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Efficiency in milk production on Reunion Island: Dealing with land scarcity

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ABSTRACT

This paper aims to analyze efficiency on dairy farms in Reunion Island, a French overseas district located in the Indian Ocean. On this island, dairy farming is promoted with financial and technical support from the European Union, with the French and local governments aiming at reducing dependency on imports of milk powder and dairy products and creating employment. A critical factor for increasing the local milk production is the limited availability of arable land because of the small size and the volcanic nature of the island. In this paper, we study the efficiency levels of dairy production on 34 farms by using a data envelopment analysis approach. The average technical efficiency score of farms, assuming constant returns to scale, was 0.927, with 19 out of 34 farms not being efficient. The technical efficiency with a variable returns to scale specification was 0.951. The efficiency with which farmers used their land (subvector efficiencies) was estimated in a second model. The average subvector efficiencies calculated with constant returns to scale and variable returns to scale models were lower than the technical efficiencies. The farmers on the efficiency frontier had a relatively higher milk production, milk production per cow, and land surface than those who were less efficient. A policy promoting better use of the land on inefficient farms should increase the milk production-to-land ratio. Possible on-farm strategies are improved feeding systems, farms having their own heifer breeding, and improved genetics.

Key words: milk production, efficiency analysis, Reunion Island

INTRODUCTION

Reunion Island is a French overseas department located in the tropics, approximately 800 km east of the coast of Madagascar, in the Indian Ocean. Because of the scarcity of agricultural land and the hilly landscape, the potential for agricultural activities is limited. The economy of the island once depended on sugarcane plantations, the derived products of which are still the main agricultural export. Today's economy thrives on tourism and services (BBC, 2007). In the early 1960s, local dairy production was begun on Reunion Island. Three main factors have since contributed to the growth of the dairy sector, namely, 1) a well-organized local dairy chain; 2) financial and technical support of the French and local governments and the European Union for establishing farms in hilly areas, covering initial investment costs in dairy farm equipment; and 3) the mobilization of a group of highly motivated farmers interested in dairy farming (Alary et al., 2008). Despite the continued governmental support, steady growth in milk production, and unsatisfied demand from the local processing sector for local fresh milk, the local dairy sector faces an uncertain future because of area limitations and environmental risks. Because of increased urban pressure, land is particularly scarce on the small and volcanic island. The purpose of this paper was therefore to study the potential of the dairy sector to respond to increasing demands for fresh milk produced on the island by increasing the production efficiency. Special attention was paid to the potential gains in efficiency of land use.

In 1962, SICA-Lait, a cooperative of dairy farmers, was created (Louhichi et al., 2004; Institut d'Emission des Departement d'Outre-Mer, 2006). The SICA-Lait cooperative devoted its activities to the collection of milk and the provision of material and technical support to dairy farmers (Louhichi et al., 2004). Almost all milk produced on the island is collected by this cooperative. Over the last several years, the number of dairy farms has decreased, but the total number of milking cows, and hence local milk production, has increased. The milk collected and bulked by SICA-Lait is sold to Compagnie Laitière des Mascareignes for processing into UHT bricks, yogurt, and cheese. Local milk is

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mixed with imported milk powder in the final products, except for the UHT milk brand Piton des Neiges and local cheeses, which are produced from local milk only. An estimated 75% of the milk and cheese products consumed on Reunion Island are imported.

The milk price paid to the farmers is fixed per liter by the interprofessional organization Association réunionnaise interprofessionnelle pour le bétail et les viandes (**ARIBEV**), which regroups all actors within the milk chain. (ARIBEV was created in 1975 for the beef, milk, and pork chain, and an interprofessional association for the poultry sector was begun in 1994.) The ARIBEV organization rallies representatives of the wholesalers, retailers, and importers. It provides a discussion forum, enables the enforcement of agreements throughout the chain, and defends the interests of its members. Furthermore, ARIBEV hosts the Fonds de Développement de l'Elevage Laitier, which was established in the 1980s as part of the Poseidom program, which is a European Union support program directed to French overseas departments. (Poseidom stands for "Programme d'options spécifiques à l'éloignement et à l'insularité des Départements d'outre-mer" or Programme of specific options to overcome the remote and isolated nature of French overseas departments.) The main activities of Fonds de Développement de l'Elevage Laitier are to support milk prices and to provide milk quality control and financial support for milk collection. In addition to the guaranteed fixed milk prices, farmers are also supported in several activities and investments [see Louhichi et al. (2004) for a detailed overview].

Regarding the price for fresh milk, it is worth mentioning that although the price paid to the dairy farmers does not depend on fat and protein content or on microbiological quality, contaminated milk is rejected by SICA-Lait. An extra payment is made periodically to farmers who consistently provide milk of good microbiological quality.

The total milk consumption [in milk equivalents, calculated as the sum of total imported (customs statistics) and locally produced milk and milk products] on the island averaged 137 L per capita in 2005, which is far below the level of 330 L per capita in mainland France (Centre National Interprofessionnel de l'Economie Laitière, 2005). The different actors in the supply chain consider that the dairy sector on Reunion Island has the potential to increase production far above the 20 million tons of milk currently produced. Moreover, the milk quota of 40 million tons (Louhichi et al., 2004) attributed to Reunion Island is far from being reached. A major aspect of increased demand for fresh milk is the current dependence of the processing and retail industry on imported milk powder and dairy products. The world market price for milk powder as well as transportation costs has fluctuated during the last several years. For the industry to reduce its reliance on imports, the demand for fresh milk has increased. Given the limited land available for agriculture, however, it is unlikely that this demand for milk production could be satisfied by operating more farms.

To explore the potential for gains in efficiency, we calculated the technical and land use efficiency of the dairy farms on the island using a data envelopment analysis (**DEA**) approach. The model used data collected in the year 2000 for 34 farms. The DEA yields the relative efficiency levels of the farms. It calculates a frontier of efficient farms by assuming inputs to be optimally minimized for a given output level. Recently, Stokes et al. (2007) used a DEA model to study factors contributing to the efficiency in production and business management of dairy farmers in Pennsylvania. A DEA approach to calculate the efficiency of dairy farming was also used by Piesse et al. (1996), Jaforullah and Whiteman (1999), Mbaga et al. (2003), Balcombe et al. (2006), and Hansson (2007). Although these studies considered a multiple-input production system, they did not analyze subvector efficiencies of one specific input. Subvector efficiency measures are introduced to generate technical efficiency measures for a subset of inputs rather than for the entire vector of inputs. We used this extension of the DEA model to analyze the importance of land as a key input. The subvector efficiency of land use provides an indication of the relative efficiency with which farmers use land and, consequently, of the scope for improvements in land use efficiency.

MATERIALS AND METHODS

Technical and Subvector Efficiency

We used measures for technical efficiency that originated from the seminal work of Farrell (1957). Technical efficiency was defined by Farrell (1957) in 2 ways, namely, 1) the ability of a farm to produce the maximum feasible output with a given bundle of inputs; or 2) the ability of a farm to use minimum inputs to produce a given level of output. These 2 definitions of technical efficiency lead to what is known as the output-oriented and the input-oriented efficiency measure, respectively (Coelli et al., 2002; Dhungana et al., 2004; Rodríguez Díaz et al., 2004). In this study, we assumed an input-oriented model, which enabled us to calculate subvector efficiency scores for a subset of inputs, rather than for the entire vector of inputs (Färe et al., 1994; Oude Lansink et al., 2002; Oude Lansink and Silva, 2004). We were interested in the subvector efficiency of land use. The subvector efficiency reflects a possible reduction in land use, keeping the levels of all other inputs and outputs constant.