



IFAS EXTENSION

Measuring Technical Efficiency in Venezuela: The Dual-Purpose Cattle System (DPCS)¹

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The dual-purpose cattle system (DPCS) describes traditional cattle production practice in the lowland tropics of Latin America where a mix of Zebu, Criollo, and European breeds are used in meat and milk production (Sere and de Vacarro, 1985; Castillo, 1992). The economic importance of DPCS to these regions is clear since Tropical America uses this production system for 78% of its total bovine population and 41% of its milk production (Fernandez-Bacca, 1995; Estrada, 1993). In Venezuela, this system represents approximately 90% of total national milk production and around 60% of total milk consumption (Plasse, 1992). In the last two decades, several agricultural policies, particularly in Venezuela, have attempted to address questions about the economic efficiency of the DPCS based on the assumption that it is inefficient for production. To design and implement meaningful policies, there needs to be precise measures of efficiency that show what does and does not influence efficiency. These measures are necessary to understand the magnitude of the public policy challenge.

It is also important to address the concept of efficiency applicable to any production sector and then, using empirical analysis, to draw specific

inferences about the DPCS, which is pervasive throughout Central and South America. These results are very useful for broadening the economic welfare of neighboring countries which often turn to Florida for educational and Extension assistance.

The Concept of Technical Efficiency

Technical efficiency is a measure of how well the individual transforms inputs into a set of outputs based on a given set of technology and economic factors (Aigner, Lovell, and Schmidt, 1977; Kumbhakar and Lovell, 2000). Two individuals using the same set of inputs and technology may produce considerably different levels of output. While part of the difference may just be random variations found in all aspects of life, other parts may be attributed to individual fundamental attributes and to opportunities that could be influenced through public policies. For example, does education or the age of the operator make a difference? One attribute may be influenced by public policies while another is not. Yet, in both settings, the impact of these attributes on the level of output can sometimes be measured. Without going into great detail, the concept is easily illustrated (Figure 1). For example, visualize a set of inputs

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(point “x”) on the horizontal axis of Figure 1. If everything worked perfectly, that particular set of inputs yields an output at point “a” on what is usually called the production frontier (i.e., the maximum level of technical efficiency). Individuals using the same set of inputs, but with values below the production frontier, are considered less technically efficient. This leads to two questions that must be answered. First, to what extent do the production units lie below the frontier? Second, what factors influence production units lying below the frontier? One way to reveal potential DPCS efficiency problems is to measure farm output lying below the estimated frontier.

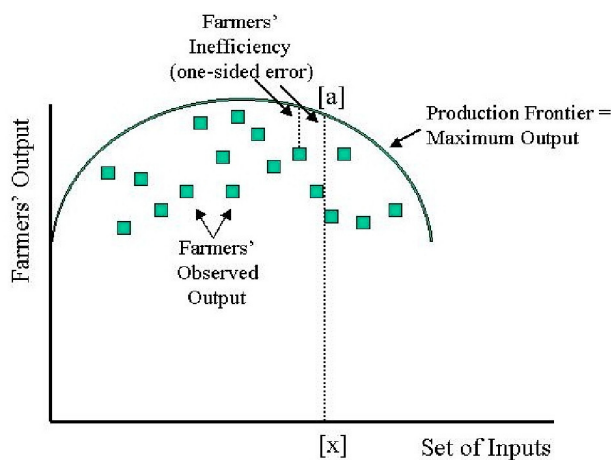


Figure 1. Frontier production function.

Section Heading

Technical Efficiency for DPCS

The first step for determining the level of technical efficiency is using numbers in Figure 1 to show the linkage between the production output and the sets of inputs for the DPCS used in Venezuela. A total of 124 farms were surveyed in the Zulia State of Venezuela. These farms reported their milk and meat inputs and outputs, production practices, and operator/owner demographics. These data were used to estimate the production frontier suggested in Figure 1 and the degree of variation from the frontier. The level of technical efficiency for each farm was calculated using a scale, with one indicating complete technical efficiency (Farrell, 1957). Deviations below one indicate the degree of inefficiency found in the Venezuelan DPCS. Using Figure 2, the 124 farms

were ranked from the most efficient to the least efficient (moving left to right), with efficiency declining moving right. While these numbers are for the Venezuelan DPCS, the concept for illustrating the degree of efficiency can be applied to almost any agricultural sector (Ortega, 2002).

On the horizontal axis, the 124 farms are ranked from the most efficient to the least efficient. Figure 2 is divided into four areas, with each area representing 25% of the farms. Technical efficiency levels are on the vertical axis. Each ranking on the horizontal axis represents the percentage of firms that have a technical efficient level equal to or greater than the level corresponding to the plotted points in Figure 2.

