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**RESEARCH ARTICLE** **ARAŞTIRMA MAKALESİ**

# Impact of out of pocket health expenditure on rice producers' technical efficiency in South-West Nigeria

Cepten sağlık harcamalarının Güneybatı Nijerya'da pirinç üreticilerinin teknik verimliliği üzerindeki etkisi

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**ABSTRACT**

The costs of agricultural input are reduced by significant out-of-pocket health bills, which results in decreased productivity or poverty. The study examined the effect of out-of-pocket health expenditure on technical efficiency of rice producers in southwest Nigeria, using a translog functional form approach. The study's samples were selected using a multistage sampling procedure. The findings had a mean area of farmland cultivated (3.02ha), output obtained (2438.33Kg), cost of drugs and herbs (₦8,253.44; $23.19), cost of medical consultation (₦1,378.82; $3.87), cost of feeding (₦751.57; $2.11), cost of travelling (₦732.96; $2.06) and cost on preventive measures (₦651.11; $1.83). On average rice farmers lost 32.37 days to illness and healthcare facilities were located 20.67Km from the farmers home. The rice farmers were able to obtain 91.5% output from their input mix. Area of farmland cultivated, quantity of seed, quantity of herbicide and tractor hour hired positively influenced rice output while labor and quantity of insecticide had negative effects. Increased cost of; drugs and herbs, medical consultation, and distance to healthcare provider decreases technical efficiency while increase in preventive cost of ill-health, and contact with health extension workers increase technical efficiency. The study concluded that rice growers were not operatin on the frontier.

**ÖZET**

Tarımsal girdi maliyetleri, önemli ölçüde cepten sağlık faturaları ile azaltılmakta ve bu da üretkenliğin veya yoksulluğun azalmasına neden olmaktadır. Çalışma, cepten yapılan sağlık harcamalarının güneybatı Nijerya'daki pirinç üreticilerinin teknik verimliliği üzerindeki etkisini, translog fonksiyonel form yaklaşımı kullanarak inceledi. Çalışmanın örnekleri çok aşamalı bir örnekleme prosedürü kullanılarak seçildi. Bulgular, ekili tarım arazilerinin ortalama bir alanına (3.02ha), elde edilen çıktıya (2438.33 Kg), ilaç ve bitki maliyetine (₦8,253.44; 23.19 $), tıbbi konsültasyon maliyetine (₦1,378.82; 3.87 $), beslenme maliyetine (₦751.57; 2.11 $), seyahat maliyetine (732.96 ₦; 2.06 $) ve önleyici tedbirlerin maliyetine (₦ 651.11; 1.83 $) sahipti. Ortalama olarak, pirinç çiftçileri hastalıktan 32.37 gün kaybetti ve sağlık tesisleri çiftçilerin evinden 20.67 km uzaktaydı. Pirinç çiftçileri, girdi karışımlarından% 91,5 çıktı elde edebildiler. Ekili tarım arazilerinin alanı, tohum miktarı, herbisit miktarı ve işe alınan traktör saati pirinç üretimini olumlu yönde etkilerken, işçilik ve böcek ilacı miktarı olumsuz etkilere neden olmuştur. Artan maliyet; ilaçlar ve otlar, tıbbi konsültasyon ve sağlık hizmeti sağlayıcısına olan mesafe teknik verimliliği azaltırken, kötü sağlığın önleyici maliyetindeki artış ve sağlık uzatma çalışanlarıyla temas teknik verimliliği artırmaktadır. Çalışma, çiftçilerin sınırda faaliyet göstermediği sonucuna varmıştır.

