NEW MEDIT

CIHEAM

MEDITERRANEAN JOURNAL OF ECONOMICS, AGRICULTURE AND ENVIRONMENT

4

QUARTERLY
VOL. XX - N.4
SEPTEMBER
2021

Bononia University Press

NEW MEDIT

Contents

FOREWORD

The aim of the paper of *Elfkh et al.* is to determine the organisational and technological factors associated with the most economically efficient Tunisian olive-growing organisations. The results obtained show that the academic training of the top manager, training in information technology, the age of the organisation and the existence of plans and budget items for the adoption of information and communication technologies are variables that explain this greater efficiency.

Fetoui et al. deals with a livelihood vulnerability assessment and compares the levels of exposure, sensitivity and adaptation to climate change of the local populations in mountains area and coastal plains in Tunisian arid regions. Findings show that households in coastal plains are more vulnerable in terms of sociodemographic profile, food security, social networks, access to water and climate variability.

Cruz et al. analyse the role of a specific kind of Short Food Supply Chains (SFSCs) and its contribution to the restoration of consumers' trust in Spain. The authors draw a map that signals which of SFSC attributes (such as labelling, common values or direct contact with producers) are more relevant in order to build consumers' trust. The information provided by the article offers ideas to policy makers and producers for designing their marketing strategies according to different consumers' demands.

Turkish agriculture, in a context marked in recent years by a rural exodus of young people, marks the vagueness of the current state of the agricultural sector and its future. *Akdemir et al.* assess the impact of the ageing of the rural population on the agricultural sector. The results show that with age, producers invest less in agricultural activity, altogether abandoning productions requiring more labour.

Mehmeti et al. investigate non-financial factors affecting performance of livestock farms in the meat supply chain in Albania. The result shows that trust is positively associated with farm's performance. On the other hand, communication (i.e. resulting from the merge of information sharing and information quality) is negatively associated with performance. However, communication appears to have a positive association with farm's performance indirectly through its effect on trust.

Kaygisiz and Akdağ determine sheep farmers' selection of marketing channels in livestock sales and the factors affecting their choices. According to the results, four marketing channels were identified to be efficient in livestock marketing. These were final consumers, brokers, retailers, and mixed channels. Besides, it was determined that the variables of selling additional products (milk, cheese, fleece) in the enterprise other than livestock, being a member of the Sheep and Goat Breeders Association, and the reason of choosing marketing channels had a weak impact on the selection of marketing channels.

Gurbuz and Ozkan examine livestock farmers' intention to move manure waste to an allocated landfill and the impact of financial support by municipalities on farmer's behavior. This study emphasizes that local governments should employ more proactive environmental measures, raise financial incentive initiatives in animal waste management to ensure farmers' participation in these practices and sustainable agriculture.

ICT as a development factor in the Tunisian olive oil sector

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Abstract

Olive oil is one of the main agricultural products of the countries that make up the Mediterranean basin. The low profitability of this sector of activity and the growing challenges of an increasingly turbulent market force the sector to search for more efficient organization. The aim of this paper is to determine the organisational and technological factors associated with the most economically efficient Tunisian olive-growing organisations. To this end, firstly the Data Envelopment Analysis method has been used to establish a hierarchy of the most efficient organizations. Secondly, the Qualitative Comparative Analysis method has been used, which allows us to establish the relationships of variables that explain the highest levels of economic efficiency. The results obtained show that the academic training of the top manager, training in information technology, the age of the organisation and the existence of plans and budget items for the adoption of information and communication technologies are variables that explain this greater efficiency.

Keywords: Olive oil, Efficiency, DEA, fsQCA.

1. Introduction

Olive oil is a basic product of the so-called "Mediterranean diet". The world production of olive oil presents a continuous tendency of growth due to the technological improvements, the extension of the irrigation system and the gradual increase of the olive grove surface (Parras *et al.*, 2013). Consumption is also increasing, due to the benefits and attributes of this product with respect to other existing oils and fats (Vilar and Cárdenas, 2016). In Tunisia the olive oil sector plays a very important role, both at the economic level and at the environmental and so-cial levels. The olive grove occupies 36% of the total arable land and 79% of the surface dedicated to arboriculture. It should be noted that 95% of the Tunisian olive grove is a traditional crop, cultivated on dry land and with almost no input of chemical fertilizers, which has facilitated its conversion to the organic system. Thus, Tunisia is positioned as one of the largest producers and exporters of organic olive oil in the world (Ben Abdallah *et al.*, 2018).

Within the commercial flow of agri-food products in Tunisia, olive oil occupies a leading position. In fact, 75% of the olive oil production

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was destined to international markets during the period 2013-2018 (IOC, 2019). This situation is the result of public policies that encouraged "bulk" olive oil exports, with low added value. In fact, only a few countries of the European Union (the traditional markets), namely Italy, Spain and France, are the usual markets for the sale of oil from Tunisia. These target markets are currently much more diversified thanks to their new strategic orientation towards the modernization of the producing entities and towards the sale of olive oil with higher added value, either through bottling or marketing under different quality signs, such as the one that certifies the organic origin of the oils (Elfkih, 2013).

The predominance of the "bulk" sales format among the producing entities adds a serious commercial problem to this sector, which translates into a lack of orientation towards the final market. Few are the producing entities that control the entire value chain, except for some large producers, producers of organic olive oil, in addition to the agro-complexes belonging to the State (Elfkih and Karray, 2011). Currently, the sector has more than 1,750 mills, 15 refining plants, 14 olive-pomace oil extractors, more than 35 bottling plants and more than 200 private sector traders and exporters, together with the national oil office and the state public domains (IOC, 2017). However, this sector faces many challenges and still has a long way to go before it can be modernized, because the continuity of its exports, its capacity to defend itself against competition and the maintenance of its profitability are not guaranteed.

In improving trade, the use of and commitment to technology can play a fundamental role. The development of information and communication technologies (henceforth ICTs), with the use of the Internet and the tools it integrates, has brought about a technological revolution in the use and distribution of information. ICTs are a powerful competitive tool and, above all, an indispensable requirement for successfully competing in today's market (Kaplan and Haenlein, 2010; Bernal *et al.*, 2019). The presence of an increasingly technological society explains the relevance of using these media, especially the Internet, where more than 55 percent of the world's population is present[1]. Various theories, such as that of transaction costs, have been used as a basis for arguing the benefits of these technologies for business performance (Mozas-Moral *et al.*, 2016). Indeed, information, negotiation and guarantee costs have been reduced by the use of these means, allowing the organization to provide a more economical, personalized and flexible service to consumers (Stephen and Toubia, 2010; Karoui *et al.*, 2015).

It follows that the use of ICTs should contribute to improving the performance of firms investing in this type of asset. However, the empirical work carried out does not show conclusive results regarding this relationship. The dominant academic literature has documented numerous studies that examine the relationship between investments in technology and the benefits obtained in terms of improved organizational performance (Brynjolfsson and Yang, 1996; Kohli and Devaraj, 2003). The results obtained so far have been contradictory (Lee, 2001; Lichtenberg, 1995) and range from pessimistic positions on the contribution of ICT to business performance (Solow, 1987; Strassmann, 1990) to more optimistic positions in recent times (Brynjolfsson and Hitt, 1996, 2003). These positions have generally focused on the so-called "productivity paradox" (Brynjolfsson, 1993), which describes the phenomenon seen in the 1970s and 1980s whereby firms that invested more in ICTs suffered a relative decline in labor productivity.

Many efficiency studies have been conducted on the agrifood sector and the factors that favor it (Vidal Giménez *et al.*, 2000; Dios Palomares *et al.*, 2006), but few have focused on the relationship between ICT and efficiency in this sector. Among the latter, it is worth mentioning the study by Medina *et al.* (2016), which dealt with the relationship between efficiency and the use of ICT in the organic olive oil sector.

This context justifies the need to identify the most efficient organizations, in order to deter-

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[1] Available at: https://www.internetworldstats.com/stats.htm. Revised February 2020.

mine common patterns that can explain these best organizational practices. Thus, the objective of this study is to analyze Tunisian olive entities in terms of economic efficiency, in order to determine organizational and technological variables that are directly associated with greater efficiency. The methods used to achieve this objective have been the Data Envelopment Analysis (hereinafter DEA) and fuzzy sets Qualitative Comparative Analysis (hereinafter fsQCA) techniques. The present study is structured as follows: after this introduction, the contextual framework is presented, detailing the proposals of this paper; subsequently, the population and methodology are detailed; then, a section of results and discussion is presented; and finally, the corresponding conclusions are presented.

2. Theoretical framework

2.1. *The Tunisian olive oil sector*

Olive cultivation plays a very important social role in Tunisia, with more than 309,000 growers accounting for 20% of the active population in the primary sector (Agridata, 2019). Furthermore, this sector significantly strengthens the industrial and commercial infrastructure of the country. It currently boasts more than 1,750 oil mills, 15 refining plants, 14 olive pumice oil extractors, over 35 bottling plants and more than 200 private sector traders and exporters, as well as the national oil office and state-owned public domains (IOC, 2020). There are few producers that have control over the whole value chain except for a handful of large producers, organic producers and state-owned agro-complexes (Elfkih *et al.*, 2011).

Olive oil is a strategic product both for Tunisian agriculture and for its economy as a whole. Indeed, it is the first agri-food product to be exported. In the last five years (2015-2019) the production of olive oil has been estimated at 196,000 tons of which 165,000 tons have been exported, representing 84% of the total produced. The volume of oil exported by Tunisia represents 20% of world exports (without taking into account intra-community exports) (IOC, 2019). The export of olive oil occupies first place

in the Tunisian agro-food trade balance, both in quantity and in value of exports, and represents more than 50% of the total value of the agro-food exports of this country (Institut National de Statistique Tunisien, 2019). With an average value of 1,277 million Tunisian dinars (average 2014/2018) (Institut National de Statistique Tunisien, 2019), olive oil exports represent about 5% of total Tunisian exports and about 1.4% of the country's GDP.

This situation is the result of public policies to incentivize olive oil exports. Until 1962, the domestic market for vegetable oils was fully supplied by olive oil produced in the country. From this date onwards the Tunisian government resorted to a policy of exporting olive oil in bulk and importing seed oils, with the twofold objective of protecting the purchasing power of low-income households and promoting olive oil exports. This policy made it possible, on the one hand, to stabilize the balance of payments, and on the other to promote the olive oil sector by widening the olive-growing area and modernizing the corresponding industrial infrastructure, increasing both processing and storage capacity (Saï and Msallem, 2005).

As a result of this policy and the preferential export deals signed with the EU in the 1980s, Tunisian olive oil exports saw a steady increase in their share of international markets, which currently stands at 19% of total world olive oil trade. However, for a long time these exports were highly concentrated geographically and were sold in bulk with low added value. Indeed, historically Tunisia only exported olive oil to a few EU countries (the traditional markets), namely Italy, Spain and France. These target markets are now much more diversified thanks to their new strategic approach of modernizing production facilities and adding greater value to the product, either through packaging or quality labels, such as the label that certifies organic origin (Elfkih, 2013).

In response to these new challenges the Tunisian olive oil sector now benefits from a national development strategy that aims to boost production and reduce fluctuations in annual output by expanding the growing area into more adequate soils, improving olive oil quality through

the modernization of production processes, improving international market positioning to gain greater product visibility through diversifying end markets and targeting markets with greater added value, and improving export shares of bottled oil and organic olive oil. A series of innovative and promising measures and initiatives have been implemented to fulfil these objectives. In this regard, various funds have been set up to support export activity and provide a favorable framework for investors (IOC, 2020).

2.2. *Proposed development factors for the Tunisian olive sector*

In the current context, technological development is considered a key aspect for business success (Kaplan and Haenlein, 2010). In relation to the olive sector, the use of ICTs and the commitment to e-commerce have been identified as key factors for its modernization (Bernal *et al.*, 2019). In the Tunisian olive sector, there is very little information on the role of ICTs in these organizations, their management and the level of training of those responsible for taking advantage of their potential. Among the few studies related to this topic we highlight those of Ben Ayed Mouelhi (2009), Kosai and Piget (2014), Sadok *et al.* (2016) and Bakir *et al.* (2018). The first three works cited highlight the importance of ICTs in Tunisian industrial organizations, as well as the role of ICTs as facilitators of new opportunities for socio-economic growth and regional balance. With regard to the olive oil sector, the work of Bakir *et al.* (2018), carried out on olive oil producing entities in the area of Sfax (Tunisia), highlights the extreme importance of the profile of the organization managers for the development of ICTs.

The figure of the maximum organizational leader has been frequently pointed out as a determining variable in the success of this business (Medina *et al.*, 2016). Specifically, many studies have considered the academic training of the maximum leader a determining factor in the economic efficiency of the organization (Levie and Autio, 2011), since it will stimulate their commitment to innovation and the implementation of more efficient organizational practices

(Fernández-Uclés *et al.*, 2020). Similarly, ICT training for top management is relevant in order for organizations to integrate these tools and improve their business performance (Nguyen and Barret, 2006). Managers with training in these technologies will be more aware of their importance and will devote more effort to their proper use and to their commitment to innovation, contributing to the improvement of the organization's economic efficiency (Kim and Jee, 2007). These arguments lead us to formulate the following proposals:

Proposition 1. The academic training of the head favours the economic efficiency of the organisation.

Proposition 2. The specific training in ICT of the head favours the economic efficiency of the organisation.

One source of competitive advantage comes from innovation, through its internal management (Gray, 2006). The presence of personnel trained and qualified in technological management will allow an efficient use of the different technological tools made possible by the Internet (Peansupap and Walker, 2006). In spite of this, the organizations of the olive oil sector generally lack internal personnel trained and qualified ad hoc in the management of these technologies (Fernández-Uclés *et al.*, 2016). An alternative to this problem is outsourcing, to external professionals dedicated to this function (He *et al.*, 2017). As opposed to the different existing alternatives, the most recommendable option is to have qualified professionals who manage these tools internally, in order to take full advantage of the potential offered by information and communication technologies (Rita and Sunny, 2012). This line of argument leads us to make the following proposal:

Proposition 3. Training in ICT for those responsible for managing these technologies contributes to the economic efficiency of the organization.

The age of the organization can also be considered a trigger for its innovative attitude (Díaz *et al.*,

2006). In this sense, authors such as Pavitt (2003) maintain that the organizations of greater antiquity can find greater difficulties in innovation, because they have adopted organizational and commercial automatisms that make them more reticent and, therefore, present a worse business performance (Cucculelli *et al*., 2014). Innovation and market orientation is an essential aspect of profitability in the agri-food sector (Gorgues *et al*., 2019). Similarly, it has also been noted that younger organizations are more prone to innovation and better adaptation to markets (Frenkel *et al*., 2001), which translates into better organizational practices and greater economic efficiency. In this regard, Czarnitzki and Delanote (2012) point out that young organizations are more likely to grow faster and consequently to perform better, especially those that are committed to innovation. Considering these arguments, we make the following proposal:

Proposition 4. The age of the organization is inversely related to the economic efficiency of the organization.

The study of the ICT planning process has traditionally focused on its influence on business results. Thus, Sohal *et al.* (2000) and Sieber *et al.* (2006) argue the importance of planning the use of ICTs in enterprises in order to employ them in the most efficient manner. For their part, other authors highlight the importance of the ICT plan being aligned with the organization's general strategy, with organizations adapting to these technologies and these, in turn, adapting to the organization's characteristics and general lines of action. Thus, these studies maintain that the ICT strategy and the company's general strategy must be in line (Hurley and Birkwood, 1997; Parra and Molinillo, 2001; Peppard and Ward, 2004; Hidalgo *et al.*, 2008).

In the light of the studies carried out, it seems clear that ICT planning has a positive influence on profitability, without any studies that maintain a direct relationship between ICT planning and the possibility of adopting these technologies in the organization. However, in this study we consider that planning can be a key factor in organizations deciding to adopt this type of technology, based on the following arguments:

Proposition 5. The existence of plans and budget items for the adoption of ICT in the organization *positively conditions the economic efficiency of the organization.*

3. Population and methods

3.1. *Population*

The population under study is made up of Tunisian olive oil producers and marketers who have a presence on the Internet through their own websites. In order to obtain the registration of these operators we contacted the Tunisian Agency for the Promotion of Industry and Innovation, which is a public institution where all industrial and agro-food organizations are registered in order to benefit from subsidies, as well as from the support and monitoring of their projects. The total number of olive oil processors and marketers provided by this agency amounted to 351 organizations. An Internet search was then carried out to determine the number of organizations with their own website, resulting in a total of 90 organizations with a website. Therefore, these 90 organizations make up our study universe. Subsequently, a structured face-to-face survey was carried out for the top organizational managers and was answered by 47 organizations (52.22% response rate).

3.2. *Methods*

For this research primary and secondary sources were used, reviewing the existing literature on the subject. Regarding the methodology used, firstly an economic efficiency analysis was carried out on the Tunisian olive-growing organisations, applying the Data Envelopment Analysis technique (hereinafter DEA). This method is reliable and valid for efficiency analysis, standing out for its popularity and widespread use (Kuosmanen *et al*., 2015; Liu *et al*., 2015). The purpose of this technique is to compare different homogeneous decision units by evaluating the influence of a series of production factors or inputs used in obtaining outputs, assigning a level of efficiency of between 0 and 1. Thus, based on linear programming and considering identical

Table 1 - Average value of the variables considered in the economic efficiency model.

Variables		Average value
Input	Personnel costs	91,994 €
Input	Expenditure on raw materials and materials	6,371,712 €
Input	Depreciation of tangible fixed assets	34,400 €
Output	Turnover	8,845,954 €

Source: own data.

inputs and outputs, the entities that are totally efficient are determined (they obtain a score equal to 1) and are located in the so-called efficiency frontier (Samoilenko, 2014).

There are different developments of the DEA method, in particular the classical BCC model has been used, which evaluates inputs and outputs considering variable returns to scale (Charnes *et al*., 2013). An output orientation has also been chosen for the model proposed, which consists of focusing the efficiency approach on maximising outputs. This choice is due to the fact that we consider it more relevant to focus on the outputs of the process, due to the outstanding commercial problem faced by agricultural entities as well as to the agricultural nature of these entities, in which the inputs are partially subject to the seasonality of the crop. One of the main weaknesses of DEA lies in its sensitivity to extreme values (Charnes *et al.*, 2013). To alleviate this handicap, the super-efficiency technique has been used, eliminating those values that exceed an efficiency threshold of 2 and can be considered outliers (Banker and Chang, 2006). As a result, the number of entities on which the DEA analysis is performed is 46 organizations.

The primal approach of DEA with the BCC-O model is: max $(\emptyset, \lambda, s+, s-)$ subject to the following conditions: ; ; . In this case, if $\emptyset=1$, the unit is considered efficient, meaning that there is no other unit that produces more or that achieves the same output using fewer resources. If this model is used, all efficient units return the same value $(\emptyset=1)$, so it is not possible to establish a ranking. With the use of the super-efficiency method created by Andersen and Petersen (1993) this restriction is eliminated, therefore previous studies have taken advantage of this approach to remove very distant values considered outliers.

Continuing with this study, it is frequent to find a second phase that closes the DEA technique, to characterize or strengthen the results obtained. Among the different procedures used for this second phase of analysis, the use of regression models is common in order to know the contextual variables that explain the resulting efficiency scores (Charnes *et al.*, 2013). Thus, an intense debate has been generated to identify the statistical procedure that best suits this purpose (Kuosmanen *et al.*, 2015). In this paper, and with reference to this second stage of analysis, the Qualitative Comparative Analysis (QCA) technique has been used, employing the fuzzy set approach (fsQCA), in order to establish variables of a technological and organisational nature that are jointly associated with a higher level of efficiency. It is precisely these DEA efficiency indices that will act in this second phase of analysis as a dependent variable.

The average values of the variables used to carry out the DEA method are presented (Table 1). As can be seen in Table 1, these variables correspond to a classical model of economic efficiency on the Tunisian olive sector. In order to increase the rigour of this study and reduce the variability of the organisational results, which are the result of the crop's variability, an average of the values of these variables has been calculated considering three consecutive years, corresponding to the campaigns 2014, 2015 and 2016.

To deepen this analysis, which consists of identifying the organizational and technological variables associated with a higher economic efficiency score, the fuzzy sets Qualitative Comparative Analysis (fsQCA) technique has been used. QCA uses a verbal, conceptual and mathematical language that configures it as a qualitative and quantitative approach, combin-

Table 2 - Variables considered for the fsQCA technique.

Outcome	Description	
BCC scores	Results of DEA economic efficiency model	Continuous variable
Causal condition	Description	
Education	Education level of managing director	Categorical variable[a]
ICT.director	ICT training of managing director	Categorical variable[b]
ICT.staff	ICT training for staff	Categorical variable[b]
Age	Longevity of organization	Continuous variable
ICT.plan	ICT planning	Dichotomous variable
ICT.investment	Invest in ICT	Dichotomous variable

[a] *Five-level categorical variable (no education; primary level; secondary level; first-level university degree; second-level university degree). Calibrated according to Rihoux and Ragin (2009).*
[b] *Four-level categorical variable (no knowledge; user level; intermediate level; advanced level). Calibrated according to Rihoux and Ragin (2009).*
Source: own data.

ing the main advantages of these (Ragin, 1987). Thus, by applying QCA it is possible to systematically analyze a set of cases, to determine causal patterns in the form of need and sufficiency relationships between a set of conditions and an outcome (Schneider and Wagemann, 2010). The development of fuzzy sets (fsQCA) is one of the most widely used variants of QCA, as it resolves one of the main drawbacks and criticisms of the initial approach called csQCA, which is its strictly dichotomous approach (Sehring *et al*., 2013).

The fsQCA technique was developed for small sample sizes or populations (Ragin, 1987), so it does not pose a problem for this research, in which the study universe is small. This technique offers as a result one or several antecedent combinations sufficient to obtain a specific result such as: X1*~X2*X3 sufficient for outcome (Y), or expressed in the notation system of this method (X1*~X2*X3→Y), where X1, X2 and X3 are antecedents; Y, the outcome; * indicates "AND"; and ~ absence or negation, in this case the opposite value to X2 (1- X2). For the correct execution of this technique the phases recommended in the literature are followed (Schneider and Wagemann, 2012): calibration of the variables that require it, both of the conditions and of the result; analysis of necessity; and analysis of sufficiency.

Thus, the economic efficiency scores obtained with the DEA method are the dependent or outcome variable considered. On the other hand, the independent variables that have been proposed are detailed in Table 2.

4. Results

The economic efficiency results obtained after applying the DEA technique, according to the output-oriented BCC model, are detailed in Table 3. Firstly, six organizations out of 45 analyzed are considered efficient, forming the well-known efficiency frontier. The number of efficient organisations can be considered low, at 13.33 percent. The average efficiency of the organisations that are not considered efficient (not reaching a value of 1) is 0.60, with a standard deviation of 0.23, which reveals a high variation between the efficiency scores obtained by the different organisations analyzed.

Table 3 - Economic efficiency results.

Number of efficient DMUs	6
Percentage of efficient DMU	13,33%
Average efficiency	0,60
Standard deviation	0,23
Inefficiency on average	0,40

Source: own data.

Table 4 - Results of fsQCA analysis.

Solutions	1	2	3	4
education	●	●		●
ICT.director	●		○	○
ICT.staff			●	●
Age		○	○	●
ICT.plan	●	●	●	●
ICT.investment	●	●	●	
Gross coverage	0.677153	0.544514	0.372268	0.354668
Single coverage	0.166837	0.015824	0.030318	0.050182
Consistency	0.871282	0.828038	0.848682	0.863622
Solution coverage	0.837849			
Solution consistency	0.776811			

Source: own data.

The results of the BCC_O efficiency analysis show that a very small group of organisations can be considered efficient, namely 13.33 percent. Characterizing these organizations with higher values of economic efficiency it is observed that they respond to large entities, which develop a greater control over the value chain, as is the case of the State's agro-complexes. This control entails a complete quality control process, which has an immediate and positive effect on the volume of turnover, as well as a greater control over raw material expenses (Elfkih and Karray, 2011).

The results of this second stage of the study, in which the fsQCA method is applied, are shown in Table 4. The resulting causal configurations have been ordered from highest to lowest according to their gross coverage. For the presentation of the results, the configurations use black circles to indicate the presence of the condition (●), white circles to indicate the absence of the condition (○) and the absence of a circle indicates that the condition is not binding in that configuration. The first configuration covers a gross coverage of 0.677153, indicating the relations between the manager's academic training and his/her ICT training and the existence of plans and budgetary items for the adoption of ICTs as a set of variables that explain greater economic efficiency. Similarly, it is worth highlighting the second casual configuration, which

again includes the manager's academic training, the existence of plans and budgetary items and inversely, seniority, with a gross coverage level of 0.544514.

