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Use of Renewable Energy as a Strategic Behaviour for Companies in the Agricultural Sector

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ABSTRACT

Objective: To describe the use of renewable energies in firms in the agricultural sector in order to associate their use to competitiveness variables and to determine if their incorporation has an impact on the competitive performance of the firms.

Design/Methodology/Approach: An instrument was designed aimed at managers and owners of companies in the agricultural sector based on the theory of industrial organization and competitiveness. The information was coded, and association tests as well as comparative cluster analysis were performed.

Results: The use of renewable energy by the firms addresses economic and commercial strategies. Of the twelve competitiveness variables used to compare firms, nine were linked to the use of renewable energies. The firms using renewable energy demonstrated superior results in competitiveness.

Study Limitations/Implications: The results are applicable to firms in the agricultural sector within the region analyzed. Financial and energy consumption variables should be considered if the method of analysis is to be replicated.

Findings/Conclusions: The use of renewable energy is a strategic behavior that allows companies to improve their market position. Companies that use renewable energy as a strategic behavior are more competitive.

Key words: Agriculture, competitiveness, energy, industrial organization.

INTRODUCTION

Firms in the agricultural sector are often regarded as being linked to competitive market structures, also known as perfect competition structures. This is due to their products being categorized as commodities, and because the companies that participate in this type of market are price takers. However, authors such as Cabral (2017); Reimer and Stiegart (2006); Sexton *et al*. (2007); Vettas (2010), argue that this is not necessarily so, since competitive firms in the agricultural sector meet market requirements and make use of strategies typical of oligopoly markets.

Hence the relevance of using the industrial organization theory (IOT) as a reference, particularly strategic behaviors (SBs), and the competitiveness approach to analyze the use of renewable energies by agricultural sector firms (ASF).

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SBs are part of an oligopoly market structure and according to Ramírez and Unger (1997), they are defined as strategies that allow firms to maintain or improve their position in the market in which they compete. This study is preceded by research that addresses the SBs of agricultural sector firms in the region of Northeastern Mexico. Authors such as Taddei-Bringas and Robles (2002); Taddei and Preciado (2008), identify and analyze the strategic behaviors used by food industry firms to adapt to changes in the market. Velderrain-Benitez *et al*. (2019) focus on companies that produce grapes in this region and seek to prove that the market structure under which they compete is an oligopoly.

Concerning studies about renewable energies, none were found that approached the subject with this theoretical framework. In this regard, research in Mexico is aimed more toward productivity potential and energy transition (Martinez, 2020). The objective was to describe the use of renewable energies in companies in the agricultural sector in order to associate their use with competitiveness variables, and to determine if their incorporation has an impact on the competitive performance of the companies.

MATERIALS AND METHODS

This study was carried out with 32 agricultural sector firms (ASF) in the municipalities of Hermosillo, Carbo and San Miguel de Horcasitas, in Sonora, Mexico, in the period between March and December, 2019. Of these, 14 firms used renewable energy (FRE), particularly photovoltaic solar energy, and 18 operated without this technology (FWRE). An instrument divided into five dimensions was designed: strategic behavior and renewable energy; market scope; vertical and horizontal integration; profitability and market positioning; and product differentiation. Based on the field work conducted, the information obtained was then coded and a database was developed. A Chi-square test was performed to identify the association between the use of renewable energy and competitiveness variables followed by a hierarchical cluster analysis, using Rstudio software version 1.21335.

RESULTS AND DISCUSSION

The results of the study indicate that the use of renewable energies comprises a strategic behavior (SB) that allows companies to maintain or improve their market position by enabling cost reduction, improve the image within their market, as well as anticipate their market needs and the possibility of obtaining institutional benefits and price incentives.

The primary areas where this technology is used are: cold storage, packaging, drying process and product separation areas, offices, irrigation systems, and housing and sports facilities for workers.

Of the 14 companies that used renewable energy, 11 of them received financial support from the government (Shared-Risk Trust Fund, Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food; and Agriculture-related Trust Funds). Once this was identified, the data obtained were coded corresponding to the different sections of the methodology applied, and association tests were performed between competitiveness variables and the use of renewable energies. Once the Chi-square test (Table 1) was performed, the companies were grouped so that they could be compared.

Table 1. Competitiveness variables associated with the use of renewable energies.

