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RESILIENCE AND EFFICIENCY OF AGRICULTURAL COOPERATIVES IN THE SOUSS-MASSA REGION: A DATA ENVELOPMENT ANALYSIS (DEA).

- **AUTHOR 1 :** ZAHOUR Brahim,
- **AUTHOR 2 :** RACHIDI Lahoussine,

(1) : Doctor in applied economics, Ibn Zohr University, faculty of economics, laboratory for studies and applied research in economics.

(2) : Research Professor, Ibn Zohr University, faculty of economics, laboratory for studies and applied research in economics.

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Résumé :

L'étude de la Résilience des coopératives agricoles de la région Souss-Massa et leur capacité réelle à honorer leurs engagements, met en exergue la notion de leur efficience. L'objectif de ce travail étant de proposer une mesure multidimensionnelle qui sert à évaluer la résilience des coopératives agricoles étudiée.

Pour y arriver, nous avons réalisé une étude empirique sur les coopératives agricoles de la région du Souss-Massa. Pour l'approche méthodologique, nous avons fait recours à la méthode de data enveloppement analysis (DEA) et la méthode de classification hiérarchique ascendante sur des données d'une enquête par questionnaire. Les résultats entrepris à partir des scores de DEA trouvés sur les 74 coopératives de notre échantillon montrent que 28,4% des coopératives étaient à 100% inefficientes durant la période de l'enquête, contre 36,5% qui étaient parfaitement efficientes sur la même période. De même, aux alentours de 17% des coopératives ont un score moyen d'efficience. Ceci a fait constituer trois principaux groupes pour l'étude des déterminants de la résilience de ces coopératives agricoles de la région du Souss-Massa.

Mots clefs : résilience, DEA, CAH, coopérative agricole, efficience.

Abstract:

The study of the resilience of agricultural cooperatives in the Souss-Massa region and their actual capacity to achieve their obligations, considers the notion of their efficiency. The purpose of this study is to propose a multidimensional measure that is used to evaluate the resilience of agricultural cooperatives studied in the Souss-Massa region.

In this context, we have appealed to an empirical study on agricultural cooperatives in the Souss-Massa region. For the methodological approach, we used the Data Envelopment Analysis (DEA) method and the Ascending Hierarchical Classification (HAC) method on data from a survey carried out by questionnaire.

The results generated from the DEA scores, established on the agricultural cooperatives in our sample show that 28% of the cooperatives were 100% inefficient during the survey period, against 37% who were perfectly efficient over the same period. Similarly, around 17% of cooperatives, have an average efficiency score. This has led to the formation of three main groups whose factors of resilience and efficiency of these agricultural cooperatives in the Souss-Massa region have been characterized.

Keywords: Resilience, DEA, CAH, Agricultural cooperative, Efficiency.

Introduction

In the world scene, the future of the agricultural cooperative system is increasingly posed with growing interest: is it a resilience of the past? (Draperi & Touzard, 2003).

In addition, Morocco is no exception; the Moroccan agricultural cooperative landscape has been undergoing a major transformation in recent years, between creation, merger, consolidation, and disappearance[1].

As of December 31, 2019, the Moroccan cooperative fabric has more than 27,262 cooperatives and unions of cooperatives, these cooperatives are divided into about twenty sectors and a hundred branches of activity. This cooperative fabric is characterized by the preponderance of the agricultural sector[2].

The evolution of the cooperative sector is the result of programs provided by the State to boost the national economy in general and the cooperative economy in particular through the implementation of the program of the National Initiative for human development (INDH) in 2005 and the Green Morocco Plan in 2008 and the promulgation of Law No. 112-12 in 2014 (Ahrouch, 2010).

Also, these mechanisms put in place by the government do not make it possible to guarantee that the cooperatives created are formed with real common objectives other than access to government incentives. "*This phenomenon has given rise to a large number of less resilient, non-operational cooperatives, whose ability to survive and succeed is much weaker and which are probably only instruments for these cooperatives to seek to benefit from private advantages*" (Zahour & Rachidi,2020,page:160).

