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Effect of Land Administration on allocative efficiency of Rice Farmers Under Public and Private Authorities in Dadinkowa Irrigation Area in North-Eastern Nigeria

[1]Ayoola, J. B., [2]Mohamadou, S., [2]Abu, G. A., [2]Umeh, J.C., [2]Asogwa, B.C., [3]Ayoola, G.B. and [3]Sani, R. M.

[1]Institute of Food Security, Joseph Sarwuan Tarka University Makurdi (Formerly, Federal University of Agriculture Makurdi) Benue State, Nigeria.

Abstract
The study analyzed the effects of land administration on allocative efficiency of rice farmers in Dadinkowa Irrigation Scheme (DKIS) area of Gombe and Borno States, Nigeria. Multi-stage sampling technique was used to select 400 rice farmers under irrigation farming. Descriptive and inferential statistics were used to analyze data. Specifically, descriptive statistics was used to identify the types of land administration processes and land exchange approaches, and evaluate the performance of land administration in the study area. Stochastic frontier model was used to estimate the allocative efficiency of rice farmers. Tobit regression analysis was used to assess the effects of land administration, land exchange and other factors on allocative efficiency of rice farmers in the study area. The result showed that, despite the fact that all lands belong to the government, land transactions were carried out informally under customary laws with poor or lack of documentation. The result also revealed that land administration was efficient (67%) in the study area and especially in DKIS (0.74).The study also found that farmers were allocatively efficient given the current level of technology, and efficiency could be increased if the available resources are efficiently used. From the result, farmers under the administration of Integrated Savanna Vegetables and Fruits Canning Factory (VEGFRU) and local authority are more allocatively efficient than those under the administration of DKIS and National Institute of Horticultural Research and Training (NIHORT) and College of Horticulture (CoH) (NIHORT/CoH). Improvement in land administration service deters farmers from efficiently allocating resources for production. Similarly, an increase in hired labour decreases the allocative efficiency of farmers. It was recommended that land administration system should clearly state rights related to the use of government lands and allow land transactions such as the sale of rights of occupancy, the transfer of leasehold rights or rent among farmers so as to strengthen the land markets and improve the efficient use of land. Government should also facilitate the process of obtaining property rights on local lands so as to eliminate the anxiety and uncertainty of expropriation that discourage farmers to make long term investment decision on land and or to use land as collateral for credit.

Keywords: land administration, public, private, allocative efficiency, irrigation, Nigeria

1. Introduction

Agriculture is one of the most important sectors of the economic activities of many countries, and its importance varies from country to country (Oladeebo and Fajuyigbe, 2007; Adeshina, 2018). However, in Sub-Saharan Africa (SSA), agriculture is mostly dominated by low land productivity and per capita food availability is permanently decreasing over time (Clover, 2003; Lambin *et al*., 2003; Mutoko *et al*., 2015). According to Norton *et al.* (2010), the wide variations in crop yields are due to challenges of reallocation of productive resources among different small farms. Land as a natural resource is subject to intense competition as a result of population growth, unsustainable land use and climatic crisis. This increasing competition for land as well as social inequality and social tensions may affect the proper use of land and alter the way farmers manage their resources. Consequently, the land administration system has a vital importance to ensure efficiency of farmers.

The definition of land administration changes over time as national and global socio-economic system changes. While in former colonial regions, the main concern was how to make land administration inclusive; the western world was concerned with how to register landowners in order to tax land (Simon-Hull *et al*, 2020). For the latter concern, land administration was defined as *"the processes of recording and sharing information about the ownership, value and use of land and its associated resources"* (UNECE, 1996). More recently, Lindsay (2002), Enemark et al. (2016), and Lengoiboni et al. (2021) respectively described land administration as the management of a system of land rights, including: procedure of land right allocation and recognition, definition and delimitation of boundaries between parcels, recording information about land rights, rights holders and parcels, as well as land transaction procedure (sales, mortgages, leases and dispositions); institutions and processes of planning, controlling and monitoring of land use; land valuation and taxation procedures; resolution of uncertainty or adjudication of disputes concerning land rights and boundaries.

According to Fisher and Whittal (2020), an optimal land administration system which operates in an efficient manner presents four core functions: land tenure, land use, land value and land development. Land tenure was defined as relationship, institution, and rules that define how property rights to land are allocated among individuals or groups of people within societies (FAO, 2005). Land tenure provides a very important role in

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determining farmers' land use decision and influence farmers' profit margin (Tenaw*et al.*, 2009). Land use describes the manner in which land is used. In the world, one of the most important users of land resources is agriculture (World Bank, 2013). In Sub-Saharan Africa, 43.8% of the total land area is used as agricultural land (FAO, 2014; Ihemezie, 2019). In Nigeria, 80% of employment and outputs from agriculture is provided by land use that represents the livelihoods of majority of people. Its contribution is estimated at 43% to the gross domestic product (GDP) (Apata, 2011; Ohwo, 2015; Apata, 2019).Land valuation is a process of providing either agronomic value using soil quality and land productivity (through relative scores or index) or market monetary value (as a result of transaction between a willing buyer and willing seller, after suitable bargaining and where the parties acted knowledgeably, prudently and without compulsion) to all parcels of the consolidated area (Bullard, 2007; Asiama, 2018).However, there is not a standard land valuation approach for all countries. The type of land valuation to adopt for each country depends on the existing culture and experience (Nisanci *et al.*, 2006). Some countries like Poland and Sweden focus their land valuation on open market (Hartvigsen, 2015), where landowners act knowledgeably, prudently and without any compulsion, after suitable marketing to determine a market price (RICS, 2017). In other countries, such as in Germany, Netherlands, Greece and India, the valuation of farmland is based on agronomic value (i.e. agricultural productivity and the soil quality) (Van Dijk, 2003; Asiama, 2018). In Sub-Saharan African countries with customary land like Ghana, the valuation of farmland parcels is based on the local people's view of land value due to the limited land market (Asiama, 2018). Land development or land improvement or land amelioration is altering the landscape in any number of ways such as changing land forms from a natural or semi-natural state for a purpose such as agriculture or housing, subdividing real estate into lots, real estate development or changing its purpose. Land development encompass various activities: building new physical infrastructure and utilities; the implementation of construction planning, public acquisition of land, change of land use through granting of construction permissions and building land use permits; and the distribution of development costs (IFRI, 2016).

