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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

ESTIMATING FARM LEVEL FINANCING GAP AND ALLOCATIVE EFFICIENCY AMONG TOMATO PRODUCERS IN NORTH WEST, NIGERIA

KUZEY BATI NİJERYA'DAKİ DOMATES ÜRETİCİLERİ ARASINDA ÇİFTLİK DÜZEYİNDEKİ FİNANSMAN AÇIĞI VE TAHSİS ETKİNLİĞİNİN TAHMİNİ

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ABSTRACT

The study estimates farm level financing gap and allocative efficiency among tomato producers in North West, Nigeria. Primary data are collected based on a well-structured questionnaire. The result shows that the significant stimulus influencing technical efficiency of tomato producers are farm size, seed, fertilizer, chemical, and labour. The significant regressors influencing technical inefficiency of tomato producers are age, amount of credit received, years of experience, educational level, and extension contact. The addition of first order derivatives of the production factors which is called the scale efficiency shows the decreasing return to scale in the frontier version adding up to 0.9748. The outcomes of the allocative efficiency [r] show that tomato producers under-utilized seed, land, fertilizer, chemical, and labour. The mean amount of finance (credit) per season the tomato producers had obtained is ₦ 54,470, while the mid-estimate of financing gap (FINGAP) in the form of finance (credit) needed to produce (yield) at the frontier stage is ₦ 312,641.66, this shows a credit shortfall of about 82.57%. Filling the FINGAP of smallholder tomato producers would increase the efficiency and productivity of rice farmers to meet the rise in demand.

Keywords: Farm Level, Financing Gap, Allocative Efficiency, Tomato Producers, Nigeria.

JEL Classification Codes: B23, C01, C40, D20, D51

ÖZ

Bu çalışma, Kuzey Batı Nijerya'daki domates üreticileri arasında çiftlik düzeyindeki finansman açığını ve tahsis etkinliğini tahmin etmiştir. Birincil veriler, iyi yapılandırılmış bir anket temelinde toplanmıştır. Sonuçlar, domates üreticilerinin teknik verimliliğini etkileyen önemli faktörlerin tarla büyüklüğü, tohum, gübre, kimyasal madde ve işgücü olduğunu göstermektedir. Domates üreticilerinin teknik verimsizliğini etkileyen önemli değişkenler ise yaş, alınan kredi miktarı, deneyim süresi, eğitim seviyesi ve uzatma bağlantısıdır. Üretim faktörlerinin birinci dereceden türevlerinin eklenmesiyle elde edilen ölçek etkinliği, sınır versiyonunda 0,9748'e kadar azalan ölçek getirilerini göstermektedir. Tahsis etkinliği sonuçları [r], domates üreticilerinin tohum, arazi, gübre, kimyasal madde ve işgücünü yeterince kullanmadığını göstermektedir. Domates üreticilerinin bir sezon boyunca elde ettikleri ortalama finansman (kredi) miktarı 54.470 Naira iken, sınır aşamasında üretim yapmak için gereken finansman (kredi) açığının (FINGAP) ortalama tahmini 312.641,66 Naira'dır. Bu, yaklaşık %82,57'lik bir kredi açığını göstermektedir. Küçük ölçekli domates üreticilerinin FINGAP'ının giderilmesi, pirinç çiftçilerinin verimlilik ve üretkenliğini artırarak artan talebi karşılamalarını sağlayacaktır.

Anahtar Kelimeler: Çiftlik Düzeyi, Finansman Açığı, Tahsis Etkinliği, Domates Üreticileri, Nijerya.

JEL Sınıflandırma Kodları: B23, C01, C40, D20, D51.

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GENİŞLETİLMİŞ ÖZET

Amaç ve Kapsam:

Bu çalışma, Kuzey Batı Nijerya'daki domates üreticileri arasında çiftlik düzeyinde finansman açığını ve tahsis etkinliğini tahmin etmiştir. Domates üreticileri, kredi veren kurum eksikliği, kaynakların verimsiz kullanımı ve çiftlik teknolojilerinin eksikliği nedeniyle düşük verimlilik ve düşük ürün miktarları ile karşı karşıyadır. Nijerya'da tarımsal üretimde karşılaşılan en önemli sorunlardan biri krediye (finansa) erişimdir (Ayyagari vd., 2012, s.13). Yetersiz bilgi, doğru FINGAP (finansal açık) büyüklüğünü tahmin etmeyi oldukça zorlaştırmıştır (Peer vd., 2013, s.15). Finansman (kredi) açığına dair veriler, politika yapıcıların Nijerya'daki domates üretiminin artan talebi nasıl karşılayabileceği ve domates üreticilerinin refahı ve verimliliğinin nasıl artırılabileceği konusunda politikalar oluşturmasına yardımcı olacaktır. Ayrıca, Murthy vd. (2009, s.9), kredi eksikliği ve domates üreticilerinin mevcut kaynakları ve çiftlik teknolojilerini tam olarak kullanamama durumunun, tarımda düşük verimlilik ve düşük üretkenlik deneyimlerine yol açtığını vurgulamıştır. Finansal açık, domates üreticilerinin verimliliği artırmak ve sınır düzeyinde üretim yapmak için ihtiyaç duyduğu kredi miktarıdır. Domates çiftlik faaliyetlerinin verimliliğinin artırılması isteniyorsa, büyük iş gücü, kredi, yüksek düzeyde yönetim, teknoloji ve bu kaynakların etkin kullanımının temin edilmesi gerekir. Nijerya'da domates üretimi 2021 ve 2022 yıllarında sırasıyla 3.477.981 ton ve 3.684.566,41 ton olarak gerçekleşti. 2021 ve 2022 yıllarında domates üretimine ayrılan alan sırasıyla 809.602 hektar ve 702.275 hektardır. 2021 ve 2022 yıllarında dünya domates üretimi sırasıyla 189.281.485,32 ton ve 186.107.972,48 ton olarak gerçekleşti. Dünya çapında domates ekim alanı 2021 ve 2022 yıllarında sırasıyla 5.046.596 hektar ve 4.917.735 hektardır (FAO, 2024). Nijerya'da tarımsal verimlilik düşüş göstermekte, domates üretimi düşük kalmakta, ülke hala kredi olanakları gibi kritik girdilerde, düşük verim, düşük üretkenlik, yüksek hasat sonrası kayıplar, gelişmiş teknolojilerin eksikliği, pazarlama altyapılarının eksikliği, kötü üretim uygulamaları ve işleme tesislerinin eksikliği gibi sıkıntılar yaşamaktadır (Akinniran vd., 2020, s.7). Bu çalışmanın özel hedefleri şunlardır: (i) domates üreticileri arasında ilgili faktörlerin özet istatistiklerini belirlemek, (ii) domates üretiminin teknik verimliliğini (TE) değerlendirmek, (iii) domates üretiminin tahsis etkinliğini (AE) değerlendirmek ve (iv) domates üreticileri arasındaki finansal açığı (FINGAP) tahmin etmek.

Yöntem:

Çalışma, Nijerya'nın Kano ve Kaduna eyaletlerinde gerçekleştirilmiştir. Örnekleme yöntemi olarak çok aşamalı bir yöntem kullanılmıştır. Birincil veriler, iyi tasarlanmış bir anket temel alınarak toplanmıştır. Toplam örneklem sayısı 120 domates üreticisinden oluşmakta olup, her iki eyaletten 60 domates üreticisi seçilmiştir. Anket, güvenilirlik ve geçerlilik testlerine tabi tutulmuştur. Örneklem sayısının hesaplanmasında Yamane'nin (1967, s.17) tarafından geliştirilen ve yaygın olarak kullanılan formül tercih edilmiştir. Veri analizi için tanımlayıcı ve çıkarımsal istatistikler kullanılmıştır. Çıkarımsal istatistikler arasında SPEFM (Stokastik Üretim Verimliliği Sınır Modeli), girdi tahsis etkinliği (AE) ve finansal açığın (FINGAP) tahmininde kullanılan HD (Harold-Domar) büyüme modeli yer almaktadır.

Bulgular:

Ortalama yaş, eğitim durumu, domates tarımındaki deneyim ve hane halkı büyüklüğü, sırasıyla yaklaşık olarak 47 yıl, 7 yıl, 11 yıl ve 5 kişi olarak belirlenmiştir. Benzer şekilde, ortalama çiftlik büyüklüğü, alınan kredi miktarı, krediye erişim ve domates üretimi sırasıyla 1,5 hektar, 54.470 Naira (1$ = N 1.170), 0,64 ve 11.809 kg olarak tespit edilmiştir. Teknik Verimlilik (TE) bileşenine dahil edilen uyaranların tahminleri pozitif olup, bunlar tarla büyüklüğü (0,3450), tohum (0,1201), gübre (0,1924), kimyasal (0,1428) ve işgücü (0,1745) olarak belirlenmiştir. Teknik Verimsizlik (TIE) bileşenine dahil edilen tahminleyicilerin türevleri ise negatif olup, bunlar yaş (-0,3472), kredi miktarı (-0,2028), deneyim süresi (-0,3472), eğitim seviyesi (0,1164) ve uzatma bağlantısı (-0,1164) olarak tespit edilmiştir. Ortalama TE skoru 0,71 olup, bu durum 0,29'luk bir verimsizlik açığına neden olmaktadır. Seçilen girdilerin tahsis etkinlikleri (AE), tohum için 281,78; arazi için 1,148; gübre için 19,687; işgücü için 6,967 ve kimyasal için 7,795 olarak belirlenmiştir. Domates üreticilerinin aldığı ortalama kredi miktarı sezon başına 54.470 Naira iken, ihtiyaç duyulan kredi miktarı (FINGAP) sezon başına 312.641,66 Naira olarak hesaplanmıştır.

