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Evaluating the productivity gap between commercial and traditional beef production systems in Botswana

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ABSTRACT

The beef cattle production system in Botswana is dualistic in structure in that it includes both traditional and commercial production systems, which are distinct from one another in terms of objectives, land tenure, technology, and management practices. The purpose of this paper is to measure the key performance indicators of beef cattle production systems in Botswana and explore the drivers of change in those indicators. We examine differences in productivity and production technologies between the two beef production systems. The results show that traditional farms are technically inefficient and that their technology lags behind that of commercial farms. The use of improved breeds, off-take rates and selling to the Botswana Meat Commission (which control the only exporting abattoirs in Botswana) were found to improve technical efficiency in the commercial production system, but only off-take rates had a positive effect on efficiency in the traditional production system. Both farming systems have the potential to overcome technology constraints and achieve the highest attainable productivity level through improvements in; beef cattle technologies, farmer capacity in production and marketing, and the effectiveness of the technology transfer process.

1. Introduction

Beef cattle production plays a significant role in the economy of Botswana; it contributes 57% to agricultural GDP and remains the main source of food, income, employment and investment opportunities for the rural population (van Engelen et al., 2013). Despite its importance to the economy and rural livelihoods, the beef sector is currently facing serious challenges; both cattle sales for slaughter and beef exports have declined significantly since the 1990s leading to commentators having doubts about the sustainability of the industry (Bahta and Malope, 2014; van Engelen et al., 2013; Jefferis, 2005). Generally, this has been attributed to low productivity caused by low efficiency and the small scale of farms, and slow adoption of improved breeding and feeding technologies. This is worsened by the semi-arid production environment in Botswana (i.e., poor soils, low and unreliable rainfall and high temperatures) and frequent outbreaks of diseases such as foot and mouth (FMD).

The purpose of this study is to measure and compare production technologies and productivity of traditional and commercial beef production systems in Botswana and to explore some of their performance drivers. The two production systems are distinct from one another in terms of objectives, land tenure, technology and management practices. They face varying constraints; have different resource endowments and a variety of opportunities for growth. Observed differences in productivity and efficiency may be influenced by differences in technology, herd sizes and biological factors (e.g., birth rates, breeds), environmental factors (e.g., climate, vegetation and soils) and economic factors (e.g., access to markets and infrastructure). Therefore, it is imperative to investigate how these factors affect each production system and their productivity. Improving productivity among these systems may help to overcome, or to ameliorate, the constraints that the beef industry currently faces.

Our study contributes to previous studies which have attempted to understand the performance of different beef production systems and what drives them (e.g., Barnes et al., 2008; Behnke, 1985, 1987; Mahabile et al., 2005; Malope and Batisani, 2008; Rennie et al., 1977; Otieno et al., 2014). Due to unavailability of data on external inputs (biological and environmental factors) our study focusses only on economic aspects of the production systems and hence we have not explored how stocking rate, forage allowance, production intake and forage utilisation efficiency influence livestock productivity. We estimate technical efficiency (TE) which provides useful information on the competitiveness of farms and their potential to improve productivity with existing resources and levels of technology (Abdulai and Tietje, 2007). Some of the previous studies which have measured the performance of different livestock systems in Botswana have been carried out using data from experimental ranches run for scientific purposes with uneconomic levels of management and which are not subject to commercial constraints (e.g., Rennie et al., 1977; Behnke, 1985). Hence, it was not clear how the knowledge gained from the results of these studies

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could be applied on the ground. The few other studies that have analysed farm (household) level data (e.g., Mahabile et al., 2002; Barnes et al., 2008) have calculated partial measures of productivity such as per head/hectare measures. It is well established that these types of studies may lead to misleading policy implications because they fail to explain what portion of output difference is due to inefficient use of a given input and/or the existence of scale economies (Coelli et al., 2005; Temoso et al., 2015a). Recent studies such as Bahta and Malope (2014) and Temoso et al. (2015b) have also analysed the performance of beef production in Botswana, however, they only focussed on the traditional beef production system.

This study aims to advance the understanding of productivity differences in beef production systems in Botswana using a stochastic production frontier that can simultaneously model for factors that may be associated with the inability of producers to reach their production potential and thus is useful in identifying those aspects of the production process or environment which farmers and/or policy makers might target in order to improve beef production. To make comparisons across the two production systems a metafrontier approach is employed that enables us to measure the extent of technology gaps between the two production systems. This will help us answer the question of whether it is indeed the case that traditional beef farms really lag behind their commercial counterparts in terms of productive performance and production technology; as previous literature has shown. A comparison of the two production systems is of particular relevance to policy makers in Botswana given the ongoing policy efforts that attempt to develop a more dynamic agricultural sector; where both commercial and traditional farms play a role in agricultural development. The results allow us to identify the differences in productive performance between the two beef production systems in Botswana and the drivers of those differences, and hence where policies to improve production technologies could be focused.