Indeed, the study of the survival and resilience of agricultural cooperatives operating in the SM region and their real ability to meet their commitments brings into play the notion of their performance. This concept needs to be used with caution in this study. Three concepts are generally used interchangeably: performance, effectiveness, and efficiency.

The Souss Massa region achieves a significant share of the national GDP, this region benefits from significant and diversified economic assets, especially in the field of agriculture. It is also the region in which a large number of agricultural cooperatives are domiciled[3].

Indeed, with the creation of this large number of cooperatives, and given the significant

[1] FAO report, 2018
[2] ODCO statistics(2020), FAO report, 2018
[3] Including cooperatives in the citrus, market gardening and olive sectors

contribution of these cooperatives in the creation of wealth in our economy, and the difficulties that threaten the resilience of the said cooperatives, the study of the characteristics of resilient agricultural cooperatives and efficiency remains increasingly important.

Our problem revolves around a main question, namely: what are the characteristics of efficient agricultural cooperatives in the citrus, market gardening, and olive growing sectors of the Souss Massa region?

To answer this problem and by referring to the literature, we will begin first to fly over the conceptual and theoretical framework of our object of research, and a second time we will highlight our methodology and our results, starting with a data envelopment analysis (DEA) to determine the score of each agricultural cooperative object of our sample and thereafter to raise the descriptors which characterize the efficiency or the inefficiency of the said cooperatives, and this through the method ascending hierarchical classifications and the value test method.

1. *Conceptual And Theoretical Framework Of The Research*

During the existence of organizations[4], survival is the crucial indicator to allow the next phases of development, namely success. Also, the minimum criterion of success that the company can achieve is its survival, in other words, the first fundamental step in access to success is survival (Tamassy, 2006).

It is therefore wise to consider survival as the element that initiates the process leading the organization to its success.

We defend in this work the idea that the company which does not survive cannot have resilience or obtain success or efficiency, and this, by the lineage of authors such as Lussier (1995), Lussier and Pfeifer (2000), Littunen and al (1998) or even Tamassy (2006). The concept of survival, therefore, appears to be a necessary element for having resilience or achieving success.

From the foregoing, it appears the existence of close links between survival, success, and more generally efficiency. For this, and as the literature has shown, survival, resilience, success, and efficiency have sometimes been confused or lumped together in their definitions (Witt (2004).

Organizational resilience is defined as "the ability of an organization to maintain a system of organized actions in the face of an unusual situation to preserve the survival of the organization" (Weick, 2003). Weickian resilience involves three mechanisms namely:

- An absorption capacity that allows the organization to cope with shocks without collapsing

-A capacity for renewal that allows it to reinvent itself to adapt to a new situation and build new futures.

[4] Including the cooperatives

-A capacity for appropriation that allows him to strengthen himself by learning from the crises experienced

Certainly, these mechanisms when they occur, allow the company to resist in the first place and then to achieve efficiency.

According to this definition above, it turns out that the resilience of the company is translated by the result of its survival and by extension of its future efficiency, therefore we defend that the resilience explored in this work is captured by its forms of survival in a first level and of efficiency in a second level.

In the literature, there are several descriptors characterizing the resilience and efficiency of agricultural cooperatives including factors relating to the profile of the manager, factors relating to the strategy of the cooperative, factors relating to the organizational elements of the agricultural cooperative, and factors related to the environment of the agricultural cooperative, the table below summarizes all these factors:

Table 1: descriptors characterizing the resilience and efficiency of agricultural cooperatives

Type of factors	Variables	Effect	Authors
factors relating to the profile of the manager	Age	Positif	Teurlai 2004, Praag 2003 béthune 2005,
	Motivation	Positif	Praag. 2003; Solymossy & Hisrich, 2000: Solymossy 1998
	Educational level	Positif	cooper 1991, honjo 2004,
factors relating to the strategy of the cooperative	Innovation strategy	Positif	Gerben et al. 2003; Cooper 1990; Buddelmeyer et al. 2006
	Marketing	Positif	Gerben et al. 2003; Kleinschmidt & Cooper. 1995
	Networking relationship	Positif	Singh, 1997; Singh, 1995; Duchesncau et Garner 2002;
factors relating to the	Governance	Positif	Ait el amria et Attouch, 2016;

organizational elements of the agricultural cooperative			el hidani 2017.
	Financial structure	Positif	Lasch et al. 2005; Praag, 2003; Folopoulos et Louri 2000;
factors related to the environment of the agricultural cooperative	Sector of membership of the cooperative	Positif	Praag, 2003; Persson, 2002; Littunen 2000; Béthune 2005,

