the study of Ndem and Osundu (2018) who reported that most of the farmers in Northern Nigeria belongs to at least one farmers' association and derive timely agronomic information to enhance their productivity.

The distribution of farmers' technical efficiency indices derived from the analysis of the stochastic production function is presented in Table 2. The technical efficiency of the sampled farmers ranged from 0.19 to 1.0. The mean technical efficiency was estimated to be 0.93 and 0.94 among out-growers in North-central and North-west region respectively, meaning that an average farmer in the study area has the scope for increasing technical efficiency by 7% and 6% in the short run under the existing technology. This would enable the average farmer equates the marginal value product (MVP) of the inputs to the marginal cost of the inputs thereby increasing seed crop output and improving farm income.

Table 2: Technical efficiency estimates of the seed out-growers

Variables	**North Central**	**North West**	**Pooled**
TE levels	**Freq (%)**	**Freq (%)**	**Freq (%)**
≤0.20	1 (0.60)	16 (7.70)	17 (4.3)
0.21-0.40	12 (7.7)	22 (9.20)	34 (8.60)
0.41-0.60	7 (4.50)	30 (12.55)	37 (9.40)
0.61-0.80	11 (7.10)	46 (19.25)	57 (14.50)
0.81-1.00	124 (80.0)	125 (52.30)	249 (63.20)
Total	155 (100)	239 (100)	394 (100)
Mean TE	0.93	0.94	0.94
Minimum	0.19	0.19	0.19
Maximum	1.0	0.99	1.0

Source: Field survey, 2023

Only 8.3% and 16.9% of the out-growers farmers had technical efficiency of 40% and below, while about 4.5% and 12.5% had technical efficiency of 41-60% among the out-grower farmers in North-central and North-west region respectively. The result also shows that 7.1% and 19.25% had technical efficiency of 61-80%, indicating higher technical efficiency of the out-grower seed farmers in North-west region. The majority of the respondents (80% and 52.3%) had technical efficiency of 81-100%. The pooled results also shows that 63.2% of the out-growers farmers have technical efficiency of about 81-100% among the farmers across the study area. Thus, this result revealed that farmers in the study area were highly efficient in technical allocation of

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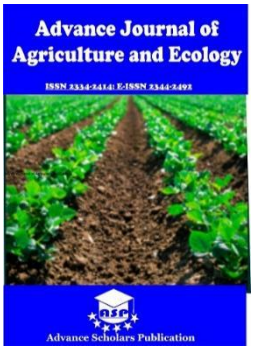

resources in producing a given level of output using cost-minimizing input ratios, which reflects the farmers' tendency to minimize resource wastage associated with production process. This finding is in line with the research of Yakubu *et al.* (2019) who showed that the majority of farmers (73%) had allocative efficiency of 71-90%, while only about 18% had efficiency of 91-100%. Thus, crop farmers were efficient in allocation of resources in producing a given level of output using cost-minimizing input ratios, which indicate the farmers' tendency to minimize resource wastage during production in Northern Nigeria.

Conclusion and Recommendations

Based on the findings of the study, it can be concluded that seed out-grower farmers were operating under increasing returns to scale while farm size, fertilizer and agrochemicals positively influence the technical efficiency of farmers. However, quantity of seed used by farmers had inverse relation with technical efficiency. More so, amount received as credit, numbers of extension contacts and membership of cooperative decreases technical inefficiency. The study recommended that seed companies should offer value-added services such as agronomic advisory, soil testing, and tailored fertilization plans. These services can help farmers make informed decisions, enhancing productivity and consequently, profitability.

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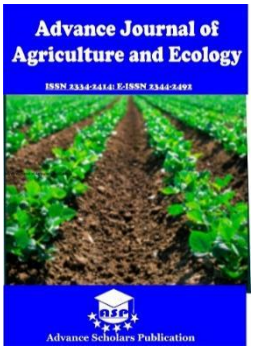

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