Benchmarking the Fertilizer and Crop Protectant Application Activities of Agricultural Cooperatives

Frederic B. Ouedraogo[1] and **Phillip Kenkel**[2]
[1] PhD. Candidate, [2] Regents Professor & Bill Fitzwater Cooperative Endowed Chair, Department of Agricultural Economics, Oklahoma State University
frederic.ouedraogo@okstate.edu, phil.kenkel@okstate.edu

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Abstract

This research aims to benchmark agricultural supply cooperatives regarding their fertilizer application services. Cooperative fertilizer application departments are essentially an extension of member farm operations. Because farm supply cooperatives return profits to their user members, the efficiency of the application department directly impacts farm profitability. Therefore, a benchmark analysis is needed to compare performances among competitive cooperatives, identify the best practices, and inform decision makers of the less competitive cooperatives about actions that need to be taken to improve inefficiencies. Mail surveys were sent to Oklahoma grain and farm supply cooperatives. In addition to the financial data collected for benchmarking purpose, the survey investigated the adoption and availability of variable rate application technology and the educational and training needs of application service technicians.
Key words: Benchmarking, supply cooperatives, applicators, farm business, efficiency

Introduction

Agricultural cooperatives are an extension of the farm business, allowing producers to gain economies of scale and scope. According to the National Council of Farmer Cooperatives (NCFC), cooperatives are member owned businesses, whose ultimate goals are to sustain bargaining power and improve access to competitive markets, to reduce production costs for the benefit of their members, to reduce vulnerability to risk, and to capitalize on new market opportunities. Nearly 3,000 farmer cooperatives exist in the United States with a significant portion of them, operating in the sector of inputs manufacture, sales, and distribution. These co-ops are classified as Farm supply cooperatives. The sales and application of fertilizer and plant protectants are an important business area accounting for 22% of the gross revenue of those cooperatives (Cooperative Statistics, 2012).

Application services are capital intensive due to equipment specialization and technology. Self-propelled applicators can cost $300,000 or more and can cover 100 or more acres per hour. Fertilizer and agricultural chemicals also require specialized storage structures which could be costly if they are owned and used by individual farmers. Supply cooperatives enable local farmers to use these services at a shared cost. Because farm supply cooperatives return profits to their user members, the efficiency of the application department directly impacts farm profitability.

Site-specific crop management technology is being introduced recently in the United States and is being progressively adopted by some agribusinesses. Also known as precision agriculture, it consists on using spatial and geographical information, issued by the global positioning system (GPS) and the geographical information system (GIS), along with soil-specific data to provide useful information, which could be used for management decision making. Variable-rate applications of chemicals are nowadays being promoted in the agricultural sector as a result of multiple technology adoption and have the potential of lowering production costs and therefore, improving farm business profitability. However, as any new technology, “high-tech” farming is capital intensive, requires investment in human capital, and is not always accessible to the small businesses. For many producers, access to precision application and related technologies is controlled by their cooperative's equipment investment decisions. While there has been extensive research on investment decisions, field efficiency and technology adoption at the farm level, these issues have not been examined in cooperatives and other aggregated agribusinesses.

The objective of this research is to examine the profitability of the fertilizer application activities at farm supply cooperatives and examine how it is affected by equipment utilization, firm size, competition in the trade area and other factors. This information will be useful in benchmarking these business units and in identifying opportunities for efficiency gains.

Review of Literature

The Japanese are generally credited for developing the concept of benchmarking and Xerox was the one who introduced the concept in the United States (Nickerson and Sloan, 2002). Their approach, which is now known as modern benchmarking analysis, consisted on sending people to learn good practices from other similar firms outside the country in order to reorganize the local industry. Extensive literature exists regarding the evolution of the benchmarking including Camp, (1989), Jacob (1992), McNair and Leibfried (1992), Ohno (1988), and Watson (1993). If at the beginning, the Japanese expeditions were focused on the organizational structure and the technics of the firms they visited, the modern benchmarking analysis is much broader, including in the investigation, a comparison of the economic and the technical efficiencies between firms. Today, Benchmarking is divided into many branches (internal, external, competitive, industry, generic, process, performance, strategic benchmarking) with the same goal of improving firm profitability.