Variables	Significance level (p-value)
Market reach	
Level of exported products	0.1031
Level of export markets (LEM)	0.04762
Harvest fields level (HFL)	0.03437
Number of export strategies (NEE)	0.04447
Profitability and market position	
Investment level (IL)	0.04032
Investment amount level (AmountL)	0.02448
Number of problems to satisfy demand (NPSD)	0.05634
Vertical integration and horizontal integration	
Vertical integration level (VIL)	0.02814
Horizontal integration level (HIL)	0.01486
Differentiated products	
Product differentiation level (PDL)	0.02216
Certification level	0.8826
Green labels level	0.2156

Source: Prepared by the authors based on Chi-square test.

The use of renewable energy represents a strategy used by companies to form the clusters. However, different behaviors that have allowed the companies to remain in the market were also considered important, which were obtained within the dimension of strategic behaviors and renewable energies (Table 2).

Subsequently, the means of competitiveness variables were compared between the clusters and the type of company. In figures 1-5, the mean is represented by a thick line and the data per company by points. Group one shows FRE (right side of the graphics) and group two FWRE (left side).

One of the first findings of the cluster analysis is that FRE have a higher field level than FWRE (Figure 1), which shows a greater installed capacity for production; FRE were also proven to have more harvest fields in municipalities and states other than the ones being evaluated.

The LEM variable for the three clusters shows that the FRE have the highest means, which indicates that they have access to a higher number of export destinations (Figure 2). The theory signals that companies which export to a greater number of markets tend to stabilize their sales faster, especially when there are price drops and fluctuations in product demand (Hirsch and Lev, 1971).

Table 2. Main Characteristics of the clusters

Clusters	Characteristics
Commercial cluster (COC)	- Marketing company integrated to the firm - Three firms use renewable energies - Two firms don't use renewable energies
Quality Cluster (QC)	- Quality product strategies - Six firms have renewable energies - Eleven firms don't use renewable energies
Adaptation and innovation cluster (AIC)	- Strategies of adaptation to market conditions, innovation, and research - Five firms use renewable energies - Five firms don't use renewable energies

Source: Prepared by the authors based on hierarchy analysis.

In this regard, 10 of the FWRE have the United States as their sole destination market. Also within that scenario is the only company that does not export, which would indicate a limited capacity to respond to adverse situations.

In a study conducted for other industries, Denis and Depelteau (1985) argue that firms with greater market information are better positioned in international markets and do not depend on public institutions or private companies to export their products.

In this case, it was found that there are FWRE that depend on FRE to export their products. In regards to NEE, only in the COC did CRE demonstrate a higher average than CWER: in the remaining clusters the results were equal.

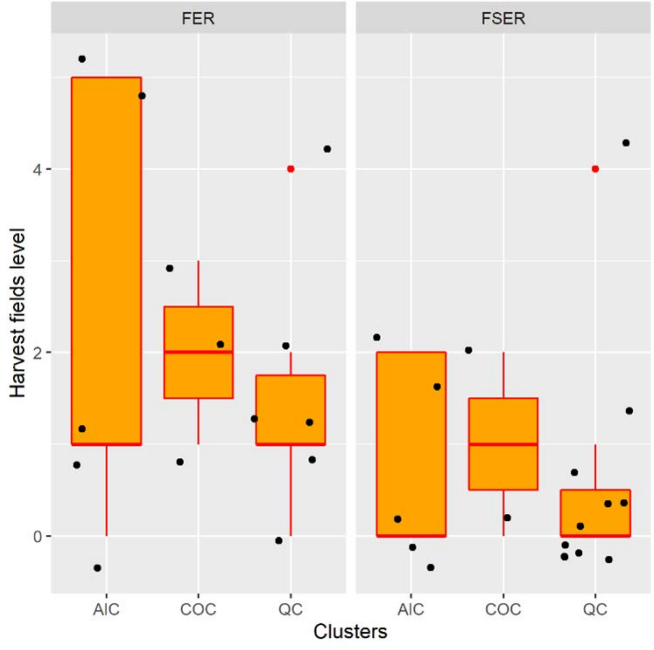

Figure 1. Comparison between CRE (FER) and CWRE (FSER) firms on harvest fields level.