The global solution of this model gives a coverage of 0.837848, which denotes the proportion of organizations that are explained by the variables considered, and a total consistency of 77.68 percent of the cases. The results obtained are in line with those of other previous studies that have demonstrated the existence of a positive impact of the use of ICTs and the academic training of the CEO or leader on the efficiency of Tunisian organizations.

5. Conclusions and discussion

This study encourages Tunisian olive oil agro-food organizations, and in general the olive oil agro-food business network, to increase their commitment to innovation and the use of new ICTs as a means of growth, development and economic efficiency. It has become clear that the incorporation of these technologies in the olive sector is a decisive competitive factor in guaranteeing the survival and profitability of the organization, as well as in responding to the challenges brought about by this digital transformation (Jorge-Vázquez *et al.*, 2019). The use of virtual social networks, as well as other means incorporated by the Internet, are essential elements to

be incorporated into business management, in order to respond with guarantees to the current environment (Borrero, 2019; Corrons and Gil, 2019). In this way the presence of a website, as a reception point for Internet users, the existence of a virtual store, such as an online sales channel, and the use of virtual social networks as a communication channel and relationship marketing strategy, are low-cost elements that can increase the competitiveness of this sector and therefore its profitability.

The results obtained in the economic efficiency analysis by DEA show that only a very small number of Tunisian olive-growing entities can be considered efficient. The organisations that are outside the efficiency frontier have economic efficiency indices that can be designated as low. The fsQCA analysis has highlighted the importance of the variables proposed as explanatory factors for the higher economic efficiency scores, allowing the validation of the proposals initially put forward. In fact, Ben Ayed Mouelhi (2009) confirms that organizations that make intensive use of ICTs have greater technical efficiency than other organizations.

The combinations of variables associated with the most efficient organizations, in economic terms, allow us to conclude the following: The descriptors of better economic results are those organisations that are directed and have personnel trained in ICTs. The incorporation of these technologies in the olive sector is a response to the challenges brought about by this digital transformation and a decisive competitive factor in guaranteeing the survival and profitability of the organisation (Jorge-Vázquez *et al.*, 2019). Seniority is not a handicap if Tunisian olive oil organizations have personnel trained in these technologies, which allows them to take full advantage of the potential of these social and technological tools. As a recommendation we suggest encouraging the use of ICT in companies for commercial purposes, and not only with the presence of these tools, but with a planning strategy and human capital trained to maximize their contribution to the efficiency of the company.

The limitations that can be attributed to this study are the following: the general economic efficiency model proposed, despite being a common one in this type of study, may not bring together all the relevant variables that accurately determine the best organizational practices. However, its reliability has been demonstrated in the literature by bringing together the main economic items associated with the organisation. If the intention is to generalize these results to the agri-food sector, it is a limitation that this research should focus exclusively on the entities of the olive sector. However, the whole agrifood sector presents, in general terms, a similar problem in terms of marketing. Therefore, we believe that these results can be extrapolated to a large part of this sector.

This research opens up an immense field of work for future investigations. Among them we can highlight the following: deepening the study of which structural and organisational variables favour market orientation through virtual social networks or other ICT applications and determining whether this explanatory model coincides in other sectors of agrifood.

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Vulnérabilité des moyens d'existence des ménages ruraux au changement climatique : analyse comparative des territoires montagneux et littoraux des zones arides tunisiennes

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Abstract

This paper presents a livelihood vulnerability assessment and compares the levels of exposure, sensitivity and adaptation to climate change of the local populations in mountains area and coastal plains in Tunisian arid regions. The United Nations Intergovernmental Panel on Climate Change vulnerability index (LVI-IPCC) has been adapted and applied to assess this livelihood vulnerability, based on socio-economic surveys and semi-structured interviews with the local populations.

Findings show that households in coastal plains are more vulnerable in terms of socio-demographic profile, food security, social networks, access to water and climate variability. This territory is much more exposed to climate change, despite being slightly less sensitive. On the other hand, households in mountainous territory are more vulnerable in terms of livelihood strategies, land tenure and health, despite their adaptation capacity, which reduces their vulnerability to climate change. Based on this vulnerability assessment, this work suggests specific adaptation strategies and measures for livelihoods sustainability in each territory.

Keywords: Climate change, Vulnerability, Livelihoods, Tunisian arid zones.

1. Introduction

L'IPCC a annoncé que la superficie des zones arides touchée par la sécheresse a augmenté durant la période 1961-2013 de 1% en moyenne par an, avec une grande variabilité interannuelle. Il annonce également qu'en 2015, environ 500 millions de personnes vivant dans des zones touchées par la désertification sont de plus en plus touchées par le changement climatique (IPCC, 2018).

En Tunisie, les études d'évaluation de la vulnérabilité au changement climatique (Neffati *et al.*, 2015) ont montré que le pays subit déjà les impacts de ce phénomène planétaire, en particulier les impacts liés à l'augmentation des températures moyennes, la réduction des précipitations et surtout l'accentuation de la fréquence des phénomènes météorologiques extrêmes (sécheresses, inondations, érosions). Ces changements engendrent des effets néfastes majeurs surtout sur les écosystèmes et les moyens de

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subsistance des communautés rurales des zones arides tunisiennes, dont les revenus sont fortement dépendants des activités agricoles et de l'exploitation des ressources naturelles rares et fragiles (Fetoui, 2011).

L'activité agricole devient incapable de procurer en quantité et en qualité des produits agricoles pour la commercialisation et même pour l'autoconsommation familiale. La régression de la productivité agricole a affecté négativement les moyens d'existence des communautés rurales, la viabilité économique de l'exploitation agricole et la vulnérabilité de ces communautés, qui ont perdu leur capacité à faire face au changement et aux variabilités climatiques (Neffati *et al.*, 2015). La vulnérabilité est encore plus exacerbée en raison de la marginalisation politique (disparité régionale) (Béchir et Sghaier, 2013), de la faiblesse du tissu institutionnel et des infrastructures rurales des zones arides tunisiennes (santé, éducation, transport, communication, etc.). Elle risque de s'aggraver au fil des années si des mesures concrètes ne seront pas entreprises, notamment avec la multiplication des besoins des communautés rurales, de surexploitation des ressources et surtout des effets du changement climatique (MARH, 2007 ; Neffati *et al.*, 2015).

Or, la sensibilité de ces systèmes à la variabilité climatique ne se manifeste pas de la même façon d'un espace à un autre, voire d'un paysage à un autre et peut changer sur des courtes distances. L'aridité est ressentie différemment par rapport aux types de milieu édaphique, aux types de végétation, aux modes de vie et à l'usage des ressources naturelles (Loireau *et al.*, 2015). Ces différences font que les populations présentent des niveaux différents de vulnérabilité en termes d'exposition et de sensibilité à la variabilité et changement climatique. Alors que la sensibilité est le degré auquel un système est affecté par une catastrophe, la capacité d'adaptation est sa capacité à résister et à absorber une catastrophe, et l'exposition est l'ampleur et la durée auxquelles la population est exposée à une catastrophe (Hahn *et al.*, 2009). Cette vision locale de la vulnérabilité a été jugée plus appropriée pour comprendre l'impact de ces changements (Rossignoli *et al.*, 2015), puisque l'évaluation de la vulnérabilité des moyens d'existence des ménages est déterminée par leur capacité spécifique à se remettre et à s'adapter durablement à ces conditions socioéconomiques et climatiques défavorables (Rossi *et al.*, 2020).

L'apport de cette recherche réside dans l'importance de l'analyse de la vulnérabilité des moyens d'existence des communautés rurales des zones arides tunisiennes à l'échelle locale, afin d'identifier les facteurs déterminants de cette vulnérabilité ainsi que les stratégies et mesures d'adaptation spécifiques au changement climatique.

Différents modèles et méthodes d'évaluation de la vulnérabilité ont été élaborés. L'approche en matière de moyens d'existence durables (SLA) est un outil conceptuel utilisé pour améliorer la compréhension de la vulnérabilité des ménages. Elle mobilise plusieurs indicateurs pour évaluer l'exposition, la sensibilité et la capacité d'adaptation des ménages à la variabilité climatique et changement climatique. Les caractéristiques sociales et économiques des ménages affectent la capacité d'adaptation de ces ménages et les caractéristiques actuelles de la santé, des ressources en nourriture et en eau déterminent leur sensibilité aux impacts du changement climatique (Chambers et Conway, 1992).

S'appuyant sur l'approche SLA et les travaux du GIEC (groupe d'experts intergouvernemental des Nations Unies sur le changement climatique) ou IPCC, Hahn *et al.* (2009) ont développé un indice de vulnérabilité des moyens d'existence au changement climatique (LVI) visant à utiliser les données au niveau des ménages pour éclairer la planification stratégique au niveau des communautés rurales dépendantes des ressources naturelles. Après avoir intégré les trois facteurs contributifs du GIEC (sensibilité et exposition au climat et les pratiques d'adaptation des ménages) dans leur approche, ils ont testé le LVI et le LVI-IPCC dans deux communautés du Mozambique, où il s'est avéré utile de saisir les différences de vulnérabilité climatique au niveau de la communauté. Cette approche a été appliquée également dans plusieurs autres pays en développement qui ont déjà connu les impacts du changement climatique, avec des conséquences graves pour

les moyens de subsistance des ménages, les systèmes de production et l'environnement. Elle a été adaptée et appliquée aux territoires montagneux subtropicaux humides de l'Inde (Tewari et Bhowmick, 2014), de Népal (Aryal *et al.*, 2014 ; Poudel *et al.*, 2020) et de Vietnam (Huong *et al.*, 2019), aux territoires tropicaux subhumides de Ghana (Adu *et al.*, 2017) et de l'Ethiopie (Simane *et al.*, 2016), aux territoires insulaires subhumides de Trinidad et Tobago (Shah *et al.*, 2013), etc.

L'analyse de la vulnérabilité des moyens d'existence des ménages des zones arides tunisiennes au changement climatique par la méthode du GIEC nous semble être pertinente, car ces ménages dépendent fortement des ressources naturelles et sont fortement exposés au changement climatique. Elle pourrait également être un moyen pour enrichir des études antérieures sur la vulnérabilité en Tunisie qui étaient principalement basées sur la pauvreté sans prendre en compte les données sur les capitaux des ménages et leurs moyens d'existence (Béchir et Sghaier, 2013).

Les indices LVI et LVI-IPCC ont été adaptés au contexte de la présente recherche. Ceci afin d'analyser et comparer les profils de vulnérabilité des moyens d'existence des communautés rurales, ainsi que leur niveau d'exposition, de sensibilité et d'adaptation à la variabilité et changement climatique dans les principaux types des milieux en zones arides tunisiennes (les territoires montagneux et littoraux). Ces deux territoires présentent des différences significatives en termes de fonctionnements biophysiques et socioéconomiques et sont considérés comme les territoires les plus marginalisés à l'échelle nationale (Béchir et Sghaier, 2013).

2. Materiel et methodes

2.1. *Approches d'analyse de la vulnérabilité*

L'intérêt croissant de la communauté scientifique à l'étude de la vulnérabilité est exprimé par le large éventail de définitions de la vulnérabilité. Nous retenons pour notre étude la définition du GIEC (IPCC, 2007), la plus utilisée dans le cadre des évaluations de la vulnérabilité au changement climatique : « *La vulnérabilité est une mesure dans*

laquelle un système est sensible ou incapable de faire face aux effets défavorables des changements climatiques, y compris la variabilité du climat et les phénomènes extrêmes. Elle est fonction de la nature, de l'ampleur et du rythme de la variation du climat à laquelle le système considéré est exposé, de la sensibilité de ce système et de sa capacité d'adaptation ». Cette définition identifie explicitement les systèmes sociaux et leurs caractéristiques comme objet d'analyse tout en reconnaissant les risques naturels comme sources de dommages au système, faisant référence à l'interface Homme/Nature et aux relations sociales. Dans cette approche, la vulnérabilité présente des facteurs externes englobant les perturbations et les risques du système en termes d'exposition et de sensibilité, et un facteur interne qui comprend la capacité du système à faire face et réagir aux contraintes socioéconomiques et aux aléas climatiques (O'Brien *et al.*, 2007).

L'analyse de ces facteurs contributifs ou variables clés de la vulnérabilité repose souvent sur l'utilisation et l'intégration d'indicateurs tout en tenant compte de leur importance relative et de leur influence sur la vulnérabilité du système homme-environnement en général. Pour quantifier les niveaux d'importance ou d'influence de ces composantes sur la vulnérabilité, certaines études impliquent les parties prenantes et/ou utilisent les connaissances d'experts (Preston *et al.*, 2009). Chaque facteur étant déterminé par une série d'indicateurs, de conditions et ressources ou composantes majeures (Hahn *et al.*, 2009). De nombreuses approches utilisent ces indicateurs pour caractériser et quantifier des problèmes multidimensionnels, combinant souvent divers indicateurs dans un seul indice composite de vulnérabilité. Les indices de vulnérabilité sont construits à trois fins principales. Premièrement, ils offrent un point de référence pour évaluer les cadres de la politique de développement (Eriksen et Kelly, 2007). Deuxièmement, ils peuvent fournir des informations pour élaborer des plans d'adaptation et d'atténuation (Gbetibouo *et al.*, 2010). Troisièmement, ils peuvent fournir un moyen pour normaliser la mesure de la vulnérabilité, permettant ainsi la comparaison de différents contextes. Cela permet également d'établir des priorités dans l'allocation des res-

sources pour l'adaptation et l'atténuation (Preston *et al.*, 2009).

Nous retenons dans cette étude que ces indices constituent un moyen utile de comparer et d'évaluer différentes régions géographiques en intégrant des variables locales (composantes principales et sous-composantes associées) spécifiques au contexte. Sans cette flexibilité, notre évaluation de la vulnérabilité peut souffrir d'un manque d'indicateurs locaux spécifiques pouvant fournir des informations fiables pour élaborer des plans d'adaptation et d'atténuation spécifiques et ciblés.

2.2. *Choix et adaptation des composantes et sous-composantes pour l'évaluation de la vulnérabilité des ménages en zones arides tunisiennes*

Hahn *et al.* (2009) ont développé l'indice LVI où ils ont défini sept composantes principales de vulnérabilité (le profil sociodémographique, les stratégies de subsistance, les réseaux sociaux, la santé, la sécurité alimentaire, l'eau et les catastrophes naturelles et variabilité du climat). Ces composantes correspondent aux trois facteurs contribuant au calcul du LVI-IPCC du GIEC (exposition, capacité d'adaptation et sensibilité). Nous adoptons ce cadre de LVI et LVI-IPCC du GIEC pour les zones arides tunisiennes en proposant de nouvelles composantes principales et sous-composantes caractérisant les populations locales de ces zones. Ces adaptations ont été effectuées sur la base d'une revue de littérature (Sghaier et Fetoui, 2006 ; Neffati *et al.*, 2015).

Aux sept composantes suggérées par Hahn *et al.* (2009), nous avons ainsi ajouté une nouvelle composante principale : « le foncier », sachant le rôle crucial que joue ce facteur dans la gestion des ressources naturelles en zones arides tunisiennes (Sghaier et Fetoui, 2006). Les huit profils considérés pour l'évaluation de la vulnérabilité ont été ensuite mis en correspondance avec les trois facteurs contribuant à la vulnérabilité du GIEC, de la même manière que dans Hahn *et al.* (2009).

Les adaptations ont concerné également l'intégration des nouvelles sous-composantes pour toutes les composantes principales. Pour le profil sociodémographique, nous avons intégré trois nouvelles sous-composantes qui concernent l'âge moyen des chefs des ménages, la taille des ménages et la formation agricole. Nous avons intégré les équipements agricoles comme nouvelle sous-composante de stratégies de subsistance. L'importance des dépenses annuelles sur la santé et l'accès aux établissements sanitaires sont également considérés comme des variables importantes pour évaluer la vulnérabilité des ménages par rapport à la composante principale de « santé ». Pour la nouvelle composante du foncier, trois sous-composantes ont été considérées qui sont le capital foncier et les deux phénomènes de parcellisation et de morcellement des terres. La composante « Réseaux sociaux » comporte trois sous-composantes qui concernent l'importance des aides familiales, mais aussi les aides de la part de la famille, des amis, des associations, de l'Etat, etc. et l'adhésion des ménages à des associations locales. L'adaptation a concerné également la composante « sécurité alimentaire » par l'ajout des sous-composantes « proportion des ménages qui obtiennent leur alimentation principale du marché », « satisfaction des besoins alimentaires des ménages » et « satisfaction des besoins du cheptel en alimentation ». Concernant la composante « Accès et gestion de l'eau », les adaptations ont concerné l'ajout de la sous-composante « disponibilité et accès à l'eau d'irrigation », en plus de celle qui représente les problèmes de conflits liés à l'eau. Enfin, pour la composante « Variabilité et changement climatique », cinq sous-composantes ont été intégrées notamment le bilan hydrique (proportion des années excédentaires et déficitaires), la fréquence des années de sécheresse, la proportion des ménages déclarant une augmentation de la salinité de l'eau d'irrigation, la proportion des ménages déclarant l'augmentation de la mortalité des animaux et la proportion des ménages déclarant des changements dans leur système de culture à cause du changement climatique. En parallèle, plusieurs sous-composantes suggérées par Hahn *et al.* (2009) n'ont pas été prises en compte dans notre évaluation de la vulnérabilité.

2.3. *Méthodes de calcul des indices de vulnérabilité des moyens d'existence (LVI et LVI-IPCC)*

2.3.1. Etapes de calcul d'un LVI moyen pondéré : Modèle 1

Le LVI utilise une approche moyenne pondérée, où chaque sous-composante contribue également à l'indice global, même si chaque composante principale est constituée d'un nombre différent de sous-composantes. La formule de LVI utilise donc une approche simple qui applique des poids égaux à toutes les composantes principales. Il y a quatre étapes dans le calcul de chaque LVI (Hahn *et al.*, 2009). Tout d'abord, il s'agit de transformer les données brutes des sous-composantes en mesures appropriés (unités), telles que les pourcentages, rapports et indices. Étant donné que chacune des sous-composantes est mesurée sur une échelle différente, il est ensuite nécessaire de normaliser chacune comme un indice à travers l'équation ci-dessous. Ceci est nécessaire pour combiner toutes les mesures en un seul indice LVI.

$$\text{Indice } S_r = (S_r - S_{min}) / (S_{max} - S_{min})$$

Où Sr est la sous-composante observée pour la région r et Smax et Smin sont les valeurs minimale et maximale pour chaque sous-composante.

Après la standardisation de chaque indice des sous-composantes, on utilise l'équation suivante pour calculer la valeur de chaque composante principale. C'est la moyenne des scores normalisés de chaque composane principale, qui donne un score final (Mr) pour chaque composante principale.

$$M_r = (\sum_{i}^{n} \text{Indice }_{Sri}) / n$$

Où n est le nombre de sous composantes dans chaque composante.

Enfin, l'indice de vulnérabilité global des moyens d'existence des ménages pour une région r (LVI$_r$) est calculé en combinant les moyennes pondérées de toutes ces composantes principales. Les poids de chaque composante principale est déterminé par le nombre de sous composantes dont elle est constituée. Cela garantit que toutes les composantes principales contribuent également à l'LVI global.

$$LVI_r = (\sum_{i=1}^{8} W_{Mi} M_{ri}) / (\sum_{i=1}^{8} W_{Mi})$$

Où WMi représente les poids des composantes principales qui correspondent au nombre des sous-composantes qui composent chaque composante principale. Le LVI global est mis à l'échelle de 0 (moins vulnérable) à 0,5 (plus vulnérable) (Hahn *et al.*, 2009).

2.3.2. *Calcul de LVI-IPCC (Cadre de l'approche du GIEC) : Modèle 2*

Le LVI-IPCC regroupe les composantes principales dans chacune des trois catégories ou facteurs contributifs du GIEC. Pour le cas de cette étude, la capacité d'adaptation est définie par la contribution des composantes de « profil sociodémographique », « stratégies de subsistance », « accès et gestion de l'eau » et « réseaux sociaux ». La sensibilité est définie par les composantes « sécurité alimentaire », « foncier » et « santé ». L'exposition est un facteur lié surtout aux catastrophes naturelles et à la variabilité du climat. Le calcul de ces trois facteurs contributifs se fait par l'équation suivante :

$$CF_r = (\sum_{i=1}^{n} W_{Mi} M_{ri}) / (\sum_{i=1}^{n} W_{Mi})$$

Où CF$_r$ est le facteur contributif des trois facteurs (exposition, sensibilité et capacité d'adaptation). M$_{ri}$ est la composante principale indexée par i. W$_{Mi}$ sont les poids des composantes principales et n est le nombre des composantes principales dans chaque facteur contributif.

Une fois l'exposition, la sensibilité et la capacité d'adaptation sont calculés, les trois facteurs contributifs sont combinés en utilisant l'équation suivante :

$$LVI\text{-}IPCC_r = (e_r - a_r) * s_r$$

Où LVI-IPCC$_r$ est le LVI pour la zone d'étude r exprimé en utilisant le cadre de la vulnérabilité du GIEC. Les valeurs e$_r$, a$_r$ et s$_r$ sont respectivement celles d'exposition, de la capacité d'adaptation et de sensibilité calculées pour une région r. Le LVI-IPCC est mis à l'échelle de -1 (moins vulnérable) à 1 (plus vulnérable) (Hahn *et al.*, 2009).

2.4. *Zone d'étude*

Les zones arides tunisiennes présentent des variations climatiques, du couvert végétal et des géofaciès qui sont très observables sur une courte distance. Ceci résulte de la nature et de
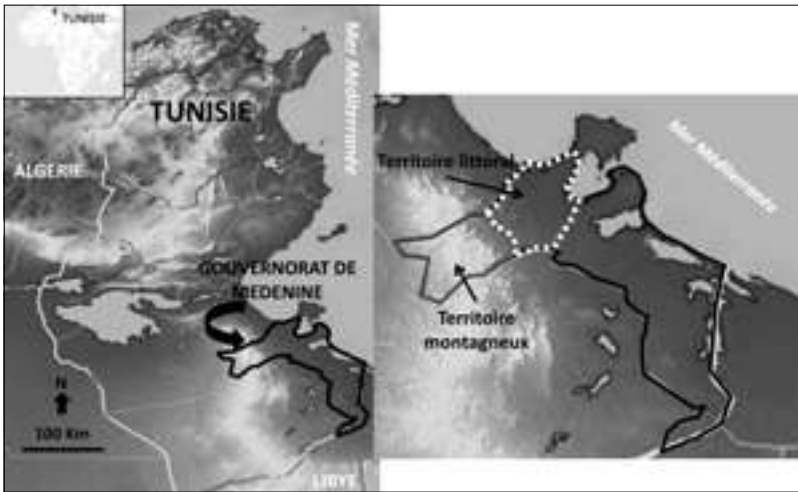
Figure 1 - Localisation géographique de la zone d'étude.

la complexité des influences littorales, continentales, désertiques liées à la situation géographique, mais aussi les influences de l'Homme qui apparaissent à travers ses activités et la nature des apports qu'il entretient avec le milieu (Ouessar *et al.*, 2006 ; Fetoui, 2011).

Deux zones situées selon un gradient désertique-littoral/amont-aval représentant les principales régions naturelles de ces zones arides ont été choisies pour l'analyse de la vulnérabilité des moyens d'existence des ménages à l'échelle locale : le territoire montagneux (délégation de Béni Khédache (BK)) et le territoire littoral (délégation de Sidi Makhlouf (SM)) (Figure 1). Ces deux territoires présentent des conditions climatiques très contraignantes, un potentiel en ressources naturelles très limité et des seuils de pauvreté très élevés (Béchir et Sghaier, 2013). Les populations à dominante rurale de ces régions (25885 habitants à BK et 25206 à SM (INS, 2014)) sont en perpétuelle mutation depuis au moins un siècle à un rythme qui diffère entre les deux territoires, engendrant des transformations profondes des conditions socioéconomiques, des structures foncières, des systèmes de production, et des modes d'accès, d'exploitation et de gestion des ressources naturelles (Fetoui, 2011). Ces mutations ont créé des opportunités différenciées en termes de capacités d'adaptation, mais aussi de vulnérabilité des populations locales de chaque territoire.