Secure property right to land provides the incentives for investment and sustainable development (UNCHS, 1999). According to Feder and Noronha (1987), the relationship between access to land and agricultural productivity is characterized by the fact that the establishment of property rights removes the anxiety and uncertainty of expropriation that entice farmers to undertake a long term investment decision on land. Moreover, title of land represents an easy way for farmers to get access to credit for investment since these titles are used as collateral for credit. That is to say that the international banking norms and practices required a certainty and secure ownership of land to provide credit so that landowners can invest through purchasing chemical fertilizers and improved seeds, introducing new farming techniques and technologies, improve and construct new buildings (UN, 1996). Consequently, the lack of access to credit may force farmers to adopt a traditional land use practices despite their willingness to change. In the same way, the inability of land tenure systems to provide adequate land rights is a source of conflict among farmers, which is common to the vast majority of Sub-Saharan countries (Shimelles *et al*., 2009).

In Nigeria, land ownership structure has evolved over time through pre-colonial, colonial and post-colonial systems; and all activities related to land are regulated by government through policies and programs. In 1978, the Land Use Act was established to harmonize and organize land ownership in Nigeria. However, the Land Use Act of 1978 seems to provide more importance to socialist consideration characterized by excessive state control of land ownership, land use and development (Udoekanem *et al*., 2014). According to the land Use act of 1978, the beneficiaries of the communal land allocation system are not formally recognized as legal holders of right to the land (Oluwatayo *et al*., 2019).

The land administration system in Nigeria is facing a range of constraints that alter the good delivery of land administration services to citizens. Some of these constraints are the bureaucratic nature and cost of current land registration, long and expensive registration process, the failure to properly register ownership of land. Because of these constraints small percentage of population is engaged with formal land sector (only 3% of land in Nigeria has formal property title), the business environment is affected by uncertainty over land discouraging farmers to invest on land or to use land as a collateral for credit (IFPRI, 2016).

Nowadays, farmers exploit more and more fragmented lands necessitating additional time and effort to manage distant plots. Moreover, land fragmentation is said to hinder the efficient use of irrigation and the development of mechanical technologies (Demetriou, 2014). To this end, exchange of fragmented parcels seeks to overcome the problem of fragmented distant plots to achieve plots that are as large as possible (Len, 2017).

The effects of land administration on economic development have been argued among authors. According to some authors, land administration is an important factor to ensure economic development through the use of land. For instance, Dale and McLaughlin (1999), argued that a good land administration provides security to investors and permits government to raise taxes on the basis of the value of land and property. In the same way, Zabout *et al.* (2006), Subedi (2016) advocated that a good land administration system based on secure land tenure is essential to obtain economic growth. However, empirical findings from different studies all over the world are not the same,

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since some studies (Ouedraogo *et al*., 1996; Bugri, 2008; Markussen, 2008) found a weak effect of land administration factors on agricultural production and economic growth. Moreover, the microeconomic analysis of the theory of land administration has not been discussed and tested by many authors. Lasisi *et al.* (2018), Alarima *et al.* (2012) and Eze et al. (2011) found a negative effect of land administration (land tenure system) on agricultural development in Nigeria. Nevertheless, the study of Van der Molen (2002) analyses the macroeconomic effect of the theory of land administration in the Netherlands. He concludes that the presence of good land administration is responsible for growth of 5.9 percent of the GDP in the Netherlands.

The land administration practice is likely different from one area to another in the study area and might explain a difference in allocative efficiency in the study area. The lack of the microeconomic analysis of effect of land administration on agricultural development has created a vacuum. It is based on these backdrops that this study aimed at an assessment of the effects of land administration on allocative efficiency of rice farmers under irrigation farming in Gombe and Borno States, Nigeria.

This study therefore examined: (1) the existing land administration processes and land exchange approaches in the study area, (2) the relative performance of land administration under the different land authorities, (3) the allocative efficiency of rice farmers under different land administration authorities, and (4) the effects of land administration and other factors on allocative efficiency of rice farmers. The study also tested an hypothesis of no significant difference in the performance of land administration under the different land authorities in the study area.

2. Conceptual Framework

This conceptual framework (fig. 1) provides an insight to the relationship among the key variables of this study. Firstly, allocative efficiency of farmers was determined respectively based on the costs of some inputs, farm size, labour used, quantity of seeds planted, quantity of fertilizer used, quantity of pesticides used, and quantity of herbicides used, in order to compare the efficiency of farmers under different land administration and to deduce their efficiency scores. Secondly, some factors like: land administration service index, land tenure factors, land use intensity, land development, land value, distance between plots, distance between farm and homestead, practice of land exchange, household size, age, labour, rice output and land fragmentation index (Simpson's Index) were used to assess the effects of land administration and other factors on allocative efficiency of rice farmers in the study area.