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**INTRODUCTION**

One of the most significant agricultural pursuits in Nigeria is rice farming. The third most popular staple grain in Nigeria, rice is crucial for food security and brings substantially more income for farmers than other cash crops (FAO, 2021). All agro-ecological zones in Nigeria, from the mangrove swamps of the Niger Delta to the arid zones of the Sahel in the north, are used to produce rice on a small scale (Ojo et al., 2020; KPMG, 2019) with an average yield of approximately 1.8 tonnes per hectare (Chidiebere-mark et al., 2019). However, 72% of the nation's total rice crop is produced in North Western Nigeria (KPMG, 2019). Nigeria is the top producer of rice in West Africa and the second-largest producer overall in Africa after Egypt (KPMG, 2019). Rice production in Nigeria has increased from 3.7 million metric tons in 2017 to 4 million metric tons in 2018, but it still falls short of demand because the nation imports more than 3 million metric tons each year, which costs more than US$ 480 million in scarce foreign currency (Kamai et al., 2020). In recent years, over 750 million tons of paddy has been produced on an area of approximately 164 million hectares in the world. The majority of paddy farming is in Asia. China, India, Indonesia, Bangladesh and Thailand are the leading countries in paddy production (Kaya & Ateş, 2022). The majority of Nigerian rice farmers now employ outdated technology with little to no upgraded input technology. Meanwhile, rice farming involves several operations such as land preparation, making seedlings, nursing the seedlings, planting, and harvesting which result in musculoskeletal disorders such as wrist disorders, and hand and back pain (Swangnetr et al., 2014). Rice farming requires huge energy from farmers, especially land preparation. Some Nigerian rice farmers still practice the traditional method of threshing by beating of paddy on wood which results in drudgery, injury, and health challenges them. Farmers also suffered significant losses in agricultural production as a result of the health risks that rural areas are susceptible to. Sick farmers are unable to visit their farms or abandon their farm activities (Moses, 2017). These led to out-of-pocket health expenses incurred by farmers to improve their health status.

Cost-sharing, self-medication, and other costs directly borne by private households are some examples of out-of-pocket expenses in the healthcare industry. These costs are incurred by patients when their insurance does not fully cover the cost of a health good or service (OECD, 2009). The impact of out-of-pocket health spending on farmers, including their productivity, can be severe in the majority of developing nations where it is the main source of healthcare finance. Farmers in Nigeria generally face high out-of-pocket expenses due to the low level of insurance premiums purchased by them. The good health of farmers and agricultural productivity are important in any nation because good health improves work effectiveness and individual productivity through enhancing physical and mental capacities (Ajani & Ugwu, 2008). According to the human capital theory, those with better health should be more productive workers (Séne & Badiane, 2016).

According to the Grossman theory of demand for health care, out-of-pocket medical expenses have an impact on household productivity and well-being, which in turn affect health. When these payments reach a particular threshold, which is when they account for a significant portion of the household budget, they might constitute a financial burden (reducing household disposable income and forcing them to sell an asset to pay for medical services) (Séne & Badiane, 2016). When out of pocket spending becomes catastrophic, they reduce the expenses on agricultural input, thus leading to limited efficiency or impoverishment. This is because the money that the farmers would have used to buy farm inputs, updated implements, or hire laborers and tractors was instead utilized on treatment, which resulted in low productivity (Moses, 2017; Fanello & Baker, 2010).

Farmers in developing countries, including Nigeria, typically live in rural areas that lack adequate infrastructure like good roads, clean water, and hospitals. The majority of health problems in rural areas are caused by treatable conditions such as malaria, pains, meningitis, diarrhea, typhoid fever, HIV/AIDS, catarrh, and cough (Ojo et al., 2018). Rural farmers were unable to access good health facilities which hindered their wellbeing and productivity. In case of emergency, they need to travel many miles before accessing healthcare centers which resulted in the

death of many rural dwellers. These, however, contributed to their poor health status and high out of pocket spending. An improved health facility especially in rural areas is prerequisites to good health among the farmers which will in turn improve their efficiency. This is because a healthy farmer will have the required energy needed to be productive. Previous research on health and agriculture focused on the impact of ill health on farmers (Moses, 2017; Iheke & Ukaegbu, 2015; Egbetokun et al., 2014). Also, most studies on out-of-pocket expenditure concentrated on its effect on the welfare of people (Aboaba, 2020; Amos et al., 2016; Rashad & Sharaf, 2015). Meanwhile, how out of pocket expenditure by farmers affects their technical efficiency, especially rice production in Nigeria received less attention. Thus, this study intends to fill the gap by investigating the impact of out-of-pocket health expenditure on rice producer's technical efficiency. Identifying the impact of out-of-pocket health spending on rice farmers' technical efficiency showed the linkage between out-of-pocket health expenditures and rice farmers' technical efficiency in a bit to produce efficiently and to improve rice farmers' health status.