Dans les zones montagneuses, la population est caractérisée par une densité très faible (7 habitants/Km²) (INS, 2014) et demeure dans des petits villages anciens et des habitats plus ou moins dispersés. Elle occupe, de plus ou moins longue date, certaines vallées et dépressions où elle a développé une agriculture de subsistance dominée par l'arboriculture, en particulier les oliviers et les figuiers, accompagnée de quelques cultures céréalières et maraîchères épisodiques. Cette population profite des conditions climatiques relativement favorables (plus que 160 mm/an) par rapport à celles des plaines (moins de 140 mm/an), pour développer ces cultures sur des petites parcelles ayant des sols riches et profonds, créés suite à la confection des petits barrages de collecte des eaux pluviales ruisselées (les jessour). Elle pratique également l'activité d'élevage qui est plutôt extensif sur des petits espaces de parcours créant une charge animale importante. Le reste des sols sont généralement très peu profonds et pauvres en matières organiques, de texture et structure sensibles à l'érosion éolienne et hydrique (Ouessar *et al.*, 2006). Ces sols sont peu ou non aptes à l'agriculture et au développement d'une végétation naturelle capable de subvenir les besoins de plus en plus importants de la population. La végétation naturelle est souvent éparse, rabougrie et clairsemées. Le revenu familial dans ce territoire est issu quasi-totalement des activités extra-agricoles (petits métiers, services, commerce, artisanat, etc.) (Fetoui, 2011).

La population des zones littorales est caractérisée par une plus grande densité (57 habi-

Tableau 1 - Caractérisation socioéconomique et biophysique des deux territoires d'étude (territoire montagneux et territoire littoral).

	Territoire montagnard de BK	Territoire littoral de SM
Caractéristiques physiques	Montagnes, pentes fortes	Plaines, Sebkhas, zones basses
Ressources naturelles	- Sols très peu profonds, fragiles et pauvres, peu évolués d'érosion hydrique et éolienne, quelques sols alluviaux derrière jessour riches et profonds - Végétation dégradée, arboriculture dominante derrière jessour - Eau très fréquente en bonne année	- Sols peu profonds, fragiles et pauvres, sableux et gypseux avec charge caillouteuse importante - Végétation peu dégradée, céréaliculture dominante, arboriculture plein champs - Eau très rare, tarissement des nappes, salinité
Climat	Pluviométrie > 160 mm, bilan hydrique déficitaire, vents peu violents et peu chargés de sable	Pluviométrie < 140 mm, bilan hydrique déficitaire, vents très actifs, violents, secs et chargés de sable
Densité de la population	7 hab/km²	57 hab/km²
Mode d'occupation humaine de l'espace et caractéristiques de l'habitat	Installation humaine très ancienne sur des petits villages et ksour	Installation humaine plus ou moins récente (habitat rare et très dispersé)
Activité principale	Agriculture de subsistance, activité extra-agricole, élevage extensif	Agriculture familiale et marchande, élevage plutôt semi-extensif
Revenu agricole annuel moyen	3065 DT	2160 DT
Impact des politiques d'aménagement	Aménagements de collecte des eaux pluviales sur les versants et dans les cours d'eau	Faible impact

tants/km²) et demeure dans des habitats et des villages très dispersés sur les vastes plaines de la Jeffara tunisienne. Les sols sont en majorité plus profonds, peu fragiles, sableux et gypseux avec une charge caillouteuse importante. Ces conditions favorisent la diversification des cultures sur les vastes parcelles, notamment les cultures céréalières et irriguées, l'arboriculture en plein champs, etc. L'activité agricole pratiquée est plutôt familiale et marchande, avec un élevage semi-extensif engendrant une faible charge animale. Les conditions biophysiques (rareté de l'eau, vents très actifs, violents, secs et chargés souvent du sable, tarissement et salinité des nappes, etc.) sont des facteurs déterminants du déclin de la productivité agricole. Le revenu familial est généralement faible et est issu principalement de l'activité agricole, mais aussi de quelques activités extra-agricoles (Fetoui, 2011) (Tableau 1).

La conjugaison de ces différentes conditions biophysiques et socioéconomiques de ces deux territoires fait que ces derniers présentent des niveaux différents de vulnérabilité des systèmes « Homme-milieu », de dégradation des ressources naturelles et de risques de désertification. Le choix de ces deux territoires émane de l'importance de l'analyse de la vulnérabilité des moyens d'existence des ménages dans ces contextes locaux différents représentant les zones arides tunisiennes. Ceci afin d'identifier les facteurs déterminants ou variables clés de cette vulnérabilité ainsi que les stratégies et mesures d'adaptation spécifiques au changement climatique.

2.5. Collecte des données

Des enquêtes socio-économiques et de perception ont été conduites auprès des ménages ruraux dans ces deux territoires (85 enquêtes à Béni Khédache et 80 enquêtes à Sidi Makhlouf) durant les mois de mars, avril et mai 2018. Les échantillons ont été conçus de façon à ce que les ménages enquêtés aient une représentation sta-

Tableau 2 - Répartition des enquêtes ménages par territoire et par délégation.

Territoire	Délégation	Imada	Total des ménages*	Echantillon
Montagneux	Béni Khédache	Rahala	115	5
		Menzla	171	7
		Bhaira	243	10
		Hmaima	310	12
		El Binya	306	12
		Zammour	117	5
		Béni Khédache	619	24
		El Fjij	255	10
		Total Béni Khédache	*2136*	*85*
Littoral	Sidi Makhlouf	Ragouba Ouest	402	16
		Ragouba Est	715	28
		Gosba	402	16
		Sidi Makhlouf	491	20
		Total Sidi Makhlouf	*2010*	*80*
Total zone d'étude			*4146*	*165*

Source : INS, 2014.

tistique significative pour l'ensemble de la population résidente dans les deux zones.

La méthode d'échantillonnage a suivi une technique d'échantillonnage aléatoire stratifiée. Les ménages enquêtés ont été tirés d'une manière aléatoire sur les registres de chaque délégation, en tenant compte de plusieurs répartitions spatiales (délimitation administrative et zonage biophysique). Ainsi, l'échantillon est réparti sur les deux zones géophysiques de la zone d'étude (montagnes et plaines littorales) et par imada (plus petite unité administrative) (Tableau 2). L'échantillon compte 165 ménages qui ont été sélectionnés parmi 4146 ménages dans la zone d'étude (INS, 2014), soit une fraction d'enquête de 4%. L'identification finale des agriculteurs enquêtés a été entreprise avec la collaboration des acteurs locaux et des services techniques.

Le questionnaire de l'enquête renseigne sur les caractéristiques générales des ménages et de leurs systèmes de production (critères démographiques, capitaux fonciers, financiers, physiques et sociaux, production agricole, vulnérabilité des systèmes, principales sources d'information, politiques agricoles, etc.). Le questionnaire intègre également des parties qui traitent l'analyse des connaissances locales, le transfert de connaissances, la sécurité alimentaire, les stratégies d'adaptation au changement climatique et la durabilité du système en général. Chaque entretien a duré en moyenne 35 min. Les données collectées ont été utilisées pour caractériser les composantes du LVI et LVI-IPCC adaptés au contexte des zones arides. Elles ont permis en premier lieu d'analyser les capitaux des ménages par le logiciel SPSS et ont servi ensuite au calcul du LVI et LVI-IPCC pour les deux territoires.

3. Resultats

3.1. LVI par composante et par type de territoire

L'analyse montre que les ménages du territoire littoral de SM présentent une plus grande vulnérabilité que ceux du territoire montagneux de BK en termes de « profil sociodémographique » (respectivement 0,57 et 0,49) (Tableau 3). La vulnérabilité à SM est expliquée surtout par la grande proportion (61%) des familles nombreuses (>6 membres) ayant des charges familiales ardues face à des conditions financières

Tableau 3 - Vulnérabilité des moyens d'existence des ménages à Béni Khédache (BK) et Sidi Makhlouf (SM) par composantes principales et sous-composantes.

Composante principale	Sous-composante	Valeur		Valeurs normalisées des sous-composantes (Indice S_r)		Valeurs d'indice pour la composante (M_r)	
		BK	SM	BK	SM	BK	SM
Profil socio-démographique	Moyenne des âges des chefs des ménages (ans)	54	45	0,48	0,33	0,49	0,57
	% des ménages ayant une famille nombreuse (>6)	47	61	0,47	0,61		
	% des chefs des ménages ayant un niveau d'instruction faible (<=primaire)	67	65	0,67	0,65		
	% des chefs des ménages sans formation agricole	37	69	0,37	0,69		
Stratégies de subsistance	% des ménages ayant l'agriculture comme seule source de revenu	62	46	0,62	0,46	0,48	0,37
	% des ménages n'ayant pas de matériel agricole	50	39	0,50	0,39		
	% des ménages qui travaillent en dehors de la communauté	33	26	0,33	0,26		
Foncier	% des exploitations ayant 3 parcelles et plus	58	43	0,58	0,43	0,40	0,30
	Superficie moyenne par exploitant (ha)	2	3,9	0,23	0,17		
	% des exploitations ayant une superficie inférieure à 2 hectares (ha)	39,4	32,6	0,39	0,32		
Santé	Rapport moyen des dépenses de santé par rapport aux dépenses totales du ménage	36	28	0,36	0,28	0,32	0,26
	Temps moyen pour arriver à un établissement de santé (minutes)	45	15	0,34	0,18		
	% des ménages avec des membres ayant des maladies chroniques	27	30	0,27	0,30		
Réseaux sociaux	% des ménages n'ayant pas une aide familiale	16	25	0,16	0,25	0,20	0,25
	% des ménages ayant reçu une aide auprès des voisins, des amis, des associations, de la communauté, de l'Etat	32	29	0,32	0,29		
	% des chefs des ménages qui ne sont pas adhérés à une ONG	12	22	0,12	0,22		
Sécurité alimentaire	% des ménages qui obtiennent leur alimentation principale du marché	58	70	0,58	0,70	0,62	0,67
	% de satisfaction des besoins de la famille en nourriture	68	72	0,68	0,72		
	% des exploitations qui ne satisfaisaient pas les besoins de cheptel en alimentation	62	60	0,62	0,60		
Accès et gestion de l'eau	% des ménages ayant un problème de disponibilité de l'eau	40	43	0,40	0,43	0,24	0,30
	% des ménages qui déclarent un conflit d'eau	8	17	0,08	0,17		
Variabilité et changement climatique	% des années déficitaires (présentant un déficit hydrique)	44	58	0,44	0,58	0,35	0,50
	Fréquence des années sèches tous les 10 ans	6	7	0,60	0,70		
	% des ménages déclarant une augmentation de la salinité de l'eau d'irrigation à cause du changement climatique	25	45	0,25	0,45		
	% des ménages déclarant l'augmentation de la mortalité des animaux à cause du changement climatique	28	33	0,28	0,33		
	% des ménages déclarant des changements dans leur système de culture à cause du changement climatique	19	42	0,19	0,42		

Source : Propres analyses, 2020.

précaires, et par l'importance des ménages sans formation agricole (69%). En termes de stratégies de subsistance, BK montre plutôt une plus grande vulnérabilité (0,48) qu'à SM (0,37) à cause du pourcentage plus élevé de ménages qui ont déclaré compter uniquement sur l'agriculture pour obtenir un revenu (62% contre 46% à SM). BK montre également la plus grande proportion des ménages n'ayant pas de matériel agricole (50% contre 39% à SM), ce qui influe négativement sur la productivité agricole. Une autre stratégie d'existence pratiquée par les ménages est de travailler en dehors de la communauté. Cette migration concerne un chef de ménage sur trois pour le territoire montagneux (33%) dont 66% à l'étranger. Bien que cette migration puisse dans certains cas combler les besoins des familles à travers des investissements agricoles, elle engendre dans la plupart des cas l'abandon des terres agricoles. Ce phénomène était la raison d'attribuer des scores de vulnérabilité plus élevés aux ménages déclarant ayant des membres de la famille travaillant en dehors de la communauté. Dans le territoire littoral de SM la situation est différente et la migration concerne seulement 26% des ménages.

Les analyses montrent également que les ménages à BK sont plus vulnérables par rapport à la composante « foncier » (0,40 contre 0,30 à SM), tenant compte du niveau d'emprise agricole (superficie moyenne faible par exploitation égale 2 ha, contre 3,9 ha à SM) et de l'importance du phénomène de morcellement et de parcellisation des terres. En effet, ce territoire présente une proportion plus élevée des exploitations agricoles ayant plus de 3 parcelles (58% à BK contre 43% à SM) et dont la superficie est inférieure à 2 ha (39,4% à BK et 32,6% à SM).

La composante « Santé » présente en revanche des indices de vulnérabilité plus ou moins faibles et similaires pour les deux territoires (0,32 à BK et 0,26 à SM). Les différences entre les deux territoires concernent surtout l'éloignement des ménages des établissements de santé (le temps moyen pour arriver à un établissement de santé est plus élevé à BK (45 minutes contre 15 minutes à SM)) et le rapport des dépenses de santé par rapport aux dépenses totales des ménages (36% à BK contre 28 % à SM).

Pour la vulnérabilité liée aux réseaux sociaux, les analyses montrent que le pourcentage des ménages n'ayant pas eu une aide familiale est faible dans les deux territoires. En effet, en cas de besoin, ces ménages bénéficient d'une solidarité sociale considérable, notamment les aides financiers de la part des voisins, des amis, des associations locales ou de la part de l'Etat sous forme d'aides sociales ou de subventions. Ce facteur est le principal déterminant de la faible vulnérabilité des ménages par rapport à cette composante (0,20 à BK et 0,25 à SM). Les résultats montrent également que le pourcentage des ménages n'adhérant pas à une ONG (organisation non gouvernementale) est faible et est égal à 12% et 22% respectivement à BK et SM. Ceci a permis également de diminuer le niveau de vulnérabilité, grâce au rôle des ONG qui consiste essentiellement à vulgariser les bonnes pratiques, transférer les connaissances et informer les agriculteurs sur les nouvelles technologies.

Les résultats montrent également que les ménages dans les deux territoires sont très vulnérables en termes de sécurité alimentaire, avec un score de vulnérabilité à SM légèrement supérieur à celui de BK (respectivement 0,67 et 0,62). Ceci est expliqué par l'incapacité de la production agricole à satisfaire les besoins des populations locales en termes de nourriture et d'alimentation du cheptel dans les deux territoires. Un grand pourcentage de ménages déclarait ne pas compter uniquement sur leurs exploitations agricoles pour combler les besoins nutritionnels et obtiennent leur alimentation principale du marché (70% à SM et 58% à BK).

Pour la composante « accès et gestion de l'eau », les deux territoires présentent des scores de vulnérabilité plus ou moins faibles, avec plus de vulnérabilité du côté de SM (0,30 contre 0,24 à BK). Le territoire littoral est caractérisé surtout par le nombre le plus élevé des conflits entre les usagers de cette ressource rare. Le nombre limité de conflits à BK est expliqué par la présence d'un système traditionnel de partage équitable des eaux de ruissellement de pluie sur les ravins et les terres en pente, connu localement par le système des « jessour » (Ouessar *et al.*, 2006).

Enfin, en termes de variabilité et changement climatique, le territoire littoral s'avère plus vul-

Figure 2 - Vulnérabilité des moyens d'existence des ménages par composante principale à Béni Khédache et Sidi Makhlouf.
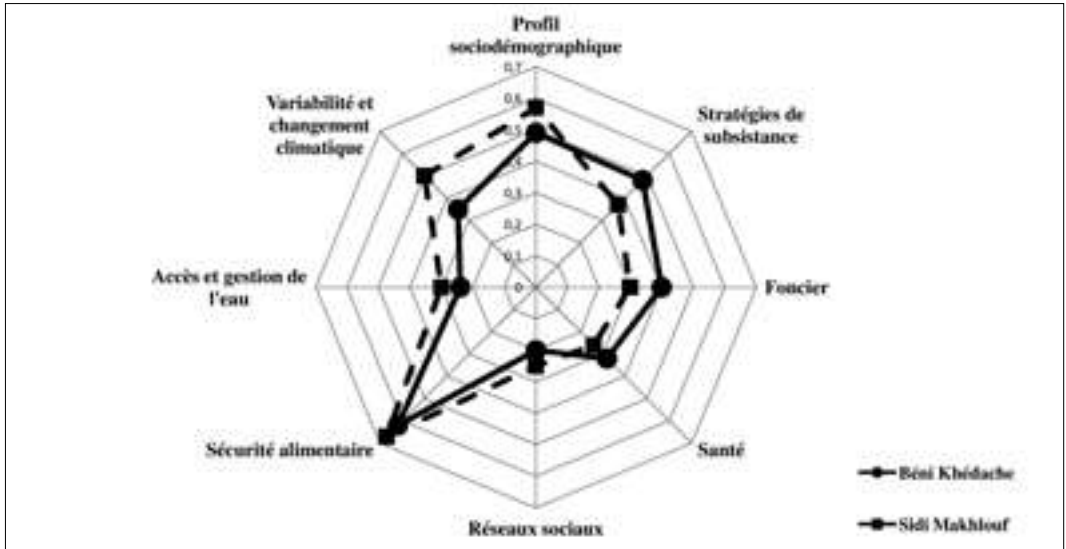
Source : Propres analyses, 2020.

nérable aux conditions climatiques sévères que le territoire montagneux (respectivement 0,50 et 0,35). Cette différence est expliquée par la proportion plus élevée des années déficitaires enregistrée à SM au cours des 60 dernières années (58% contre 44% à BK). De plus, ce territoire est caractérisé par les plus grandes proportions des ménages déclarant des changements dans leurs systèmes de culture (42%) et des problèmes de salinité de l'eau d'irrigation (45%) (Figure 2).

3.2. *LVI-IPCC (approche du GIEC)*

Rappelons que le GIEC caractérise la vulnérabilité au changement climatique en fonction de l'exposition d'un système, de sa sensibilité et de sa capacité d'adaptation. Cela implique le groupement des huit composantes principales dans chacune de ces trois facteurs contributifs (Tableau 4). Le résultat du calcul du LVI-IPCC en fonction de ces trois facteurs contributifs montre également un comportement général de vulnéra-

Tableau 4 - LVI-IPCC global dans les deux territoires de Béni Khédache (BK) et Sidi Makhlouf (SM).

Facteur contributif	Composante majeure	Nombre de sous composantes	Valeur d'indice (composantes Principales)		Valeur des facteurs contributifs		Valeur de LVI-IPCC	
			BK	SM	BK	SM	BK	SM
Capacité d'adaptation	Profil socio-démographique	4	0,49	0,57	0.36	0.40	-0,0045	0,041
	Stratégies de subsistance	3	0,48	0,37				
	Accès et gestion de l'eau	2	0,24	0,30				
	Réseaux sociaux	3	0,20	0,25				
Sensibilité	Foncier	3	0,40	0,30	0.45	0.41		
	Santé	3	0,32	0,26				
	Sécurité alimentaire	3	0,62	0,67				
Exposition	Variabilité et changement climatique	5	0,35	0,50	0,35	0,50		

Source : Propre analyses, 2020.

Figure 3 - Vulnérabilité des moyens d'existence des ménages en fonction des facteurs contributifs du GIEC à Béni Khédache et Sidi Makhlouf.
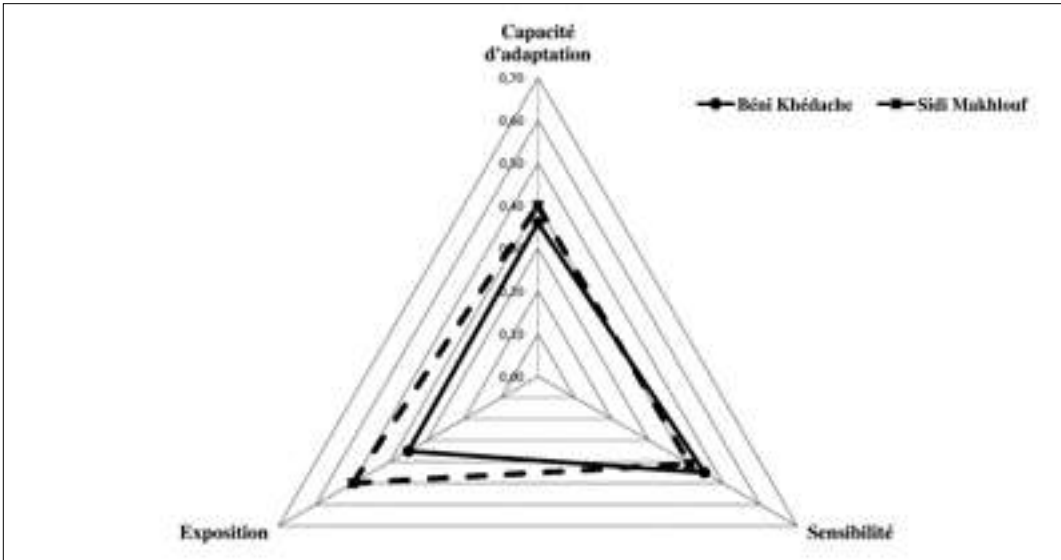
bilité plus ou moins similaire pour les deux types de territoires, sachant que BK est moins vulnérable (-0,0045) que SM (0,041).

Le facteur déterminant de la sensibilité des deux territoires est la sécurité alimentaire. Le profil sociodémographique et les stratégies de subsistance sont les facteurs les plus déterminants de la capacité d'adaptation des ménages. Les analyses montrent que le territoire littoral est celui le plus exposé aux changements climatiques, bien qu'il soit légèrement moins sensible (Figure 3). Le score plus faible et négatif du LVI-IPCC à BK est expliqué par la bonne capacité d'adaptation des ménages dans ce territoire montagneux, ayant un savoir-faire ancestral important concernant la conservation des eaux et des sols à travers les aménagements installés soit sur les pentes (jessour) ou sur les plaines (tabias) (Ouessar *et al.*, 2006 ; Fetoui, 2011).

4. Discussion

La présente étude fournie des indices LVI permettant d'identifier et comparer les principaux facteurs contribuant à la vulnérabilité des moyens d'existence des ménages dans deux territoires différents des zones arides tunisiennes. Les écarts de vulnérabilité sont fondés surtout sur le degré relatif de l'exposition à la variabilité et changement climatique, les limitations du foncier, les stratégies de subsistance et la sécurité alimentaire. Dans des contextes différents dans le monde, ces écarts ont concerné par exemple les limitations physiques et sociodémographiques dans le cas de Mozambique (Hahn *et al.*, 2009). Dans les régions montagneuses subtropicales humides de l'Inde, les écarts ont concerné le degré relatif d'urbanisation et la capacité d'adaptation (Mohan et Sinha, 2010). Dans les régions subtropicales subhumides du nord du Ghana, les écarts de vulnérabilité sont liés surtout au niveau d'accès aux ressources en eau (Etwire *et al.*, 2013).

Des recommandations stratégiques peuvent être avancées sur la base des résultats d'évaluation de la vulnérabilité des ménages dans les deux territoires des zones arides tunisiennes. Cette étude a montré en premier lieu que l'agriculture est une activité qui ne garantit pas généralement la sécurité alimentaire des ménages surtout pendant les années de disette. Ceci incite à diversifier les cultures pratiquées et à bien

gérer les productions en bonnes années pour couvrir le maximum des besoins alimentaires et garantir l'autonomie et la durabilité des exploitations agricoles. La diversification des cultures est une stratégie efficace de gestion de la précarité du climat. Cette stratégie est pratiquée par les populations afin de laisser une marge de flexibilité quant à la reproduction des systèmes de production. L'introduction des cultures fourragères, par exemple, peut être une alternative importante pour satisfaire les besoins du cheptel et la meilleure rentabilité de l'activité d'élevage. En situation de forte vulnérabilité socioéconomique et climatique, ces populations adaptent des techniques de mobilisation et de gestion appropriées tels que les techniques de conservation des eaux et des sols, la mise en culture pluviale des terres, la plantation des arbres fruitiers adaptés aux conditions climatiques sévères, etc. Elles jouent également sur la flexibilité du système de production entre les activités extra-agricoles et les activités agropastorales selon le climat. Selon la capacité d'investissement, il y a des choix qui sont fait en termes de mobilisation des moyens de production vers l'achat d'aliments du bétail, l'achat de l'eau pour l'irrigation des arbres fruitiers en périodes de pointe, l'affectation de la main d'œuvre masculine pour conserver l'activité d'élevage en années sèches. Cette flexibilité autour de la gestion de trésorerie est basée aussi sur la diversification des activités économiques des ménages qui présente une marge de manœuvre et peut diminuer la vulnérabilité. D'autres mesures peuvent être adoptées par ces populations en vue d'atténuer les charges économiques de leurs systèmes de production, mais aussi de préserver les ressources naturelles. L'utilisation, par exemple, des sous-produits des cultures annuelles et arboricoles forment des aliments de bétail que les éleveurs stockent au moment des récoltes pour les valoriser par les animaux pendant les périodes de crise d'alimentation animale (paille, foin, résidus des cultures maraîchères, feuilles et grignons d'olives). L'éducation sur le stockage des aliments et la conservation des semences pourrait constituer ici une intervention appropriée.