The underlying idea of the benchmarking is that performance is associated with "best practices" used by the leading firm and that others can identify and implement in their businesses to improve their profitability. Benchmarking is a management tool used by firm managers to gain and sustain their competitiveness (Ahmed and Rafiq, 1998). It is a never ending process within the business that has to be updated continuously to inform the decision makers about the position of the business as compared to that of the competitors (Scott 2011).

Surveying the health of the business by comparing what is being done in the business, and what the most successful competitor is doing, helps improve firm productivity via the process of discovery of innovative approaches (Scott 2011). Benchmarking is formally defined as a continuous process of comparing the organization and the efficiency of some firms against the industry's leading firm (Goetsch and Davis, 1997) and applying the best practices of the benchmark firm, to reduce or eliminate the inefficiencies in the poorly performed firms (Anand and Kodali, 2008). The ultimate objectives of benchmarking can be grouped into three categories: (1) identify the weaknesses and the strengths of the business, (2) identify the "best practices" of the benchmark business, and (3) identify/create new opportunities to sustain the competiveness of the business.

Fertilizer Application Revenues and Costs

In this research we examined the revenues and direct costs associated with fertilizer application activities to estimate the profitability of the business unit. The calculated profit measure was a "gross profit" and did not include the allocation of overhead expenses such as the managers salary or general administrative expenses. While the fixed cost of the application equipment was estimated, our data did not allow us to model the fixed costs of fertilizer and chemical warehousing. Our gross profit measure was appropriate for our objective which was to examine difference in the economic efficiency of fertilizer application activities.

In modeling revenues and direct costs we considered the per acre fees associated with application along with the margins from fertilizer and chemical sales. In most farm supply cooperatives the majority of fertilizer and chemical sales are generated in conjunction with application services. It is therefore appropriate to associate the margins on those product lines with the application services. Fixed and variable costs such as fuel, oil, repairs, labor interest and depreciation were subtracted from the revenues to obtain the gross profit. This measure was expressed as a percent of sales so that it could be compared across firms. The detail of the modeling assumptions are described below.

Gross Margin of Fertilizer Application Department (GMF)

The GMF corresponds to the sum of revenues from liquid and dry fertilizer application, plus the gross margin from fertilizer and chemical sales. The survey included a specific question on fertilizer margin so it could be measured directly. The survey only elicited information on chemical sales so the gross margin on chemicals was estimated at 10% of the chemical sales. Per acre fees for application were fairly consistent across firms at $5/acre fir liquid application and $4/acre for dry products. The gross margin as a percent of sales was calculated by dividing the previously described margin by the sum of application fees, fertilizer sales and chemical sales.as

Fuel and oil costs

Fuel and oil costs are estimated based on the monthly forecasted prices on the crude oil futures market. (Dhuyvetter) using the May futures contract closing prices in 2014 has derived the actual crude oil and diesel fuel prices in Southwest Kansas and those forecasted prices were used in this paper to represent oil and fuel prices in Oklahoma. We therefore assumed a fuel cost of \$2.49/gallon representing the state data-average in Kansas. Oil cost follows the Agricultural Machinery Management Standard 6.3.3, which relates oil price to fuel price by the relation that oil price represents 15% of fuel price. That is, oil price used here is \$0.37/gallon.

Repair and maintenance costs

These costs represent the amount of money needed to bring an asset back to a useful condition. Failed parts for instance need to be fixed for the machine to operate. Cost for acquiring these parts is then credited to the maintenance and repair section of the balance account. Following the model developed by the ASAE, the repair and maintenance cost function (RMC) can be mathematically expressed as:

$$RMC = \frac{1}{F}\left\{ \frac{\left(IC * R_1 * \left(\frac{h+u}{1000} \right)^{R_1} \right) - \left(IC * R_1 * \left(\frac{h}{1000} \right)^{R_2} \right)}{u} \right\} \quad (1)$$

where R_1 and R_2 are the repair factor 1 and 2, respectively, u is the use of machine in terms of hours during the year, h is the total hours of service earned by the machine, and IC is the initial cost of the machine. From the ASAE (1998) estimation, the repair factors 1 and 2 are 0.04 and 2.1, respectively. Field efficiency is about 70%.