## MATERIALS and METHODS

### *The study area*

There are six states in Nigeria's southwestern region: Osun, Ogun, Oyo, Ondo, Lagos, and Ekiti. The study was conducted in the state of Ogun. With a capacity of 15,000–20,000 tonnes per year, the state is one of the top producers of rice in the southwest of Nigeria (Osabohien et al., 2018). The state has an estimated population of 3,728,098 according to the 2006 National Census (NPC, 2006). Its arable land area is 1,204,000 hectares, however, only roughly 350,000 hectares of that are now being farmed. The state is fortunate to have good soil and climate conditions that encourage the growth of food and cash crops including rice, maize, cassava, yam, cocoa, and citrus.

### *Sampling technique*

The study samples were selected using a multistage sampling technique. The four Agricultural Development Project (ADP) zones were purposively selected in the initial stage by choosing a sample block with the most rice being grown there. In the second stage, a major rice-producing cell was selected by random sampling from the selected blocks; in the third stage, three rice-producing villages were likewise selected at random using a table of random numbers. The final step involved selecting twenty rice farmers at random from each village, totaling 240 rice farmers in the sample. During the data cleaning process, only 220 responses representing 94%, were suitable for analysis.

### *Data collection and analysis*

With the aid of a standardized questionnaire, data were gathered. Data on the socioeconomic characteristics of the rice farmers, data on the inputs and outputs of rice cultivation, and information on healthcare costs were elicited. Descriptive and inferential statistics like mean, standard deviation, minimum, maximum, and stochastic frontier analysis were used to analyze the acquired data.

### *Model specification*

The impact of out-of-pocket health expenditure on rice producers' technical efficiency was estimated using Stochastic Frontier Analysis (SFA) adopting a translog functional form technique. Because it lays fewer restrictions than a Cobb-Douglas specification or any more conventional specification, the translog specification was chosen as it represents a second-order approximation to any actual functional form (Tan et al., 2010).

The production frontier to be estimated is specified as;

$$\ln(Y_i) = \delta_0 + \sum_{j=1}^{7} \delta_j \ln X_{ij} + \frac{1}{2} \sum_{j=1}^{7} \sum_{k=1}^{7} \delta_{jk} \ln X_{ij} \ln X_{ik} + v_i - u_i \quad (1)$$

where, $\ln(Y_i)$ is the logarithm of rice output in Kilogram (outputkg), $X_j$ are rice production inputs, $V_i$ are stochastic random errors, and $U_i$ are non-negative random errors accounting for technical efficiency in rice production.
The variable $X_1$-$X_7$ represents area of farmland cultivated in hectares (areaha), quantity of seed planted in Kilogram (seedkg), man-days of labor in adult equivalent (labor), quantity of fertilizer in Kilogram (ferilizerkg), quantity of insecticide in litres (qinsect), quantity of herbicide in litres (qherb) and tractor in hours (Tractorhr) respectively.
According to Akinbode et al. (2011), an average male works for 8 hours each day when estimating man-days of labor. The actual total hours spent working on farms were multiplied by 1 for men, 0.75 for women, and 0.5 for children in order to convert them to male adult equivalent hours.

Efficiency model is specified as;

$$TE_i = \lambda_0 + \sum_{j=1}^{15} \lambda_j K_j \quad (2)$$

where, $TE_i$ represents the technical efficiency of each rice farmers. The K variables represent farmers socioeconomic and health variables that influence technical efficiency.

The variable name, measurement and hypothesized sign were described in table 1.