Néanmoins, ces stratégies d'adaptation et de subsistance des populations locales des deux territoires sont confrontées de plus en plus aux politiques de développement rural et agricole et tendent à se simplifier et à diminuer pour augmenter la pression sur les ressources naturelles disponibles dans la zone. La rareté et la salinité de l'eau, mais aussi les problèmes fonciers présentent aussi des obstacles au développement de ces stratégies.

Les moyens d'existence des ménages à BK se sont avérés vulnérables à cause de ces problèmes fonciers. Ce constat suggère que le gouvernement tunisien doit intervenir en priorité dans ce territoire par l'application des politiques de consolidation des terres (Sghaier et Fetoui, 2006) afin de résoudre le problème de morcellement et par suite l'accès aux crédits agricoles. En effet, ces politiques de consolidation ont été appliquées au gouvernorat de Médenine depuis 2006 et ont montré leurs impacts sur l'amélioration des conditions de vie et la fixation des exploitants, mais aussi sur les systèmes de production (accès aux crédits, amélioration des productions agricoles) (Fetoui, 2011).

Pour le cas de SM, vu la faible sensibilité de ce territoire en termes de sécurité alimentaire et de disponibilité et accès à l'eau, les ménages peuvent avoir plus de flexibilité pour mettre en œuvre différentes autres stratégies d'adaptation à l'avenir. Dans les deux territoires, les pratiques de collecte de l'eau doivent être adaptées aux nouveaux défis de développement local durable en considérant les scénarios de changements climatiques et les conditions socioéconomiques en perpétuelles mutations. Nous citons ici l'exemple du territoire tropical équatorial du Nord du Ghana (Adu *et al.*, 2017 ; Williams *et al.*, 2020) et l'importance des stratégies d'adaptation au changement climatique à travers de nouveaux modes de stockage de l'eau.

Le développement agricole dans ces territoires incite également à trouver des alternatives socioéconomiques afin de minimiser le phénomène d'abandon des terres agricoles et garantir la sécurité alimentaire. En fait, l'État tunisien s'est attaché depuis au moins quatre décennies à instaurer des programmes de développement économique et social. Un grand nombre d'actions ont été affectées aux zones arides dans le cadre de l'inscription territoriale des politiques

nationales de développement rural, notamment le programme de développement rural intégré (PDRI), le fond de solidarité nationale (FSN), le plan de développement agricole intégré (PDAI), etc. Ces politiques nationales ont encouragé les jeunes par l'octroi des crédits bancaires et des subventions, mais aussi par la création de nouveaux projets et emplois locaux. Cependant, en dépit de ces efforts, les résultats n'ont pas été à la hauteur des attentes (Ouessar *et al.*, 2006). Le bilan des actions témoigne de succès incomplets, et le phénomène de migration des jeunes persiste encore dans ces zones (Fetoui, 2011 ; Loireau *et al.*, 2015). Dans la plupart des cas, les échecs sont liés soit à la conception des projets qui n'intègrent pas en général tous les acteurs impliqués, soit à la mauvaise gestion des projets alloués par les bénéficiaires eux-mêmes (Fetoui, 2011). Ainsi, il est opportun d'intégrer tous les acteurs, ainsi que leurs rapports de force, alliances et conflits à la conception et à la mise en œuvre des projets de développement. Ceci permettra de garantir une meilleure gouvernance pour assurer le succès et la durabilité de ces projets. Fetoui *et al.* (2020) ont démontré l'importance des relations entre les acteurs pour la promotion de la chaine de valeur de l'huile d'olive dans les zones arides tunisiennes.

La solidarité et la cohésion sociale ont montré également leur impact sur le succès et la durabilité des projets de développement et les systèmes de production. Nous citons l'exemple de la solidarité des ménages des zones arides pour l'accès et l'usage des ressources en eau à travers leurs stratégies collectives de mise en culture et le principe de partage équitable des eaux de ruissellement (Fetoui, 2011). En outre, les liens et les niveaux élevés de confiance entre les ménages dans les deux territoires d'étude, ainsi que leur adhésion à des ONG améliorent l'accès des jeunes exploitants à l'information, le soutien technique agricole et la sensibilisation sur les impacts de l'abandon. Ceci a été démontré par l'indice des réseaux sociaux qui n'ait pas beaucoup contribué à l'indice LVI de l'un ou l'autre territoire étudié.

Le problème de santé à BK comme à SM (éloignement des établissements de santé, dépenses, maladies chroniques) a également un effet considérable sur le mode de vie et la fixation des populations locales. Ce problème incite à mieux choisir l'emplacement et améliorer la qualité des établissements de santé, ce qui pourrait aider à améliorer la résilience des ménages. Nous citons ici l'exemple du territoire insulaire de Trinidad et Tobago et des communautés des régions subtropicales équatoriales du Nord du Ghana, où la composante « santé » s'est avérée le facteur le plus déterminant de la vulnérabilité des communautés locales (Shah *et al.*, 2013 ; Etwire *et al.*, 2013).

Dans les zones arides tunisiennes, les évènements climatiques extrêmes augmentent la vulnérabilité des moyens d'existence des ménages. Les systèmes d'alerte précoce peuvent aider les populations des deux territoires à se préparer à ces évènements surtout la succession des années de sécheresse. Les prévisions météorologiques saisonnières distribuées par le biais des associations locales peuvent aider les agriculteurs à mieux s'adapter aux contraintes climatiques. Le gouvernement tunisien a lancé en 2020 un système d'alerte précoce dans le cadre de l'initiative « We Care » de l'association internationale des réseaux mobiles (GSMA), en collaboration avec tous les opérateurs de téléphonie tunisiens. Ce système d'alerte consiste à lancer des solutions numériques sous forme de messages courts (SMS) afin d'avertir les citoyens des zones urbaines et rurales en cas de catastrophes naturelles (inondations, etc.) ou de menaces pour leur vie ou leurs biens. L'Institut des Régions Arides (IRA) de Médenine (Tunisie) a intégré le réseau « International Network to study Deposition and Atmospheric composition in AFrica » (INDAAF) depuis 2015. Dans ce cadre, une station a été installée, dédiée au suivi de l'érosion éolienne et des aérosols terrigènes. Valdivia *et al.* (2010) ont montré l'importance de ce système d'alerte pour améliorer l'adaptation des populations locales dans différents territoires de la Bolivie.

Enfin, cette analyse de vulnérabilité basée sur les différents types des territoires permettra de cartographier les profils de vulnérabilité dans l'ensemble des zones arides tunisiennes. Cette capacité à généraliser est essentielle pour la planification de l'adaptation parce qu'elle permet d'échanger des expériences d'apprentissage dans

des communautés ayant des profils de vulnérabilité similaires et qu'elle permet aux décideurs de comprendre les tendances ou l'impact d'un programme ou d'une politique de développement sur la vulnérabilité des moyens d'existence des communautés locales. Le LVI pourrait également être utilisé pour évaluer l'état de vulnérabilité suite à des scénarios de changements climatiques. Hahn *et al.* (2009) ont démontré l'impact d'une augmentation de température de 1,8°C sur le LVI global et le LVI-IPCC dans les deux zones d'étude de Mabote et Moma au Mozambique.

Sur le plan méthodologique, d'autres méthodes pourraient être pertinentes pour enrichir les analyses comparatives de vulnérabilité des moyens d'existence des ménages en zones arides, mais aussi dans d'autres contextes. Par exemple, l'indice de vulnérabilité sociale (SoVI), développé par Cutter *et al.* (2003), utilise un ensemble commun d'indicateurs généraux pour explorer les différences de vulnérabilité sociale entre des lieux différents. Il a été appliqué pour évaluer l'impact des inondations sur les communautés rurales au Bangladesh (Brouwer *et al.*, 2007).

5. Conclusion

L'évaluation de la vulnérabilité des ménages ruraux dans différents types de territoires des zones arides tunisiennes a permis de fournir une indication explicite sur les moyens de subsistance de ces ménages et de comparer les déterminants de leur vulnérabilité au changement climatique. S'appuyant sur le modèle développé par Hahn *et al.* (2009), cette étude a exploré l'utilité analytique de l'utilisation du LVI et LVI-IPCC pour comprendre cette vulnérabilité. A travers ce modèle, l'étude a adapté, intégré et comparé les variables qui ont une incidence importante sur la vulnérabilité des ménages et met en évidence les avantages de la comparaison de la vulnérabilité.

Les analyses ont montré un comportement général de vulnérabilité plus accentué à SM qu'à BK, sachant que l'analyse par composante révèle certaines différences. Alors que SM semble plus vulnérable en termes de profil sociodémographique des ménages, de sécurité alimentaire, de réseaux sociaux, d'accès à l'eau et de

changement climatique, BK révèle en revanche plus de vulnérabilité en termes de stratégies de subsistance, de foncier et de santé. Les résultats montrent également que la sécurité alimentaire est le facteur le plus déterminant de la sensibilité et que le profil sociodémographique et les stratégies de subsistance sont les facteurs les plus déterminants de la capacité d'adaptation des ménages des deux territoires. Le territoire littoral est celui le plus exposé au changement climatique, bien qu'il soit légèrement moins sensible.

Vu les niveaux de vulnérabilité enregistrés dans chaque territoire et afin d'améliorer la résilience des populations locales des zones arides tunisiennes, les principales recommandations et orientations politiques qui peuvent être signalées se rapportent principalement à l'amélioration du niveau de sécurité alimentaire et la capacité d'adaptation au changement climatique dans le territoire littoral. La résolution des problèmes fonciers est considérée comme priorité dans les zones montagneuses afin de diminuer la sensibilité de ce dernier au changement climatique.

Cette recherche a permis ainsi de fournir des informations décisionnelles à deux niveaux d'adaptation et de planification et d'identifier des stratégies d'adaptation spécifiques à chaque territoire pouvant être incorporées dans les politiques relatives au changement climatique. Il faut néanmoins noter que l'approche LVI simplifie la réalité complexe (Hahn *et al.*, 2009), mais son application a montré sa capacité d'exploration des facteurs déterminants de la vulnérabilité des ménages. Ces résultats seront peu utiles s'ils ne peuvent pas être facilement communiquées et comprises par les décideurs et les services de développement. Le cadre des « plateformes d'innovation pour le climat », qui a été établie dans certaines communautés de l'Himalaya par exemple et étendu à d'autres régions comme l'Ethiopie (Simane *et al.*, 2016), pourra être un moyen efficace pour ce maillon communicationnel faible entre résultats de recherche et décision. L'observatoire des zones arides pour la surveillance environnementale (Loireau *et al.*, 2015) pourra également être valorisé comme cadre de suivi de la vulnérabilité. Ceci permettra de produire des informations sur la manière dont l'exposition, la capa-

cité d'adaptation et la sensibilité des territoires changent à mesure que les pratiques d'adaptation sont mises en place. Ceci peut s'appliquer aussi dans des contextes comparables aux zones arides tunisiennes, ainsi que dans d'autres pays en développement.

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Short Food Supply Chains: rebuilding consumers' trust

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Abstract

Whereas population is showing increasing distrust rates in the regular agri-food system, Alternative Food Networks (AFN) are gradually gaining space. This paper analyses the role of a specific kind of AFN, Short Food Supply Chains (SFSCs) and its contribution to the restoration of consumers' trust in Spain. An online survey (n= 423) focus on trust and concern over food safety was conducted. The survey was addressed to very concerned and active consumers, which are interesting because they represent a powerful consumers' profile from the policies point of view. Principal Component Analysis (PCA) studied consumers' preferences on the different SFSC categories. This paper draws a map that signals which of SFSC attributes (such as labelling, common values or direct contact with producers) are more relevant in order to build consumers' trust. In addition, this paper offers a classification of SFSC consumers according to their priorities. The information provided by the article offers ideas to policy makers and producers for designing their marketing strategies according to different consumers' demands.

Keywords: Short food supply chains, Alternative Food Networks, Farmer markets, Consumer, Trust.

1. Introduction

Nowadays it is not possible to have food quality information on all the elements needed to make most certainly safety decision. The high level of complexity (number of stakeholders and their relationships) in conventional agri-food system hampers the access to information of production processes (Yu and Nagurney, 2013). This fact triggers a situation of asymmetry in which producers could have more information than consumers (Dierks, 2005).

In absence of sufficient information, consumers need trust to simplify food-related decision-making processes and minimize the risks associated to feeding (Adler *et al.*, 2003; Ritenthofer and Klitgaard, 2015). In other words, trust can be used as a substitute of full knowledge (Grebitus *et al.*, 2015). In this way, the existing agro-industrial model is generating detachment and mistrust among consumers (Allen *et al.*, 2003; Cleveland *et al.*, 2014; Giampietri *et al.*, 2018; Kriege-Steffen *et al.*, 2010; Levkoe, 2015; Pejic *et al.*, 2013). The occurrence

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of food safety scandals, like the bovine spongiform encephalopathy (at the beginning of the 21st century) or the episode of eggs contamination in Europe (August, 2017), serves to further damage public trust on food chains (Calle *et al.*, 2012; Carbone *et al.*, 2007; Ding *et al.*, 2013).

This growing mistrust in conventional agri-food system is being accompanied by the expanding of ethical concerns among some consumers (Dowd and Burke, 2013; Giampietri *et al.*, 2018). Food consumers' value systems plays a key role in consumers' choice (Grebitus *et al.*, 2015), and increasing sectors of society are including a "responsibility factor" in their consumption patterns due to environmental, animal compassion or social equity reasons (Casia *et al.*, 2012). For these sectors of society, mega-farms, the high levels of delocation of production and consumption sites, or other attributes of industrial agri-food systems, are at odds with their ethical concerns (Higgins *et al.*, 2008).

In this context, Alternative Food Networks (AFN), as Short Food Supply Chains (SFSCs), are emerging as an answer to consumers' concerns and the lessening of trust on agri-food system (Torquati *et al.*, 2016). Although there are different typologies of SFSCs, European Union characterizes this kind of AFN in the Regulation (EU) No 1305/2013. SFSCs shall cover only supply chains involving no more than one intermediary between farmer and consumer (article 35.2d), and the geographical distance from production, transformation and distribution sites to the final consumer is also limited.

1.1. *Trust in the agri-food system*

Trust is an essential element for the good development of commercial relationships. There are several works about trust definition, Morgan and Hunt (1994, p. 23) define it "as existing when one party has confidence in an exchange partner's reliability and integrity". McKnight and Chervany (2001) include a review of trust definitions from different approaches (psychology, social psychology, sociology), all of them turn around the idea of trust as the belief that a voluntarily accepted duty will prevail, ensuring that no party exploit the others' vulnerabilities,

under conditions of risk and interdependence. Mooradian *et al.* (2006) define trust as "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" (Mayer *et al.*, 1995, p. 712).

Farmers need to develop trust-based relationships with their customers in order to create a better market access for their products (Roy *et al.*, 2017). In the past, knowledge sharing and trust were built and maintained through direct contact and a regular relationship between producer and consumer. Along with the increase in complexity of production and distribution systems, consumers placed trust in other stakeholders or sources of information.

The various definitions of trust have certain elements in common, as the existence of a risky or complex context, uncertainty and dependence on other people (Coveney *et al.*, 2012; Dierks, 2005). In the food chain, trust is not built on specific products, but rather on the human agents responsible for food production, processing, control and commercialization (Kjærnes, 2014). Social interaction and face-to-face relationships enable and help to consolidate deep trust (Roy *et al.*, 2017).

The published literature shows a collection of factors used by producers and consumers to generate and maintain trust. The most frequently quoted factor in generic literature about trust-building is integrity. Feeling that the people we are making business with are honest and will maintain their promises, and that they care about the others' well-being, is an essential factor in trust-building. Other frequently cited factors are openness, positive previous experiences, reputation and tradition, personal bonds, good treatment and producers' professionalism (Table 1). Direct contact between actors let to evaluate these elements and to build trust.

The process of trust building can be divided on two phases: a first one of bond generation or "Initial trust" (McKnight and Chervany, 2001) and a second one of confidence preservation. In the first phase, producer's integrity and reputation are among the major influencing factors. In

Table 1 - Database with information on studies of food trust generators among consumers and on studies of SFSCs advantages.

Trust generators	A sample of studies
Integrity and reputation: perception of honesty and responsibility towards customers	Fritz and Fischer, 2007; Lombart and Louis, 2014; McKnight and Chervany, 2001; Migliore *et al.*, 2015; Pieniak *et al.*, 2007
Openness: transparency, traceability, information access	Pejic *et al.*, 2013; Pieniak *et al.*, 2007
Positive previous experiences	Fritz and Fischer, 2007; Jansen and Hamm, 2011
Personal bonds	Fritz and Fischer, 2007
Good customer service and kindness	Fritz and Fischer, 2007
Professionalism: perception of knowledge and experience possession	Fritz y Fischer, 2007; Jansen and Hamm, 2011; Lombart and Louis, 2014; McKnight and Chervany, 2001; Pieniak *et al.*, 2007
SFSC advantages	A sample of studies
Higher transparency and traceability	Lanfranchi and Gianetto, 2015
Rural development, employment generation, costs reduction and increase of farmers' income	Carbone *et al.*, 2007; Kneafsey *et al.*, 2013; Lanfranchi and Gianetto, 2015; Mundler and Laughrea, 2016
Higher quality foods	Aubry and Kebir, 2013; Carbone *et al.*, 2013; Kneafsey *et al.*, 2013
Environmental sustainability	Lanfranchi and Gianetto, 2015; Mundler and Laughrea, 2016
Lower prices	Carbone *et al.*, 2013; Lanfranchi and Gianetto, 2015
Direct contact	Aubry and Kebir, 2013; Carbone *et al.*, 2013; Casia *et al.*, 2012

the second phase, trust is under constant evaluation, and openness is among the most influencing factors (Table 1). The need for face-to-face interaction is often perceived as a prerequisite for diffusion of knowledge, because it allows for trust building, which in turn is critical to share knowledge. "Knowledge sharing" is defined as the provision or receipt of task information, know-how and feedback regarding a product or procedure (Mooradian *et al.*, 2006). Absorption of knowledge requires time, therefore, spend time and meeting places would foster knowledge sharing (Ipe, 2003). The amount of information available to assess another's abilities, intentions, and behaviors within a relationship provides more opportunity for people to develop a shared vision and language and so increase trust in one another's competence (Abrams *et al.*, 2003). Establishing communication mechanisms in supply chains increases trust building and knowledge sharing (Cheng *et al.*, 2008).

1.2. Short Food Supply Chains as trust rebuilders

Consumption is a conscious act of exercising choice and, as a consequence, the consumer actively participates in the creation of a fairer society (Schifani and Migliore, 2011). SFSCs present several attributes that place them in a favourable situation to regenerate the public trust that regular agri-food systems are losing (Table 1). First, SFSCs offer consumers what is lacking in conventional agri-food systems: closeness and transparency. Second, SFSCs show a better performance in most of the areas related to economy, the environment, ethics, health impacts and social consequences, such as biodiversity conservation, nutritional value or producers' income (Schmitt *et al.*, 2017). Following the means-and-chain theory, consumers would make their choices driven not solely by products' concrete attributes, but also by the final values the products can help to achieve (Gutman, 1982).

In consequence, SFSC products would be better placed to respond to several consumers' personal concerns. Third, a new kind of consumer is asking for a more central position in food production and distribution processes, along with new forms of cooperation between farmers and consumers (Bloemmen *et al.*, 2015; Hayden and Buck, 2014; Moschiz, 2008; Nost, 2014). The prototype of this new kind of consumer is the *prosumer*, which corresponds to the most frequent type consumer in SFSCs. The term prosumer is generally attributed to Alvin Toffler. He proposes that "contemporary society is moving away from the aberrant separation of production and consumption and towards a 'third wave' that, in part, signals their reintegration in the rise of the prosumer" (Ritzer and Jurgenson, 2010). However, the demand for a higher implication in agri-food related processes is not restricted to *prosumers*, as increasing sectors of society are motivated for these commercial interactions (Pascucci and de-Magistris, 2016).

This situation represents a window of opportunity for SFSCs to strengthen their position in the agri-food system. Indeed, some of SFSC attributes are already being used by farmers in their strategies to face agri-food system challenges, such as the establishment of direct relationships between producers and consumers, and the valorization of regional products (Schermer *et al.*, 2010). For the last few years, SFSCs have been spreading in Europe, although their impact remains limited (EIP-AGRI, 2015). One of the best opportunities for SFSC rise is the capture of consumers' vanishing trust, but this also remains a major challenge for producers. Further research to cast some light on the different processes to build consumer trust in SFSCs is needed.

The objective of this study was to analyse the relationship between trust and SFSCs, and to identify consumers' preferences on SFSCs' attributes and typologies. The final goal was to map consumers' demands, so they can be considered in the definition of SFSC promotion policies.

2. Materials and methods

A survey was conducted online and distributed among the Facebook followers of the Spanish Consumers Organization (OCU). The pro-liferation of social media applications such as online communities, social networking sites or blogs gives the public new means for receiving, and, more importantly, providing information (Elghannam *et al.*, 2017). OCU is the most important Spanish consumers association. OCU develops a very important activity in mass media and social networks, with more than 400.000 followers all around Spain. Another recently published work (Cruz Maceín and Benito Barba, 2018) highlighted the interesting profile of these followers. Facebook OCU followers are a more open profile than OCU members. The latter pay to get some specific information and services. However, the first ones just follow some open access information and they do not pay any fee. These followers are not Spanish average consumers, they are warier consumers and they represent one of the most important potential market niche for SFSCs in Spain. Currently, SFSCs are supported by activist consumers with different strong motivations (environment, rural development, health…), however, the expansion of this market niche is very limited. Next programming period for Common Agricultural Policy (2021-2027) will emphasize SFSCs and other market niches are necessary in order to scale up SFSCs. These wary consumers can be a good option. They have a very high willingness to buy in SFSC, however some barriers are hinder them from participating more often in SFSCs.

A brief post about SFSCs and the survey was added in the Facebook OCU profile. This post included a link to the online survey. A total of 423 responses were collected from all around Spain during the months of August and September 2017. Previously, a pilot test survey was performed with consumers (n= 15) in July to close the questions and minimized the biases. We are dealing with convenience sampling focused on OCU followers. They are aware consumers and they represent one of the most important potential market for SFSCs in Spain (Cruz Maceín and Benito Barba, 2018). Profile of respondents has been tested with OCU social network managers.

The survey is divided in two blocks with ten main closed questions, some of them multi-questions (Annex 1). The first block perceptions with regard to food supply chain. This block includes

Table 2. Sample.

		%
Sex	Men	19.4
	Women	54.5
	Dk/Da	26.1
Age	<35	27.7
	35-50	42.7
	>50	3.3
	Dk/ Da	26.3
Studies	University studies	52
	No university studies	22
	Dk/ Da	26

questions about concern and information about food. In addition, there are questions about drivers of trust on the different food chain stakeholders. The second block is focused on SFSCs. It includes questions about willingness and reasons to buy in different SFSCs, and barriers and drivers for buying in SFSC.

The survey was designed using a 0 to 10 rating scale classification since it allows factorial techniques such as Principal Components Analysis (PCA) (Abascal and Díaz de Rada, 2014). An 11-point scale is able to get a much broader spread of the results yielding better predictive analysis. On the other hand, Five-point, seven-point and 10-point scales are relatively easy to use. Although shorter rating scales are rated as quicker to use, scales with 10 and 11 alternatives are much preferred to express respondent feelings adequately (Taherdoost, 2019).

Descriptive statistics and bivariate correlations were used. For all analyses, the level of significance was a set to <0.05. Exploratory factor analyses, PCA, were performed. In the extraction method by principal components, the factors obtained are the autovectors of the matrix of rescaled correlations. The statistical contrasts used to evaluate the goodness of the fit of the factorial models formulated were: the mean of the KMO (Kaiser-Meyer-Olkin) measure and Bartlett's test of sphericity. In this study, a factorial PCA was carried out by a Varimax rotation with Kaiser normalization.

Initially, all independent variables were analyzed using PCA as a data reduction technique. Finally, PCA was focused on two key issues getting a better simplified structure. These issues were defined as *SFSC form* and *SFSC content or core*, where *SFSC form* refers to the existence or absence of intermediary agents, and *SFSC content* refers to the nature of the warranty for food safety.