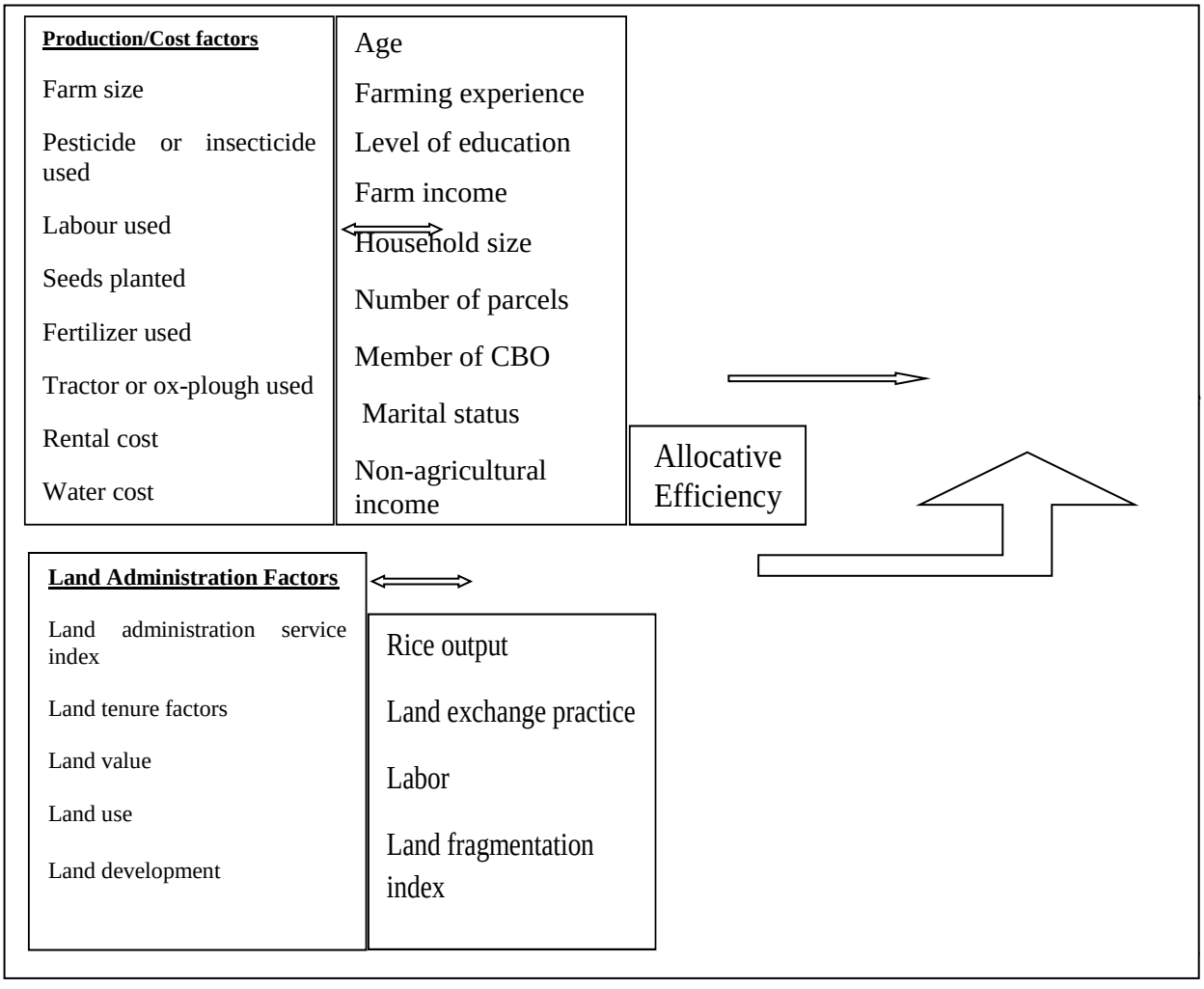

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Fig.1: Conceptual Framework for Analyzing the Effect of Land Administration on Allocative Efficiency of Rice Farmers
Source: Authors' conceptualization

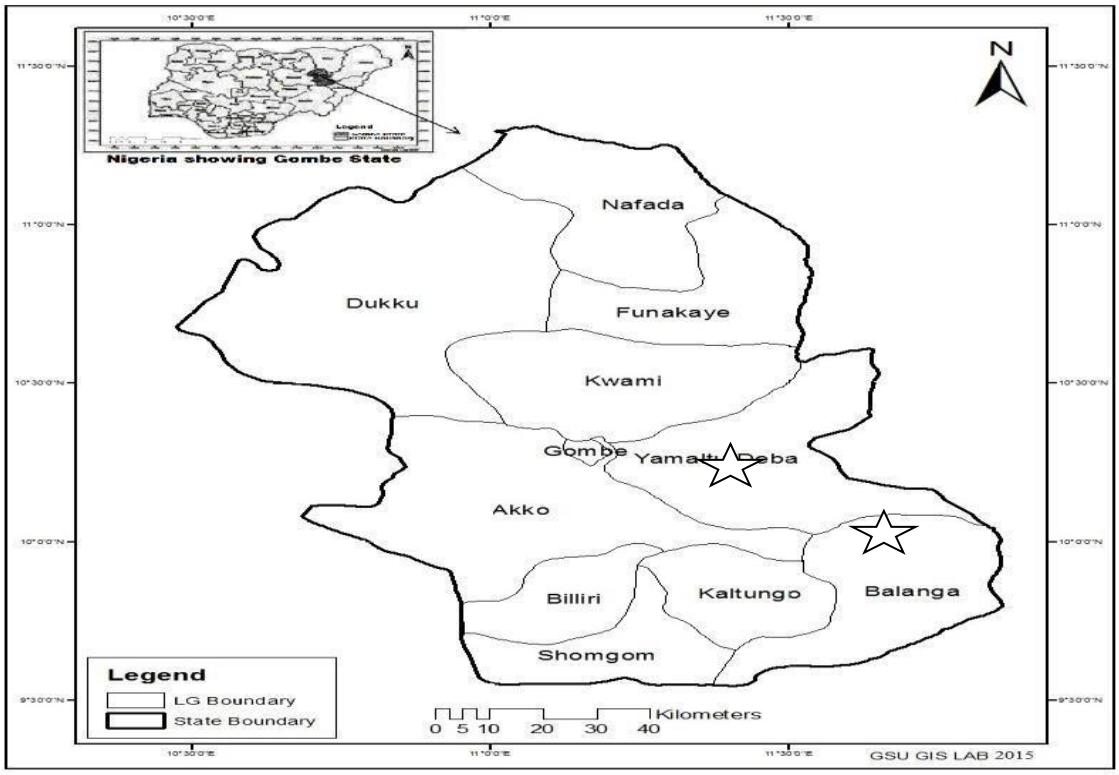
3. METHODOLOGY

3.1 Research Design

This study adopted cross-sectional survey design using questionnaires to obtain data for the analysis of causality effects of land administration and land exchange on allocative efficiency of rice farmers. The design also permits a comparative analysis of the allocative efficiency of rice farmers under different land administration authorities in the study area.

3.2 The study Area

This study was carried out in Borno and Gombe States of Nigeria, two of the 36 States of the country. The two States are characterized by good climatic and soil condition that support rice production. Gombe State, with headquarter in Gombe, is located within the latitude 10°15 N and longitude 11.10°E in the Northeastern part of Nigeria. The state has an area of 20,265 km² and a population of around 2,365,000 people; two distinct climates, the dry season (November–March) and the rainy season (April–October) with an average rainfall of 850mm. The State comprised eleven Local Government Areas (Fig. 2): Akko, Balanga, Billiri, Dukku, Funakaye, Gombe, Kaltungo, Kwami, Nafada, Shongom, and Yamaltu-Deba (NPC, 2006).
Borno is located within the latitude 11°N and longitude 13.5°E in northeastern part of Nigeria. Its Headquarter is Maiduguri. The state has an area of 57,799 km² and a population of around 4,171,104 people. The climatic condition of the state is hot and dry for most part of the year in the north, while in the south it is a bit milder. The annual rainfall ranges between 500-1,000 mm. The rainy season starts in June and terminates in September in the Northern part of the state. While the rainy season is between the months of May and October in the South with relative humidity of approximately 49% and evaporation of 203 mm year (Wikipedia, 2015). Borno State consists of twenty-seven (27) Local Government Areas (Fig. 3), grouped into three Senatorial Districts: Borno Central, Borno South, and Borno North (NBS, 2006).