Sonuç ve Tartışma:

Bu çalışma, Kuzey Batı Nijerya'daki domates üreticileri arasında çiftlik düzeyinde finansman açığını ve tahsis etkinliğini tahmin etmektedir. Birincil veriler, iyi yapılandırılmış bir anket temelinde toplanmıştır. Örneklem sayısı 120 domates üreticisinden oluşmaktadır. Veri analizi için çıkarımsal istatistikler kullanılmıştır. Domates üreticilerinin ortalama yaşı 47 olup, bu durum üreticilerin genç, güçlü ve kaynaklara erişebilir olduğunu göstermektedir. Domates üreticileri, ortalama tarla büyüklüğü 1,5 ha olan küçük ölçekli çiftçilerdir. Domates üretiminin teknik verimliliğini (TE) etkileyen istatistiksel olarak anlamlı uyaranlar tarla büyüklüğü, tohum, gübre, kimyasal ve işgücüdür. Üretim tahminleyicilerinin birinci dereceden türevlerinin eklenmesiyle elde edilen ölçek etkinliği, sınır versiyonunda 0,9748'e kadar azalan ölçek getirilerini göstermektedir. Bu, tüm faktörlerin belirli bir oranda artırılmasının, küçük ölçekli domates üreticilerinin çıktısında orantısız olarak daha az bir artışa neden olacağını ifade etmektedir. Domates üretiminin teknik verimsizliğini (TIE) etkileyen istatistiksel olarak anlamlı uyaranlar ise yaş, kredi miktarı, deneyim süresi, eğitim seviyesi ve uzatma bağlantısıdır. Seçilen uyaranların tahsis etkinlikleri (AE), tohum, arazi, gübre, işgücü ve kimyasalların yeterince kullanılmadığını göstermektedir. HD büyüme modeli, domates üreticilerinin sezon başına eriştiği ortalama kredi miktarının 54.470 Naira olduğunu, sınır aşamasında üretim yapmak için gereken ortalama kredi miktarının ise 312.641,66 Naira olduğunu göstermektedir. Bu, yaklaşık %82 oranında bir kredi açığı olduğunu ortaya koymaktadır. Domates çiftçilerinin TE, AE ve üretkenliği, zamanında kredi olanakları sağlanarak artırılabilir; küçük ölçekli domates üreticilerinin FINGAP'ının giderilmesi, pirinç üretiminin verimliliğini artırarak artan talebi karşılamalarını sağlayacaktır.

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1. INTRODUCTION

Tomato (*Lycopersicum esculentum*) is one of the most important vegetable crop in Nigeria, it contains vitamins, sugars, minerals, and essential amino acid. It is a crop that can be used to solve the problem of under-nourishment in sub-Saharan Africa (Ogaji et al., 2013, p. 12). Nigeria ranks 11th position in terms of world output of tomato (FAO, 2024). Tomato production contributes to Nigeria economic growth, generates income, employment and alleviate poverty among urban and rural dwellers (Adenuga et al., 2013, p. 8; Singh et al., 2017, p. 19). According to Abu et al. (2011, p. 6) who reported that output of tomato in Nigeria is low. In addition, Murthy et al. (2009, p. 9) reported that lack of credit and the inability of tomato producers to utilize fully the available farm technologies have resulted to lower efficiencies of output and low productivity experience in tomato production. Tomato farm activities require large labour, credit, high level of management, technologies, and efficient use of resources if productivity is to be enhanced.

The output of tomato in Nigeria for 2021 and 2022 are 3, 477,981 tons, and 3684566.41 tons respectively. The area cultivated for output of tomato in 2021 and 2022 are 809602 ha and 702275 ha respectively. The world output of tomato in 2021 and 2022 are 189281485.32 tons and 186107972.48 tons respectively. The world area cultivated for tomato in 2021 and 2022 are 5046596 ha and 4917735 ha respectively, the yield of tomato is low in Nigeria which was estimated in 2022 at 4295.9 kg ha^{-1} compared to world yield of tomato estimated in 2022 at 37844.2 kg ha^{-1}(FAO, 2024). Agricultural productivity in Nigeria is declining, output of tomatoes remains low, the country still experience deficiency in critical inputs such as credit facilities, low yield, low productivity, high post-harvest losses, lack of improved technologies, lack of marketing infrastructures, poor production practices, and lack of processing facilities (Akinniran et al., 2020, p. 7).