3. Results

3.1. *Consumers' trust on food supply chains*

Results showed that surveyed consumers are concerned about food safety (8.3/ 10) and, at the same time, they considered that they do not have enough information about the food products they acquire (5.1/ 10). Concern about food safety was associated to a lack of information
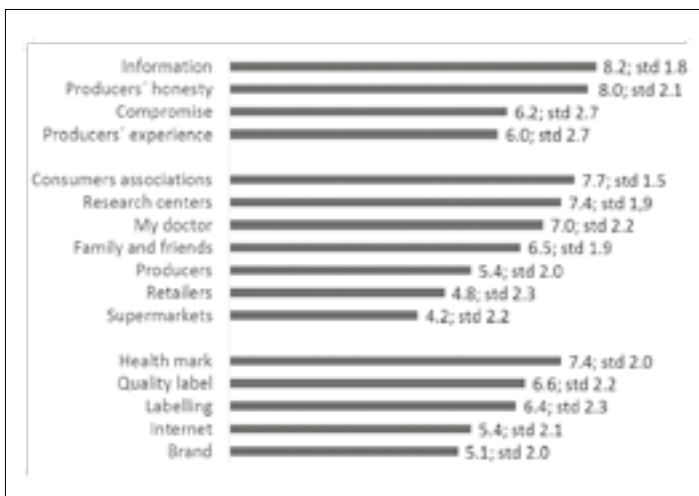
Figure 1 - Drivers of trust.

Main drivers of trust. It presents the average of trust of three types of drivers. First group (from information to producers' experience) includes producers' characteristics that work like drivers of trust. Second group (from research centres to supermarkets) are driver of trust people. And third group focuses on information exchange mechanisms (from health mark to brand) that work like driver of trust. All of them are evaluated from consumers point of view (n=423). Rating is from 0 (low trust) to 10 (high trust).

Table 3 - Consumers' willingness to buy in each SFSC category (n=423).

SFSC type	%
Farmer markets	68
Willingness to buy directly in the farm	67
Willingness to participate in a collective food buying group	61
Ecologic food shop	60
Willingness to buy directly to the farmer with a periodic contract signature	59
Internet	31

(C.Pearson=-0.065; Sig.bilateral=.028). In this situation, trust plays a key role in the relationship between consumers and food producers.

The main trust drivers (Figure 1) indicated by this sample were information availability (8.2/ 10) and producers' perceived honesty. Surveyed consumers prefer information from consumers associations (7.7/ 10), research centers (7.4/ 10), health professionals and close relationships. On the contrary, they place little trust on producers (5.4/ 10) or retailers. Supermarket had the worst rating in consumers' trust (4.2/ 10).

Interestingly, the low punctuation for producers as trust deservers was accompanied by the consideration that producers are good professionals (7.3/ 10). This can be explained by the fact that consumers perceived that producers prioritise their profits rather than consumers' health (6.5/ 10) and that they are unconcerned about environmental issues (3.9/ 10).

On the other hand, health marks (7.4/ 10) and quality labeling (6.6/ 10) were important instruments in the process of trust building. These factors offer relevant information about food safety to consumers.

3.2. Consumers' perception about SFSCs

The survey indicated that just 34% of respondents buy in any kind of SFSC, although an important percentage of surveyed consumers (69%) were willing to do so. This tendency increases with higher levels of concern about food safety and health risks (C.Pearson=,183; Sig. bilateral=.001). Preferred SFSC systems were producers organized markets (68%) and direct purchase at the farm (67%) (Table 3).

The main reason exposed by surveyed consumers to acquire SFSC products was obtaining higher quality products. Consumers' interest to have a direct contact with farmers and supporting rural development were also important factors in determining SFSC choice (Figure 2).

On the other hand, the main barriers for consumers to access SFSCs were the difficulties to find trustworthy producers and the higher efforts associated to this option. It is easier to buy in a supermarket or close to the home than in SFSCs (Figure 3).

3.3. Information exchange and intermediaries in SFSCs

Information exchange between producers and consumers is a key issue in trust building processes, and SFSCs provide easier ways for it. Direct contact is a common practice in SFSCs, but

Figure 2 - Reasons to buy through SFSCs.

Figure 3 - Barriers to buy through SFSCs.
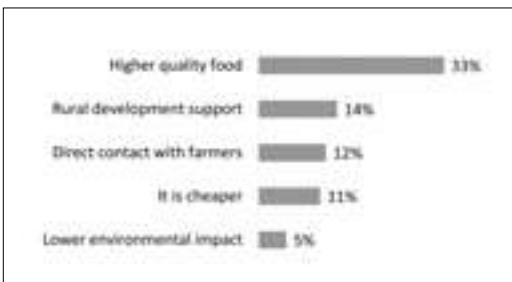
Main reasons to buy through SFSCs. It presents the percentage of surveyed consumers that consider each issue like a SFSCs opportunity (n=423).
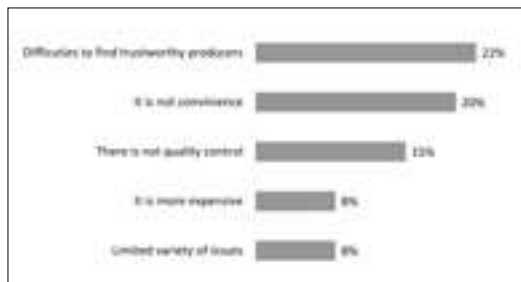
Main barriers to buy through SFSCs. It presents the percentage of surveyed consumers that consider each issue like a SFSCs barrier (n=423).

Table 4 - Total variance explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.422	34.600	34.600	2.422	34.600	34.600
2	1.878	26.824	61.424	1.878	26.824	61.424
3	.827	11.819	73.243	.827	11.819	73.243
4	.610	8.708	81.951			
5	.486	6.940	88.891			
6	.458	6.548	95.439			
7	.319	4.561	100.000			

Seven variables have been reduced in three factors (73.2% of cumulative variance explained). Each component focuses on a kind of relationship between producers and consumers.

Table 5 - Component Score Coefficient Matrix.

	Component		
	1	2	3
Willingness to participate in a collective food buying group	.791		
Willingness to buy directly to the farmer with a periodic contract signature	.780		
Willingness to buy directly in the farm	.766		
Trust on supermarket		.813	
Trust on retailer		.756	
Trust on family and friends		.708	
Willingness to buy in farmer markets			.678

This matrix highlights only the highest scores for each component. It clarifies how each component has been built.

SFSC definition opens the way for the participation of intermediary agents. However, the direction and magnitude of their influence remains to be assessed. Conducted PCA included variables about consumers' willingness to buy in different SFSCs with direct contact and their trust on a number of intermediaries.

PCA clustered variables in three components (KMO= 0.7). Component 1 grouped those variables associated with direct contact ("Willingness to participate in a collective food buying group", "Willingness to buy directly to the farmer with a contract signature", "Willingness to buy directly in the farm"). This component reflected the willingness of a strong reconnection with farmers. It explains a 34.6 of total variance. On the other hand. Component 2 clustered variables related to trust on different intermediaries ("Supermarket", "Retailer" and "Family and friends"). This component does not focus on farmers. It focuses on intermediaries. Finally, component

3 differentiated farmer markets as a special element. This component is a mix of component 1 and 2. It focus on a direct relationship with farmers but in a market.

3.4. SFSC content or core: food safety certification in SFSCs

Food safety is the first driver for SFSC products consumption. Labelling or certification offer warranties about the quality of food, especially when consumers do not meet producers in person. However, the role of labelling and certification when direct contact occurs remains to be evaluated. Next PCA focused on the content of the relationship between producers and consumers. It included variables about trust on several certification systems, and at the same time it analysed consumers' perception of farmers' behaviour (KMO=0.7).

Component 1 (trust on research centre, trust on quality label, trust on health mark) included

Table 6 - Total variance explained.

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.625	43.747	43.747	2.061	34.349	34.349
2	1.242	20.697	64.444	1.806	30.096	64.444
3	.759	12.657	77.102			
4	.685	11.420	88.521			
5	.412	6.867	95.388			
6	.277	4.612	100.000			

Six variables have been reduced in two factors (64.4% of cumulative variance explained). Each component focuses on a trusted source. First component highlights on third party certification. Second component underlines the direct relationship with the farmers.

Table 7 - Rotated Component Matrix.

	Component	
	1	2
Trust on research centre	.673	
Trust on quality label	.855	
Trust on a health mark	.851	
Farmers "…offer safety food"		.783
Farmers prioritize their profit before consumers' health		-.742
Farmers "…are concern about environment"		.762

This matrix highlights only the highest scores for each component. It clarifies how each component has been built.

variables focused on the certification approach. That is third party certification (public institutions, NGOs or certification companies). Farmers are not the main reference from the food safety point of view. It explained 34.3% of variance. On the other hand, Component 2 (farmers' concern about food safety and environment) clustered consumers' perception about producers' behaviour. This component pay attention on farmers as a reference for food safety.

4. Discussion

In the light of these results, Spanish consumers are significantly concerned about the quality of food. Additionally, surveyed consumers show detachment and mistrust in conventional agri-food systems, as observed in Italy, Canada or Australia (Giampietri *et al.*, 2018; Levkoe, 2015; Roy *et al.*, 2017). On the other hand, this survey confirms the narrow relationship between consumers' perception about food safety and the lack of information, as observed in previous studies (Calle *et al.*, 2012; Carbone *et al.*, 2007; Dierks, 2005; Ding *et al.*, 2013). Information exchange and honesty are signalled as key factors in trust-building processes, as found by Migliore *et al.* (2015). In this sense, as showed in previous research, these results also highlight the relevance of trust in farmer markets, as it has been proven that it can be an effective substitute for full knowledge (Grebitus *et al.*, 2015).

Although this study shows high levels of interest about SFSCs, a very small percentage of consumers use this option to acquire their food products. SFSCs have the potential to continue growing, but important barriers difficult their development, as the Agricultural European Innovation Partnership (EIP-AGRI) concludes (EIP-Agri, 2015).

The first barrier for SFSCs in Spain is the distance between producers and consumers. Consumers do not meet trustworthy farmers as a consequence of the absence of close links between rural and urban areas, as well as current leading role of supermarkets in the food chain.

In addition, consumers' perception about farmers highlights some relevant differences with their values. From the point of view of consumers, health, and environment are not too much important for farmers. Any strategy for SFSCs sprawl needs to be preceded by the rapprochement of food producers and consumers, as it has happened in Canada or California (Cleveland *et al.*, 2014; Levkoe, 2015). The second major barrier for SFSCs are logistics. The lower level of organization needed to acquire food through conventional channels, and the higher presence of supermarkets and conventional food stores in urban areas, makes it easier to buy in these establishments than through SFSCs. It would be necessary to bring consumers closer to SFSCs. The farmer markets are the best valued option. Intermediary agents play a conflicting role in the process of surpassing SFSC barriers. On the one hand, they improve commercial logistics, which facilitates the acquisition of SFSC products. On the other hand, they reduce the communication between consumers and producers. First PCA shows this reality, as it separates those factors associated to direct contact from those factors related to consumers' trust on intermediary agents.

These results showed that, while direct contact with food producers is preferred, or even critical, for a segment of consumers, another segment of the population accepts the involvement of intermediary agents. These contrasting preferences define the two extremes of the range of SFSC modalities.

Farmers' markets are a special case within SFSCs, as they facilitate logistics for consumers, while allowing direct contact with food producers. For this reason, farmers' markets receive a greater variety of customers than any other kind of SFSCs.

Survey results showed the relevance of what Casia *et al.* (2012) named as CCTI stimulus intangibles: customer, company, territory and interaction. This theory suggests that support to rural development and direct contact with the farmer are important incentives to choose SFSCs. Shared values between the consumer and the producer are also a key aspect for SFSC choice (Adler *et al.*, 2003). Another predictor of sustainable food preference is the importance of health and ethical values (Dowd and Burke,

2013). However, as observed in other studies (Aubry and Kebir, 2013; Carbone *et al.*, 2007; Kneafsey *et al.*, 2013), these results suggested that the acquisition of high quality and safe products is the primary aspect for SFSC choice. In that sense, quality assurance is also a major barrier for the absorption of a segment of consumers in SFSCs, as indicated by Migliore *et al.* (2015), who talk about "the black box of food quality in the short supply chain". Second PCA reflected consumers' segmentation towards this aspect, grouping factors related to the need for quality certification and those associated to environmental or social engagement.

Contrary to previous studies that did not find a direct relation between organic labels and consumer choices (Ritenthofer and Klitgaard, 2015), These results clearly indicated the existence of a population segment that asks for quality certification as a necessary condition to purchase SFSC products. These data allow us to draw a conceptual map supported on two axes: *SFSCs form* (Axis 1) and *SFSCs content* (Axis 2). As indicated in section 3, *SFSCs form* refers to the existence or absence of direct relations between consumers and producers, while *SFSC content* refers to the use of quality certification or labels. Looking at the conceptual map, it can be notice that, while some consumers prefer to obtain direct information about food products on the hand of producers (F1E1), others find it enough, or even prefer, to get information through labeling or intermediaries (F2E1). On the other hand, it can be notice that some consumers search for products with safety or quality certification labels (F1E2), but others look for producers that share their personal values and beliefs (F2E2).

The intersection between these two axes defines four kinds of consumers preferences, that can be associated to four different categories of SFSC (Figure 4).

Type 1.- Prosumers (Pr): consumers that look for producers that share their personal values and beliefs and that like to have a direct contact with them. They prefer to participate in consumers' groups and to buy directly at the farm.

Type 2.- Logistics limited (Ll): they are interested in sharing values with producers, but they do not prioritize to have direct contact, so they look
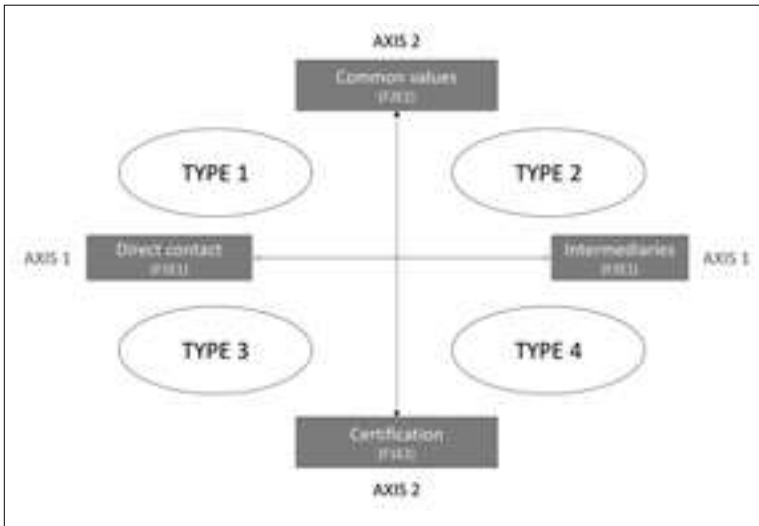
Figure 4 - Conceptual map. Classification of consumers according to SFSC priorities.

Combining above PCA components in a conceptual map we can get four types of consumers. Axis 1 is based on first PCA and Axis 2 is based on second PCA. Each type can receive a tag: type 1= prosumers (Pr), type 2= logistics limited (Ll), type 3= guaranteed concerned (Gc); type 4= certification focused (Cf). Text details their characteristics.

for intermediaries to simplify the purchase of food products. They tend to buy in organic stores.

Type 3.- Guarantees concerned (Gc): this type of consumer likes to have direct contact with producers, but they need further guarantees on the quality of food products. They get these guarantees by acquiring their products in markets backed by recognized organization or public administration (e.g., weekly food markets).

Type 4.- Certification focused (Cf): they do not need direct contact with producers, but a quality and safety certification of the products that they are buying. They are especially interested on local products and the type of commerce where they tend to buy their food products regular supermarkets (specialized shelves).

Public administration plays a different role towards each of these kinds of SFSCs. Because of that, when at national, regional or community level appears the intention to support SFSCs, it is important to determine the preferred option prior to any other action. Furthermore, when a SFSC model is already in place, it is also possible to define public policies that help to foster a transition from one model to another. For instance, if a community where certification focused population (type 4) is predominant would be interested in evolving towards a prosumer (type 1) or a logistics limited model (type 2), it would be necessary to develop actions that foster the creation of producers-consumers networks. The guiding

lines would be very different if the desired transition was towards more formal models. This same logic applies to SFSC producers that want to target other consumer groups.

The classification of consumers also serves to identify the best strategies to reduce barriers to SFSC choice (Table 4). Prosumers do not need further intervention, as they already engage with local producers to increase trust in food products and get them through SFSCs. In the case of Logistics limited type of group, it would be necessary to make access to SFSCs easier. Guarantees concerned consumers need external guarantees that the products that they are buying are safe, which could be achieved with public administration support. Certification focused group do not show special interest in changing their consumption patterns. A strategy to encourage the SFSC choice in this group could be to increase SFSC products presence in regular markets. However, this is unlikely to have a direct effect in consumers' trust. It might be a better strategy to carry out awareness campaigns, educating consumers in the functioning of agri-food systems, and promoting their interest in the products that they are buying.

Currently, it is possible to find regions in the Mediterranean countries where the direct relationship between food producers and consumers takes place. However, this paper focuses on those Mediterranean regions with an intensive

Table 8 - Strategies to reduce barriers to SFSC choice among different consumer types.

Consumer type	Barrier	Strategy
Pr	Already convinced	Quality and good treatment maintenance.
Ll	Logistics	Bringing SFSC products closer to consumers, increasing distribution networks.
Gc	Safety guarantees	Increasing public support: public spaces habilitation, organization collaboration, etc.
Cf	Logistics and safety	Increasing SFSC products presence in conventional spaces. Designing awareness campaigns to achieve their involvement.

urbanization process, an agro- industrial model and a radical disconnection between urban and rural areas. In these regions, small farmers need to find alternatives to the supermarkets, hypermarkets and discount stores. At the same time, some market segments are looking for a reconnection between consumers and producers.

This paper offers the perceptions of relevant potential consumers of SFSCs (Cruz Maceín and Benito Barba, 2018). The above conceptual map integrates all these perceptions. This map can help to different stakeholders (like farmers or policy makers) to design stronger marketing strategies according to their target.

5. Conclusions

Information exchange and direct contact are highly effective instruments in the process of trust building. SFSCs allow to meet these requirements. However, potential SFSC consumers' drivers are very heterogeneous. From a theoretical point of view, this paper offers a way of classifying consumers according to these drivers. The need for official or institutional warranties about food safety and the relationship between producers and consumers (direct or quasi-direct contact) are the main distinctive elements that set the difference when consumers choose their SFSC typology. This categorization has important implications from practical point of view. Promotion policies about SFSCs need to analyse what the consumers' preferences are. This paper notes a typology of SFSCs and the elements working in each type in order to build consumer' trust. Furthermore, it supports policy-makers and producers in designing promotion strategies for SFSCs. The categorization highlights different preferences and strategies in order

to foster a specific SFSC. At the same time, the conceptual map allows producers to identify where they are focusing their production and where they would like to offer their products.

The present paper focuses on social networks followers of consumers associations. They are not general consumers, so this information would complementize with other surveys focused on representative pools of consumers. In addition, it is relevant to contrast these results with consumers' perception whose purchase in SFSC.

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Annex 1 - Survey questions

1. To what extent do you feel informed about food safety? (0= nothing informed and 10= strongly informed)

2. To what extent do you care the food safety? (0= nothing worried and 10= strongly worried)

3. To what extent do you agree with following statements? (0= nothing agree and 10= strongly agree) "Farmers…

a. "…inform perfectly about their productions"	
b. "…know how to grow"	
c. "… offer safety food"	
d. "…prioritize food safety over their benefits"	
e. "…prioritize their benefits over the food safety"	
f. "…are concerned with gaining the trust of consumers"	
g. "…are concerned with agricultural environmental impact"	

4. How often do you buy… (0= never; 10= always)

a. Local products	
b. Protected designation of origin (PDO)	
c. Food directly from farmers	
d. Organic food	

5. To what extent do you trust on the following people about food safety? (0= nothing and 10= absolutely)

Supermarkets	
Retailers	

Producers	
Family and friends	
My doctor	
Research centers	
Consumers associations	

6. To what extent do you trust on the following elements about food safety? (0= nothing and 10= absolutely)

Brand	
Internet	
Labelling	
Quality label	
Health mark	

7. What is the main reason of consumers to buy through SFSCs? (circle one)

Higher quality food	
Rural development support	
Direct contact with farmers	
It is cheaper	
Lower environmental impact	

8. What is the main barrier of consumers to buy through SFSCs? (circle one)

Limited variety of issues	
It is more expensive	
There is not quality control	
It is not convenience	
Difficulties to find trustworthy producers	

9. To what extent do you consider important the following trust drivers? (0= nothing and 10= absolutely)

Producers' experience	
Producers' compromise	
Producers' honesty	
Clear information offered by the producer	

10. To what extent are you willing to buy in…? (0= nothing and 10= absolutely)

Willingness to buy directly in the farm	
Willingness to buy in farmer markets	
Willingness to participate in a collective food buying group	
Willingness to buy directly to the farmer with a periodic contract signature	

Ageing population and agricultural sustainability issues: Case of Turkey

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Abstract

Agriculture is a sector that is widely known to be impacted not only by the natural conditions of a country but also by other economic and political sectors. Turkish agriculture, in a context marked in recent years by a rural exodus of young people, marks the vagueness of the current state of the agricultural sector and its future. It is with this in mind that this research was carried out, based on a questionnaire survey of 312 producers in 5 provinces of Turkey, to assess the impact of the ageing of the rural population on the agricultural sector. The results of this study show that with age, producers invest less in agricultural activity, altogether abandoning productions requiring more labour. The possibility of taking over the family farm by descendants plays an important role in the degree of involvement of producers. Through these findings, this study makes it possible to address targeted agricultural policies according to age stages.

Keywords: *Aging farming population, Farm succession, Impact, Farming sustainability, Turkey.*

1. Introduction

Living in rural areas brings with it spatial disadvantages in reaching basic living standards for elderly people. The inability of the elderly to participate in the migration process and their "being behind" change the age structure of the rural area and brings along problems in accessing services. While a significant portion of the elderly population lives in rural areas, they cannot have regular access to basic public services due to the physical and social infrastructure deficiencies in rural areas. During the migration process, the migration of relatives of the elderly to urban areas does not only affect the service consumption of the elderly residents but also causes the decrease and weakening of social and support networks. Old age is not a period that is expressed only in chronological terms of the number of years lived. This period is a period that includes individual differences, social conditions of the period, and environmental conditions. Rural old age reflects an old age that is shaped according to the conditions of the place of residence. Studies on rural areas draw a graphic that decreases in number especially with the phenomenon of urbanization. However, the change in social

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structure, especially with the phenomenon of immigration, caused the rural area to be associated with the elderly. This situation raises the necessity to analyze the rural area in terms of old age. Rural life is a disadvantageous place in many aspects such as education, transportation, and health. Besides, the ageing process becomes more difficult with the emergence of conditions such as illness, disability, and need for care. A problematic area emerges when both the impossibilities of rural life and the negativities of old age combine (Acici, 2019).

Turkey is facing an accelerated ageing population phenomenon in rural areas. While the percentage of the population of 65 years old or above is at 9.1% on average in the country, rural areas count 13.4% of them (TurkStat, 2020). The sectoral distribution of the employed elderly population was examined with the household labour force survey (TurkStat, 2020). According to the results, 64.7% of the elderly population older than 65 work in agriculture, 28.1% in services, 5.3% in industry, 1.9% in construction. It is good that the agriculture sector provides several jobs for them, on the other hand; some precautions should be taken to have younger people work in the sector for the sustainability of agricultural activities. In France for instance, since 1975, the age structure of the active agricultural population in rural areas makes farm exploitations turn to the familial workforce (Reboul, 1980). The author explains the diminution of the active population by the disappearance of farms. Factors such as longevity and rural exodus are the ones driving the changes (Akdemir and Miassi, 2019). This major demographic trend implies a possible transition in the farming scheme in the way of exit or disinvestment. The findings of Griffin *et al.* (2019) about "retirement age farmers' exit and disinvestment from farming" in the USA show that demographic factors such as gender, race, and age have statistically significant impacts on farmers' decisions to exit or to disinvest. Population structure in rural areas is a very important factor both for agricultural growth and for uncovering non-agricultural potential in rural areas. The modernization of agriculture, the spread of the use of new technologies, the growth of scales, the realization of new initiatives in rural areas seem more possible with a young, qualified, and entrepreneurial population. On the other hand, the solution of structural problems in agriculture is possible with a young population that ensures its future from agriculture and the rural economy. The EU has understood the importance of this issue and has been giving priority and weight to agricultural policies to promote the participation of youth in rural development (Shucksmith, 2010). Today, the use of the technologies of the fourth industrial revolution in agriculture is rapidly becoming widespread. Industry 4.0, which includes the Internet of Things (IoT), cloud technology, drones, sensors, and big data analytics, significantly reduces production costs and increases productivity and profitability in the agricultural sector. The expansion of the fourth industrial revolution in the agricultural sector in Turkey is holding back by one of the biggest structural problems to ensure food security, the ageing of the population living in rural areas. The migration of the active population living in rural areas for reasons such as work and education constitutes one of the main reasons for this demographic trend. According to 2017 migration statistics, approximately 50% of the 2.7 million internal migration population is between 15-30 years old (TurkStat, 2019).