☆ Yamaltu/ Deba and Balanga Local Government Areas of Gombe State
Figure2: Map showing the study area in Gombe state. Source: Maps.google.com.ng, 2019

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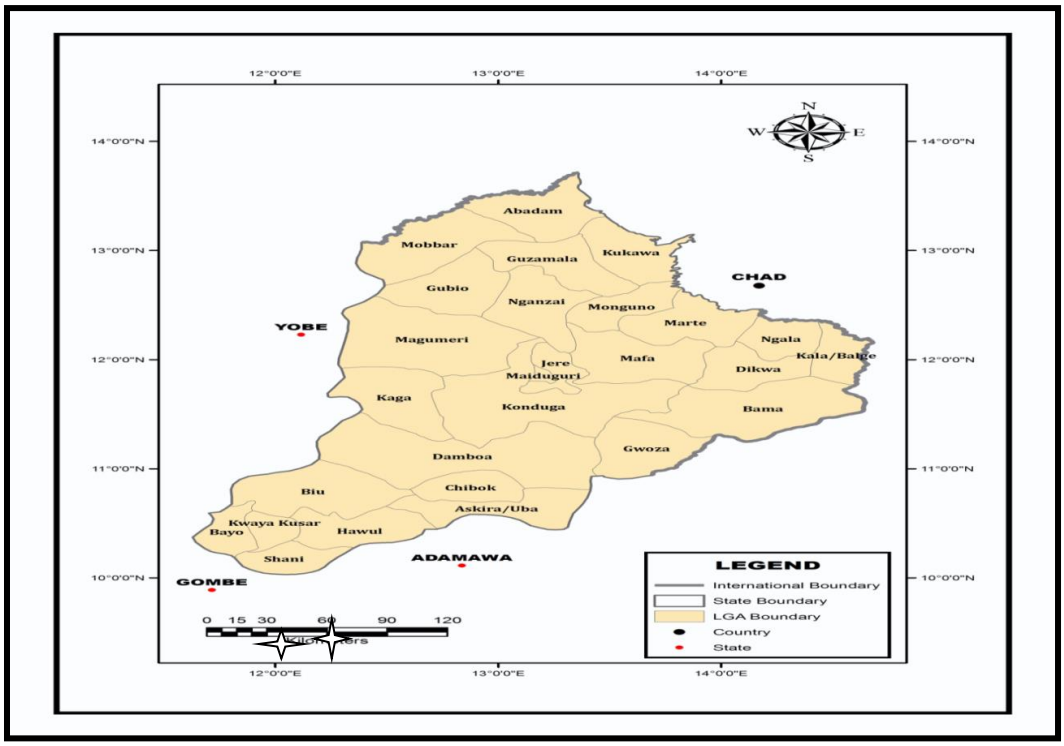

Bayo and Kwaya Kusar Local Government Areas of Borno State

Figure 3: Map showing the study areas in Borno State. Source: Maps.google.com.ng, 2019

3.4 Population, Sampling Procedure and Data Collection

The sampling frame for this study consisted of farmers growing rice under various cropping systems in the study area. The population of the study comprised all rice farmers of Gombe and Borno States under Dadin-Kowa Irrigation Scheme (DKIS) and those that are not but that are practicing irrigation farming under other public, private and local land administration arrangements.

Multi-stage sampling technique was used for sample selection. Firstly, based on proximity to the DKIS, one senatorial district was purposively selected from each State, and two (2) LGAs were further purposively selected from each of the two Senatorial districts. From each of the LGA selected, one ward was also purposively selected based on their proximity to the study area. Secondly, three (3) villages were selected using random sampling technique. Finally from each village, respondents were randomly selected after stratifying them into four (4) land administration authorities: large scale public DKIS authority, small scale public/government authority, private land administration authority, and local land administration authority. The sample sizes of the various strata were obtained by randomization to get the number of respondents for the various strata using Taro Yamani (1973) formula from a sample frame of 3988 registered farmers practicing irrigation farming. The formula is expressed as follows:

$$n = \frac{N}{1 + N(e^2)}$$

Where; n = sample size; N = real or estimated size of the population; e = level of significance (5% or 0.05). The study takes into account a non response rate of 10% that is close to 9% recorded during the last national surveys (UN, 2010). This gives total sample size of 400 randomly selected rice farmers under irrigation system in the study area (table 1). Questionnaires were also used as instrument for collecting data from individual rice farmers under different land administration authorities.

Table 1: Sample Size Selection Plan

Land Administration Authorities	Sampling Frame	Sample Size
DKIS	839	107
VEGFRU	2451	181
NIHORT / CoH	120	35
PRIVATE AUTHORITY	281	77
Total	3691	400

Source: Field survey, 2021

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3.5 Methods of Data Analysis

The data collected for this study was analyzed using both descriptive and inferential statistics. Descriptive statistics such as mean, frequency and percentage were used to describe the types of land administration processes and land exchange approaches and to score the performance of land administration in the study area. Stochastic frontier regression model was used to determine the allocative efficiency of rice farmers under different land administration authorities. Tobit regression model was used to assess the effects of land administration factors and other factors on allocative efficiency of rice farmers in the study area.

3.5.1 Land Administration Index (LAI)

The land administration index for each farmer was calculated by multiplying the score of each factor (S_{fp}) by the corresponding weight (based on equal weight of the factor of land administration) of the factor (W_p) (in percentage), and summing for each farmer, as depicted in the equation function below;

$$LAI_p = \sum_{p=1}^{n} S_{fp} W_p$$

The value of land administration index for the study area was given by the average value of the land administration indexes. $\overline{LAI}=\frac{1}{n}\sum_{p=1}^{n} LAI_p$

if $\overline{LAI} < 50$, the land administration system is not efficient. Otherwise, If $\overline{LAI} \geq 50$, the land administration system is efficient.

