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Research Application Summary

Economic efficiency of rice production in smallholder irrigation schemes in Southern Malawi

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Abstract

This study used a parametric frontier approach to analyze technical, allocative and economic efficiency levels of smallholder rice farmers and the determinant factors in Nkhate irrigation scheme in southern Malawi. Technical and allocative efficiency levels were analyzed using a trans-log stochastic production function and the trans-log cost frontier function, respectively. Subsequent results from these efficiencies were used to derive the allocative efficiency levels. Inefficiency model was further used to analyze the underlying factors for efficiency differentials amongst the smallholder rice farmers sampled farm households. Results revealed an average technical, allocative and economic efficiency levels of 65%, 59% and 53%, respectively. This suggests that farmers have a rice yield potential of 35% (100%-65%) to be exploited, and can raise their current rice profitability and/or production levels by 47% (100%-59%) by adjusting input use. Soil fertility status, access to credit, household size and farmers experience were among the socio economic factors that influenced efficiency levels of the sampled smallholder rice farmers. It is therefore recommend that a well-functioning input and output markets through better policies and strategies in order to enhance efficiency levels of these smallholder rice farmers be put in place. The smallholder farmers can further be organized into farmer groups that can enhance efficient transfer of technical advice, access to agricultural credits as well as learning and sharing of knowledge among group members.

Key words: Economic efficiency, parametric frontier, smallholder rice farmers

Résumé

La présente étude a utilisé une approche paramétrique pour analyser, le niveau d'efficacité économique des petits exploitants rizicoles et les facteurs déterminants dans les exploitations irriguées de Nkhate au Sud du Malawi. Les niveaux d'efficacité technique et d'allocation ont été analysés en utilisant la fonction de production trans-logarithmique stochastique et la fonction de frontière de coût trans-logarithmique de façon respective. Les résultats obtenus ont ensuite été utilisés pour dériver les niveaux d'allocation. Par ailleurs, le model d'inefficacité

a été utilisé pour analyser les facteurs qui sous-tendent les différences de rentabilité au sein des ménages des exploitants agricoles échantillonnés. Les résultats ont révélé des valeurs moyennes respectives d'efficacité technique, d'allocation et économique de 65%, 59% et 53%. Ceci suggère que les exploitants ont un potentiel rendement de riz de 35% (100% - 65%) à exploiter et peuvent augmenter leur profitabilité actuelle et/ou niveau de production de 41% (100%-59%) en ajustant l'utilisation des intrants. Le niveau de fertilité du sol, l'accès au crédit, la taille du ménage et l'expérience de l'exploitant faisaient partie des facteurs socio-économiques qui influencent les niveaux d'efficacité des exploitants échantillonnés. Il est donc recommandé de mettre en place un marché performant d'intrants et d'extrants à travers de meilleures politiques et stratégies afin d'améliorer les niveaux d'efficacité de ces petits riziculteurs. Les petits exploitants peuvent, en outre, s'organiser en des groupes qui peuvent favoriser le transfert efficace d'appui technique, accès aux crédits agricoles ainsi que le partage de l'information au sein des membres des groupes.

Mots clés : Efficacité économique, frontière paramétrique, Petits exploitants riziculteurs

Introduction

Rice is the second main cereal food crop after maize in Malawi. Other food crops grown include sorghum, millet, pulses, root crops (tubers), vegetables, and fruits. Rice is also an industrial crop grown by the smallholder farmers mainly along the lake shore areas. Other industrial crops include, cotton, groundnuts, coffee, macadamia nuts and tobacco (FAO, 2008). For some time, yield levels for rice have been revolving around the same levels. In most flood plains, the yield levels have been ranging from 1.6- 1.9 t ha^{-1}. However, under good management, the potential yield levels range from 4 - 5 t ha^{-1} (Aune *et al*., 2014). The wide gap in yields indicates possibilities of improving rice productivity. Currently the Government of Malawi is failing to meet its cereal food requirements. This has been attributed to the failure of food production systems to keep pace with the growing population; droughts (climate variability) and inability of farmers to exploit available water facilities and wetlands for production; declining soil fertility combined with small land holdings and overreliance of farmers on maize as the only staple food crop, hence failure to diversify (FAO, 2008). One of the key strategies that the Government of Malawi put in place to increase agricultural productivity was the development of irrigation schemes (Malawi Government, 2006).

As part of fostering rural development, irrigated agriculture in Malawi is also being promoted as a means of reducing rural poverty, malnutrition, and disease as well as stemming the growing social economic inequalities between the rural and urban areas (Nkhoma and Mulwafu, 2004). This entails the need to improve productivity of rice as one of the major income generating irrigated crop in the country. According to FAO (2004), improving productivity of rice systems in Malawi would contribute significantly to eradication of hunger, poverty alleviation, national food security and economic development. Agricultural performance in Malawi has improved substantially over the past five years. This is mainly due to the input subsidy program. From its inception, Malawi has experienced increased use of inorganic fertilizer and improved seed, increase in land area under crop production and the favorable rains received in most parts of the country. Recent reports, however, indicate

that agronomic efficiency in smallholder crop production remains very low (Chirwa, 2003; Edriss, 2004; GOM, 2006; Tchale, 2009). Further analysis is required to understand factors affecting and interventions necessary to increase efficiency of crop production in smallholder agriculture. This study thus sought to evaluate farmer specific technical, allocative and economic efficiencies among rice producers in Nkhate irrigation scheme and determine the social economic characteristics that influence the efficiency levels.