Table 1. Variable name, unit and hypothesized sign on technical efficiency
*Çizelge 1. Değişken adı, birimi ve teknik etkinlik üzerindeki hipotez işareti*

| Name | Variable | Unit | Expected signs |
|---|---|---|---|
| **Age** | Age of household head | Years | +/- |
| **Sex** | Sex of household head | Dummy (1=male, 0=female) | + |
| **Hhsiz** | Number of person per household | Person | +/- |
| **Maritalsta~s** | Marital status of household head | Dummy (1=married, 0=otherwise) | + |
| **Ysis** | Number of years spent in school | Years | + |
| **Cooperate** | Member of farmers' cooperative association | Dummy (1=member, 0=otherwise) | + |
| **Farmexp** | Rice farming experience | Years | + |
| **Cdrug** | Cost of drugs and herbs | Naira | - |
| **Cconsultan~** | Cost of medical consultation | Naira | - |
| **Cfeeding** | Cost of feeding | Naira | - |
| **Ctravelling** | Cost of travelling to healthcare provider | Naira | +/- |
| **Cpreventive** | Preventative cost | Naira | - |
| **Dfproduction** | Number of days forgone production | Days | - |
| **Dths** | Distance to healthcare facilities | Kilometers | - |
| **Chew** | Contact with health extension workers | Dummy (1=had contact, 0=otherwise) | + |

The number of production days lost due to illness was translated to adult equivalent by multiplying the number of days lost by males by 1, females by 0.75, and children by 0.5 (Aboaba et al., 2019)
1 USD ($) is equivalent to 355.99 Naira (₦).

## RESULTS and DISCUSSIONS

### *Descriptive statistics of variables*

Production variable result showed that the average area of farmland cultivated; seed, labor hours, fertilizer, insecticide, herbicide, and tractor hours that was used to obtain 2438.33 Kg of rice were 3.02 ha, 337.89 Kg, 90.52 days, 342.33 Kg, 9.89 liters, 9.52 liters and 4.34 hours respectively. These results imply that rice output harvested in the region is lower than that realized in Asia; this result is in line with the assertion of PwC (2018). With a mean age of 54.34 years, a household size of six people, six years of education, and 26.35 years of agricultural experience, roughly 73% of rice farmers were male. The percentage of married rice farmers and cooperative society members was about 58% and 19%, respectively.

The average cost spent by the farmers on; drugs and herbs, medical consultation, feeding, travelling, and preventive measures were ₦8,253.44 ($23.19), ₦1,378.82 ($3.87), ₦751.57 ($2.11), ₦732.96 ($2.06) and ₦651.11 ($1.83) respectively. It follows from this finding that rice farmers greatly overspend on their health and may have a negative influence on the amount of income available for production which will invariably inhibit their productivity, economic growth, and development (IFPRI, 2007). About 46% of the rice farmers had access to public healthcare facilities, primary healthcare, and health centers were located within 20.7 Km from the farmer's home; the farmers lost approximately 32 days to illness when impaired by diseases and less than half had contact with community health extension workers. The implication is that bringing healthcare facilities closer to the farmers and having contact with health workers will reduce transportation costs and improve the appropriate use of healthcare facilities. This outcome backs up the conclusions made by Aboaba et al. (2019).

Table 2. Descriptions of variables in the model

*Çizelge 2. Modeldeki değişkenlerin tanımları*

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| ***Production variables*** | | | | |
| **Outputkg** | 2438.33 | 2618.35 | 375 | 15000 |
| **Areaha** | 3.02 | 2.77 | 0.5 | 15 |
| **Seedkg** | 337.89 | 449.90 | 25 | 2500 |
| **Labor** | 90.52 | 66.05 | 18 | 180 |
| **Ferilizerkg** | 342.33 | 806.99 | 0 | 2000 |
| **Qinsect** | 9.89 | 12.41 | 0 | 60 |
| **Qherb** | 9.52 | 12.08 | 0 | 60 |
| **Tractorhr** | 4.34 | 7.28 | 0 | 36 |
| ***Socioeconomic variables*** | | | | |
| **Age** | 54.34 | 14.10 | 20 | 78 |
| **Sex** | 0.73 | 0.44 | 0 | 1 |
| **Hhsiz** | 5.88 | 2.44 | 1 | 12 |
| **maritalsta~s** | 0.58 | 0.49 | 0 | 1 |
| **Ysis** | 5.52 | 4.85 | 0 | 18 |
| **Cooperate** | 0.19 | 0.39 | 0 | 1 |
| **Farmexp** | 26.35 | 14.93 | 4 | 63 |
| ***Health related variables*** | | | | |
| **Cdrug** | 8253.44 | 4655.96 | 870 | 21900 |
| **cconsultan~** | 1378.82 | 2133.81 | 0 | 12300 |