The tomato farmers are faced with low productivity, low yields due to lack of credit facilities, and lack of technologies. The research gap is that there is no enough data on comprehensive information on technical and allocative inefficiencies, financial gap among tomato producers, and the need to educate tomato producers of the efficient use of resources available at their disposal. Research investigation into efficiencies of tomato producers and stimulus that influence their levels of efficiencies is very significant in formulating policies targeted at enhancing productivity of the smallholder tomato producers within the constraints of available resource base and existing technology (Yusuf and Malomo, 2007, p. 8). The efficiency by which producers use existing resources and improved technologies is significant in agricultural production (Rahji 2005, p. 11). The productivity which is low in Nigeria agriculture has arised from the incapability of producers to completely use available innovations hence causing inefficiencies in production (Kumar et al., 2018, p. 14).

The influence of credit on TE (technical efficiency) of smallholder tomato producers have been given less attention. The documents on the financing (credit) gap can help the policy makers on how output of tomato in Nigeria can meet the rising demand and also the welfare and productivity of tomato farmers can be enhanced. Access to credit (finance) is one of the vital problems in agricultural production (Ayyagari et al., 2012, p. 13), and inadequate statistics has made it very hard to estimate the correct measurement of financing gap (Peer et al., 2013, p. 15). This shortage of finance (credit) from the traditional credit sector is high and this is a circumstance where the poor constitute the highest share of the population in many sub-Saharan African countries. The informal sector constitutes the major part of the economies of these developing nations (Ojo et al., 2020, p. 18). The financial gap is the credit availability (financial amount) required by tomato producers to enhance efficiency and produce at the frontier level (target efficiency) and this constitutes the external financing in the pattern of credit that would be needed by smallholder tomato producers.

The non-performance of tomato farms to meet the rising demand in Nigeria and globally has raised worry over the capacity of these farms to raise the output of tomato (Akinniran et al., 2020, p. 7). In line of the rising demand for tomato in Nigeria, increasing the efficiency of factor use would be the significant way to raise the output of tomato. Globally, the production of vegetables and fruits has been on the increase due to increase in growth of the population, increase in the living standards, and enlightment on the need to consume vegetables and fruits by government departments. Tomato is significant globally both for processed food firms or industries and for fresh fruit market. Tomato is highly perishable vegetable, hence poor infrastructures, poor handling and high post-harvest losses are major setback in increasing output of tomato in the industry. Availability of tomato throughout the year round is very significant for consumers as well as producers because tomato is a vegetable crop of excellence which is used for every meal and also for salad. Good packaging and storage of tomato might also increase the quantity, quality, and the shelf-life. Wanjiku (2015, p. 250) documented that availability of land

resource for agricultural production has decreased, and this is due to growth in population, degradation of soil, climate change, and fragmentation of soil. In addition, the high level of poverty has made it hard for farmers to raise the production through the addition of more resource factors (Simwaka et al.,2013, p. 11). Ochilo et al. (2019, p. 14) reported that tomato productivity and production can be increased through raising input use, technical and allocative efficiencies of producers. Evaluating the TE (technical efficiency) helps to estimate the performance of producers and identify the regressors that express the inefficiencies (Kassa and Demise, 2019, p. 8). TE estimates the farmers' capacity to obtain production optimally from the resources available and based on the level of equipment (Shettima et al., 2015, p. 9). Dessale (2019, p. 10) reported that the achievement of a producers and stimulus that influence the output of tomato are significant features in evaluating the TE. Technically, well-planned and managed tomato farms produce close to the frontier, while the inefficient tomato farms produce below the production frontier (Tirra et al.,2019, p. 8). Furthermore, tomato farms nearer to the production frontiers are well-planned, managed (efficient) than those distant from the frontier (Katungwe et al., 2017, p. 11). Raising the efficiency and productivity of tomato producers enables them to raise the yields short of additional factors and technologies (Saavedra et al., 2017, p. 12). In addition, considering smallholder producers, inefficiencies in output and resources factors may be as a result of producer and farm characteristics (Singh et al., 2017, p. 19). The TE provides confirmation and differences between agricultural outputs. AE (Allocative Efficiency) evaluates the gap between the producers' actual yield and the output that can be produced through the efficient use of factors in agriculture. AE can be obtained by maximizing the produce at minimum cost of resources (Khan et al.,2020, p. 6).

The objective of this paper is to estimate farm level financing gap (FINGAP) and allocative efficiency (AE) among tomato producers in North West, Nigeria. Specifically, the study intends to achieve the following:

- identify the summary statistics of stimulus of interest among tomato producers
- evaluate the TE of tomato production,
- evaluate the AE of tomato production, and
- estimate the FINGAP among tomato producers