These land administration factors were:

S1= Guarantee ownership and security of tenure; S2= Equal access to property rights; S3= Managing disputes regarding land rights and plot boundaries; S4= Transferring property or use; S5= Determining and allocating plot boundaries; S6= Transparency of information on land; S7= Assessing the value of land; S8= Assessing rental cost; S9= Adopting planning policies and land use regulations.

3.5.2 Allocative efficiency model

The Cobb-Douglas stochastic cost frontier model used to estimate allocative efficiency scores was stated as:

$$\text{Ln}\, C_i = \alpha_0 + \alpha_1 \text{LnW}_1 + \alpha_2 \text{LnW}_2 + \alpha_3 \text{LnW}_3 + \alpha_4 \text{LnW}_4 + \alpha_5 \text{LnW}_5 + \alpha_6 \text{LnW}_6 + \alpha_7 \text{LnW}_7 + \delta_i - \varphi_i$$

Where;

Ln = Natural logarithm to base 10

C_i = the cost of producing rice for the ith farm (Naira/ha). α_s = The parameters to be estimated.

W_1= price of seeds (Naira/kg); W_2 = price of fertilizers (Naira/kg); W_3 = price of herbicides (Naira/L); W_4 = land rental cost (Naira/ha); W_5 = price of pesticides (Naira/L); W_6=cost of labour (average payment per day and per ha); W_7= cost of water (Naira).

δ_i = Random errors which are assumed to be independently and identically distributed. φ_i = Non negative random variable associated with economic inefficiency.

This is assumed to be independently distributed such that φ_i is obtained by truncation (at zero) of the normal distribution with variance δ'^{2} and means φ.

The economic inefficiency was modelled in terms of factors such as

$$\varphi_i = \sigma_0+\sigma_1 Z_1+\sigma_2 Z_2+\sigma_3 Z_3+\sigma_4 Z_4+\sigma_5 Z_5 + \sigma_6 Z_6 \quad (2)$$

Where: σ = a vector of unknown parameters to be estimated, Z_1= age of farmers in years, Z_2= Level of Education measured in number of years spent in formal education, Z_3= experience in selected crop in years, Z_4= household size measured as number of family member living together in a house, Z_5= Number of parcels, Z_6= Non-agricultural income (Naira)

3.5.3 Tobit Regression Model

To determine the effects of different factors on allocative efficiency, Tobit regression model was used. The model was specified as:

$$Y_i^* = \lambda_0 + \lambda_1 V_{1i} + \lambda_2 V_{2i} + \ldots\ldots\ldots + \lambda_{15} V_{15i} + \lambda_{16} V_{16i} + \rho_i$$

Where; $Y_i = 0$ if $Y_i^* < 0$

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$$Y_i = Y_i^* \text{ if } 0 \le Y_i^* \le 1$$
$$Y_i = 1 \text{ if } Y_i^* \ge 1$$

With, $Y_i^* = AE_i$

λ_0 = intercept, the value of AE_i, when others variables are null. λ_i = are the parameters to be estimated, V_1 = rice output (Kg/Ha), V_2 = experience (years), V_3 = Household size, V_4 =inheritance (1=yes; 0=no), V_5 = purchase (1=yes; 0=no), V_6 = rent (1=yes; 0=no), V_7 = individual lease (1=yes; 0=no), V_8 = gift (1=yes; 0=no), V_9 = government allocation (1=yes; 0=no), V_{10} = land administration service index, V_{11} = land value (soil quality), V_{12} = land use (Herfindahl index), V_{13} = land development index (quality of infrastructures), V_{14} = land exchange practice (1=yes; 0=no), V_{15} = land fragmentation (Simpson's Index), V_{16} =labor force (man-day), ρ_i is an error term which is assumed to be independent and identically distributed.

3.5.4 ANOVA Test

The analysis of variance (ANOVA) F statistic for testing the equality of several means was used to test the statistical significance of the differences of land administration service index among the sampled groups. It was specified as follows:

$$F(observed) = \frac{variation\ between\ groups}{variation\ within\ groups}$$

If F(observed)>the critical F value, we reject the null hypothesis that all the group means are the same, and coincidently supports that at least one group mean differs from other group means.

4. Results and Discussion

4.1 Description of land administration processes in the study area

The result of the descriptive analysis in table 2showed that rice farmers in public administered land area acquired land mainly through government allocation as in the case of DKIS, VEGFRU and NIHORT/CoH (59.8, 82.3, and 77.1% respectively). However, even though land belongs to government, farmers also acquired land informally, especially through inheritance (26.2, 11 and 8.6% respectively for DKIS, VEGFRU and NIHORT/CoH) and rent (13.1, 5.5 and 17.6% respectively) for DKIS, VEGFRU and NIHORT/CoH). This result is in conformity with Oluwatayo *et al.* (2019), who found that despite the fact that all lands belong to the government (as bound by the Land Use Act 1978), the bulk of the land transactions are carried out informally under customary laws with poor or lack of documentation, especially in rural Nigeria. Forland under local authority, which is the area of private land, land is mainly acquired through inheritance (50.6%), rent (33.8), purchase (7.8) and individual lease (6.8).

The result of farmers' perception of their rights over land revealed that under government land authority, farmers think that they have right to transfer land, as indicated by 79.4%, 71.3% and 45.7% respectively for DKIS, VEGFRU and NIHORT/CoH land administration authorities. Also, 70.1%, 49.2% and 34.9% of farms have right to rent land under DKIS, VEGFRU and NIHORT/CoH authorities respectively; while33.6%, 16.6%, and 20% respectively have right to lend land under DKIS, VEGFRU and NIHORT/CoH authorities. However, very few of them think that they had the right to sell land under government allocation. In local authority, majority of them think that they had all rights (sell, rent, lend and transfer); with 67.1% of farmers indicating that they had the right to sell land. This implies that for some cultural reasons, 32.9% of rice farmers under local administration said that they had no right to sell their land. On the other hand, 97.1% said that they have the right to transfer and 98.4% have the right to rent and lend. This result agrees with Boudreaux and Sacks (2009), who found that in some African countries like Nigeria and Ethiopia, government is the holder or owner of much land; the purchase, sale, or rental of plots is formally banned, while land transactions do take place informally.