Source: quoted by Praag (2003)

2. *Methodology Followed*

In this study and from our survey data by questionnaire whose factors cited in the table above were measured by direct questions, the survey was also conducted among 74 agricultural cooperatives in the citrus, market gardening, and olive trees in the Souss-Massa region, the analysis of these survey data was made using the Data Envelopment Analysis (DEA) method via the R software initially, as well as the hierarchical ascendant classification method (CAH) and the value test using TANAGRA software in a second step. The objective was on the one hand to draw up a typology of cooperatives according to their efficiency, and then to characterize each typology by our descriptors, including survival. On the other hand, to analyze the variables that contribute more to characterize the resilience and efficiency of the cooperatives studied (Miles, M.et al,2003).

It should be noted that the resilience of the agricultural cooperative was captured by its survival and efficiency was measured by a DEA score per agricultural cooperative, this score was calculated by the output/input ratio through the DEA method.

To conduct our empirical study, we opted for the exhaustive sampling or census method, in which each individual (agricultural cooperative) in the population is studied according to the characteristic under study.

In other words, we surveyed all the cooperatives in these sectors. The first part of the survey was conducted between January and February 2020, and the second part between June and December of the same year.

According to the databases provided by the ODCO and the ORMVA dated at the end of 2019, the number of agricultural cooperatives in the citrus, market gardening and olive oil sectors is around 126 cooperatives identified with these organizations, of which 74 were actually interviewed.

3. *Results And Discussion*

3.1. DEA Results

Data envelopment analysis, known as Data Envelopment Analysis (DEA), with which the work of Charnes, Cooper, and Rhodes (1978) is associated; Banker, Charnes, and Cooper (1984); Farrell (1957)[5], is a non-parametric method which measures, using linear programming, the relative efficiency of a set of decision-making units for an empirical frontier on which the efficient units are situated. , those that are not on this boundary are considered inefficient (Emrouznejad, A. and Yang, G,2018).

The objective of this paragraph is to propose, a multidimensional measure that serves to evaluate the survival of the agricultural cooperatives studied in the Souss-Massa region. A measure that considers the articulation between the efforts deployed (the means employed) and the results obtained. This, leads us to choose to measure the efficiency for each of the cooperatives in our sample by a method that, allows a multidimensional evaluation of this indicator (efficiency). This evaluation will allow us to note the disparities in terms of efficiency with regard to the achievements of these cooperatives. The Data Envelopment Analysis (DEA) method adapts to both the objective set and the data available.

For our case, we consider the turnover of the last two financial years carried out by the cooperative as the result of a production activity whose invested capital and number of employees are considered respectively as the two factors of production: the Capital and the work.

Table 02 presents the efficiency scores relating to the agricultural cooperatives studied. For the two years 2019 and 2020, the cooperative with a score equal to 1 is an efficient cooperative and, therefore, is on the empirical efficiency frontier. On the other hand, the more the score achieved by the cooperative for the two years 2018 and 2019 deviates from 1 (with the score must be between 0 and 1) the more the cooperative is less efficient or is not efficient over the two years. .

The table below, which summarizes the statistical information of the DEA scores found on the 74 cooperatives in our sample, reveals that 28.4% of the cooperatives were 100% inefficient during the survey period against 36.5% who were perfectly efficient over the same period. Similarly, around 17% of cooperatives have an average efficiency score.

Table 02: Summary of DEA Scores

[5] Cited by Dia and Bozec (2019) and Dia, M. et al. (2018).