Among the biggest structural problems of Turkish agriculture, the small size of farms, the fragmented and scattered nature of agricultural land, which, moreover, is subject to joint ownership, come first. In other words, 6 ha of land per enterprise consists of 10 parcels belonging to 13 shareholders. These lands are cultivated by one of the shareholders living in the village. The number of parcels of land can be reduced by land consolidation, but the shareholding problem could not be solved, as land-banking applications could not be implemented. This situation prevents taking efficiency-increasing measures such as access to land and drilling wells on multi-share lands, improvement, and fruit growing. This structure causes productivity and income losses in limited land assets, increases costs, and weakens the competitiveness of enterprises.

Another crucial problem in rural areas is that formerly cultivated land is left unused due to the ageing of the farming population and the migration of young people to the cities. In particular, the migration of young people living in disadvantaged regions where the soil, topography, and climatic conditions are insufficient for sustainable agriculture, and the elderly population contenting themselves with less land, leads to leaving previously cultivated land empty. According to a study conducted in 2018-2019, for reasons such as the elderly population, the rural exodus, including excessive fragmentation, questions of inheritance and succession, security issues, it emerges that in Turkey on 24 million hectares of agricultural land, about 2 million hectares (8.2%) are unused, with 25% of those lands having irrigation possibilities (TOB, 2019). Efforts are underway to implement land banks, particularly leasing and co-production models, to bring empty land into production.

Studies on rural exodus in Turkey are many (Avsar, 1995; Coskun and Zaman, 2012; Altin, 2014) and various analyzing the economic and social impacts (Ekmekciler, 2011), its links with socioeconomic characteristics (Gurbuz and Karabulut, 2008), the gender aspect by focusing on women conditions during the transition, or even the threats it represents for the rural development (Tasgin, 2009). Akdemir (1994) and Yalcin and Kara (2016) oriented their studies onto rural exodus and its impacts on agricultural production; furthermore (Kuçuk, 2018) analyzed the ageing population and social politics' application in the world and Turkey. Despite the abundance of literature about important rural questions, studies about the ageing population from the farming perspective in Turkey are rare. Though the presence of an active population in rural areas is the guarantee of food security and sustainable agriculture. In the context where environmental and ecological conditions' degradation associated with climate changes constitute a serious threat to food supply (Eswaran *et al.*, 1997) for a growing population, understand the implication of ageing in agriculture in Turkey – that is ranked among the least efficient countries of OECD in terms of ecological sustainability of its agriculture (Mollavelioglu *et al.*, 2010) – is driven by the need to understand farmers' decisions factors, their involvement in agricultural activities and hence the impact on the sustainability of agriculture in Turkey. This study aims to reveal the socio-economic characteristics of the elderly population and to determine the relationship between ageing and agricultural sustainability.

2. Methodology

To shed light on the consequences of ageing on agriculture in rural areas, our study opted for a cross-sectional study that was carried out through a field survey. The questionnaire tool was used for this purpose during a field survey carried out in September 2019 in 5 provinces (Kars, Erzurum, Sivas, Corum, and Bolu) with 312 producers aged at least 40 years with purposive sampling, which is commonly used in qualitative research for the selection and collection of information (Palinkas *et al.*, 2015).

The fact that the provinces where the surveys were conducted are also the provinces with many idle lands and the rural exodus continues, has special importance in terms of researching the sustainability of the elderly population and agriculture in these regions. In this study, farmers needed to be easily accessible, have enough amount of willingness to participate, and the ability to communicate, and also the farmers were included in the study based on the research purposes namely their lifestyles and the sustainability of farms. Therefore, purposive sampling was used rather than a random sampling method (Etikan *et al.*, 2016).

The diversity of the villages made it possible to ensure the representativeness of the different possible social classes. As the overall objective of the study is to determine whether ageing indeed poses a threat to agricultural activity in Turkey, variables that can indicate the level of activity, and socio-economic characteristics were collected. These data were processed using the statistical software SPSS 23 giving results of descriptive statistics, cross-tabulation analyses, comparison test, and Kruskal Wallis non-parametric statistical Tests to describe the general characteristics on the

socio-demographic level of the participants. Then was established the links between the socio-demographic variables, the agricultural activity levels of the respondents, and how the sustainability issues are affected by age.

We verified whether the variations were statistically important in the pre-test results. Although the assumption of a normal distribution of observed variables was not justified, we used the non-parametric approach referred to as the Kruskal-Wallis test to check the statistical significance of discrepancies between farmers' groups in pre-test results (Wilcox, 2009). It makes it possible to test the H_0 hypothesis that the independent k samples ($k \geq 3$) derive from the same distribution. The test criterion of the Kruskal-Wallis test is the statistics distributed asymptotically with k-1 degrees of freedom under the validity of the null hypothesis χ^2-1 (Hettmansperger *et al.*, 1998).

$$H = \frac{12}{n(n+1)} \sum_{i=1}^{k} \frac{T_i^2}{n_i} - 3(n+1)$$

If $H \geq x_\alpha^2(k-1)$, where $x_\alpha^2(k-1)$ is the critical value of the χ^2- distribution of k - 1 degree of freedom, the tested hypothesis H_0 is rejected at the significance stage α. If the null hypothesis in favour of the alternative hypothesis H_1 is dismissed, meaning that k independent samples ($k \geq 3$) come from the same distribution, a new question is posed as to which sample pairs vary significantly (Andel, 2003). To answer this question, the Duncan test, Tukey method, Scheffe method, or Neményi test can be used (Voss, 2010). In our case, the multiple comparisons of mean ranks for the Kruskal-Wallis test were performed using the Kruskal-Wallis test of multiple comparisons via Z-score in the SPSS program.

$$Z = \frac{|\bar{R}_i - \bar{R}_j|}{\sqrt{\frac{n(n+1)}{12}\left(\frac{1}{n_i} + \frac{1}{n_j}\right)}} ; Z \geq Z_\alpha$$

3. Results and discussion

3.1. *Socioeconomic characteristics*

A total of 92.3% of the participants in our study are male with a modal age range of 56 to 65 years (44.2%). With a literacy rate of 92%, most of them (46.5%) have a primary education level, are married (93.3%), living mostly (69.9%) in their village native. A large majority (85.2%) live with their partner, and only 5.9% live alone. Living alone is often frowned upon and can even be the subject of mockery and gossip[1]. This explains the reason why producers, following the death of their wives, most often proceed to a second marriage at the cost of rather expensive dowries (agricultural land, other precious goods). The number of children per household is often 3 or more (82.4% of cases), of which 6.1% are from different mothers. Focusing on marital status, 7% got married more than once, the cause is mainly the death of their previous partner. Almost three-fourth (73%) of study participants live with one, two, or more of their child (ren); for those with whom they do not live together, 94.1% say they are still in contact. Contacts are frequent daily when they live in the same village (47.5%), regular for those who are in the same province (21%), or on special occasions for those not living in the same provinces (31.5%). When it comes to affinities towards their children, 50.8% of participants are more satisfied with their girls. The reasons are mainly the frequency of visits (37% of participants), telephone conversations (18%), and then financial support (8.3%). 87.6% own agricultural land, 79.9% of farmers who own it operate their land themselves, 9.67% derive income from it through rental. 59% have a retirement allowance and 13.4% of respondents benefit from social assistance.

Cross tabulation analyses reveal age as a key differentiator between groups. This is the case

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[1] This testimony is certified by Akdemir, one of the authors, whose late father Göçer Akdemir has personally experienced it. Mr. Göçer has migrated from Van to Murat province; over there after the death of his first wife, he had to offer a house to his second wife for the family to accept the marriage. When his second wife passed away, he could marry at the condition to ensure his pension of retirement and lands to his third wife. This work is therefore dedicated to him.

Table 1 - Education level sorted by age (%).

		Illiterate	Literate	Primary school graduate	High school graduate	College/University graduate	Total
Age	40-55	3.20	7.40	43.60	38.30	7.40	100.00
	56-65	5.10	15.90	51.40	21.70	5.80	100.00
	>65	18.80	23.80	41.30	15.00	1.30	100.00
Average		9.03	15.70	45.43	25.00	4.83	100.00

Source: Survey results, 2019.

with the level of education where the proportion of those with a secondary level or above decreases with age as shown in Table 1. Likewise, with age the number of children living with them decreases, results corroborated by the rate of marriage of their children, which changes positively with the age of the respondents.

The division of property between children, by the farmers, while they are still alive, is rare (9.2%). In the event of a division of property, relations with the children are always good (93.3%), as is the satisfaction they feel from the management of property by them. When asked to know the appreciation of the other inhabitants of the village (city or province) in the face of decisions on whether or not to divide property between heirs, the farmers in our survey do not often face controversial reactions; less than 6% of those around them believe they have made bad choices.

In the enterprises examined, the socio-economic characteristics of the operators by age groups and their opinions on agricultural activities are given in Table 2. To determine whether there is a relationship between variables, cross-tabs tabulation and chi-square contingency tests were performed.

3.1.1. Producers' lifestyle

Participants in our survey are generally able to carry out their activities without the need for on-going assistance. For their intimate needs (using the toilet, bathing, eating, clothing), they almost do it on their own. However, the more the activity requires a certain amount of effort or travel (paying bills, banking procedures, travel, etc.), the more help they get; 70% of the time the help comes from their wives or someone else in the supply runs. The cross-tabulation analysis was performed to determine a group difference based

on age if any. Even though older people use help more than younger people do, the difference is not significant enough.

When it comes to farm-related decisions, producers claim to make their own decisions in over 60% of cases. However, representing at least 30%, the weight of the family and its participation in decisions is not negligible.

To get informed, farmers do not often use the press; 28% read it daily or weekly. The radio is used significantly more than the press (35% daily or weekly); 26.6% use it for information on agriculture. However, television is a channel, which brings together almost all farmers; in fact, 93.3% follow it on a daily or weekly basis, with 67% following programs related to agriculture. The rate of internet use is not negligible, however. The internet is used by 39.2% of producers per day or per week; 30.3% use it regularly to learn about agriculture. Even though the television audience among farmers remains high, cross-tabulation analysis indicates a significant difference across age groups. The older the age, the less frequently farmers follow programs relating to agriculture via television channels.

3.2. Sustainability of farms

3.2.1. Farm succession

One of the concerns about the subject of this study is the question of the ageing of the rural population and thus, the question of the succession of agricultural activity by future generations. Almost half (45.6%) of the farmers questioned do not think that their children will continue farming activities. The reasons are specified in Figure 1.

Figure 1 reveals that the risks level and economic conditions are considered by farmers

Table 2 - Farmers' socio-economic characteristics and views on agricultural activities by age groups.

Variables	Specifications	Age groups			P-value	Difference among groups
		40-55	56-65	Above 65		
Education	Primary school graduate or less	54.3	72.5	83.8	0.000	***
Marital status	Widow	3.2	4.3	10.0	0.178	
	Second wife	5.3	7.2	5.0	0.612	
Health	With chronic illness	16.5	18.5	37.7	0.002	***
Additional income	Pensionable	27.2	64.5	86.3	0.000	***
	No additional income	36.0	18.3	6.7	0.000	***
Transfer of ownership	Goods-sharing	6.0	9.8	11.5	0.440	
Decision making regarding agricultural activity	Investment decisions	72.2	66.7	58.4	0.001	***
	Saving decisions	68.2	59.7	58.7	0.005	***
	Financial decisions	69.0	60.4	59.2	0.005	***
	Future decisions	66.7	56.7	59.2	0.017	***
	Business decisions	67.8	60.2	56.6	0.003	***
	Marketing decisions	73.3	60.2	60.5	0.010	***
	Decisions regarding the production pattern	70.1	64.7	63.2	0.010	***
	Outside business decisions	70.1	62.4	57.9	0.002	***
	Production process decisions	72.2	66.7	58.4	0.001	***
Satisfaction	Satisfied with life	51.2	53.0	49.3	0.874	
Use of technology	Internet users every day	46.1	24.2	9.1	0.000	***
Leaving agricultural land empty in the village	Those who answer: because of old age	16.0	9.4	23.7	0.197	
What would I want to do if I was young or my children continued my job?	Growing my business	89.0	93.9	94.9	0.257	
	To buy a machine. to renew	86.4	93.1	90.0	0.251	
	Investing in livestock	91.1	91.7	87.3	0.556	
	Setting up an irrigation system	82.8	77.7	72.4	0.281	
	Choosing a more profitable production system	88.6	95.4	89.6	0.137	
	Use credit	57.6	49.6	51.3	0.503	
Agricultural activities that cannot be done recently due to old age	I did not receive a production loan.	34.5	33.9	48.6	0.085	
	I did not get a consumer loan.	34.1	31.7	50.7	0.022	
	I avoided labour-intensive products such as vegetable, fruit, and livestock activities.	28.9	41.9	60.6	0.000	***
	I did not use agricultural tool machines.	20.0	33.6	40.3	0.021	***
	I did not work in the field.	23.8	26.4	39.7	0.061	
	Other	18.6	28.8	33.3	0.332	

*** = There is a significant difference among the groups
Source: Survey results, 2019

Figure 1 - Motivations against farm succession (%).
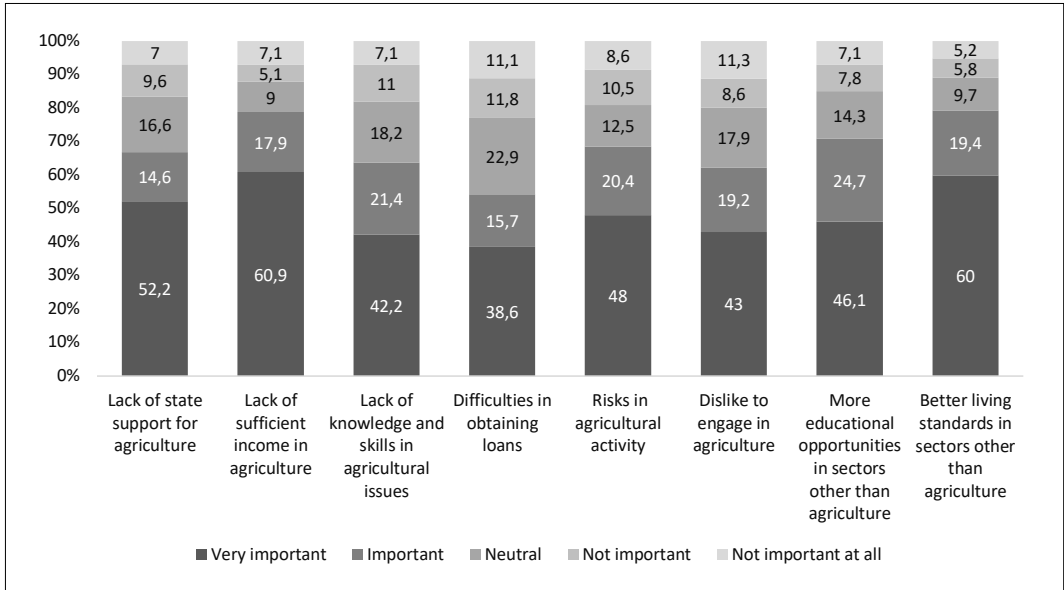
Source: Survey results, 2019.

to make the agricultural sector less and less attractive, added to that the fact that 62.2% of respondents think that their children are not at all interested in agricultural activities. As could be guessed, among the reasons mentioned by the participants in our study, the most notorious ones are the insufficiency of income generated by the activity (78.8% of respondents answering no to succession), the better standards, and the living conditions in other sectors (79.4%). Not insignificantly follow the outlets offered by branches of study other than agriculture (70.2%), insufficient state support for the sector (66.8%), and the risks of the activity itself (68.4%).

In the study, 26 questions assigned scale points 5 (1. very important, 2. important, 3. neutral, 4. Not important, 5. it doesn't matter) were asked to determine the importance of elements that help farmers to continue agricultural activities in term of the sustainability issues in the agriculture sector. Since the points from answers are discrete type data, non-parametric Kruskal Wallis Tests were performed to understand an age effect on sustainability in agriculture.

Kruskal Wallis Test results are given in Table 3; the degree of freedom for all tests is 2 since the age variable has three groups. In the study, the per-

centages of 40-55, 56-65, and above 65 years old farmers are 30.3, 44.23, and 25.64 respectively.

According to test results, the importance attached to making dissemination programs, conducting agricultural training programs for young people, having childcare (home economy) services, increasing credit opportunities, training on marketing, etc. is statistically different due to the ages of farmers (p-values < 0.05). Since the mean rank of younger farmers is less than that of the above 65-year-old farmers, the factors mentioned above are more important for younger farmers to continue agricultural activities. For young farmers, it is obvious that educational supports and activities take great importance in terms of future working in agriculture. Also, credit opportunities should be increased and more accessible.

Experiences of farmers above the age of 65 would be important to understand precautions in staying in the agriculture sector for youngsters. Among the means of ranks belonging to old farmers, the means of ranks for guaranteed product prices (144.12) and providing additional job opportunities for family members (144.97) are less comparing other statements but not statistically different from other ages' ones. Even though, it could be said that they evaluated these

Table 3 - Kruskal Wallis Test Results of elements for continuing agriculture production.

Statement	Age Groups			Chi-Square	P-value
	40-55	56-65	Above 65		
	Mean Rank	Mean Rank	Mean Rank		
Making dissemination programs	128.26	144.51	163.36	7.56	0.020
Not having too much debt	141.62	138.08	161.04	4.35	0.110
Finding loan when needed	144.57	139.95	156.39	2.06	0.358
Having non-agricultural income	141.51	138.55	156.30	2.54	0.281
Agricultural support by State	145.69	139.01	154.73	2.04	0.361
No difficulties in recruiting workers	142.07	135.02	161.76	5.41	0.067
Visit and assistance of agricultural engineers from pesticide dealers	135.43	140.81	161.64	4.70	0.096
Visit and assistance of agricultural engineers from agricultural organizations	132.98	141.38	157.59	3.91	0.142
Family members working outside the firm	131.56	145.08	156.72	3.90	0.142
Conducting agricultural training programs for young people	135.54	136.09	164.49	7.02	0.030
Having childcare (home economy) services	136.70	134.50	165.57	7.74	0.021
Increasing / improving educational opportunities	149.24	135.65	152.66	2.70	0.259
Improving infrastructure facilities (road, communication, etc.)	148.13	137.84	150.07	1.51	0.470
Increasing non-agricultural job opportunities	133.98	142.65	151.93	2.07	0.356
Providing support against natural disasters (flood, hail, frost, etc.)	141.46	138.83	154.31	2.00	0.368
Providing additional job opportunities for family members	143.41	140.56	144.97	0.17	0.920
Guaranteed product prices	144.16	143.82	144.12	0.00	0.999
Increasing credit opportunities	132.07	141.05	165.12	7.38	0.025
Increase in the number of agricultural cooperatives	134.29	144.13	157.04	3.27	0.195
Training on marketing etc.	133.65	139.82	163.34	6.14	0.046
Developing to produce agricultural products with contracts	135.78	142.27	158.62	3.46	0.177
Having information about product prices before producing	139.70	143.78	147.38	0.39	0.823
Availability / increase of storage services	139.29	145.36	149.03	0.63	0.730
Having transportation services	141.92	143.49	149.30	0.38	0.827
Information on packaging	137.22	141.99	157.45	2.76	0.251
The convenience of packaging supply. etc.	140.11	140.94	155.96	2.02	0.364

Source: Survey results, 2019.

factors more important than others did. They wouldn't like to lose money because of unpredictable product prices and have additional jobs their children against if something goes wrong in production phases. Prices of products can be guaranteed by the government, which has provided so far for some strategic products.

3.2.2. *Impact of ageing on agricultural activities*

Figure 2 - Decisions taken because of ageing (%).

Source: Survey results, 2019.

Producers see ageing as a state marked by a physical or physiological change, several experiences acquired, sometimes being accompanied by health problems, loneliness due to the departure of children, or the loss of loved ones, all of this reminding them of the approximation to death. Because of their advanced age, 50% of the farmers say they have difficulties in carrying out activities such as administrative formalities (registration in the register of farmers, insurance, etc.) and in the use of new technologies. Regarding operations, the impact of ageing can be seen through the disinvestment of 57.7% of the farms surveyed. The farm manager, seeing his advanced age, refrains from making considerable investments such as the acquisition of new equipment or tractors (60% of farms that are disinvesting). Among the group of farmers that are disinvesting, the sale of land capital (5.6%), and the sale of their tractor (s) (12.2%) are other decisions taken over the past 10 years due to ageing. The results from the cross-tabulations analysis are shown in Figure 2.

This analysis shows that compared to younger producers, 23.8% of older producers refrain (more than the latter) from undertaking profitable new crops.

However, the idea of expansion in the event of youth or resumption of activity by the children heirs, whether through the renewal of equipment (90.3%), diversification towards more profitable speculations (91.8%) such as breeding (90.4%), or even the installation of an irrigation system (77.8%), is fully approved by most producers regardless of age; the idea of using credit was much less prominent (52.4%).

Another impact of age on decisions is the limitation of credit. According to our result, ageing also impacted the loan demand of farmers. Famers above 65 avoid taking consumption loans 18% and production loan 14.5% times more than the youngers.

In addition to the reduction in the level of agricultural activities mainly by older producers, there is the sale of land capital and the reduction in the number of producers. The participants of our survey affirm that in the space of 10 years the number of farmers in the areas of our study has fallen by 23.71% and by 26.26% for that of large farms. 6% of the producers surveyed reveal that they have personally sold agricultural land over the past 10 years (on average 10 decares per person) and 75.1% of the respondents state that during this same period, agricultural land was sold. Among the reasons for the sale, the willingness of the heirs not to continue the activities weighs 15%, the move of the owner outside the village contributes 16%.

In many cases, these lands were acquired by people outside the village, with the objective of agricultural production (36.6%), an investment or to live in the countryside (28.8%).

In addition to the disinvestment of farms by the sale of land capital or work equipment, there are unexploited lands according to 50.7% of participants in our survey. On average per village, 54.6% of unexploited land covers 101 to 400 decares and 25.9% more than 400 decares. The causes identified are mainly conflicts of division between heirs (38.8%), insufficient income from the farm (23.0%), and the advanced age of the farm manager (15.1%).

4. Discussion

Our study works on the sustainability issue in the ageing rural population context. Starting with the implication of farmers' family members in the activity, the results show that at most 30% of the decisions are made in concert with family (wife and children); the implication of the family in the decisions is more around future, marketing planning than production activity. Errington (1998) in his study claims that when there is a successor, the delegation of tasks and decisions starts first with technical decisions, farm planning operations; then come to the managerial and strategic planning decisions, and lastly the financial decisions.

Our study reveals that 45.6% of the farmers do not expect a succession by their children whereas Lobley et al. (2010) in their study about farm succession and retirement found a rate below 35% for United States farmers that could identify a successor. In comparison with England that has a succession rate lightly above 50%, the authors established a link between the age of the farmer and the likelihood of having a successor for England and Canada. The reasons evocated are mostly the attractiveness of the other sectors (Figure 1). Off-farm income being higher and stable, children of older farmers are more likely to exit agriculture for the off-labour market (Corsi and Salvioni, 2017). Besides the insufficiency of the income of farmers, the amount of subsidies is considered as not enough to encourage the production. In their study, Mili et al. (2017) demonstrate the role of subsidies through simulation; when subsidies are well addressed, there will be more conversions of olive farms to more environment friendly systems in Andalusia. These assessments and opinions gathered corroborate with the phenomenon of the rural exodus that occurs during the transition of the economy of the countries. In their study about the farm succession process, Uchiyama et al. (2008) noticed that the farm size play an important role in the decision of heirs to take up the succession. They explain it by the fact that larger farms present more opportunities for the older and younger generation to work together whereas heirs from smaller farms prefer to be employed off the farm.

The phenomenon of transition in the economy which can be noticed by the reduction in the percentage contribution of the agricultural sector to GDP (in favour of the tertiary sector), manifests itself in the agricultural sector through mechanization and, to a certain extent, through its industrialization whose origins date back to post-war 1939, when scientific progress was used to ensure the food for populations mostly devastated by war (FAO, 1955). This explains why 65.8% of producers strongly agree with the fact that agricultural activities are easier than before, just as much as agronomic knowledge is more accurate (64.4%).