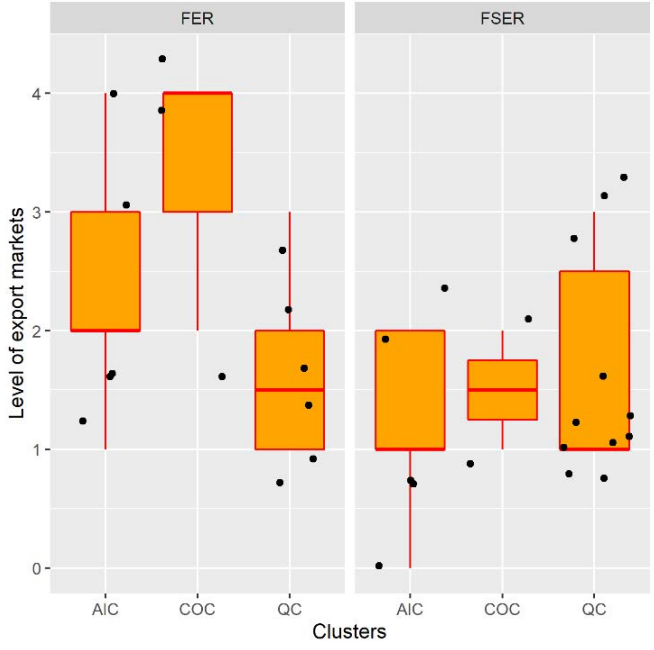

Figure 2. Comparison between CRE (FER) and CWRE (FSER) firms on export markets level.

The principal strategies used by COC firms are related to compliance with international export standards. Xiong and Beghin (2014) argue that when firms comply with these export standards, a demand for their products in the international market is incentivized.

The number of investments and the amount in Mexican pesos of the investments made in the past five years were used to determine the IL and the AmountL. For the IL variable, CRE firms in the COC and AIC clusters were found to have a higher average than CWRE; in the QC cluster, findings show equal mean values. For the AmountL variable (Figure 3), CRE have a higher average than CWRE.

The profitability of a firm allows observing its performance in the market (Boccard, 2010). Likewise, the investment amounts represent the capacity a firm has to maintain economic activity and identify market opportunities (Arslan-Ayaydin *et al*., 2014).

To determine the VIL, the integration of goods production, packaging, product transport to the final client and trading company were considered (Figure 4). The results indicate that the AIC and COC of CRE show more vertical integration than CWRE; however, in the QC, both types of firms have equal averages.

Authors such as Lin *et al*. (2014) point out that in markets where the demand is dominant, it becomes more attractive to integrate vertically going forward, and in this sense the trading companies are the ones that set the standard in terms of product specifications and packaging. In this regard, all the CRE have two integrated activities moving forward: packaging and product transportation.

According to Shepherd and Shepherd (2004) and Tarziján and Paredes (2006), this type of integration is directed at the efficiency in the organization, use of resources, and control of processes.

The above is consistent with the strategies of some CRE as they integrate packaging facilities and product transportation, to reduce the risks and uncertainty caused by hiring third parties to carry out these activities and reduce costs.

For HIL, activities of the firms in the same or different sector were considered, as well as the number of alliances that the companies have (Figure 5). In the three clusters identified, CRE demonstrated better results than CWRE, which would indicate that they are more horizontally integrated.

Concerning alliances, Pawlewicz (2014) points out that the firms in the agricultural sector that are associated with other firms have higher possibilities of gaining access or cooperating with clients that demand a higher volume of products. In that regard, the CRE interviewees indicated that they had alliances with small-scale producers, which allowed them to meet the production volume

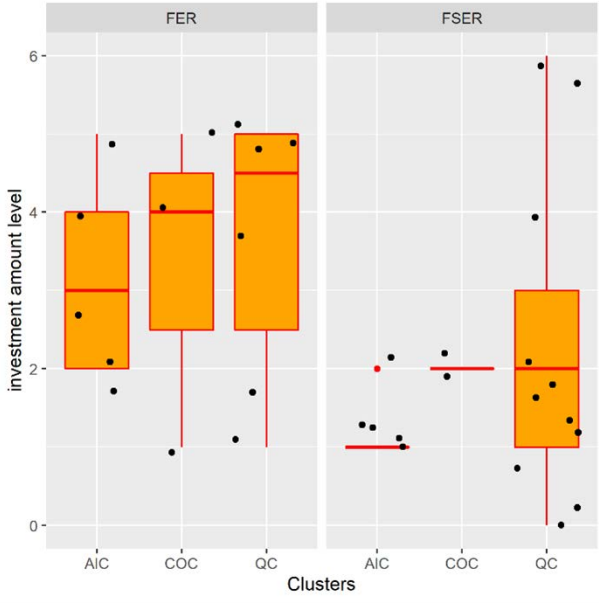

Figure 3. Comparison between CRE (FER) and CWRE (FSER) firms on investment amount level.

