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RESEARCH ARTICLE

Efficiency and productivity analysis of vegetable farming within root and tuber-based systems in the humid tropics of Cameroon

Ajapnwa Akamin[1], Jean-Claude Bidogeza[2], Jules René Minkoua N[1], Victor Afari-Sefa[3]

[1] *Faculty of Economics and Management, University of Yaounde II, P.O. Box 18 Soa Yaounde, Cameroon*
[2] *Liaison Office Cameroon, West and Central Africa, World Vegetable Center, P.O. Box 2008 Messa Yaounde, Cameroon*
[3] *Samanko Research Station, West and Central Africa, World Vegetable Center, P.O. Box 320 Bamako, Mali*

Abstract

The study analyzes the technical efficiency of vegetable farmers in root and tuber-based farming systems within selected sites of the humid tropics of Cameroon. Multistage sampling was used to collect primary data from a cross-section of vegetable farmers drawn from eight selected sites in Santa sub division, Northwest region of Cameroon. Stochastic frontier analysis was used to estimate the technical efficiency of vegetable farmer and to examine its determinants. The results showed that farmyard manure was the most productive factor input, followed by farm equipment and labor. The mean technical efficiency level was 67%, revealing production shortfalls and indicating possibilities of significantly increasing production with the current input levels. Female, as well as more educated farmers were found to be significantly more efficient than their counterparts. The results also showed that farmers become less technical efficient as farm sizes become larger. Our study findings suggest that smallholder farmers' access to manure, farm implements, and increased women participation in vegetable farming, will produce huge payoffs in vegetable production efficiency in Cameroon.

Keywords: technical efficiency, vegetable productivity, farming systems intensification, crop diversification, stochastic frontier analysis

1. Introduction

The role of agriculture in building the economy of many countries in sub-Saharan Africa (SSA) is well known. The agriculture sector employs the major work force and contributes significantly to the gross domestic product (GDP) in these SSA economies (AGRA 2015). Agriculture is still regarded as the backbone of most economies and draws significant attention from governments and development agencies as it is the main source of employment and livelihood for the major population, particularly the most vulnerable. In Cameroon, the total agricultural production turnover in terms of value including food production has been on the rise, notably between 1997 and 2012. Agricultural production rose from 2.6 billion USD in 1997 to 3 billion USD in 2002, to 4.3 billion USD in 2007, and to 5.6 billion USD in 2012 (FAO 2015). The major crops in terms of production volume include cassava (*Manihot esculenta*), plantain (*Musa paradisiaca*), maize (*Zea mays*), taro (*Colocasia esculenta*), banana (*Musa acuminata* and *Musa balbisiana*), sugar cane (*Saccharum officinarum*), sorghum (*Sorghum*

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Ajapnwa Akamin, E-mail: akaminajap@gmail.com;
Correspondence Jean-Claude Bidogeza, E-mail: bidogeza@yahoo.fr; jeanclaude.bidogeza@worldveg.org

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bicolor), fresh vegetables, cocoa (*Theobroma cacao*) and coffee (FAO 2015). Despite the steady increase in food crop production, the country is still experiencing food deficit and severe malnutrition. Food inflation was estimated at 1.71% in 2014, while the economic cost of malnutrition incurred per annum is estimated at 0.6 billion USD for Cameroon (UNICEF 2013). In addition, there has been a gradual decline in the agricultural sector contribution to total GDP. The agricultural sector input to GDP in 2014 for instance was only 16.9%, though it holds more than 42% of the total labor force (Doffonsou and Singh 2014).

Vegetables are an important source of micronutrients for human nutrition. When taken in sufficient quantities, vegetables help to prevent cardiovascular diseases such as diabetes and cancer (Yang and Keding 2009; Uusiku *et al*. 2010; FAO 2013). Given the nutritional importance of vegetables, the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) recommend the consumption of fruits and vegetables at least 400 grams per capita per day (excluding starchy root crops) to avoid micronutrient deficiencies, heart and cancer related diseases (FAO 2014). In Cameroon, like many other SSA countries, vegetables are poorly consumed in terms of quantities. Kagma *et al*. (2013) have estimated that on the average, only 46 grams of vegetables per capita per day in Cameroon. This represents only 11.5% of the FAO/WHO recommended intake.

Generally, cropping enterprise interest in the humid tropics of Cameroon has mainly focused on the potential of technologically intensive root and tuber crops, other staple food crops, timber, non-timber forest products, coffee and cocoa (Nchare 2007; Binam *et al*. 2008). Traditional and exotic vegetables have received little research and development attention in SSA in terms of their contributions to reducing malnutrition and poverty, and by extension for improving national economic growth (Shackleton *et al*. 2009; Drechsel and Keraita 2014; FAO 2014). Though some efforts are being recorded owing to synergy between local government institutions, and regional and international agricultural research centers such as the World Vegetable Center and the Consultative Group on International Agricultural Research centers (for instance the Humidtropics Program and the Traditional African Vegetables Project).

Smallholder vegetable farming in the humid tropics of Cameroon is one of the major drivers for change towards sustainable agricultural production with optimal efficiency. Inefficiency in farming at the smallholder level has been identified as one of the major constraints hampering the effective development of the agricultural sector (Dewbre and Borot de Battisti 2008). In Kenya's drylands, inefficiency in the use of scarce farm production resources has resulted in low farm productivity (Lemba *et al*. 2012). Haji (2006) equally noted that technical, allocative and economic inefficiencies cause efficiency differentials among vegetable farmers in vegetable-dominated mixed farming systems of eastern Ethiopia. Hence, there is need for an accurate assessment of the technical efficiency of vegetable farming and subsequent identification of the sources of technical inefficiencies thereof in order to suggest possible policy options and scenarios to optimize farm production. To this end, this study aims to estimate the technical efficiency of vegetables farmers within root and tuber-based cropping systems, identify sources of technical inefficiency, and investigate the relationship existing between technical efficiency and socio-economic variables that characterize vegetables farmers. We hypothesize that all the vegetable farmers under consideration are equally and fully technically efficient, and that there is no significant relationship between their technical efficiency levels and factors assumed to influence them. The remainder of this paper is structured as follows: Section 2 describes methods and data used for the study, Section 3 presents the results of the study, while Section 4 highlights the conclusions and policy implications of the study.

2. Methods and data

2.1. Modeling framework

Various approaches have been used to empirically measure technical efficiency and these techniques can be classified based on whether they impose a functional form on the underlying production function or not (i.e., parametric *versus* nonparametric). The two most popular techniques used in the literature are Data Envelopment Analysis (DEA, nonparametric) and Stochastic Frontier Analysis (SFA, parametric). The DEA technique first introduced by Farell (1957) and further developed by Charnes *et al*. (1978) employs a nonparametric approach to estimate technical efficiency. However, the main criticism of this technique as underscored in the literature is that it ignores the effect of stochastic error and ascribes all deviation from the frontier to inefficiency (Kopp and Smith 1980; Thiam *et al*. 2001; Murillo-Zamorano 2004). Moreover, the non-inclusion of a disturbance term makes it difficult to perform statistical tests. Unlike DEA attributes all production shortfalls to inefficiency, SFA is usually preferred in the agricultural economics literature because it allows for distinguishing deviation from the frontier that is due to inefficiency from that attributable to measurement error and exogenous shocks (Coelli 1995).

Given the agricultural context of this study, where most small-scale farmers seldom keep records of farm transactions and where farm yields are vulnerable with respect to erratic weather, pest attacks and other external factors,