Table 2 (continued). Descriptions of variables in the model
*Çizelge 2 (devamı). Modeldeki değişkenlerin tanımları*

| | | | | |
|---|---|---|---|---|
| **Cfeeding** | 751.57 | 703.55 | 0 | 6000 |
| **Ctravelling** | 732.96 | 974.58 | 0 | 4700 |
| **Cpreventive** | 651.11 | 1099.99 | 0 | 6300 |
| **Dfproduction** | 32.37 | 19.22 | 3.5 | 61 |
| **Dths** | 20.67 | 25.53 | 0 | 100 |
| **Chew** | 0.46 | 0.50 | 0 | 1 |

***Technical efficiency of rice farmers***

Table 3 displays the findings of the Maximum Likelihood Estimates (MLE) of the parameters of the translog functional form for rice farmers. Sigma-square and gamma, two variance parameters, were estimated to be 0.046 ($p<0.01$) and 0.550 ($p<0.01$), respectively. This conforms to the findings of Tanko and Obalola (2013). While the gamma reveals systematic influences that are unaccounted for by the production function and the main causes of random error, the sigma-square attests to the goodness of fit and accuracy of the distributional assumption about the composite error term. This suggests that the differences in the technical inefficiency of rice farmers account for around 55% of the variation in their output. Production estimates revealed that area cultivated ($p<0.1$), quantity of seed ($p<0.01$), quantity of herbicide ($p<0.01$), and tractor hour hired ($p<0.01$) positively influence rice output while labor ($p<0.01$) and insecticide ($p<0.01$) had a negative influence on rice output.

The coefficient of the cultivated farm area showed that a 1 % increase in the area of farmland cultivated with rice would increase the output of rice by 1.398 %. The outcome is consistent with Muhammad-Lawal et al. (2013) who reported a significant and positive relationship between the area of farmland cultivated and output. According to the coefficient of quantity of seed, a 1% increase in the amount of seed planted would result in a 4.364% increase in rice production. This result shows that the more seed that is planted, the higher the rice production. This outcome is consistent with the position of Ulimwengu (2009) and Ambali et al. (2012) who reported a direct relationship between output and quantity of seed planted. The output of rice decreased by 3.634% as a result of an increase in labor hours. The result suggests that increasing labor use reduces rice production, a pointer that rice farmers were not efficient in their use of labor. This is because the majority of rice farmers employ members of their households on their farms, leading to a failure of the labor market. This outcome supports the work of Shittu (2014) that farm household heads used their domestic labor inefficiently.

Table 3. Maximum likelihood estimates of technical efficiency
*Çizelge 3. Teknik etkinliğin maksimum olasılık tahminleri*

| Variable | Coefficient | Standard Error | t-ratio |
|---|---|---|---|
| **Constant** | 3.118*** | 1.200 | 2.598 |
| **ln(area)** | 1.398* | 0.809 | 1.728 |
| **ln(seed)** | 4.364*** | 0.701 | 6.230 |
| **ln(labour)** | -3.634*** | 0.760 | -4.783 |
| **ln(fert)** | 0.635 | 0.419 | 1.515 |
| **ln(insect)** | -0.450*** | 0.147 | -3.063 |
| **ln(herb)** | 2.417*** | 0.820 | 2.946 |
| **ln(tractor)** | 8.062*** | 0.948 | 8.508 |
| **ln(area) x ln(seed)** | 1.571*** | 0.173 | 9.082 |
| **ln(area) x ln(labour)** | -1.348*** | 0.193 | -6.971 |