Focusing on the consequences of ageing on productivity, results reveal that 50% of our survey participants declaring not being able to do administrative formalities. When analyzing the issue in Thailand and Japan, Poungchompu et al. (2012) discovered that despite their will, old farmers tend to be less productive thence leading to the risk of food insecurity when the phenomenon is coupled with labour force reduction. Guo et al. (2015) came to a similar conclusion in their study where 58.53% of Chinese agricultural producers are likely to quit farming representing a threat to the active population if the succession does not take place.

Going on with the productivity perspective, the disinvestment rate of farms in our study is alarming (57.7% are concerned). The decision of disinvestment and turning to static management can be explained by the lack of successor just as have noticed Inwood and Sharp (2012) in their study. Calus et al. (2008) in their work reveal that farms with designated successors may do more investments. Still, to assess the impact of age on the decision-making of farmers, they

were asked what actions or initiatives they have not taken due to the age factor.

Like it can be guessed, the age factor made 60.60% of older farmers (23.8% more than the less old ones) avoiding some new crops (Figure 2). One of the reasons is the amount of labour involved in these farming activities. In his study of the ageing of the rural population in India and its implication for agriculture, Milovanović (2018) came out with a similar result that farmers younger than 60 work twice harder and more intense than their older counterparts.

The sale of land capital and the reduction of the producer population are self-explanatory. In his study about the rural exodus, Akdemir (1994) came up with the result that during the migration, families disinvest their farm to start a new life and invest in the city. Lobley *et al.* (2010) in their comparative study noticed that a great percentage of Canadian farmers (Ontario and Quebec) plan to sell land and other farm assets to fund retirement. The more farmers have enough income amount plan from private sources or government allocation, the less they plan to sell land or farm assets.

One information conveyed by 23% of sales of agricultural land to pay off debts is that agricultural producers, instead of resorting to consumer credit, prefer to sell their goods.

While analyzing a similar problem in China, it was found that the decision of leaving farmland idle is related to the absence of a successor (Sottomayor *et al.*, 2011; Lin and Wang, 2014).

The impact of ageing on productivity continues with the credit aspect also. The study helped to notice that ageing impacts the consumption of loans of farmers. That finding appears to be compatible with the one of Stiglbauer and Weiss (2000) who found that when a successor is designated, the farms increase their borrowing capacity to invest in farming. Considering these results, and also the fact that age affects the use of agricultural equipment (11.9% more than the others) and also on the accomplishment of agricultural work (14.3%), it appears that the ageing of the rural agricultural population has a significant impact on production capacities in general, through production factors.

To sum up, the study, following previous studies, reveals that ageing impacts the farmers by

their attitude of disinvestment, reduction of loan consumption, reduction of production capacity, avoidance of some new activities, and so forth that will inevitably be reflected on the performance, the innovation and competitiveness of the sector. The impact of the ageing continues to the level of the rural development in the way that, there is a capital transfer from rural areas to cities, whenever farms are disinvested due to the lack of successors or to finance the rural exodus of family members in the seek of the better farm off opportunities. Moreover, agriculture being one of the major economic activities in rural zone, rural exodus, capital transfer, and abandonment of farming also mean loss of added value and possible regression of economy in those parts of the country; which is clearly not an advantage for development in rural regions.

Tackling the threat that is planning on the sector, requests policies that will make agricultural sector and rural areas a hub of opportunities. Succeeding into making rural environments attractive (with necessary infrastructures, development projects), instead of rural exodus may lead to interest from the rural population or even urban population. One of those policies can be to develop agro-polis in or around respective production areas based on their core product(s). Developing the (or a big part of the) value chain in a rural area may solve the problem of migration and hence the one succession and farm disinvestment.

Proposing solutions requests to take into account the causes of the situation or at least the essential ones. One of the issues making agriculture less attractive for farmers and their heirs is the profitability of the agricultural activities. Indeed, in a changing economic environment with the inflation phenomenon, farmers are the ones bearing the biggest part of the augmentation of the cost of inputs' prices, as commodities' prices on the market barely change in response to the inflation. Whenever it changes, the biggest share goes to the other parts of the chain such as retailers of agro-food companies. In other words, the ageing population and its impacts on agricultural sustainability should be taken as a consequence (and not a cause) of all the difficulties that gangrene the production link of the agricultural chain, to be able, first to

diagnose those difficulties and then design tailored solutions or policies. As an example of a solution from farmers themselves, cooperative association, when well executed, turns out to be a potential solution for land consolidation, increasing farmers' power in the chain, solving the problem of succession, and thus, the one of disinvestment of farms. By the same token, converging individual strengths through cooperative or any form of association is an opportunity to reach the economy of scale, an excellent asset in this more and more competitive world.

5. Conclusion

In a context where the Turkish population is experiencing a phenomenon of rural exodus, mainly juvenile, following the transformation of its economy, study and understand the structural changes and the economic situation of the agricultural sector that employs more than 18% of the population and contributes to 5.8% of the national GDP is a necessity. The ageing of the rural and especially agricultural population has the effect of abstaining from agricultural activities among layers of older producers, both in terms of the diversification of productions, the renewal of production assets as well as investments or even acquisition of credits. Because the latter represent about a quarter of the agricultural population in our study, added to the fact that 45.6% of respondents doubted the succession of the agricultural holding, it is understood that the question of the sustainability of family farms and, by extension, that of the agricultural system is threatened. The research has also provided insight into how farmers think and make decisions and what kind of activities they do not like to do when they get older. The results are relevant for the formulation of social programs taking into account older producers, as they inform about the main turning points in the life of farmers and highlight the agricultural activities, which should be progressively more or less encouraged according to the age of the farmers.

As a result, for the sustainability of agriculture, it is imperative to solve structural problems related to land and business and to provide an environment that will ensure socio-econom-

ic prosperity. In addition to providing access to land for producers with little land (leasing, sharecropping, and land acquisition), consolidation of fragmented and scattered lands, the opening of dry agricultural lands to irrigation, widespread use of productivity-enhancing technologies can be a good start. Ensuring agriculture-industry integration, diversifying and increasing non-agricultural income sources, marketing, and taking a series of measures on value chain issues will increase the attractiveness of the countryside and contribute to the sustainability of agriculture. As a result:

- Strengthening the institutional capacities of young agricultural entrepreneurs in terms of competition, use of production technologies, mechanization, marketing, and value chain, (becoming a part of an organization and digital marketing).
- It is important to support young entrepreneurs more in Rural Development investments, to expand the projects and activities related to alternative non-agricultural income sources, and to encourage the entrepreneurship of youth in rural areas.
- About consolidating land, it is important to transfer shares to actual users by using land banking practices, to scale up and to support productivity-enhancing investments in growing lands.

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Non-financial factors affecting livestock farm's performance in meat supply chain

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Abstract

This article investigates non-financial factors affecting performance of livestock farms in the meat supply chain in Albania.

A structured questionnaire was developed to collect data in three main regions of Albania (Tirana, Korça and Lushnje). Confirmatory factor analysis is used to develop measures for the non-financial factors (i.e. trust, contracts, opportunistic behavior, information sharing and information quality) and Structural Equation Modelling is employed to test study hypotheses.

The result shows that trust is positively associated with farm's performance. On the other hand, communication (i.e. resulting from the merge of information sharing and information quality) is negatively associated with performance. However, communication appears to have a positive association with farm's performance indirectly through its effect on trust. Thus, it can be deducted that communication builds trust and trading relationship based on trust show higher levels of farm's performance. Lastly, contracts and opportunistic behavior do not show any significant association with farm's performance.

Keywords: Farm, Livestock, Meat, Supply chain, Non-financial factors, Performance, Structural equation modelling.

1. Introduction

After 46 years of centralized economy Albanian agriculture has changed significantly since the early 1990s. In the socialist era due to collectivization there have been 550 large state farms and cooperatives, but after the collapse of the socialist system and land distribution were created about 467000 small family farms. In 2014, the number of farms in Albania was 352315 with an average size of 1.16 ha (INSTAT, 2014). Family farms, as a result of the implementation of economic reforms in Albanian agriculture and the establishment of private ownership of land, are characterized by land fragmentation, financial difficulties in securing production inputs and lack of information, leading to a lack of farmers' bargaining power (Meço *et al.*, 2017). Also, Fetoui *et al.* (2020) referring to olive oil producers in Tunisia, states that land fragmentation, results in a lack of bargaining power. According to Markhof *et al.* (2010), the market driven economy forced Albanian farmers to change production patterns and major moves were made towards livestock production.

Livestock is the sector that has had the greatest development during the transition years where the number of heads and production has increased. According to national accounts' statistics for livestock,

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meat domestic production in Albania is dominated by cattle production which accounts for 45% of the total meat produced domestically. Meat consumption is already at 40 kg per capita (Markhof *et al.*, 2010). Meat exports are low, whereas imports of live animals are increasing, particularly the cattle and pigs. Imports of pork meat are quite high as well. The meat industry was the first agro-industrial sector to consolidate and develop, but it is focused on the domestic market.

Livestock is one of the main sector of agricultural development in Albania and it has a significant contribution to Gross Domestic Product (GDP). It is considered as a priority for development due to country favorable livestock breeding conditions, but its performance is still below optimal level. Performance is a concept that has multidimensional aspects. Financial and non-financial factors play a role in farm performance (Gunasekaran *et al.*, 2001; Kim, 2009).

The aim of this study is to identify how the non – financial factors impact the performance of livestock farms. A model to assess the contribution of each factor in the performance of these farms in the meat supply chain was build. Data was collected in three main districts of Albania (Tirana, Korça and Lushnje), as these three districts have a large number of livestock farms for cattle, small ruminants and pig breeding. The study applied Structural Equation Modelling (SEM) to investigate the causal relationships between some relevant factors and hypothesis testing.

To the authors' knowledge there is no similar study realized to evaluate the livestock farm performance. Latruffe and Piet (2014) have analyzed the impact of land fragmentation on farm performance, while Bojnec and Latruffe (2013) have investigated the relationship between farms size, subsidies and farm performance. Also, there is no similar study published previously in Albania in identifying and evaluating the contribution of non-financial factors on the performance of livestock farms. It should be noted that studies on this sector are mainly in the context of descriptive studies or focused on a specified meat subsector (for instance: Kipi *et al.*, 2010; Kristo and Leonetti, 2005; Kristo and Leonetti, 2010).

This paper is organized as follows. Section two reviews the literature on performance and non – financial factors that affect the performance. Section three describes the materials and methods used in this study, followed by hypothesis testing and research results. The paper ends with discussion and conclusion section.

2. Literature review on non-financial factors affecting farm performance

To better understand the factors that affect performance, first it is needed to measure it. Performance measurement involves the use of a multidimensional set of metrics, including financial and non-financial metrics (Gunasekaran *et al.*, 2001); internal and external, as well as metrics that measure what has been achieved so far, or metrics that will help to predict what can happen in the future (Bourne *et al.*, 2003). Furthermore, Gunasekaran *et al.* (2001) reviewed the literature on the supply chain performance metrics and concluded that there is not a balanced approach to financial and non-financial measures or to the number of performance indicators used.

Kim (2009) in the performance analysis of firms used financial and non-financial factors, relying on market-based performance, financial performance, as well as customer service. Cao and Zhang (2011) used sales growth, profit margin on sales, return on investment and increased return on investment to measure the performance in the supply chain. While Prajogo and Olhager (2012) in their study used production costs as one of the elements for measuring performance.

As mentioned above, this study will seek to evaluate the performance of livestock farms in the meat supply chain in Albania. In this context, the performance of livestock farms is measured through: sales revenue, production cost and the herd size, which is a measure built by the authors due to the nature of the study. Regarding the factors affecting farm performance, several factors have been identified from literature such as: trust, contracts, opportunistic behavior, information sharing and information quality.

Trust

According to Fynes and Voss (2002) trust is the foundation for business transactions because its presence creates a better working environment

by reducing contract specifications, providing incentives for collaboration or reducing uncertainty. Jap and Anderson (2003) would point out that trust is one of the most well-known mechanisms for governing the exchange relations. It is a key factor for developing partnerships between supply chain agents (Johnston *et al.*, 2004); it promotes long-term, mutually satisfactory and profitable relationships (Ganesan, 1994; Grewal *et al.*, 1999); reduces opportunistic behavior (Morgan and Hunt, 1994) and can act as a substitute for contracts (Lui and Ngo, 2004). According to Nevis and Money (2006) trust is expected to have a positive direct impact on performance, and it improves both buyer and seller commitment (Geyskens *et al.*, 1996). Therefore, the proposed hypothesis is:

Hypothesis 1: Trust between farmers and their buyers is positively associated with farm's performance.

Contracts

To achieve a better management of the buyer-seller relationship supply chain members are coordinated using contracts, which according to Nevis and Money (2006) state how the parties will have to behave. According to Lusch and Brown (1996) contracts can also be seen as an opportunity to reduce risk and insecurity, and have been suggested as improving channel profitability by enabling coordinating efforts of channel members. Therefore, the hypothesis raised by this study for contract is the following:
Hypothesis 2: The existence of contracts between farmers and their buyers is positively associated with farm's performance.

Opportunistic behavior

Opportunistic behavior is defined as a behavior in the pursuit of self-interest with stealing, lying, cheating, distorting, misleading (Williamson, 1975). At worst, opportunistic behavior is intended to cause harm, while in the best case it totally ignores the influence of others (Lai *et al.*, 2005; MacNeil, 1981). It should be noted that if there is little opportunism among supply chain members, the performance will be improved by trust; however, when opportunism is high, the positive impact of trust on performance is significantly reduced (Jap and Anderson, 2003).

A concept related to the opportunistic behavior is that of bargaining power. Bargaining power can be defined as a party ability "to obtain a concession from another party by threatening to impose a cost, or withdraw a benefit, if the party does not grant the concession" (Kirkwood, 2005). Xhoxhi *et al.* (2019) points out that farmers are reluctant to engage in contract farming with buyers with high bargaining power due to "fear" of intermediaries' opportunistic behavior which can result in extraction of higher rents from farmers' specific investments. In the same line, Sorrentino *et al.* (2018) argues that in bargaining power models one can account for opportunistic behavior.

Seeing that opportunistic behavior appears as an unfair behavior for maximizing self-interest, we can say that it will negatively affect performance. The proposed hypothesis is:
Hypothesis 3: Buyers' opportunistic behavior towards farmers is negatively associated with farm's performance.

Information sharing

Information sharing refers to the mass of critical information transmitted to one of the supply chain members (Monczka *et al.*, 1998). In fact, for many authors, information sharing among members of a supply chain is of great importance. For Lalonde (1998) information sharing is considered as one of the pillars that characterize a consolidated relationship in a supply chain. Lee *et al.* (2000) indicate that the potential benefits that may come from information sharing for producers may be: cost and inventory reduction. Marshall and Bly (2005) argue that the shared information builds and strengthens the relationship between the provider and the recipient of the information. Therefore, the hypothesis raised for information sharing is as follows:
Hypothesis 4: Information sharing between farmers and their buyers is positively associated with farm's performance.

Information quality

According to Prajogo and Olhager (2012) it is important both the quantity and the quality of the shared information. With information quality we will understand aspects related to the ac-

Table 1 - Mean, Standard Deviation (SD) and Cronbach's Alpha for each item.

	Mean	SD	Cronbach's Alpha
Information Sharing			.977
My buyer shares confidential information with me.	2.70	1.17	
Information sharing between me and my buyer is done on time.	2.73	1.18	
My buyer provides information that can help me.	2.69	1.11	
In the business relationship with my buyer, we keep each other informed of events or changes that may affect the other party.	2.77	1.16	
I share confidential information with my buyer.	2.73	1.21	
Trust			.930
My buyer keeps his promises.	3.12	1.05	
My buyer does not make false promises.	3.09	1.07	
I trust my buyer.	3.08	1.06	
My buyer does not take action that could damage my business.	3.25	1.04	
Information Quality			.947
The exchange of information between me and my buyer is accurate.	3.40	1.02	
The exchange of information between me and my buyer is complete.	3.30	0.98	
The exchange of information between me and my buyer is done at the right time.	3.33	0.96	
The exchange of information between me and my buyer is trustworthy.	3.34	1.01	
Opportunistic Behavior			.886
My buyer has benefited from the business relationship with me, in my damage.	2.51	1.27	
My buyer makes promises that does not hold.	2.50	1.20	
My buyer changes market conditions in order to benefit more from me.	2.80	1.32	
My buyer break formal or informal agreements with me, for his benefit.	2.54	1.27	
Contracts			.823
The business relationship with my buyer is governed by written contracts.	2.19	1.40	
My buyer and I have written agreements detailing the obligations, the rights of the parties and the consequences for its termination.	2.23	1.38	
I and my buyer do not formalize our agreement through a contract.	3.32	1.60	
Performance			.859
Sales revenue	3.36	0.92	
Herd size	3.74	0.89	
Production costs	3.20	1.00	

curacy, timing, sufficiency or reliability of the shared information (Monczka *et al*., 1998). It is true that information sharing is important, but the importance of its impact on the chain will depend on the information that is shared and with whom this information is shared (Chizzo, 1998; Holmberg, 2000).

Given the risk of voluntarily distorted infor-mation (Grundvåg Ottesen, 2006) from different actors in the chain, ensuring information quality becomes a very important element (Li *et al*., 2005). The proposed hypothesis for in-formation quality is:

Hypothesis 5: Information quality between farm-ers and their buyers is positively associated with farm's performance.

Figure 1 - The hypothesized model.
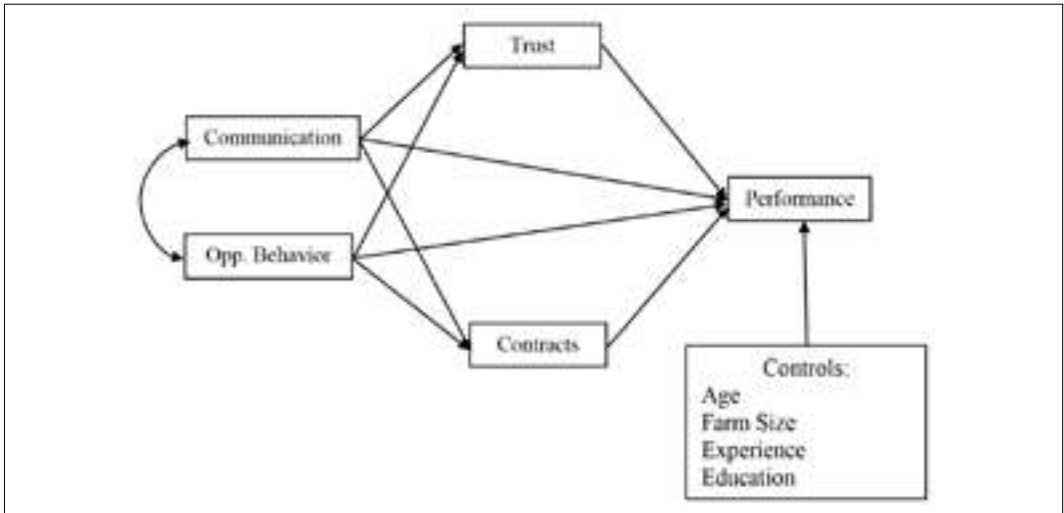
After preliminary data analysis, information sharing and information quality, two of the factors discussed above, have been merged together to give a new single factor called communication. Therefore, the new hypothesis that this study raise is the following:

Hypothesis 6: Communication between farmers and their buyers is positively associated with farm's performance.

Based on the discussion so far, the proposed study framework is presented in Figure 1, which represents the structural equation model of the research hypotheses previously outlined.

In order to consider potentially confounding variables, in the model were introduced some control variables. The control variables are:

a) Age (measured in number of years).
b) Farm size (measured in dynym[1]).
c) Farmers' experience (measured in number of years).
d) Farmers' education level (measured in number of years).

3. Materials and methods

3.1. *Data collection and sample*

Data were collected via a three-section questionnaire with close-ended questions. The first section aimed to collect general information of the farm: location, farm size, the significance of the livestock activities on the farm. Also, in this part of the questionnaire was collected information on the farm manager: gender, age, education, the number of years dealing with livestock. This information was gathered because was evaluated that these elements could have an effect on the farm's performance. The second section collected information about livestock activity on the farm, and the third section addressed the assessment of non-financial factors affecting the farm performance, using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). A total of 201 questionnaires were completed in three main regions of Albania; Tirana, Korça and Lushnje. These regions were selected due to the large number of livestock farms that these regions have.

3.2. *Measurement and construct validation*

Confirmatory Factor Analysis (CFA) was performed in AMOS 21. The model, have a good level of goodness of fit (*Chi-square* = 324.956; df = 194; p=.000; CMIN/DF = 1.675; CFI = 0.977, RMSEA = 0.05; TLI = 0.972).

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[1] 1/10 of a hectare.

Table 2 - Validity and reliability.

	CR	AVE	MSV	MaxR(H)
Performance	0.871	0.696	0.009	0.963
Trust	0.981	0.929	0.429	0.990
Opp. Behavior	0.892	0.683	0.056	0.993
Contracts	0.963	0.929	0.146	0.994
Communication	0.732	0.581	0.429	0.994

Note: CR - Composite Reliability, AVE - Average Variance Extracted, MSV - Maximum Shared Variance, MaxR - Maximum Reliability.

Table 3 - Factor correlation matrix with the square root of the AVE on the diagonal.

	Performance	Trust	Opp. Behavior	Contracts	Communication
Performance	0.834				
Trust	0.094	0.964			
Opp. Behavior	0.017	-0.193	0.826		
Contracts	0.029	0.278	-0.081	0.964	
Communication	-0.046	0.655	-0.237	0.382	0.763

Table 2 shows the results of reliability and validity of the measured constructs. Reliability will be analyzed based on the composite reliability (CR) values. Bagozzi *et al*. (1991) suggested that the minimum value of CR is 0.6. The results presented in Table 3 show that each construct has CR greater than the suggested threshold value of 0.6, in this way we conclude that reliability is achieved.

Convergent validity will be analyzed through AVE (Average Variance Extracted), as it is a strict measure of convergent validity. Malhotra and Dash (2011) would emphasize that AVE is a much more conservative measure of convergent validity than CR. The suggested threshold value for AVE is 0.5 (Hair *et al*., 2010). The results presented in Table 2 show that each construct has AVE greater than the suggested threshold value of 0.5, in this way it can be concluded that the constructs fulfil the condition of convergent validity. On discriminant validity, Hair *et al*. (2010) suggest that the three threshold values to prove discriminant validity are: a) AVE > MSV, b) AVE > ASV, c) square root of AVE greater than inter-construct correlations. Based on the results of the Table 2 and Table 3, it can be seen that the threshold values suggested by Hair *et al*. (2010) are achieved, the constructs also fulfil the condition of discriminant validity.

4. Results

The hypothesized structural model results with a very good fit (chi-square = 19.005; df = 13; p=.123; CMIN/DF = 1.462; CFI = 0.982, RMSEA = 0.048 and TLI = 0.95). Given the good fit of the model, the hypothesis was assessed by analyzing the estimated structural coefficients shown in Table 4.

As Table 4 shows, the hypothesis one (H1) regarding trust is supported, so trust has a significant positive effect on farm performance. Hypotheses two (H2) and three (H3) on contract and opportunistic behavior are not supported, so these factors have an insignificant effect on performance. While the result of the sixth hypothesis (H6) shows that communication has a significant negative effect on performance.

Also, referring to Table 4, of the four control variables used in this model only farm size and age have a significant effect on farm performance, while experience and education level do not significantly affect farm performance.

Table 4 - Structural model results.

Hypothesis (H)				Estimate	Std-Estimate	S.E.	C.R.	P
H1	Performance	←	Trust	0.259	0.306	0.082	3.164	0.002
H2	Performance	←	Contracts	0.031	0.047	0.050	0.616	0.538
H3	Performance	←	Opp. Behavior	-0.010	- 0.014	0.052	-0.198	0.843
H6	Performance	←	Communication	-0.426	- 0.308	0.145	-2.944	0.003
Controls	Performance	←	Age	-0.011	-0.136	0.006	-1.727	0.084
Controls	Performance	←	Farm size	0.127	0.172	0.055	2.314	0.021
Controls	Performance	←	Experience	-0.006	-0.067	0.007	-0.826	0.490
Controls	Performance	←	Education	-0.010	-0.041	0.018	-0.560	0.575
-	Trust	←	Communication	1.166	0.714	0.083	14.090	***
-	Trust	←	Opp. Behavior	-0.004	-0.004	0.045	-0.080	0.936
Controls	Trust	←	Education	0.029	0.098	0.014	2.011	0.044
-	Contracts	←	Trust	-0.068	-0.050	0.116	-0.557	0.578
-	Contracts	←	Communication	0.995	0.471	0.193	5.159	***
-	Contracts	←	Opp. Behavior	0.007	0.006	0.074	0.091	0.927
Controls	Contracts	←	Farm size	0.053	0.047	0.078	0.681	0.496
Controls	Contracts	←	Experience	-0.024	-0.172	0.009	-2.748	0.006
Controls	Contracts	←	Education	-0.026	-0.070	0.026	-1.027	0.304

Note: *** significant at p < .001.