Literature summary

Rice consumption and production have increased tremendously in sub-Saharan Africa (SSA) over the past decades and this trend is expected to continue. However, as argued by Hossain (2006), local rice production cannot meet the increasing demand for rice in many African countries. Although total milled rice production increased from 2.2 million Mt in 1961 to 9.1 million Mt in 2004, rice imports into SSA also increased from 0.5 million Mt of milled rice in 1961 to 6.0 million Mt in 2003 and SSA currently accounts for 25 % of global rice imports at a cost of more than US $1.5 billion per year (IRRI, 2006). This has therefore made many African governments to accord high priority to developing their local rice sector as an important component of national food security, economic growth and poverty alleviation (Balasubramanian *et al*., 2007). According to Balasubramanian *et al*. (2007) rice production constraints in SSA include: biophysical, management, human resource, and social economic/ policy constraints. These vary with rice ecosystems. Most of the constraints are similar to those experienced in Asia such as poor land preparation, leveling and irrigation management; inadequate drainage leading to the development of salinity and alkalinity; poor management of production inputs; yield instability due to weeds, insects and diseases; and deteriorating irrigation infrastructure especially in public irrigation schemes (Defoer *et al*., 2002).

Study description

The study was conducted at the Nkhate irrigation scheme (134° 562 E and latitude 16° 92 S) located in Chikhwawa district, in southern Malawi. It has distinct winter (May–September) and summer seasons (October–April) and the annual rainfall is less than 800 mm distributed between November and May. The topography is fairly flat, with slopes around 0 – 2%. The scheme covers a gross area of 243 ha of which 183 ha are irrigable. This irrigable area is mainly allocated to rice production during the dry season serving approximately 915 farm families. The remaining non-irrigable area is allocated to maize production serving about 250 farm families. The land holding size per household is 0.2 ha. During wet season, crops grown under irrigation include maize, rice, sweet potatoes, beans, cowpeas and vegetables. Purposive sampling was used to select the irrigation scheme under Chikhwawa Agricultural Development Division (ADD). This is because a lot of rice is being grown under irrigation for food and income generation; furthermore it is where the International Center for Tropical Agriculture (CIAT) in collaboration with the Irrigation Rural Livelihoods Agricultural Development Project (IRLAD) was carrying out different experiments on fertilizer use and management to ensure increased rice production. The study population consisted of rice farmers farming in Nkhate irrigation scheme. From the irrigation scheme, simple random sampling technique was used to draw a sample of 246 farmers among whom cross-sectional survey was undertaken using semi-structured questionnaires.

Methods of analysis

The study used both primary and secondary sources of data. Primary data were sourced through interviews with the rice producers using a semi-structured questionnaire. The data collected were on production data (yield data, amounts of seed and fertilizer used, amount of labour used and amount of land used), production costs data (labor costs, input costs and land rentals) and socio-economic data (age, sex, marital status, education level) and also data on institutional access such as (extension contacts and access to loans). Furthermore, information on age, sex, marital status, and education level of household head was also captured. Secondary data were sourced from publications from various stakeholders like CIAT, IRLAD, Ministry of Agriculture, policy documents and past research findings on technical (TE), allocative (AE) and economic efficiencies (EE) of agricultural products. The study employed the stochastic frontier parametric approach specified by Battese and Coelli (1995) to evaluate TE, AE and EE of rice production. One-stage stochastic production frontiers approach was used to estimate the determinants and distribution of farmer efficiency in this analysis. This involved regressing output on the input variables, as well as the socioeconomic variables that determine inefficiency in rice production (Battese and Coelli, 1995). Robust standard errors were used in the analysis to correct for possible heteroscedasticity in both the stochastic production and cost frontier models. The maximum-likelihood estimations (MLE) of all the parameters of both functions were obtained using the STATA analytical package. Furthermore, the elasticities of mean output were estimated at the means of the input variables.

Results and discussion

This study used trans-log stochastic cost and production frontier and derived technical, allocative and economic efficiencies. It also used the inefficiency model to identify the determinants of the efficiencies from a sample of smallholder rice farmers from Nkhate Irrigation Scheme in Southern Malawi. The results revealed an average of TE index of 65.49 %, an average AE efficiency index of 59.41% and EE efficiency index of 53.32% (Table 1). These results indicate that farmers are operating with substantial inefficiency and hence have a considerable yield potential of 34.51% to be exploited. Furthermore, the average EE efficiency index indicates that farmers could raise the profitability of rice production by 46.68% all these by fully adjusting input use.

Table 1. Average percentage of technical, allocative and economic efficiency of Malawian smallholder rice farmers

Efficiencies	Mean efficiency (%)	Minimum (%)	Maximum (%)	Standard deviation
Technical	65.49	13.31	93.23	13.59
Allocative	59.41	12.86	91.23	16.36
Economic	53.32	12.41	89.23	19.13

The results further revealed that provision of input credit, farmer experience in growing rice and soil fertility status are some of the significant factors that influence efficiency. These have previously been observed by Pretty *et al*. (2003), Haji *et al*. (2007) and Denning *et al*. (2009) as critical factors in improving farmer production as well as productivity. In order to improve smallholder rice farming there is critical need of improving the way farmers are organized so that they can have access to credit, input and output markets as well as technological advice. This in turn requires better infrastructure and the development of efficient input and output markets. Improvement of smallholder efficiency hence relies on the improvement of smallholder policy and institutional environments. Policies and strategies that promote rural education, credit access, better soil fertility management and better infrastructure and markets will greatly assist smallholder rice farmers to realize the unexploited production gains from rice. It is thus recommended that these farmers be mobilized into groups so as to benefit from institution innovations such as access to extension, commodity warranty schemes, contract farming from which they can learn and share farming experiences, new farming technologies, can access inputs and acquire extension support all in one package.

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