Table 3 (continued). Maximum likelihood estimates of technical efficiency
*Çizelge 3 (devamı). Teknik etkinliğin maksimum olasılık tahminleri*

| | | | |
|---|---|---|---|
| **ln(area) x ln(fert)** | 0.221* | 0.124 | 1.778 |
| **ln(area) x ln(insect)** | -0.099** | 0.039 | -2.537 |
| **ln(area) x ln(herb)** | 0.324 | 0.304 | 1.064 |
| **ln(area) x ln(tractor)** | -1.361*** | 0.232 | -5.858 |
| **ln(seed) x ln(labour)** | 0.986*** | 0.185 | 5.335 |
| **ln(seed) x ln(fert)** | -0.289** | 0.125 | -2.310 |
| **ln(seed) x ln(insect)** | 0.248*** | 0.055 | 4.489 |
| **ln(seed) x l(herb)** | -0.475** | 0.232 | -2.050 |
| **ln(seed) x ln(tractor)** | 1.167*** | 0.164 | 7.102 |
| **ln(fert) x ln(labour)** | 0.318*** | 0.093 | 3.427 |
| **ln(labour) x ln(insect)** | -0.237*** | 0.064 | -3.696 |
| **ln(labour) x ln(herb)** | 0.020 | 0.094 | 0.209 |
| **ln(labour) x ln(tractor)** | -0.018 | 0.106 | -0.173 |
| **ln(fert) x ln(insect)** | -0.076*** | 0.025 | -3.082 |
| **ln(fert) x ln(herb)** | 0.138*** | 0.053 | 2.602 |
| **ln(fert) x ln(tractor)** | 0.128 | 0.086 | 1.497 |
| **ln(herb) x ln(insect)** | 0.055 | 0.044 | 1.254 |
| **ln(insect) x ln(tractor)** | 0.214** | 0.087 | 2.451 |
| **ln(herb) x ln(tractor)** | 0.135 | 0.140 | 0.966 |
| **ln(area)$^2$** | -0.743* | 0.402 | -1.846 |
| **ln(seed)$^2$** | -1.806*** | 0.221 | -8.181 |
| **ln(labour)$^2$** | -0.124 | 0.238 | -0.519 |
| **ln(fert)$^2$** | -0.136*** | 0.044 | -3.114 |
| **ln(herb)$^2$** | -0.797** | 0.314 | -2.538 |
| **ln(insect)$^2$** | 0.176*** | 0.067 | 2.639 |
| **ln(tractor)$^2$** | 0.148*** | 0.056 | 2.621 |
| **Diagnostic test** | | | |
| **sigma-squared** | 0.046*** | 0.010 | 4.710 |
| **Gamma** | 0.550*** | 0.145 | 3.802 |
| **Log-likelihood function** | 88.095 | | |
| **LR test of one-sided error** | 43.197 | | |

Note: ***, ** and * means significant at 1%, 5% and 10% respectively.

On the coefficient of insecticide, a 1% increase in the amount of pesticide would reduce rice production by 0.45%. This might be due to rice farmers using insecticides excessively or reducing their use to save cost. The coefficient of herbicide showed that a 1 % increase in the use of herbicides will result in a 2.417 % increase in rice output. This result implies that the use of herbicides enhances rice output. This is because weeds compete with rice for nutrient and space, thus, the use of herbicide to control weeds increase rice output. A percentage increase in tractor hours would increase rice output by 8.062%. This result is in line with the findings of Okoruwa et al. (2006).

***Impacts of out of pocket healthcare costs on technical efficiency***

Factors affecting the rice farmer's inefficiency, the contribution of farmer's characteristics, and healthcare related variables were examined. The coefficient's positive sign denotes a detrimental impact on technical efficiency,

whereas its negative sign denotes a positive impact. Because the majority of rice farmers are older and have more knowledge of the factors impacting rice production, the coefficient of age suggests that as age increases, so does the efficiency of the rice farmers. The result conforms to the findings of Shafiq and Rehman (2000) and Adekunle et al. (2016). The household size coefficient suggests that as the household size grows, the technical efficiency of rice farmers declines; this conclusion is consistent with those made by Shittu (2014) and Adebayo et al. (2015).