2. LITERATURE REVIEW

The world yield of tomato in 2021 is estimated at 37506.8 kg ha^{-1}, while the yield of tomato in 2021 is estimated at 4295.9 kg ha^{-1} in Nigeria (FAO, 2024). Ogaji et al. (2013, p. 13) reported that farm size, seeds, and fertilizer were significantly different from zero in influencing the output of tomato producers in Zaria, Kaduna State, Nigeria. The average technical efficiency of tomato producers was estimated at 0.604. Adenuga et al. (2013, p. 8) documented that farm size, labour, seeds, and herbicides were significantly different from zero in influencing output of dry season tomato farmers Kwara State, Nigeria. The mean technical efficiency was estimated at 0.789. Ahmed and Oyewole (2012, p. 7) analyzed profitability and resource use efficiency of tomato production in Kano State, Nigeria and reported that the ratio marginal value productivity to unit factor cost of farm size, manure, fertilizer, seeds, and chemicals were greater than one, this means over-utilization of resources. Also, farm size, manure, labour, seeds, and chemicals were significantly different from zero in influencing the output of tomato farmers in the study area. Khan et al. (2020, p. 6) assessed the technical efficiency of tomato farms in District Lasbela, Balochistan and reported that seed, work, tractor hours, urea, pesticides, and high bride seeds were significantly different from zero in influencing the tomato yield. The average technical efficiency was estimated at 0.85, while the upper and lower limits of the technical efficiency was estimated at 0.95 and 0.75, respectively. Tabe-Ojong and Molua (2017, p. 9) evaluated the technical efficiency of smallholder tomato production in semi-urban farms in Cameroon and documented that area of cultivation, seed quantity, were significant factors influencing output of tomato farmers. In addition, the mean, minimum and maximum technical efficiency score of tomato farmers was estimated at 0.68, 0.0013 and 1.00, respectively. Ojo et al. (2020, p. 19) estimated financing gaps in rice production in Southwestern, Nigeria and reported that quantity of labour, herbicides, and quantity of seeds were significant factors influencing output of rice. The average amount of credit received was 38630.56 Naira, while the financing gap was estimated at 193626.5 Naira.

3. METHODOLOGY

This work was conducted in Kano and Kaduna States, Nigeria. Multistage method of sampling was employed for this study. The sample frame of tomato producers in the area selected in the 2 states is 171. In the fourth stage, the

proportionate-random sampling was employed to select the total sample number of tomato producers (120 respondents) consists of 60 tomato farmers each from the 2 states. Primary sources of data were based on a well-designed questionnaire. Focus group discussions, oral interviews were also employed. The questionnaire was administered to the respondent using a well-trained agricultural extension officers. The reliability and validity test was conducted. This research work used the established formula documented Yamane (1967, p. 17) in obtaining the sample size as follows:

$$n = \frac{N}{1+N(e^2)} = \frac{171}{(1+(171)(0.0025)} = 120 \quad (1)$$

Where,

n = The Estimated Sample Number

N = The Sample Frame of Tomato Farmers (Number for the 2 States)

e = 5%

3.1. The SPEFM (Stochastic Production Efficiency Frontier Model)

According to Alabi *et al*. (2022, p. 19), the SPEFM is stated thus:

$$Y_i = f(X_i, \beta_i)e^{v_i - u_i} \quad (2)$$

$$Ln\ Y_i = Ln\ \beta_0 + \sum_{j=1}^{5} \beta_i\ LnX_i + (v_i - u_i) \quad (3)$$

$$TE_i = \frac{Y_i}{Y_i^*} \quad (4)$$

$$TE_{ij} = \frac{F(X_i,\beta)\exp\,(v_i - u_i)}{F(X_i,\beta)\exp\,(v_i)} \quad (5)$$

$$TE_{ij} = \exp(-u_{ij}) \quad (6)$$

where,

Y_i = Output of Tomato (Kg)

Y_i^* = Unobserved Frontier Output of Tomato (Kg)

X_i = Inputs

β_i = Vectors of Estimated Parameters

V_i = Random Variations

U_i= Error Term due to TIE (Technical Inefficiency)

X_1 = Farm Size (Ha)

X_2 = Seed in Kg

X_3 = Fertilizer (Kg)

X_4 = Chemical (Litre)

X_5 = Labour (Mandays)

$$U_i = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 \quad (7)$$

where,

Z_1 = Age (Years)

Z_2 = Amount of Credit (Naira)

Z_3 = Years of Experience in Tomato Farming (Years)

Z_4 = Education Level (Years)

Z_5 = Extension Contact (Number per Month)

α_0 = Constant Term

$\alpha_1 - \alpha_5$ = Estimated Parameters

U_i= Error Term due to TIE

3.2. AE Model of Inputs

This is given as:

$$MP_x = \frac{P_x}{P_y} \quad (8)$$

$$MP_x \times P_y = MVP_x \quad (9)$$

$$\beta_{ij}\left[\frac{Y_i}{X_{ij}}\right] = \frac{P_x}{P_y} \quad (10)$$

Where

MP_x = Marginal Product of the input

β_{ij} = Elasticities of Input ,

P_x = Price of the Factor Input,

P_y = Price of Output

MVP_x = Marginal Value Product of Each Resource Employed

$MVP_x = P_x$ Optimum Input Utilization

$MVP_x > (<) P_x =$ There is Disequilibrium in the Use of Input that is Underutilization (Overutilization)