Is there a consistent efficiency problem in the Venezuelan DPCS? Figure 2 clearly illustrates that the top 25% of the farms have technical efficiency levels above .88 (thus suggesting a relatively high level of efficiency) while the bottom 25% of the farms have technical efficiency levels below .76. Likewise, nearly 50% of the farms are in the .76 to .88 range of efficiency. From a public policy standpoint, one goal would be to move everyone into the upper efficiency level (with the understanding of the implications for supply changes and farm numbers). What Figure 2 establishes is the scope of the policy challenge for the Venezuelan DPCS (i.e., moving the lower levels of technical efficiency into the upper level range). On a positive note, however, it can be argued that at least there are no farms lying in the extremely low technical efficiency levels (e.g., no farms had an efficiency level below .50). The obvious question is: can anything be done about the relative levels of efficiency as shown in Figure 2? To answer that, one must have an understanding of what influences efficiency levels.

Factors Impacting Technical Efficiency

Using standard statistical tools, factors contributing to different levels of technical efficiency can be measured. Such factors range from farm size to producer demographic characteristics. Some factors have the potential of being directly influenced through public policies in the short run while others, such as education, may take years to bring about

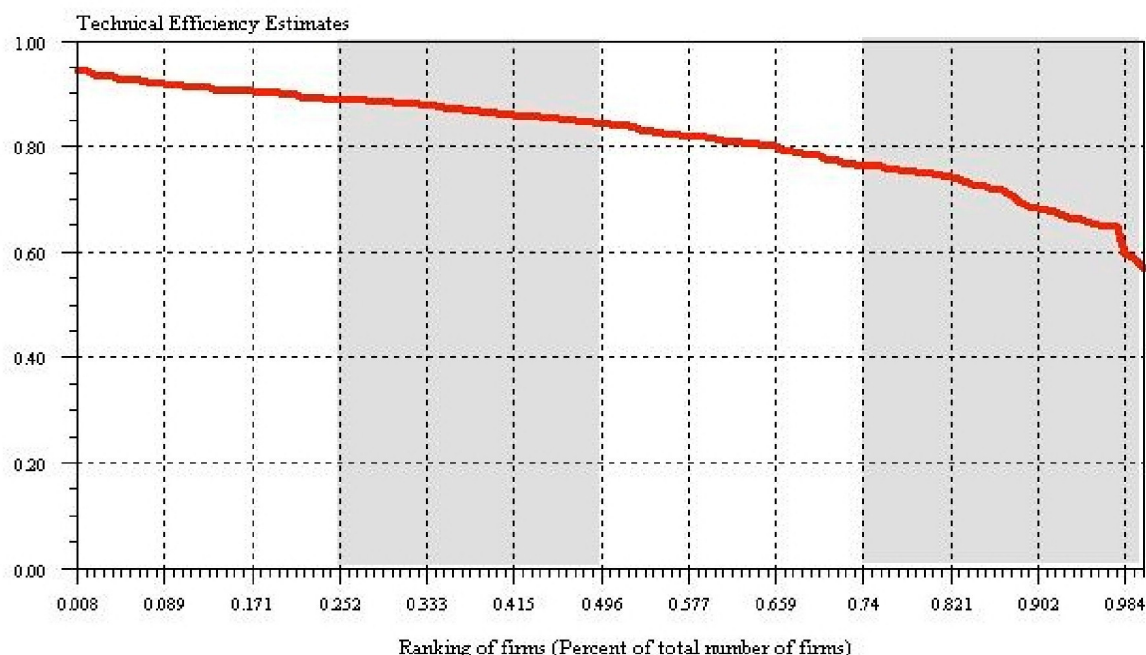


Figure 2. Ranking technical efficiency level among 124 Venezuelan farms.

change. Figure 3 illustrates 13 farm characteristic factors that are expected to impact technical efficiency. Each factor's range of impacts is ranked from most to least influential. The impacts are expressed relative to the average level of technical efficiency. Each factor's range of values is defined as:

1. Farm Size (ranging from under 300 to over 575 hectares).
2. Production (ranging from under 1,000 to over 2,500 liters of milk per cow).
3. Milkers (liters of milk per milker).
4. Experience (production experience, ranging from under 5 years to over 5 years).
5. System (production system of cow/calf, cow/yearling, or cow/steer).
6. Zone (4 production regions in the survey area).
7. Producer (present on the farm under 2 weeks or over 2 weeks during each month).
8. Technical (technical assistance less than once a month or more than once a month).

9. Credit (producer has external credit: yes or no).
10. Stocking (animal units per hectare).
11. Land (land tenure: private or government land).
12. Breeding (natural breeding or artificial insemination).
13. Education (producers education: illiterate or some schooling).

In Figure 3, each factor's range of influence is easily seen in both absolute and relative terms. Difference in farm size clearly has the greatest impact on technical efficiency, with values ranging from a low of .67 to a high of .86 across farm sizes. The right-hand portion of Figure 3 illustrates the absolute range of change (e.g., farm size has a maximum range of .19, and is the largest factor). The first three factors address mostly production practices, and clearly have the greatest impact on technical efficiency. Another important factor is producer experience. On the other hand, the last five factors (credit, land tenure, education, and both breeding and stocking practices) have considerably less impact on technical efficiency. Interestingly, while technical assistance was positive and significant, numerically it

had minimal impact on the degree of technical efficiency. This is one of those variables that potentially could be changed quickly through appropriate public policies. However, the expectation of achieving major efficiency gains through technical assistance must be put into perspective with other factors impacting efficiency. Alone, some variable impacts may be small but, in combinations with other factors, more efficiency gains could possibly be achieved. For example, credit and technical assistance together produce a 6% range. What is clear from Figure 3 is that most of the reform gains need to address farm size issues, production practices, and labor intensity. While production practices and labor intensity can be changed through public policies, influencing farm size is a far more complicated issue. It is equally apparent that policies focusing on land tenure and formal education have little impact on technical efficiency. A producer's farming experience far outweighs any gains attributed to formal education.

efficiency has direct implications for the public welfare since resources are used more effectively. Hence, public policies to assist agricultural systems are logical for many of the Central and South American countries where DPCS is used extensively. Agricultural policies range from direct government substitutes (e.g., credits) to educational and technical assistance.