		Frequency	Percentage	valid percentage	Cumulative percentage
Valid	**0,00**	21	28,4	28,4	28,4
	0,18	1	1,4	1,4	29,7
	0,24	2	2,7	2,7	32,4
	0,29	1	1,4	1,4	33,8
	0,33	1	1,4	1,4	35,1
	0,38	1	1,4	1,4	36,5
	0,40	1	1,4	1,4	37,8
	0,45	2	2,7	2,7	40,5
	0,48	1	1,4	1,4	41,9
	0,48	12	16,2	16,2	58,1
	0,50	1	1,4	1,4	59,5
	0,73	2	2,7	2,7	62,2
	0,76	1	1,4	1,4	63,5
	1,00	27	36,5	36,5	100,0
	Total	74	100,0	100,0	

Source: Author's calculation by R software

To better understand the efficiency of the cooperatives studied and characterize it by the variables of our questionnaire, we will proceed in the next step with analysis by ascending hierarchical classification (AHC).

Our method has some weaknesses, in that DEA does not consider the complexity of the relationships between variables, and does not allow us to establish direct causality, which led us to limit the input variables only to the labor factor captured by the number of jobs within the agricultural cooperative and to the turnover variable to capture the production factor.

3.2. Results Of The Ascending Hierarchical Classification (Ahc) And Test Value Method

The objective is to constitute a typology of agricultural cooperatives based on the descriptors (variables) that we have in our database. The idea is thus to draw up a typology of cooperatives according to their efficiency and to characterize each typology by variables such as survival, type of leader, diploma, governance, etc. This analysis will allow us to analyze the variables that contribute more to characterize the efficiency and resilience of the cooperatives studied.

For this reason, we propose to analyze this problem by referring to a method of exploratory data analysis, namely: The ascending hierarchical classification. To achieve this, we go through two stages for the realization of this method. In the first step, it is a question of applying the ascending hierarchical classification (AHC) on the DEA scores calculated during the previous paragraph. While the second step is reserved for the characterization of the groups formed by the classification through the test value (TV). The characterization was carried out through the variables of our questionnaire (survival, type of leader, diploma, governance, etc.).

Step 1: Hierarchical ascendant classification on DEA scores:

It appears from the results of the table below that the cooperatives in our sample can be grouped according to three distinct typologies (classes or groups). Indeed, the highest jump in the constitution of the classes corresponds to class N°3 (higher **gap** going from 0.5657 to 0.1771) which restores 96.22% of the total inertia.

Table 03: Selection of the number of classes to retain

Clusters	BSS ratio	Gap
1	0	0
2	0,7639	0,5657
3	0,9622	0,1771

Source: Author's calculation by Tanagra software

The ascending hierarchical classification (AHC) method suggested the constitution of three heterogeneous groups of agricultural cooperatives (table below). The first class is made up of 28 cooperatives with the highest DEA scores (an average of 0.991414) thus grouping the best-performing (efficient) cooperatives. The second group brings together 22 cooperatives characterized by the lowest DEA scores (an average of 0.008259) and therefore includes the worst-performing cooperatives in our sample. The third group consists of 24 cooperatives representing an average performance materialized by average DEA scores (an average of 0.460275).

Table 04: Groups formed by the (CAH)

Clusters	Number of cooperatives in the class	Average DEA score in the class
cluster n1	28	0,991414
cluster n2	22	0,008259
cluster n3	24	0,460275

Source: Author's calculation by Tanagra software

2nd Step: Characterization of the three groups by the T-value method:

The use of these techniques above, has brought out results. These results, which have been studied in detail, led to the formation of three main groups for the study of the characteristics of resilience and efficiency of agricultural cooperatives in the Souss-Massa region.

- **1st group:**

This first group brings together 29.5% of the cooperatives in our sample, namely 22 cooperatives. All the latter are non-resilient, characterized 100% by their inefficiency. Indeed, all the cooperatives constituting this group are inactive (non-surviving) and have an average score of DEA not exceeding 0.01, thus testifying to a total inefficiency of these cooperatives.