3.3. Harold-Domar (HD) Growth Model of Estimating the FINGAP

The model is given as:

$$`Y^* = \frac{1}{c}\emptyset \quad (11)$$

Where,

Y^* = Production Frontier (Technical Efficiency)

$\frac{1}{c}$ = The Inverse of the ICOR (Incremental Capital Output Ratio)

$\emptyset$ = Amount Needed to Produce at the Frontier Stage.

$$c = \frac{\omega}{\varphi} \quad (12)$$

where,

ω = Annual investment in rice output

φ = Annual rise in rice output

The FINGAP is defined as the credit requirement between the finance amount needed by farmers to produce at the frontier stage and the credit available to the farmers at present

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4. RESULTS

4.1. Summary Information of Factors of Interest

Table 1 displays the summary statistics of the factors of interest in the analysis. They include unit of measurement, sample mean, and standard deviation of each factor of interest. The average age, status of education, experience in tomato farming, and household size approximately 47 years, 7 years, 11 years, and 5 respectively

Table 1. Summary Statistics of Variables

Variables	Unit of Measurement	$\bar{X}_i$	SD
Age	Years	47	8.74
Household Size	Number	5	1.17
Farm Size	Ha	1.5	0.91
Status of Education	Years	7	4.90
Experience in Tomato Farming	Years	11	4.87
Amount of Credit	Naira	54,470	7,011
Access to Credit	1, Yes; 0, No	0.64	0.47
Tomato Output	Kg	11,809	2, 117

Source: (Field Survey, 2024).

4.2. The ML Estimates of Tomato Production

Table 2 displays the ML estimates of tomato production using SPEFM. The evaluated coefficients in the TE component fall between 0 and 1, thus all marginal products (MPs) are positive and declining at the mean of factors. This connotes with a priori expectations, this is in consonance with estimates obtained by Abdulai and Abdulahi (2016, p. 14) who documented the significant and positive influence of frontier factors on output of maize producers in Zambia

Table 2. ML Estimates Using SPEFM

Variables	Coefficient	Std. Er.	*P*-value
Farm Size	0.3450***	0.0508	0.000
Seed	0.1201**	0.0488	0.031
Fertilizer	0.1924*	0.0870	0.052
Chemical	0.1428***	0.0198	0.000
Labour	0.1745**	0.0755	0.047
Constant	2.488***	0.3724	0.000
RTS	**0.9748**		
Inefficiency Model			
Age	-0.3905**	0.1613	0.035
Amount of Credit	-0.2028**	0.0866	0.040
Years of Experience	-0.3472***	0.0530	0.000
Education Level	-0.1164***	0.0173	0.000
Extension Contact	-0.1860	0.1690	0.158
Diagnostic Statistics			
δ^2	3.2352***		
Gamma	0.7219		
Log-Likelihood Function	-618.35		
Mean Efficiency Score	0.71		

Source: (Field Survey, 2024).

4.3. The AEs of Tomato Production

The results of the marginal productivities (MPs) of each input and the allocative efficiency of tomato production among smallholder tomato farmers is displayed in Table 3. The estimates from the ML estimates of the Cobb Douglas production function version were used for the calculation of the MVPs of each particular resource input [r] among smallholder tomato farmers.

Table 3. AEs of Selected Inputs

Inputs	MPP	MVP	MFC	r	Remarks
Seed	36.74	845,327.10	3,000	281.78	Underutilization
Land	2.59	42,068	36,630	1.148	Underutilization
Fertilizer	5.78	98,436.95	5,000	19.687	Underutilization
Labour	7.48	24,386.95	3,500	6.967	Underutilization
Chemical	1.69	23,386.24	3,000	7.795	Underutilization

Source: (Field Survey, 2024).

4.4. The Estimation of FINGAP for Tomato Producers

The amount of credit presently being used by the tomato farmers is deducted from the evaluated credit at the target efficiency and the value obtained from the difference is called the FINGAP (Table 4).

Table 4. The FINGAP Analysis for Tomato Producers

FINGAP(₦)	Frequency	Percentage
20,000 – 100,000	06	05.00
101,000 – 200,000	17	14.17
201,000 – 300,000	27	22.50
301,000 – 400,000	44	36.67
401,000 – 500,000	19	15.83
501,000 – 600,000	07	05.83
Total	**120**	**100.00**
Variable	**Mean**	**Std Dev.**
Credit Amount Collected	54,470	7,011
Credit Amount Required (Financial Gap)	312,641.66	121,418.47

Note: $1= ₦1,170

Source: (Field Survey, 2024).