Under formal land administration authorities (DKIS, VEGFRU, NIHORT/CoH), land is allocated to farmers through the issuance of receipt conferring right of occupancy to farmers. Under local land administration authority, 95.7% of farmers acquired their land informally and mainly through customary title (53.8%). This result is in conformity with Oluwatayo *et al.* (2019), who stated that in rural Nigeria, land tenure is dominated by customary laws. In the same way, 4.3% of farmers under local land authority acquired their land formally, while only 2.6% of farmers had a deed of occupancy.

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Farmers have been using their land for an average of 13, 12, 8 and 9 years under DKIS, VEGFRU, NIHORT/CoH and Local authorities respectively. Using land for a long period of time is supposed to reduce anxiety of farmers and uncertainty over land. Conflicts over land use is mainly dominated by herdsmen conflict (22.4 % in DKIS, 25.4% in VEGFRU, 20% in NIHORT/CoH and 16.9% in Local authority). This result is consistent with Adisa (2012), who found that conflicts between farmers and cattle herdsmen over the use of agricultural land is still persistent in Nigeria, which has grave consequences for rural development. Similarly, inheritance conflict (especially under local land authority), boundary conflict, limited access to land due to discrimination, dispute over the payment of land duties, multiple allocation and eviction by land authorities or owners were also non negligible sources of conflict over land in the study area.

Most of the respondents are satisfied by the way land is administered in their respective land administration areas. For those that are not satisfied, the main reasons are: water competition, partiality of agents, no land development, conflict over land and high allocation cost. Concerning water competition, FAO (2013) reported that some of the countries experiencing the fastest population growth are those where land and water resources are least abundant, causing extremely high pressure on water resources for irrigation purpose.

Table 2: Existing land administration processes

	DKIS(%)	VEGFRU (%)	NIHORT (%)	LOCAL (%)
Land acquisition				
Inheritance	26.2	11	8.6	50.6
Purchase	0.9	0	2.6	7.8
Rent	13.1	5.5	17.6	33.8
Lease	0	0.6	0.5	6.8
Gift	0	0	0	0.3
Community lease	0	0.6	0	0.3
Government allocation	59.8	82.3	77.1	0.4
Land right				
Sell	0.9	1.1	0.3	67.1
Rent	70.1	49.2	34.9	98.4
Transfer	79.4	71.3	45.7	97.1
Lend	33.6	16.6	20	98.4
Ownership type				
Formal	92.5	95.0	94.3	4.3
Informal	7.5	5.0	5.7	95.7
Ownership document				
None	7.4	5.0	5.8	41.9
Deed	0	0	0	2.6
Right of occupancy	92.5	95.0	94.2	1.7
Customary title	0.1	0	0	53.8
Duration (mean years)	12.72	11.73	7.54	8.57
Conflicts				
Boundary conflict	9.3	10.5	3.4	11.7
Multiple allocation	2.8	3.0	0	0.4
Eviction	1.03	1.49	1.14	5.2
Dispute over payment	1.9	2.2	11.3	6.5
Inheritance conflict	7.9	2.2	8.6	11.7
Limited access due to discrimination	5.6	13.8	11.4	7.8
Herdsman conflicts	22.4	25.4	20	16.9
None	72.9	65.7	70.5	2.6
Satisfaction by land administration				
Yes	75.7	65.2	68.6	70.1
No	24.3	34.8	31.4	29.9
Reasons of no satisfaction				
High allocation cost	1.7	14.4	5.7	6.5
No access to water	0.8	0.6	0.6	2.6
Partiality of agent	2.1	19.3	5.7	1.3
No land development	0	23.8	17.1	1.3
Conflict over land	1.3	3.9	2.9	4.3
Water competition	17.8	18.2	14.0	20.8
Corruption	0.6	4.2	0	0

Source: Field survey, 2021

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4.2 Performance of land administration in the study area

The mean land administration service index (LASI) in presented in table 3. The result showed that the mean land administration service index in the study was 0.67 (LASI>0.5). This implies that based on farmers' perception of the performance of land administration factors in the study area, the land administration service is efficient, but there is 33% potential for improved efficiency of land administration process in the study area. The result also revealed that DKIS has the best land administration service index (0.74), followed by VEGFRU (0.67), NIHORT (0.64) and Local authority (0.6). This may be explained by the important role played by DKIS office in terms of proximity and supports to rice farmers.

Table 3: Mean scores of land administration service indexes (LASI) as perceived by farmers

	DKIS	VEGFRU	NIHORT	LOCAL	General
Mean LASI	0.74	0.67	0.64	0.6	0.67
Standard deviation	0.064	0.11	0.048	0.058	0.1

Source: field survey, 2021

4.3 Classification of factors affecting the performance of land administration

Farmers have classified the factors affecting the performance of land administration based on their importance in the study area in a descending orderas follows (table 4): guarantee ownership and security of tenure, equal access to property rights, managing disputes regarding land rights and plot boundaries, transparency of information on land, determining and allocating plot boundaries, transferring property or use, assessing the value of land, assessing rental cost, and adopting planning policies and land use regulations. This classification showed that the major worry of farmers is the one related to land tenure security. According to Byamugisha (2013), in some Sub-Saharan African countries, the performance of land administration is affected by the inefficient procedures of land transactions, fragmentation of land administration systems, and fraudulent practices that result in land conflicts and social instability. This means that land administration practices differ widely across countries throughout the world, reflecting historical, juridical, and cultural differences (Byamugisha, 2014).

Table 4: Rank of land administration factors as perceived by farmers

Land administration factors	**DKIS**	**VEGFRU**	**NIHORT**	**LOCAL**	**General**
Guarantee ownership and security of tenure	1	1	3	1	1
Equal access to property rights	2	2	1	4	2
Managing disputes regarding land rights and plot boundaries	3	4	2	2	3
Transferring property or use	6	6	4	5	6
Determining and allocating plot boundaries	5	5	6	3	5
Transparency of information on land	4	3	5	6	4
Assessing the value of land	7	7	7	7	7
Assessing rental cost	8	8	8	8	8
Adopting planning policies and land use regulations	9	9	9	9	9

Source: field survey, 2021

4.3 Estimates of the Parameters in the Stochastic Cost Frontier Analysis of Farmers' Allocative Efficiency

The result on allocative efficiency of rice farmers in the study area is presented in table 5. The analysis revealed that there were allocative inefficiency effects as shown by the gamma value of 0.98, 0.64, 0.89 and 0.97 for DKIS, VEGFRU, NIHORT/CoH and Local Authority respectively; which were significant at 1% probability level. This implies that about 98%, 64%, 89% and 97% of total variation in the maximum cost were due to the inefficiency rather than random variability. The estimated sigma squared was significant at 1% level except for VEGFRU that was 5% level. This indicated a good fit and correctness of the specified distribution assumption of the model.