As illustrated in Figure 2, the level of technical efficiency in the DPCS has room for improvement (nearly 75% of the farms had technical efficiency scores under .88). While it is encouraging that 25% of the farms were relatively efficient, effective public policies and private practices are needed to address, particularly, those farm characteristics generating much of the lower efficiency values (see the far right-hand values in Figure 2). In the case of Venezuela, significant gains could be achieved through policies focusing more on farm size, production practices, and labor productivity, and less

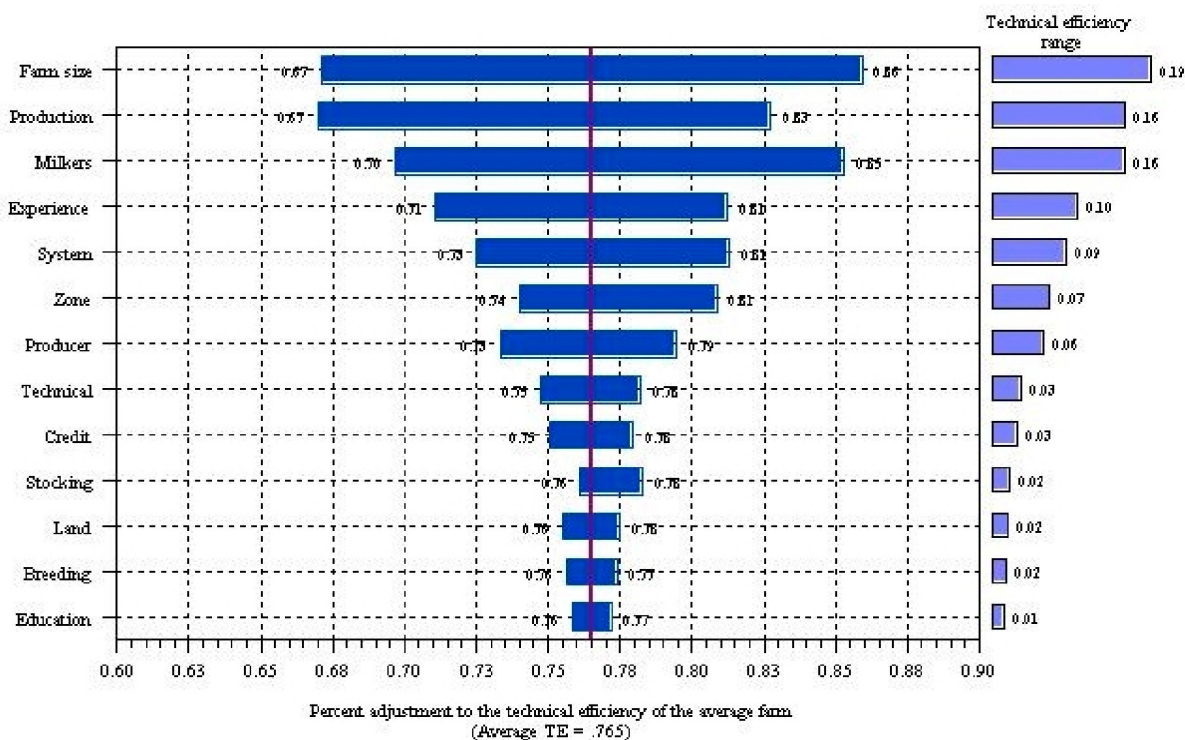


Figure 3. Ranking 13 factors impacting DPCS technical efficiency.

Public Policy Implications

For all agricultural sectors, achieving a high level of technical efficiency is essential for competitiveness and profitability. Likewise,

on land tenure and breeding practices. Also, policies addressing lower-rated factors such as credit and technical assistance may be easier to implement from public policy and political standpoints. In contrast, while farm size has the greatest range of technical

efficiency, changing farm size through public policy may be totally contrary to the political system, and the efficiency gains may be far outweighed by the social costs from implied land reform policies. At this stage, it is probably best to concentrate on practical policies with reasonably quick results such as technical assistance and credit programs.

This analysis quantifies the range of technical efficiency (Figure 2) and ranks 13 factors thought to have the greatest impact on efficiency (Figure 3). Based on the 13 factors, alternatives need to be set forth, and both political and economic judgments need to be made based on policies that are practical and implementable. At this stage, while the degree of efficiency can easily be illustrated using the frontier approach, it is difficult to set forth specific policies without understanding the geopolitical situation within each DPCS country.

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