5. DISCUSSIONS

Table 1 shows that the average farm size, amount of credit received, access to credit, and tomato output were 1.5ha, 54,470 Naira (1$ = ₦1,170), 0.64, and 11,809 Kg respectively. This connotes that the tomato farmers were young, energetic, and resourceful. The tomato farmers are smallholder who cultivated less than 5 ha of tomato farms. An average N 54, 470 was accessed by 64% of the tomato producers ranging between 20,000 and 600,000 Naira (Table 4). This means about 36% of tomato producers do not have access to credit, according to Hitayezu at al. (2010, p. 20) who documented that producers' response to the economic situations is exactly related to their input allocation potentials (allocative efficiency), and human capital endowment. Tomato producers had formal education and were literate, if the level of education is low, it could affect their adoption of appropriate technology. According to Ogaji et al. (2013, p. 12) who posited that education enables tomato producers to write, read, understand manufacturers manual and extension guide with respect to input utilization, marketing of produce and technology use.

Table 2 shows the mid-TE of 71% indicates that an average smallholder tomato producer in the sample needs about 29% additional inputs to reach to the frontier, in other terms, a smallholder tomato producers lost on balance of 29% of produce due to technical inefficiency (TIE).

The addition of first order derivatives of the output factors which is called the scale efficiency shows the decreasing return to scale in the frontier version adding up to 0.9748. This connotes that increasing all factors by a certain proportion will give rise to a less than commensurate rise in output of the smallholder tomato farmers.

The estimate of farm size as evaluated in hectares is positive (0.3450) and statistically significant in raising the output of tomato at 1% probability level. This connotes that as farm size increases by 1% keeping other factors fixed will give rise to 34.50% increase in output of tomato. This is in consonance with Adenuga et al. (2013, p. 9) who obtained 66.70% increase in output of tomato from 1% increase of farm size in Kwara state, Nigeria.

The estimates of labour as evaluated in man-days is positive (0.1745) and significant in raising the output of tomato at 5% probability level. This connotes that as farm size increase by 1% keeping all other factor fixed will give rise to 17.45% increase in output of tomato. This is in line with Ojo et al. (2020, p. 18) who documented a 5% increase in output of rice from 1% increase in labour in Southwest, Nigeria.

The values and signs of coefficients of the stimulus variables in the model for TIE components are of interest as displayed in Table 2. All the stimulus included in the TIE component has negative coefficients, this is in consonance with a priori expectations. The negative signs of the values in TIE component signifies decrease in TIE of tomato farmers, while the positive sign connotes increase in TIE of tomato farmers. Age of tomato producers as measured in years has negative effect (-0.3450) on the TIE of tomato farmers and is significant at 5% probability level. This connotes that older tomato producers can take benefit of their experience to use factor more efficiently for tomato production. Age is a decisive regressor in increasing the efficiency of tomato farms. A 1% increase in age of tomato farmers keeping all other stimulus in the TIE fixed will give rise to 39.05% increase in the TE or decrease in TIE of tomato farmers.

Also, the amount of credit received as measured in Naira (1$ = ₦ 1, 170) has negative effect (-0.2028) on the TIE of tomato farmers and is statistically significant at 5% probability level. A 1% increase in amount of credit received by tomato farmers keeping all stimulus in the TIE component fixed will give rise to 20.28% increase in TE or decrease in TIE of tomato farmers. According to Adenuga et al. (2013, p. 9) who documented that producers with better opportunity to credit will be more efficient in his study on economics and TE of dry season tomato output in Kwara state, Nigeria.

In the diagnostic statistics component, the coefficient of variance ratio(γ) also called gamma is 0.7219, this connotes that 72.19% of variations in the output of tomato were due to differences in TE. Furthermore, this connotes that 72.19% of random fluctuation in the yield of the tomato farmers were due to the farmers' inefficiency. Therefore, reducing the influence of the effect of gamma or variance ratio will improve the output of tomato and greatly enhance the TE of the farmers. The coefficient of total variance (σ^2) also called sigma square is 3.2352, which is statistically significant at 1% probability level. This means that the model used and data obtained were well fitted. The LLF (Log-Likelihood function) is -618.35. The outcome is in consonance with results of Adenuga et al. (2013, p. 9) who reported that farm size, labour, seeds, and herbicides had positive coefficients and were significant stimulus influencing output of tomato farmers in Nigeria.

The outcomes as displayed in Table 3 shows that the input-use efficiency index [r] which is the value of the ratio of MVPs to the factor price [marginal factor cost] of each resource input for smallholder tomato farmers show that tomato producers underutilized seed, land, fertilizer, chemical, and labour. Smallholder tomato farmers could still increase the quantity of input utilization at current level of price since the proportional addition of input use could lead to increase in productivity. This is in agreement with the outcomes of Alabi and Safugha (2022, p. 6) who reported farmers' underutilization of seed, fertilizer, land, agrochemical and labour among farmers in Abuja, Nigeria. This result is also in agreements with the findings of Dominic *et al* (2019, p. 13) who reported similar result in Northern Ghana that rice farmers underutilized farm size and suggests that the farmers can incur more cost in land so as to be allocative efficient in rice production.