Labor cost

Pre-tax wage rate and machinery labor hours (derived from field capacity of the machine) were used to estimate the labor cost. This cost corresponds to the inverse of the field capacity of the machine (F) times product of the payroll benefit and the adjustment factor assumed here to be 1.25. It is approximately \$12 per hour.

Insurance cost

Insurance cost per acre is an approximation of risk related costs. The ratio of the IC weighted at the insurance rate (r) to the use of the machine is then multiplied by the inverse of the field capacity of the machine to obtain the insurance cost (CI). CI is mathematically expressed as:

(2) $$CI = \frac{1}{F}\left\{\frac{IC * r}{u}\right\}$$

This value corresponds approximately to 0.25% of the initial value of the machine.

Depreciation cost

We assumed that each applicator has an average life time of five years, which gives a depreciation cost of approximately $40,000 per year assuming a salvage value of $100,000. The cost of an applicator is moreover estimated at $300,000.

Interest cost

The interest cost of the machine is derived from the relation below:

(3) $$AC = \frac{1}{F}\left\{\frac{i * SV}{u}\right\}$$

where i is the interest, SV the salvage value of the machine after the 5 years, and AC the average interest cost. An interest rate of 6% was assumed.

Acres per Hour

In order to convert the fuel, oil and labor cost to a per acre basis, it was necessary to estimate the application capacity. The capacity of the machine is defined as the number of acres cover by the applicator in an hour of operation. Because exogenous factors might prevent the machine from operating at full capacity, a field efficiency index is used to account for this inconvenience. Here, we assumed a field efficiency of 70%. Therefore, the effective field capacity, which corresponds to the machine capacity under the field actual conditions, is compute as follows:

(1) $$EFC_i = TC_i * \delta$$

Where EFC_i is the effective capacity of applicator i, TC_i is the theoretical capacity, and $\delta = 0.7$ is the field efficiency. The theoretical capacity is obtained by dividing the product of the machine speed (in mph) and the width (in feet) by 8.25.

Assuming that an applicator can operate at 15 miles per hour with a sprayer width of 80 feet , the theoretical capacity is 145.45 acres per hour and the EFC is about 102 ac/hour.

Examining Factors Impacting Gross Margin as a Percent Sales

In addition to questions about acreage covered, fees, fertilizer and chemical sales and margins, and number and type of applicator, the survey elicited other information about the cooperative structure and trade territory. This allowed us to explore factors that appeared to impact the profitability of the fertilizer application department. In particular we examined:

(1) Applicator utilization: a greater number of hours per applicator spreads the fixed cost over more unit, reducing per unit costs. On the other hand, waiting time is an important factor for cooperative customers so a firm with excess applicator capacity might be able to attract more customers and achieve higher fertilizer and chemical margins. Crop type also makes the impact of this factor somewhat ambiguous. Pasture acres tend to be much less profitable both because applicator speed must often be reduced and because the per acre dollar value of fertilizer and chemicals being applied is lower.

(2) Number of applicators: A cooperative with a greater number of applicators could have more flexibility in scheduling and achieve higher utilization. On the other hand a high number of applicators could be a function of excess capacity.

(3) Number of branch locations: Multi-branch cooperatives are typically larger and have the potential to shift equipment between branchs for more efficient utilization and lower costs. On the other hand, individual branch managers have an incentive to lobby for equipment stationed at their location since members perceive that there is better service potential when equipment is evident.

(4) Competitors in the trade territory: Cooperatives with a greater number of firms operating in their trade territory might be expected to have lower application profits since they must compete via price and/or equipment availability.