Married household heads among the rice farmers are more technically efficient than their unmarried counterparts, rice farmers who are members of cooperative associations are more technically efficient than those that did not belong to cooperative association, and this may be because joining a cooperative enables farmers to combine their resources and take advantage of significant economies of scale by getting necessary information towards efficient production. This result supports that of Ayodele et al. (2020) that being a member of a cooperative association increases productivity and level of market participation among farmers. The technical efficiency of rice farmers falls when costs of drugs rise, which suggests that as farmers' out-of-pocket expenses rise, so does their technical inefficiency. This is because, as farmers spend more on drugs, the amount of money available to purchase production inputs will reduce thereby causing a decline in technical efficiency. This result corroborates the work of Adekunle et al. (2016).

An increase in medical consultation cost reduces the technical efficiency of the rice farmers, the coefficient of preventive cost implies that as the preventive cost against illness increases the technical efficiency of the rice farmers also increases, this is so because prevention against illness increases the healthy time of the farmers, that is, it reduces days forgone to production which would invariably increase the efficiency of the farmers; increased distance from farmers home to healthcare facilities reduces technical efficiency while having contact with community health extension workers increases the technical efficiency of the rice farmers. This result implies that bringing healthcare services closer to farmers will increase their technical efficiency.

Table 4. Determinants of technical efficiency

*Çizelge 4. Teknik etkinliğin belirleyicileri*

| Variable | Coefficient | Standard Error | t-ratio |
|---|---|---|---|
| **Constant** | 0.525*** | 0.190 | 2.767 |
| **Age** | -0.014*** | 0.005 | -2.887 |
| **Sex** | -0.124 | 0.079 | -1.584 |
| **Hhsiz** | 0.046** | 0.022 | 2.067 |
| **Maritalsta~s** | -0.272*** | 0.097 | -2.808 |
| **Ysis** | -0.011 | 0.009 | -1.273 |
| **Cooperate** | -0.434** | 0.185 | -2.343 |
| **Farmexp** | 0.002 | 0.003 | 0.558 |
| **Cdrug** | 0.1e-04* | 0.1e-04 | 1.729 |
| **Cconsultan~** | 0.6e-04** | 0.3e-04 | 2.137 |
| **Cfeeding** | 0.1e-04 | 0.4e-04 | 0.312 |
| **Ctravelling** | 0.7e-04 | 0.6e-04 | 1.155 |
| **Cpreventive** | -0.19e-03*** | 0.7e-04 | -2.689 |
| **Dfproduction** | -0.003 | 0.002 | -1.539 |
| **Dths** | 0.007** | 0.003 | 2.564 |
| **Chew** | -0.309** | 0.129 | -2.405 |

Note: ***, ** and * means significant at 1%, 5% and 10% respectively.

***Technical efficiency distribution of the rice farmers***

The efficiency distribution result revealed that the majority (74.67%) of rice farmers had technical efficiency greater than 0.900, very low proportions (0.89%) had technical efficiency less or equal to 0.600, low proportions (2.22%) had technical efficiency between 0.601-0.700, low proportions (4.44%) still had technical efficiency between 0.701-0.800 while 17.78% had technical efficiency between 0.801-0.900. The rice farmers' mean technical efficiency was 0.915, which indicates that they were able to get 91.5% of their output from their input mix. This suggests that they may increase their technical efficiency by 8.5%.

Table 5. Efficiency distribution of rice farmers

*Çizelge 5: Pirinç çiftçilerinin verimlilik dağılımı*

| Efficiency range | Frequency | Percentage |
|---|---|---|
| **≤0.600** | 2 | 0.89 |
| **0.601-0.700** | 5 | 2.22 |
| **0.701-0.800** | 10 | 4.44 |
| **0.801-0.900** | 40 | 17.78 |
| **>0.900** | 168 | 74.67 |
| **Total** | 225 | 100.00 |
| **Mean** | 0.915 | |
| **Minimum** | 0.569 | |
| **Maximum** | 0.987 | |

Figure 1 depicts the box plot distribution of rice farmers' technical efficiency scores; performance scores ranged from 0.569 to 0.987, with the majority of scores falling around the mean efficiency score. The box plot's tails reveal the degree of variability for the upper and lower 25% of quartiles. The long tail toward the lower 25% quartiles demonstrated that there is a great deal of variation in performance scores for underperforming rice farmers located in the quartile compared to the higher 25% quartile.