The target efficiency or the frontier level is the expected increase in efficiency when credit is available to the tomato farmers. It is presumed that most of the tomato farmers were not yielding at the frontier stage, and the recent concern was to make credit available for tomato farmers that will effect positively on their technical

efficiency to bring about increase in output of tomato that will bring about increase in level of efficiency. The second assumption is based on the fact that the finance is used for the intent of tomato output. As documented by Bifarin et al. (2010, p. 11), if production finance is expended on the tomato farm, the expectation is that it will lead to greater levels of output. As displayed in Table 4, about 5% of the tomato producers have FINGAP of not more than ₦100, 000.Also, about 14.17% of the tomato producers experienced FINGAP of not more than ₦ 200,000, while about 22.50% of tomato producers experienced FINGAP of not more than ₦ 300,000. This connotes that one-third (44%) of the smallholder tomato producers would require between ₦ 200,000 – ₦ 300,000 to yield at the frontier level. Furthermore, about 70% of tomato producers will require amount equal to or greater than ₦ 400, 000 to yield at the frontier level. This connotes that about 44% of tomato producers would require not less than or equal to N 250,000 to fill the FINGAP being currently encountered and be able to yield at the frontier stage with other necessary positions being fulfilled. The mid-value of credit per season the tomato producers had access to is ₦ 54,470, while the mid-value of financing in the pattern of credit needed to produce (yield) at the frontier stage is ₦ 312,641.66, this shows a credit shortfall of about 82.57%. This research is in consonance with Ojo et al. (2020, p. 18) who obtained a FINGAP of 80% for rice farmers in Southwest, Nigeria.

6. CONCLUSION AND RECOMMENDATION

The differences between the findings of the literature and this study is that this research finding employed the use of parametric approach in evaluating the technical efficiency of tomato production in the study area. Previously, in the findings of literatures, non-parametric approach is very commonly used. Furthermore, no findings in the literatures have evaluated the financial gap of tomato producers in the North West, Nigeria. This study employed the use of Harold-Domar (HD) growth model in estimating the FINGAP of tomato producers. Finally, the estimation of AE's of tomato production in North West, Nigeria is an innovation in the findings of this study.

This study essentially estimates the farm level financing gap and allocative efficiency among tomato producers in North West, Nigeria. Primary data were used based on a well-designed questionnaire. About 120 tomato producers were selected. Inferential and descriptive statistics was used for data analysis. The average age of tomato producers is 47 years, this signifies that the tomato producers were young, strong, and resourceful. This is in line with Mwangi et al. (2020, p. 11) who obtained an average age of 37 years among tomato producers in Kirinyaga county, Kenya. The mean farm size of tomato producers is 1.5 ha. This agrees with the findings of Ogunniyi and Oladejo (2011, p. 8) who approximate the average farm size of tomato producers in Oyo State, Nigeria to be 2.25 ha. The predictors such as farm size, seed, fertilizer, chemical, and labour were significant different from zero in influencing TE of tomato production. This is line with Adenuga et al. (2013, p. 9) who evaluated that farm size, labour, seeds, and herbicides were significantly different from zero in influencing TE of tomato production in Kwara State, Nigeria. The summation of first order differentials of the production predictors which is called the scale efficiency signifies the decreasing return to scale in the frontier version summing up to 0.9748. This means that increasing all factors by a certain proportion will give rise to a less than commensurate rise in output of the smallholder tomato producers. The predictors such as age, amount of credit, years of experience, education level, and extension contact were significantly different from zero in influencing TIE of tomato production.

The AEs of selected predictors shows that seed, land, fertilizer, labour, and chemicals were under-utilized. This agrees with Ahmed and Oyewole (2012, p. 7) who reported that labour was under-utilized among tomato producers in Kano State, Nigeria. The HD growth model shows the average of credit per season the tomato producers had accessed to is N54, 470, while the mean amount of credit needed to produce (yield) at the frontier stage is N 312, 641.66, this means the credit shortfall of about 82%. The TE, AE, and productivity of tomato farmers can be enhanced by given opportunity to timely credit facilities, filling the FINGAP of smallholder tomato producers will increase the efficiency of rice output to meet the rise in demand. From this result, the following suggestions can be made:

- The development partners and government should jointly work to better the circumstances of access to agricultural credit by tomato producers. In addition, policy formulations and interventions should be directed at reducing the cost of borrowing common in the agricultural sector of Nigeria.
- The farm inputs such as fertilizer, chemicals, improved seeds, access to land should be made available to tomato producers

- The policy makers should facilitate the spread of know-how from academics, researchers to extension officers and then to tomato producers.
- Agricultural technologies should be provided for tomato producers, this will make mechanized farming possible for increased productivity.
- Feeder roads should be constructed for easy evacuation of tomato produce from producing areas to nearby centres.

DECLARATION OF THE AUTHORS

Declaration of Contribution Rate: The authors have equal contributions.

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