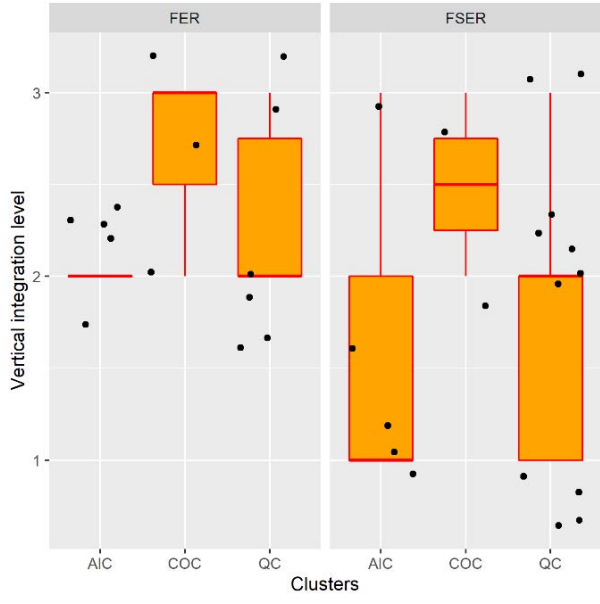

Figure 4. Comparison between CRE (FER) and CWRE (FSER) firms on vertical integration level.

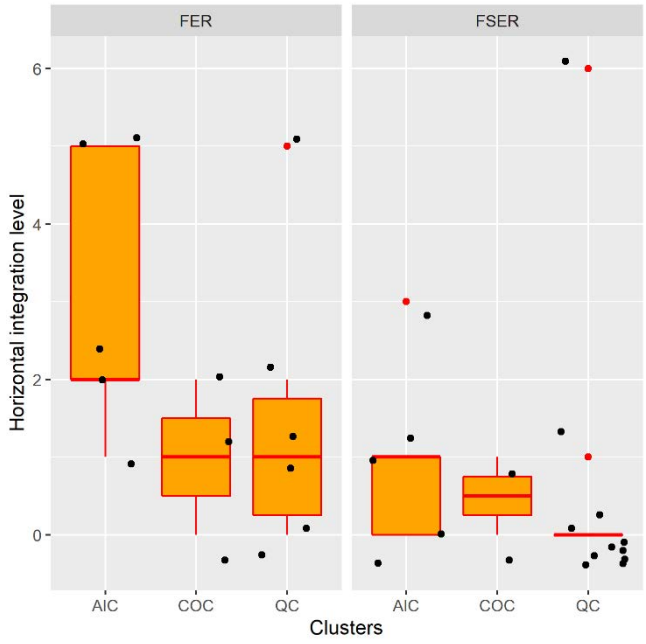

Figure 5. Comparison between CRE (FER) and CWRE (FSER) firms on horizontal integration level.

demands imposed by the trading companies; some even make alliances with trading companies in order to have greater market security and sell at more competitive prices. Concerning activities within the same market or in a different one, Ullah and Shivakoti (2014) mention that firms in the agricultural sector decide to carry out other activities within the same sector in order to better manage the market risks. When they are carried out in a different market, these activities are supported by high profits.

Using the theoretical elements of horizontal integration of the firms described by Boccard (2010); Coloma (2002); Tarziján and Paredes (2006), it is possible to assert that the CRE with their alliances, associations and collaborations could gain greater market power, increase their production capacity or reach a greater number of clients.

In product differentiation, certifications, green labelling and differentiated products were taken into account. Concerning the variables related to green labelling and certifications, no association was found with the use of renewable energies. The firms showed scarce evidence of the use of green labels. Regarding the certifications, there is no real difference between companies since they all have the same certifications: Primus GF, Global Gap, Fair Trade, among others. Although initially the assumption was made that the use of renewable energies would allow them to differentiate themselves, it was found that in the case of certifications or green labelling, these were not acquired due to the incorporation of this technology. When it comes to differentiated products, CRE have a higher level, since they have a greater variety of products such as varieties of grapes, chili pepper or squash.

Finally, although evidence was found of association with the NPSD variable, the problems signaled by the firms are related more to natural factors that endanger agricultural activities. The results show that CRE show above average levels in competitiveness variables, indicating better competitive performance in CRE companies.

CONCLUSIONS

The study developed shows that the use of renewable energies as a strategic behavior generates favorable impacts in firms in the agricultural sector, as was expressed by 71% of the CRE interview respondents. In the analyzed firms, findings show that the use of renewable energies as a strategic behavior by agricultural sector firms is aimed at meeting economic and commercial needs. The association found between different competitiveness variables and the use of renewable energies allows stating that there is a convergence. In this sense, the study carried out results in substantial findings, particularly in the comparative exercise between clusters and firms types; the CRE demonstrated better competitiveness indicators than their counterparts, which would indicate that they are more competitive. For future studies, adding variables of a financial character, of energy consumption and energy production, is suggested, which in this case were considered confidential by the interview respondents.

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