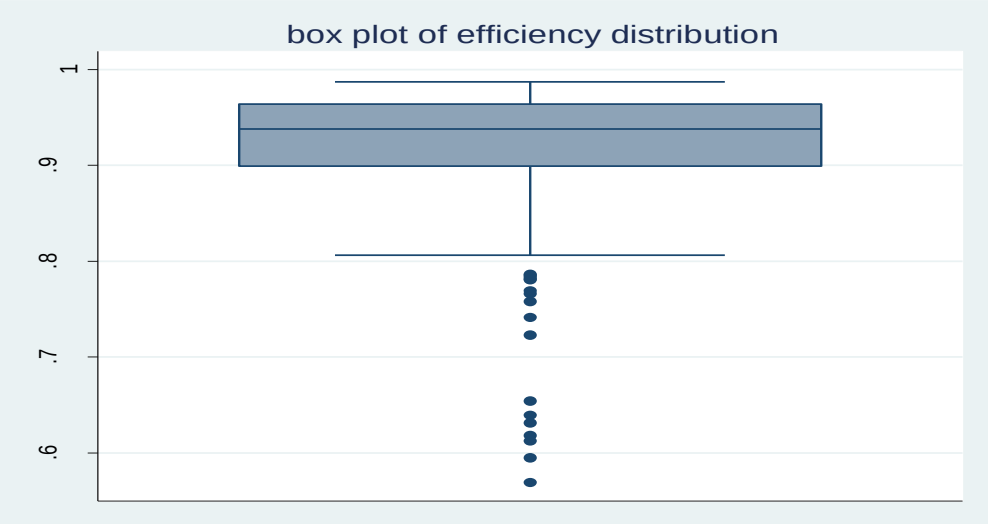


Figure 1. Box plot distribution of technical efficiency

*Şekil 1. Teknik etkinliğin grafik dağılımı*

In conclusion, the study looked at how rice farmers' technical efficacy was impacted by out-of-pocket health expenditure. The technical efficacy of the rice farmers was estimated using a translog functional form. The result

showed that the output obtained by the rice farmers was low and farmers spent a high amount on their health. Input variables such as area of farmland cultivated, seed, labor, insecticide, herbicide, and tractor hours influenced rice output while variables such as age, household size, marital status, cooperative membership, cost of drugs and herbs, cost of medical consultation, preventive cost of ill-health, distance to the healthcare provider and contact with community health extension workers influenced technical inefficiency. With their combination of inputs, the rice farmers were able to produce 91.5% of their output. The positive and significant relationship between variable inputs such as area of farmland cultivated, seed, herbicide, and tractor hours implies that better use of these inputs could lead to higher output among rice farmers.

The negative relationship between health-related variables such as cost of drugs, cost of medical consultation, and distance to healthcare provider showed that an increase in these variables decreases technical efficiency while an increase in preventive cost and contact with health extension workers increases farmers' technical efficiency. The study concluded that rice farmers were not operating at the frontier and there's a need for improvement to boost their level of food security and economic well-being. This can be achieved with healthcare facilities located closer to the farmers and equipped with essential drugs at a reduced cost. The study therefore recommends that farmers should be supplied with disease preventing materials such as mosquito nets, and repellants. This will help farmers reduce their out of pocket health expenditure and enable them to have access to better healthcare services which will improve the healthy time available for production and their well-being.

**STATEMENT OF CONFLICT OF INTEREST**

The author(s) declare no conflict of interest for this study.

**AUTHOR'S CONTRIBUTIONS**

The contribution of the authors is equal.

**STATEMENT OF ETHICS CONSENT**

Ethical approval is not applicable, because this article does not contain any studies with human or animal subjects.

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