Table 05: Characterization of the first group by the Test Value method

Variable	Test value	Average/or frequency in the group	Average/or frequency in the sample
Continuous attributes : Mean (StdDev)			
Scors_DEA	-1,26	0,01 (0,04)	0,53 (0,41)
Discrete attributes : [Recall] Accuracy			
SURVIE=Non	1,49	[100,0 %] 95,5 %	28,40%
MTINV=neant	1,49	[100,0 %] 95,5 %	28,40%
GOUVassgen=Non	1,49	[100,0 %] 95,5 %	28,40%
Motiv=A_MOTIVobjecta1	1,49	[100,0 %] 95,5 %	28,40%
STRcomm=Oui	1,49	[100,0 %] 95,5 %	28,40%
GOUVdefobj=Non	1,49	[100,0 %] 95,5 %	28,40%

SFCA=SFCAneant	1,49	[100,0 %] 95,5 %	28,40%
GOUVbeng=Non	1,49	[100,0 %] 95,5 %	28,40%
SFsatfin=Non	1,49	[100,0 %] 95,5 %	28,40%
RESrelat4a=Oui	1,39	[100,0 %] 86,4 %	25,70%
RESrelat1a=Non	1,39	[100,0 %] 86,4 %	25,70%
SFsfinvcot=Non	1,14	[81,8 %] 81,8 %	29,70%
STRinov3a=Non	1,09	[67,7 %] 95,5 %	41,90%

Source: Author's calculation by Tanagra software

In short, in this first group we note some possible relationships between the variables of our questionnaire. Thus, one could conclude that the non-survival of cooperatives is a main characteristic of inefficient cooperatives (very low or even zero DEA scores). The latter are characterized by low levels of variables relating to the dimension of governance and the financial structure. The main concern of the leaders is to ensure their employment and to overcome the problem of marketing, so they do not build any networking relationship with the partners.

- **2nd group:**

This second group is made up of 37.8% of all the cooperatives in our sample of 28 cooperatives. These are characterized by the highest DEA scores in the sample (an average of 0.99) and are entirely in a survival situation during our survey.

From the above, and the analysis of the structures of the data found within this second group, we could identify some possible relationships between the variables of our questionnaire. Indeed, in this group, there is a strong relationship between the survival of cooperatives and the DEA efficiency scores. These cooperatives have several variables in common such as governance, financial structure (turnover, amount invested, and source of investment), motivation of leaders to develop their cooperatives, cooperative strategy (innovation), networking, and the cooperative sector (olive tree).

Table 06: Characterization of the second group by the Test Value method.

Variable	Test value	Average/or frequency in the group	Average/or frequency in the sample
Continuous attributes: Mean (StdDev)			
Scors_DEA	1,12	0,99 (0,05)	0,53 (0,41)
Discrete attributes : [Recall] Accuracy			
SURVIE=Oui	0,63	[52,8 %] 100,0 %	71,60%
SFCA=SFCam1M	1,14	[100,0 %] 85,7 %	32,40%
MTINV=moins de 1M	1,06	[89,3 %] 89,3 %	37,80%
STRinov3a=Oui	0,78	[62,8 %] 96,4 %	58,10%
STRcomm=Non	0,63	[52,8 %] 100,0 %	71,60%
Motiv=B_MOTIVobjecta2	0,63	[52,8 %] 100,0 %	71,60%
GOUVassgen=Oui	0,63	[52,8 %] 100,0 %	71,60%
SFsatfin=Oui	0,63	[52,8 %] 100,0 %	71,60%
GOUVdefobj=Oui	0,63	[52,8 %] 100,0 %	71,60%
SURVIE=Oui	0,63	[52,8 %] 100,0 %	71,60%
RESrelat1a=Oui	0,59	[50,9 %] 100,0 %	74,30%
RESrelat4a=Non	0,59	[50,9 %] 100,0 %	74,30%
ENVfil=A_ENVfiloli	0,52	[68,2 %] 53,6 %	29,70%
STRinov4a=Non	0,41	[49,0 %] 85,7 %	66,20%

Source : Author's calculation by Tanagra software

- **3rd group:**

This last group is made up of 24 cooperatives, which represents 32.4% of all the cooperatives in our sample. These cooperatives are mostly in a state of survival during our investigation. However, they are all characterized by DEA scores that are low but not zero (an average of 0.46). In a way, this group illustrates the case of surviving (active) but weakly efficient cooperatives.