All the coefficient of the variables examined in the cost function have positive signs and conformed with a priori expectation indicating that the estimated cost function is an increasing function. The result showed that in DKIS, cost of labor ($p<0.01$), price of seed ($p<0.05$), price of fertilizer ($p<0.01$), rental cost ($p<0.05$) and price of pesticide ($p<0.05$), positively increase the total cost of rice production. The coefficient of the labor showed that one percent increase in the cost of labor used for rice production is likely to increase cost of producing rice by 0.46%, which is slightly lower than the result of Okello *et al.* (2019) that was 0.48%. The price of seed is positively and

ISSN 2536-6084 (Print) & ISSN 2545-5745 (Online)

significantly related to allocative efficiency. This means that if the price of seed increases by 1%, the total cost will be increased by 0.38%. The coefficient of price of fertilizer revealed that if the price of fertilizer increases by 1%, the total cost will be increased by 1.12%. This is in conformity with Laniyan *et al.* (2018). However, the result was in contradiction with Aboaba (2020), who found a negative and significant relationship between cost of fertilizer and total production cost. According to him, rice farmers did not use fertilizer in their farms, which is different from the case of our study area. The coefficient of land rental cost revealed that an increase of land rental cost by 1% will increase the total cost by 0.28%. This is so because land is a very important resource of production and any attempt to raise its rental cost will increase the total production cost. This result supports the findings of Gela *et al.* (2019).

In VEGFRU, only labor cost increases the total cost positively. This result showed that 1% increase in labor cost will increase the total production cost by 0.56%. In NIHORT/CoH, price of seeds, price of herbicide and rental cost positively increased the total cost, while in Local Authority, labor cost, price of seeds and cost of water increase the total cost positively. The coefficient of the cost of water revealed that 1% increase in expenditure for water will increase the total cost by 0.46%. This result may be explained by the high competition for water for irrigation farming under local land administration authority, thereby driving farmers to expend more on acquiring water for irrigating their farms.

The inefficiency model showed that in DKIS and VEGFRU, non-farm income had positive and significant effect on the cost inefficiency. This means that farmers' allocative efficiency decreases with increase in non-farm income, in agreement with Laniyan *et al.* (2018). In NIHORT/CoH, the inefficiency increase with age. This means that the older the farmer the more difficult was for him to manage efficiently his production costs. And, in Local authority, farmers' allocative efficiency increases with increase in age and experience. This result also revealed that the older the farmer the more experienced he was expected to be in terms of decision making in order to reduce the production costs, this result agreed with the findings of Akinbode (2011).

Table5: Maximum Likelihood Estimates of the Parameters in the Stochastic Cost Frontier Analysis (allocative efficiency)

	DKIS		VEGFRU		NIHORT		LOCAL	
Variables	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Constant	0.66	0.52	3.772	2.04**	5.82	7.98***	-1.069	-0.75
Labor cost	0.461	4.01***	0.5609	2.95***	0.1502	1.48	0.4891	3.13***
Price of seeds	0.3801	1.981**	0.069	0.57	0.1702	4.54***	0.1701	2.350**
Price of fertilizer	1.121	3.5301***	0.91	0.86	0.018	0.066	-0.085	-0.13
Price of herbicide	-0.072	-0.48	-0.244	-1.11	0.421	2.55**	-0.105	-1.08
Rental cost	0.2761	2.4**	-0.512	-0.47	0.711	2.231**	1.0311	1.46
Price of pesticide	0.3061	2.26**	-0.007	-0.065	-0.097	-1.2	0.002	0.024
Water cost	0.045	0.41	-0.376	-1.63	-0.39	-0.54	0.4601	2.981***
Inefficiency model								
Constant	-1.46	0.177	4.47	0.81	-18.76	-1.62	0.487	0.67
Age	-0.312	-1.25	-0.27	-0.64	0.31	1.75*	-0.3009	-2.22**
Education	-.249	-0.19	-0.82	-0.29	0.357	1.24	0.034	1.46
Experience	-.137	-0.57	-0.15	-0.36	-0.178	-1.13	-0.2701	-3.89***
Household size	0.157	0.53	-0.12	-0.28	-0.25	-0.86	-0.022	-1.08
Non-farm income	5.70e-6	1.99**	3.66e-6	2.02**	-1.2e-6	-0.49	-0.0001	-0.67
Number of plots	0.065	0.072	-0.33	0.81	0.537	0.61	-0.034	-0.98
Sigma-square	0.4811	54.4***	0.3809	2.14**	0.532	5.53***	0.7809	5.97***
Gamma	0.9821	6.19***	0.6432	11.09***	0.89	5.14***	0.9708	10.9***
LR test	59.27		79.13		178.92		89.05	

Source: field survey, 2021

4.4 Distribution of Allocative Efficiency of Rice Farmers

The predicted allocative efficiency (AE) of the farmers ranged between 0.24 and 0.97 in DKIS, 0.39 and 0.98 in VEGFRU, 0.73 and 0.94 in NIHORT/CoH and between 0.84 and 0.97 in Local Authority, with a mean value of 0.86, 0.93, 0.86 and 0.94 respectively (Table6). This implies that if the average farmer is to achieve the allocative efficiency of his most efficient counterpart, the average farmer could realize a 11.3, 5.1, 8.5 and 3.1% cost saving for DKIS, VEGFRU, NIHORT/CoH and local authority respectively. This also implies a cost saving of 75.2%, 60.2%, 22.3%, and 13.4 % for the most economically inefficient farmer in DKIS, VEGFRU, NIHORT/CoH and local authority respectively.

The mean allocative efficiency of 0.93 obtained for VEGFRU is similar to the value of allocative efficiency of Ofada rice farming in Ogun State of Nigeria (Aboaba, 2020), and almost the same for local authority (0.94).