Data

In this paper survey questionnaire was sent to agricultural supply cooperatives across the state of Oklahoma and in some adjacent counties in Texas and Arkansas. The questions elicited information on the structure of the cooperative, including number of locations and trade territory, unit volumes, gross sales and gross profit margin for the agronomy department, information on size and age of the fertilizer application equipment fleet, and the acres covered. The survey also elicited some basic information relating to the cooperatives balance sheet and income statement. The information allowed us to estimate the profitability of the fertilizer application departments and investigate the impact of trade territory, equipment utilization rate, cooperative structure and fee structure.

Results and Conclusions

The results indicated a fairly large range of profitability for the fertilizer application business units (Table 1). The gross profit margin as a percent of sales ranged from 3.5% to 26.0% with an average of 15.5%. There was not a clear pattern relative to applicator utilization (acres/applicator). The cooperative with the highest profitability had the fourth highest utilization rate. However, when the profitability results were sorted by applicator utilization the profitability of the top quartile and bottom quartile was similar (Table 2) and were lower than the combined remaining quartiles. This may suggest that there are efficiency gains from higher utilization but lower utilization (excess capacity) and the associated lower waiting times may be a competitive tool to attract additional business and/or higher margins.

In contrast profitability did appear to increase with the number of applicators operated. The cooperatives with the highest number of applicator also obviously tended to have a higher number of branch locations and larger total acres and sales. However the applicator utilization rate did not necessarily increase with the total number of machines. It is possible that producers are more likely to book applications (possibly at higher margins) with a firm with a larger application fleet because they anticipate a shorter waiting time. Cooperatives also operate different types of applicators (primarily those set up for dry products and those set up for liquid application) so a firm with a large fleet might be better positioned for the product demanded.

There did not appear to be any clear relationship between application department profitability and the structure of the cooperative (number of branch locations). Fertilizer application department in single location cooperatives were clearly less profitable. However the highest profitability appeared to be in the middle ground in terms of locations. It is possible that as cooperative expands to additional locations it is at first able to increase efficiency by sharing equipment across location. As their trade territory increases they may reach a point where they must maintain excess capacity to avoid transportation costs. An alternative explanation is that members of larger cooperatives are more price sensitive since they are located farther from the home office and feel less linkage with the organization.

The data also did not indicate a relationship between the number of competitors in the cooperative's trade territory and the fertilizer application department profitability. This may be due to flaws in our data which did not measure the number of non-cooperative competitors.

Table 1: Gross Margin as a Percent of Sale of the Application Department	
Top Quartile	22.6%
Combined 2nd and 3rd Quartile	18.1%
Bottom Quartile	12.0%
Average	15.5%

Table 2: Application Department Profitability by Quartiles for Various Factors

	Applicator Utilization	Number of Applicators	Number of Branch Locations	Number of Competitors in Trade Territory
Top Quartile	14.31%	8.7%	15.0%	15.6%
Combined 2nd and 3rd Quartile	17.0%	17.3%	17.9%	15.7%
Lowest Quartile	15.0%	20.0%	8.8%	14.7%

Conclusions

Fertilizer and chemical application activities are important business units for agricultural cooperatives and a important service for their producer members. This research, which focused on Oklahoma grain and farm supply cooperatives revealed a wide range of profitability for the business unit. The results revealed some interesting relationships and lack of relationships between equipment utilization, number of applicators, branch locations and competition. It appears that a moderate level of excess capacity leads to higher profitability. Because the timeliness of application services is very important to the producer they may be willing to book services at higher margins with cooperatives where they anticipate shorter waiting times. Profitability was positively linked with a greater number of machines and greater number of branch locations. It appears that larger cooperatives, operating over wider areas are better able to efficiently allocate equipment and/or increase timeliness. The level of competition did not appear to be a major factor. However our data did not include non-cooperative competitors. The apparent lack of relationship between competition and profitability may be due this flaw in our survey data.

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