Table 07: Characterization of the third group by the Test Value method.

Variable	**Test value**	**Moyenne/ou fréquence dans le groupe**	**Moyenne/ou fréquence dans l'échantillon**
Continuous attributes : Mean (StdDev)			
Scors_DEA	-0,16	0,46 (0,12)	0,53 (0,41)
Discrete attributes : [Recall] Accuracy			
SURVIE=Oui	0,63	[45,3 %] 100,0 %	71,60%
GEOCLT= CLTgéocltint	1,2	[82,1 %] 95,8 %	37,80%
MTINV=1M-2M	1,08	[94,4 %] 70,8 %	24,30%
SFsfinvrc=Oui	1	[67,6 %] 95,8 %	45,90%
SFCA=SFCA5Mm10	0,95	[93,3 %] 58,3 %	20,30%
SFsfinvsub=Oui	0,84	[64,5 %] 83,3 %	41,90%
Trancheage=HKTAGE50P	0,75	[55,0 %] 91,7 %	54,10%
RESrelat2a=Oui	0,72	[68,2 %] 62,5 %	29,70%
GOUVassgen=Oui	0,63	[45,3 %] 100,0 %	71,60%
STRcomm=Non	0,63	[45,3 %] 100,0 %	71,60%
SFsatfin=Oui	0,63	[45,3 %] 100,0 %	71,60%
GOUVbeng=Oui	0,63	[45,3 %] 100,0 %	71,60%
GOUVdefobj=Oui	0,63	[45,3 %] 100,0 %	71,60%
Motiv=B_MOTIVobjecta2	0,63	[45,3 %] 100,0 %	71,60%

RESrelat4a=Non	0,59	[43,6 %] 100,0 %	74,30%

Source: Author's calculation by Tanagra software

In sum, this group represents a best case of analysis where large cooperatives with a remarkable financial structure operating internationally with an efficiency score of 0.46% considered average, this could be attributed to the absence in this group of variables relating to innovation and governance.

Conclusion

The problem of our work was to know the characteristics of resilient and efficient agricultural cooperatives. After carrying out an analysis of the data of our survey using the DEA linear programming method and the AHC and TV method, while identifying the typologies of the agricultural cooperatives of our study.

The results show the existence of three typologies of the cooperatives studied, the statistical information of the DEA scores found on the 74 cooperatives of our sample, indicate that 28.4% of the cooperatives were 100% inefficient during the period of the investigation. against 36.5% which were perfectly efficient over the same period. Similarly, around 17% of cooperatives have an average efficiency score.

Also, for agricultural cooperatives whose DEA score is zero signifying inefficiency, which are in the first place non-resilient and they are characterized by low levels of variables relating to the governance dimension and financial structure.

In Morocco, one of the objectives of agricultural policy is to continue to view the development of agricultural cooperatives as a tool and vector for structuring certain agricultural sectors such as the citrus, market gardening, olive, tree, fruit, cereal, seed, red meat, dairy, and beekeeping sectors, etc.

Consequently, studying the resilience of agricultural cooperatives will enable public decision-makers to take the necessary measures to preserve their survival and resilience.

This study now appears to be a crucial element and challenge for the implementation of regional development policies. It is certainly within this framework that the objectives and results of our study were developed.

In light of the contributions and limitations of this research, our study opens new perspectives for the continuation of research in the field of social entrepreneurship and presents several opportunities for future studies or applications.

This research can therefore be considered, for several reasons, as a starting point for future developments.

Also, it would indeed be interesting to study the survival and resilience of cooperatives using a five years longitudinal study. Although this methodological technique will require data collection on several occasions, it would be more relevant for monitoring the survival and demographic processes of agricultural cooperatives.

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