Differentiation by farming system may give insights into the effects of different land tenure systems upon resource use and productivity. In 1975 the government of Botswana introduced a land tenure policy (the Tribal Grazing Lands Policy, TGLP) which attempted to address rangeland degradation by encouraging ranching and improving livestock productivity through the allocation of exclusive rights to groups and individuals on newly designated commercial land (Ministry of Agriculture, Botswana, MoA, 1991; Cullis and Watson, 2005). Policy makers viewed this policy as a way to encourage modernisation (commercialisation) of the livestock industry as well as encouraging more widespread participation of farmers in the modernised industry. This policy was followed by the fencing component of the 1991 National Agricultural Development Policy (NADP) (Ministry of Agriculture, Botswana, MoA, 1991), which stated that '*fencing the rangeland will increase productivity*' (Cullis and Watson, 2005, p. 19). As has been the case in other developing countries, the major argument put forward to justify implementation of these policy instruments was that farms held under exclusive and secure rights are more productive than farms held under customary land tenure (Maxwell and Wiebe, 1999; Place, 2009). However, the empirical evidence on the relationship between land tenure and agricultural productivity remains mixed (Place, 2009) and some researchers have argued that land tenure policy in Botswana has completely failed to attain its objectives (e.g., Maxwell and Wiebe, 1999). We hope to contribute to this discussion.

The rest of the paper is organised as follows. Section 2 provides a description of the differences between traditional and commercial production systems in Botswana. The empirical method and data variables are discussed in Section 3. Results are reported and interpreted in Section 4. Finally, conclusions and policy implications are drawn in Section 5.

2. Traditional versus commercial beef production systems in Botswana

The majority of the beef cattle (approximately 80% of the cattle herd) in Botswana are found within the traditional, communal grazing system. The communal livestock grazing system is largely undeveloped; characterised by extensive grazing on tribal grazing areas with no defined property rights and uncontrolled grazing (Bahta and Malope, 2014; van Engelen et al., 2013). Although communal traditional farmers lack tenure security (which prevents them from using their assets as security to access finance for purchasing inputs) they have unrestricted rights to resources such as water and grassland. In some areas small groups of farmers have drilled their own boreholes and acquired an individual right to the use of that water (van Engelen et al., 2013; Rennie et al., 1977).

In the past the Ministry of Agriculture has recommended maximum stocking rates; however, these restrictions were never enforced by the land authorities nor observed by farmers (Mahabile et al., 2002; Malope and Batisani, 2008). The literature on land tenure and agriculture in Africa (Migot-Adholla et al., 1991; Place, 2009) argues that lack of individual grazing rights may encourage high stocking rates that reduce herd productivity and leads to low calving and high mortality rates and discourages investment in improvements such as better breeds. On average farmers within the traditional production system can be characterised as smallholders with a few animals per household operating in an environment within which infrastructure and market organisation are usually poor. Livestock management within this system is primitive and it is difficult to introduce modern livestock farming practices such as the use of improved breeds and supplementary feeding.

In contrast to the traditional system, the commercial beef production system has exclusive grazing rights with fenced pastures on private land (i.e., both freehold and TGLP ranches) (Burgess, 2006; Malope and Batisani, 2008). The individual tenure system which characterises ranching systems, allows management to control for both livestock management and grazing (Jahnke, 1982). The establishment of the majority of livestock ranches in southern Africa can be traced back to the 20th century when they were created in order to improve upon traditional livestock production systems and to increase supply in order to meet the increasing demands for meat in urban areas and for export, as well as to reduce risk of pasture degradation (de Ridder and Wagenaar, 1986). This system favours rotational grazing and rotational-rest systems by which an area is grazed until there is very little forage left before cattle are moved to a new paddock (Burgess, 2006).

Beef production under this system is solely for commercial purposes and is highly specialised; employing modern animal husbandry practices and strategic feeding to produce high-value beef animals (Statistics Botswana, 2008). Breeding control is a common practice; breeding cows are kept apart from young, immature bulls and steers, and heifers (Burgess, 2006; Rennie et al., 1977). Death rates and losses are usually lower and offtake rates are higher than in the traditional production system. The hiring of labour for herding and other livestock related work is normal practice in this system. Use of purchased inputs such as vaccines, tick treatments, feed supplements, improved bulls or artificial insemination is also commonly used. On average, commercial farmers are relatively wealthier than traditional farmers are and this allows them to have better access to finance and marketing (Burgess, 2006). Unlike traditional beef producers who sell under duress, commercial beef producers raise their cattle in order to profit by their sales (Bahta and Malope, 2014; Behnke, 1987; van Engelen et al., 2013). However, it is important to note that livestock farmers in communal areas may also produce for both household and market consumption on a regular basis. Nevertheless, commercial farmers' exhibit improved herd, pasture and husbandry management and therefore are better equipped to increase productivity and take advantage of the latest industry developments such as advanced breed genetics, fodder and disease response mechanisms.

Research in Botswana has shown that one of the major limitations to beef production and productivity is that the majority of farmers practice traditional production management which is a constraint to productivity due to: low efficiency, low technological adoption, poor access to