ISSN 2536-6084 (Print) & ISSN 2545-5745 (Online)

Similarly, the average farmer in VEGFRU could realize almost the same cost saving (5.1) than the Ofada rice farmer in Ogun State (5.8%) to achieve the allocative efficiency of their most efficient counterpart. However, the most allocatively inefficient Ofada rice farmer in Ogun State could realize more cost saving than rice farmer in NIHORT/CoH and local authority.

Table 6: Percentage Distribution of Allocative Efficiency

Allocative efficiency	DKIS		VEGFRU		NIHORT		LOCAL	
	Freq	(%)	Freq	(%)	Freq	(%)	Freq	(%)
<0.3	1	0.9	0	0	0	0	0	0
[0.3 ; 0.5]	1	0.9	2	1.1	0	0	0	0
[0.5 ; 0.6]	1	0.9	0	0	0	0	0	0
[0.6 ; 0.8]	12	11.2	2	1.1	6	17.1	0	0
[0.8 ; 0.9]	39	36.5	17	9.4	18	51.5	6	7.9
[0.9 ; 1]	53	49.5	161	88.4	11	31.3	71	92.1
Total	107	100	181	100	35	100	77	100
Max	0.97		0.98		0.94		0.97	
Min	0.24		0.39		0.73		0.84	
Mean AE	0.86		0.93		0.86		0.94	

Source: field survey, 2021

4.5 Effects of land administration and other factors on allocative efficiency of rice farmers in the study area

To ascertain the effects of land administration and other factors on allocative efficiency of rice farmers under irrigation farming, Tobit regression model was estimated (table 7). The sigma revealed the fitness of the model at 1% ($p < 0.01$) level of significance. The likelihood ratio chi-square of 33.85 with a p-value of 0.0057 for allocative efficiency indicate that the model as a whole is statistically significant. That is to say that it fits significantly better than a model with no predictors.

The result also showed that land administration service index and hired labor force were the only factors affecting the allocative efficiency of rice farmers in the study area. The coefficient of land administration service index was negative and statistically significant at 1%. Thus, the result suggests that a unit increase in land administration index decreases the allocative efficiency of farmers by 12.7%. That is to say that, a unit positive increase in farmers' perception of land administration service decreases the allocative efficiency of rice farmers. Otherwise, more farmers that perceived improvement in land administration service, more that did not contribute to resource use efficiency for production. According to Shimelles *et al*. (2009), Feder and Noronha (1987), this situation may be explained by the anxiety and uncertainty of farmers over land, discouraging them to invest or to efficiently allocate resources for production.

The coefficient of hired labor revealed that an increase in hired labor decreases the allocative efficiency for rice farmers. This means that farmers cannot manage effectively the hired labor because of the low supervision. This reduces the efficiency through the poor quality and quantity of work done. Comparable results were reported by Okello et *al.* (2019), Gautam *et al.* (2012) and Obwona (2006). However, this finding is in contradiction with the result of Onubuago and Esiobu (2019), who reported that labor contributes to resource use efficiency in cassava production in Sub-Saharan Africa.

Table 7: Effects of Land Administration and other factors on Allocative Efficiency

Variables	**Coefficients**	**P-values**
Constant	0.738	0.013**
Rice output	0.069	0.178
Experience	-0.0003	0.508
Household size	0.0011	0.122
Inheritance	-0.0006	0.975
Purchase	-0.0052	0.847
Rent	0.00031	0.989
Lease	0.030	0.375
Gift	0.114	0.162
Government allocation	-0.0114	0.586
LASI	-0.127	0.003***
Land value	-0.026	0.592
Land use	-0.024	0.204
Land development	0.012	0.487
Land exchange practice	-0.0035	0.740
Land fragmentation index	-0.002	0.555

ISSN 2536-6084 (Print) & ISSN 2545-5745 (Online)

Hired labor	-0.014	0.020**
Sigma	0.0779519	0.003***
L-R $Chi^2(16)$	33.85	
Prob > chi^2	0.0057***	
Log likelihood	448.301	

***and ** significant at 1and 5% respectively.
Source: Field survey, 2021

4.6 ANOVA Test

The study revealed that there was significant difference in the performance of land administration under different land administration authorities in the study area as confirmed by the F cal (17.55), which is greater than F tab (2.60) as presented in table 8. The null hypothesis is rejected and the alternative hypothesis is accepted. This implies that the performance of land administration service was statistically different from one land administration authority to another in the study area.

Table 8 : ANOVA test of difference of land administration service index among groups

Technical efficiency	Sum of Square	Df	Mean	F	Sig.
Between groups	0.419	3	0.139	17.55	0.000
Within groups	3.15	395	0.0079		
Total	3.56	398	0.0089		

F tab at 1% is 3.78
F tab at 5% is 2.60
F tab at 10% is 2.08

5 Conclusion and Recommendations

The study concludes that farmers in the study area acquired land formally through government allocation with the issuance of receipt, conferring to them right of occupancy. However, even though land belongs to government, farmers also acquired land informally, especially through inheritance and rent. In lands under local authority, land is mainly acquired informally by means of customary laws, inheritance, rent, purchase and individual lease. Farmers' perception of their rights over land revealed that in government lands farmers had right to transfer, to rent and to lend land. In local authority, farmers perceived that they had all rights (sell, rent, lend and transfer). Conflicts over lands are mainly dominated by herdsmen, inheritance and boundary conflicts. Most of the farmers are satisfied by the way land is administered in their respective land administration areas, while few farmers have exchanged land through the processes of land exchange for use and exchange of property. Land administration service was perceived as efficient, and the performance of land administration service differed from one land administration authority to another and that DKIS has the best land administration service.

Farmers in the study area were allocatively efficient given the current state of technology, and efficiency could be increased given if the available resources are efficiently used. Farmers under VEGFRU and local authorities were more allocatively efficient than those under DKIS and NIHORT/CoH authorities. Moreover, improvement in land administration service deters farmers from efficiently allocating resources for production. Similarly, an increase in hired labor decreases the allocative efficiency of farmers, due to inability to efficiently supervise hired labor.

It is recommended that land policy should clearly state rights related to the use of government lands and allow land transactions such as the sale of rights of occupancy, the transfer of leasehold rights or rent among farmers so as to strengthen the land markets and improve the efficient use of agricultural land. Government should also facilitate the obtaining of property rights in local lands so as to eliminate the anxiety and uncertainty of expropriation that discourage farmers from making long term investment decision on land, and or to use land as collateral for credit.

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