4.1. Mediation

Since SEM provides a general and flexible framework for conducting mediation analysis (Gunzler *et al*., 2013) the following hypothesis is proposed:

Hypothesis 7: Trust mediates the positive effect of communication between farmers and buyers on the farm's performance.

The result of the mediation effect it is shown in the Table 5. Zhao *et al*. (2010) point out that the only on requirement to confirm mediation is to have a significant indirect effect. They continued their discussion by suggesting the use of bootstrap to prove the importance of the indirect effect as a more rigorous procedure compared to the Sobel test.

As shown in Table 5, trust mediates the positive effect of communication on the performance. Referred to Zhao *et al*. (2010) mediation type is competitive mediation since the mediated and direct effect both exist, but have opposite directions.

5. Discussion and conclusions

It should be noted that livestock breeding is one of the main branches of agricultural development in Albania, contributing significantly in the country's GDP. This sector has had the biggest development during the transition years, being considered as a priority sector for development due to the country favorable livestock breeding conditions.

Table 5 - Mediation effects through bootstrapping.

Hypothesis (H)	Mediation Path	Indirect Effect	P	Type of mediation
H7	Comm → Trust → Perfm	.302	.009	Competitive

Note: The type of mediation as classified by Zhao et al. (2010). Indirect effects are not standardized. Comm.- Communication; Perfm. – Performance.

This article aims to address the effects of non-financial factors on the performance of livestock farms in the meat supply chain in Albania. Literature has shown that the performance is affected by a number of non-financial factors, such as: trust, contracts, opportunistic behavior, information sharing and information quality Doney and Cannon (1997); Dasgupta (1998); Nevis and Money (2006); Lusch and Brown (1996); Weitz and Jap (1995); Williamson (1975); Monczka et al., (1998); Lalonde (1998); Prajogo and Olhager (2012).

Findings from this study show that there is a significant positive effect of trust on performance (H1). The result is in line with Nevis and Money (2006) who emphasized that trust is expected to have a positive direct impact in farm performance. In this case farmers believe in their buyer, believe that the buyer is trustworthy, that he keeps his promises, that does not make false promises and that does not take action that might harm their farm business. We can say that the result is in the same line also with Dasgupta (1998) according to which trust refers to the believe of an actor that the other party will fulfill his promises, and with Grewal et al. (1999) where trust among members on a chain is seen as an element that can lead to mutually satisfactory relationships in the long run.

Contracts were the second factor of which the impact on performance was tested, based on the work of Lusch and Brown (1996); Weitz and Jap (1995) who emphasized that the performance of marketing activities by members of a chain can be coordinated by clear and written agreements such as contracts. According to Nevis and Money (2006) contracts indicate how the involved parties should behave. Empirical findings showed that contracts had no direct effect in farm performance (H2). This means that farmers in the meat supply chain in Albania do not manage their business relationships through written contracts and that they do not have written agreements that detail the rights and obligations of the parties, as well as the consequences for their termination. This result is in line with Lusch and Brown (1996) who emphasized that various empirical studies were unable to find a link between contracts and performance; and

with Nevis and Money (2006) who viewed the contracts as a factor that does not necessary directly affect the performance.

Opportunistic behavior is defined as a behavior in the pursuit of self-interest with stealing, lying, cheating, distorting, misleading (Williamson, 1975). Findings from this study show that the opportunistic behavior does not have an effect in farm performance (H3). This because the farmer did not accept that their buyer disrupted the deals for his benefit; or that changes market conditions in order to benefit more from them, or makes promises in connection with the business relationship that does not hold.

Communication was the fourth factor for which was tested its direct effect on performance. This factor was created by merging two other factors, information sharing and information quality. Prajogo and Olhager (2012) emphasized the importance of quantity and quality of the information that is exchanged among members of a chain. According to Huo et al. (2016) in a supply chain communication facilitates the sharing of sensitive information, which is very important in the realization of transactions and in the reduction of opportunism. The study findings show that there is a significant but negative effect of communication on performance (H6). The results indicate that farmers and their buyers share information with each other, but not necessarily the shared information is qualitative because it may be voluntarily distorted (Grundvåg Ottesen, 2006). The information may not be accurate, complete or correct.

Regarding the control variables, farm size and the farmer's age had a significant association with farm's performance. The result shows that farm size is positively associated with farm's performance, while farmer's age is negatively associated with performance. Data analysis shows that farmer's education is positively associated with trust, while his experience is negatively associated with contracts. Indeed, the study does not aim to analyze the effect of control variables on the factors taken into analysis, but these results may constitute an indication for future studies.

In addition, this study also estimated the indirect effect of communication on the perfor-

mance of livestock farms through the mediation of trust for the fact that SEM provides a general and flexible framework for conducting mediation analysis (Gunzler *et al.*, 2013).

It appears that trust mediates the positive effect of communication on performance (H7). In this case, there is no voluntary distortion of the shared information as the relationship between the farmer and the buyer is based on the trust between them. While referring to the type of mediation, according to Zhao *et al.* (2010), the mediation is competitive mediation because both effects mediated and the direct effect of communication on performance does exist but have opposite directions.

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The factors affecting the marketing channel selection in sheep farming: A Turkish case study

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Abstract

This study was conducted to determine sheep farmers' selection of marketing channels in livestock sales and the factors affecting their choices. The research data were generated from the survey data of 53 enterprises selected via simple random sampling method in Samsun province in 2019. In this research, descriptive statistics were used to determine some characteristics of the sheep farmers, and the chi-square test was employed to compare the farmers' characteristics according to the selection of the marketing channels. According to the results of the study, four marketing channels were identified to be efficient in livestock marketing. These were final consumers, brokers, retailers, and mixed channels. Besides, it was determined that the variables of selling additional products (milk, cheese, fleece) in the enterprise other than livestock, being a member of the Sheep and Goat Breeders Association, and the reason of choosing marketing channels had an impact (P<0.05) on the selection of marketing channels.

Keywords: Livestock marketing, Marketing channels, Sheep farmers.

1. Introduction

Sheep breeding has an important place among animal production activities. This is because grasslands and pastures that are not used for other purposes can be utilized through sheep breeding, and main products are obtained, such as meat, milk, fleece, leather, and fertilizer. Besides, as a conventional practice from time immemorial, it is a production branch in which certain infrastructure and experience have been gained in terms of know-how and stock farming. Since sheep breeding is based on pasture, feed costs are low, the transition-to-yield period of animals is short, adaptation and breeding abilities are high, capital and fixed investment expens-

es are low, and the foreign-source dependency for breeding animals is relatively less (Tamer, 2014). According to the data by the Turkish Statistical Institute for the year 2019, there is a total of 38.449 million sheep in Turkey (TURKSTAT, 2019). The amount of meat obtained from sheep is 100.83 tons, and this amount constitutes 9% of the total meat production. Rural animal breeders are generally smallscale enterprises with poor bargaining power. Therefore, animal products' price in rural areas forms in oligopsony market conditions (Cevger *et al.*, 2011). In Turkey, the existing animal and animal products marketing system has a structure where levels other than breeders (especially a large number of interme-

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diaries) earn higher incomes. This structure is the most significant reason for the imbalance between producer and consumer prices. The distortion and price instability in the marketing system are at a high level. Lack of organization in sheep breeding causes the breeders to have insufficient bargaining power in the supply of inputs and make them unable to sell their products for their worth. Since the sheep breeders need money, they usually sell their products at low prices to the village collectors, drovers, or brokers that come to buy their animals, and they have to procure the inputs for the next production period at high prices (Kaymak, 2015). There is a shortage of roughage due to the insufficient feeding capacity of the grasslands and the limited production of forage crops. Shepherd's wage is a significant cost among other inputs in sheep and goat farming. On the other hand, it has become difficult to find qualified shepherds as the young population migrated from the region as a result of their inability to earn a living (Aksoy and Yavuz, 2012). Livestock farming input costs are considerably high in Turkey. In addition to increasing input costs, decreasing producer share in consumer prices for many products in the marketing chain consisting of the producer - collector - breeder - merchant - processor - wholesaler - retailer and consumer reveals that the support provided to production actually flows to the processes after production. In the ovine breeding sector, the organization of farmers has a weak structure. Breeder organizations in Turkey are formed as cooperatives, breeder associations, and producer unions, and their share in the marketing and processing of products besides their bargaining power are very low. Therefore, they have no effect on price formation (Ministry of Development, 2014). The main purpose of the Sheep and Goat Breeders Associations is to implement all kinds of breeding programs in order to raise high-yield animals. Besides, although the associations are also assigned duties in marketing and production issues, their marketing activities are very limited. In their study, Seçer and Boğa (2016) reported that 89.7% of the producers stated that big buyers, 7.7% big traders, and 2.6% cooperatives were effective in determining prices in animal product sales. The producers stated

the most important problems they faced in the marketing of animal products as the low number of buyers, low purchase prices, insufficiency of extension and support, lack of cash, lack of market information, and high loan interest rates (Seçer and Boğa, 2016; Tamer, 2014).

Within the scope of marketing agricultural products in Turkey, it is observed that various electronic sales platforms have been built, both from producer to consumer (B2C) and from producer to commercial enterprises (B2B). However, in marketing agricultural products, the opportunities of e-commerce cannot be utilized adequately. Furthermore, depending on the increase in demand for local food and for market structures providing them in our country, there are food center-type structures in different models, albeit insufficient. The most important examples of this are cooperatives, producer markets, organic markets, and food banks (Albayrak et al., 2020).

The marketing activities in the agricultural sector are not much advanced compared to other sectors. Since the level of organization in this sector is low and their opportunities to add value to the product are very little, the marketing orientations of most breeders are limited to the activity of selling their products (Haines, 1999).

In general, there is limited knowledge about the factors affecting the marketing channel choices of livestock breeders and the marketing strategies they employ. In the studies that investigated the livestock marketing in Turkey, mainly marketing margins (Aral et al., 2016) and market power and price asymmetry (Ozer, 2011; Bölük and Karaman, 2017) were discussed. In the study conducted by Aral et al. (2016) it was reported that 40,83% of the price paid by the consumer for lamb meat goes to intermediaries. Ozer's (2011) study put forward that producer prices were insensitive to price incentives, and the decisions of policymakers to intervene in production by using price incentives would not be reflected in the producers. There was only one study found, which was aimed at determining the factors that affect the marketing channel selections of sheep breeders. In the study conducted by Kadanalı et al. (2015) in the province of Ağrı, the factors affecting the marketing channel selections of sheep breeders were defined as

farmer's knowledge and herd size, trust in intermediaries and price, sales and relationships, and physical conditions of other farmers.

There are some studies discussing the marketing strategies applied by the breeders in several livestock businesses in the world (Davies, 2001; Tsourgiannis *et al*., 2005; Tsourgiannis *et al*., 2008); studies revealing the factors that have a significant influence on the marketing decisions of the enterprises (Tsourgiannis *et al*., 2005; Tsourgiannis *et al*., 2008; Mutura *et al*., 2015; De Bruyn *et al*., 2001; Gong *et al*., 2007; Srinivas *et al*., 2014; Benedek *et al*., 2014; Nyaupane and Gillespie, 2011) and investigating marketing channel structures and applied strategies in different sectors (Escobar and Gil, 2016; Fetoui *et al.*, 2020).

In Turkey, there is a lack of knowledge concerning existing marketing practices in terms of the development of the sheep breeding industry. This study aims to determine the channels used by sheep breeders to sell their animals and the factors that affect their selection of these channels. The present study will be helpful in order to increase the economic sustainability and competitiveness of sheep breeding enterprises.

2. Materials and methods

The research material consisted of breeders' personal information and general data on production activities, marketing activities, and factors affecting the marketing channel preferences in a total of 70 sheep farming enterprises located in Tekkeköy, Bafra, Vezirköprü, and Ladik districts in Samsun province, the region with intense sheep breeding activities. The data were obtained from face-to-face surveys with business owners. The questionnaire was prepared by utilizing the studies of Tsourgiannis *et al*. (2008), Kadanalı *et al*. (2015), Davies (2001), and Nyaupane and Gillespie (2011).

In order to determine the number of enterprises to be selected for the research, the total number of sheep farms in the province (3490) and the districts where the enterprises were concentrated were determined by using the report on Business/Small Ruminant numbers prepared by Samsun Directorate of Provincial Agriculture and Forestry. In line with the data obtained from the records, the number of enterprises between 25-500 heads where sheep businesses were concentrated in the province (2513 enterprises) and Tekkeköy, Bafra, Vezirköprü, and Ladik districts that made up the majority of these enterprises, were determined and included in the research. In the districts included in the scope of the research, a total of 70 enterprises were determined in a way to compose 5% of a total of 1408 enterprises which had a sheep number between 25-500, these enterprises were randomly selected, and face-to-face surveys were conducted with the business owners (Tsourgiannis *et al*., 2008). When entering the data of 70 enterprises surveyed for the analysis, the enterprises with missing data were excluded from the assessment, and the data of 53 enterprises in total were used in the analysis.

In the study, descriptive statistics were used to determine the mean values and standard deviations along with frequency and rates pertaining to some characteristics of sheep breeders. The chi-square goodness-of-fit test was applied to compare the factors affecting the choice of marketing channels, and Cochran-Mantel-Haenszel Statistics were utilized for the within-group comparison of the important features (McDonald, 2014).

3. Results

Some characteristics of sheep breeders are given in Table 1 and Table 2.

In this study, it was found that sheep breeders were, on average, 46 years old and had 22 years of experience in sheep breeding (Table 1). In addition, it was determined that owners of sheep breeding businesses were generally male, and they were mostly primary school graduates (49.1%). When the findings regarding the incomes of the breeders were examined, it was determined that 39.6% of them earned income only from sheep breeding, and, in this income, the rate of those selling only live animals (71.7%) was considerably high. Within income level segments, it was observed that the breeders with an income of over 40000 TL (32.7%) were more than the others.

Table 1 - Mean values and standard deviations pertaining to some characteristics of sheep breeders.

Characteristics	Mean	SD
The average age of breeders (years)	46.0	11.4
Duration of experience of breeders (years)	22.0	13.6
The share of sheep breeding in total income (%)	62.5	28.4
Number of sheep (head)	131.3	88.3
Share of livestock sales in the income from sheep breeding (%)	92.5	17.8
Livestock unit sales price (TL)	40.7	5.4

It was found that a large part of the breeders who participated in the survey had memberships in the sheep and goat breeders' association, whereas the rate of cooperative membership was quite low (18.9%). It was determined that sheep breeders chose marketing channels for their products mainly based on cash payment, familiarity, and necessity factors, and in product sales, the rate of price-setting by the buyer and the seller together (45.3%) was higher than the others (Table 2).

The marketing channels chosen by the sheep breeders and the selection rates of these channels are given in Figure 1. According to the surveys, it was determined that the breeders were marketing their products by choosing direct (final) consumers, brokers, retailers, or multiple channels at once (mixed or hybrid). Among these channels, it was observed that the rate of those choosing brokers was higher than the others.

Figure 1 - Distribution rates of the marketing channel selections.
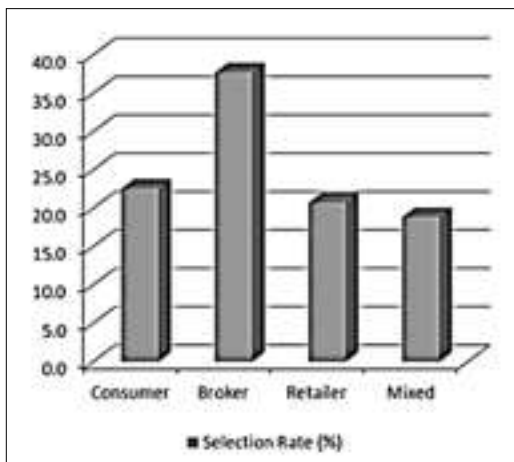
A comparison of sheep breeders' characteristics according to the selection of marketing channels is presented in Table 3. Channels that were not preferred in each of these features were not included in the analysis. The differences between the distribution of the rates of non-livestock product sales, association membership, and reasons for marketing channel selection, according to marketing channels, were determined to be statistically significant (P<0.05). On the other hand, the differences between the groups in other characteristics according to marketing channels were determined to be insignificant (P>0.05). Of these characteristics, when the distributions of those selling and those not selling products other than livestock were analyzed by marketing channels: it was determinedthat those selling products other than livestock chose brokers and final consumers more, whereas those selling only livestock chose brokers at a higher rate (P<0.05). When all breeders were evaluated in terms of association membership, it was determined that among the breeders who were members or not, the rate of those who preferred brokers was higher (26.42%) than the others. Also, when association members and non-members were compared within themselves, the rates of those who preferred brokers were found to be higher (P<0.05) in both groups. When the rates of the reasons for selection were compared in terms of the final consumers, brokers, retailers, and mixed sales channels, it was determined that the highest values were those who chose brokers due to necessity with a rate of 15.09% and those who chose the mixed marketing channels due to cash payment (P<0.01) (Table 3).

Table 2 - Frequency and rates pertaining to some characteristics of sheep breeders (%).

Characteristics	Frequency	Rate
Gender		
Male	51	96.2
Female	2	3.8
Educational level of breeders		
Literate	2	3.8
Primary School	26	49.1
Middle School	10	18.9
High School	7	13.2
University	7	13.2
Illiterate	1	1.9
Breeders' income-generating activities other than sheep breeding		
Yes	32	60.4
No	21	39.6
Total income level		
Less than 20000 TL	11	21.2
20000 – 30000 TL	13	25.0
30000 – 40000 TL	12	22.1
More than 40000 TL	17	32.7
Products other than livestock sales in sheep breeding		
Yes	15	28.3
No	38	71.7
Cooperative membership		
Yes	10	18.9
No	43	81.1
Association membership		
Yes	46	86.8
No	7	13.2
Mode of payment of the product price		
Cash	31	58.5
Installment	22	41.5
The reason for choosing the marketing channel		
Cash payment	22	41.5
Necessity	13	24.5
Higher price	2	3.8
Familiarity	13	24.5
Proximity	1	1.9
Suitability to the quality of the product	2	3.8
The person who determines the sale price of the product		
Buyer	11	20.8
Seller	10	18.9
Both of them	24	45.3
Other	8	15.1
The place for learning market knowledge regarding product prices		
By visiting the market directly	27	50.9
From other breeders	15	28.3
From friends	6	11.3
From the Internet	2	3.8
Other	3	5.7

Table 3 - Factors affecting the marketing channel selection.

Characteristics	Final Consumer		Broker		Retailer		Mixed		P value
	N	%	N	%	N	%	N	%	
Gender									
Male	12	22.64	18	33.96	11	20.75	10	18.87	0.258
Female	0	0.00	2	3.77	0	0.00	0	0.00	
Educational level of breeders									
Literate	0	0.00	2	3.77	0	0.00	0	0.00	
Primary School	7	13.21	12	22.64	3	5.66	4	7.55	
Middle School	2	3.77	2	3.77	3	5.66	3	5.66	0.428
High School	1	1.89	1	1.89	4	7.55	1	1.89	
University	2	3.77	2	3.77	1	1.89	2	3.77	
Illiterate	0	0.00	1	1.89	0	0.00	0	0.00	
Breeders' income-generating activities other than sheep breedin									
Yes	4	7.55	14	26.42	9	16.98	5	9.43	0.066
No	8	15.09	6	11.32	2	3.77	5	9.43	
Total income level									
Less than 20000 TL	2	3.77	4	7.55	5	9.43	0	0.00	
20000 – 30000 TL	2	3.77	5	9.43	1	1.89	5	9.43	0.169
30000 – 40000 TL	4	7.55	3	5.66	2	3.77	3	5.66	
More than 40000 TL	4	7.55	8	15.06	3	5.66	2	3.77	
Products other than livestock sales in sheep breeding									
Yes	5	9.43	7	13.21	0	0.00	3	5.66	0.030**
No	7	13.21	13	24.53	11	20.75	7	13.21	
Cooperative membership									
Yes	3	5.66	2	3.77	3	5.66	2	3.77	0.585
No	9	19.98	18	33.96	8	15.09	8	15.09	
Association membership									
Yes	12	22.64	14	26.42	11	20.75	9	16.98	0.015*
No	0	0.00	6	11.32	0	0.00	1	1.89	
Mode of payment of the product price									
Cash	7	13.21	10	18.87	5	9.43	9	16.98	0.100
Installment	5	9.43	10	18.87	6	11.32	1	1.89	
The reason for choosing the marketing channel									
Cash payment	5	9.43	6	11.32	3	5.66	8	15.09	
Necessity	2	3.77	8	15.09	3	5.66	0	0.00	
Higher price	0	0.00	0	0.00	2	3.77	0	0.00	0.006*
Familiarity	5	9.43	5	9.43	3	5.66	0	0.00	
Proximity	0	0.00	1	1.89	0	0.00	0	0.00	
Suitability to the quality of the product	0	0.00	0	0.00	0	0.00	2	3.77	
The person who determines the sale price of the product									
Buyer	2	3.77	5	9.43	3	5.66	1	1.89	
Seller	2	3.77	3	5.66	1	1.89	4	7.55	0.324
Both of them	8	15.09	9	16.98	4	7.55	3	5.66	
Other	0	0.00	3	5.66	3	5.66	2	3.77	
The place for learning market knowledge about the product									
By visiting the market directly	6	11.32	11	20.75	4	7.55	6	11.32	
From other breeders	4	7.55	6	11.32	3	5.66	2	3.77	
From friends	1	1.89	1	1.89	3	5.66	1	1.89	0.558
From the Internet	0	0.00	2	3.77	0	0.00	0	0.00	
Other	1	1.89	0	0.00	1	1.89	1	1.89	

4. Discussion

In our study, it was determined that 37.7% of the breeders sold their livestock to the brokers, 22.6% to the final consumers, 20.8% to the retailers, and 18.9% to more than one middleman. In a study conducted in the province of Niğde (Seçer and Boğa, 2016), it was stated that 89.7% of the breeders sold their livestock to retail butchers and 10.3% to merchants, sales were generally made in the farmyard, and the product prices were received in cash. In a study conducted in the province of Ardahan (Demir *et al*., 2015), it was reported that 86.4% of the enterprises did not use any middlemen when selling sheep or lamb, and 13.6% of them sold to merchants (drover). In their study, Tsourgiannis *et al*. (2005) determined that breeders sold their livestock to retail butchers by 21.7%, to wholesalers by 56.7%, to direct consumers by 5.4%, to other farmers by 1%, and reserved for their consumption by 6.1%, and breeders used mixed channels (multi-channel) by 9%. Some studies reported that breeders used more than one marketing channel. In the study conducted in the province of Muş (Kaymak, 2015), it was found that the breeders sold 59.6% of their livestock to merchants (drover), 27.4% to retail butchers, and 13% directly to consumers as sacrificial animals. In the study conducted in the province of Yozgat (Tamer, 2014), it was stated that the breeders sold their livestock mostly to the merchants (drover), at the rate of 36.5%.

In the present study, it was determined that the variables of selling additional products other than livestock in sheep breeding enterprises, being a member of the Sheep and Goat Breeders Association, and the reason for the breeders to choose the marketing channels were effective in the marketing channel preference. Sales of additional products other than livestock in enterprises, in other words, selling milk, yogurt, and cheese along with livestock, provide an extra source of income for the breeders and ensures that there will be no cash shortage in case of a delay in payments. Breeders who do not have this opportunity increasingly tend to prefer channels with a cash payment (Thamthanakoon, 2019). Our study revealed that breeders who did not sell any product other than livestock mostly sold to brokers and retailers. Similarly, the case that breeders earned income from activities other than sheep breeding also enabled them to make more independent decisions when choosing channels. In a study conducted in Kenya, it was reported that breeders with additional off-farm income were more likely to sell through dairy cooperatives (Mburu *et al.*, 2007). The advantage of having extra revenue increases the acceptability of late payments from the marketing channels.

Breeders' membership in a group (Sheep and Goat Breeders Association) is a significant variable that affects the decision making of channel selection. This group can be an association, cooperative, or another organization. Group membership and access to information (market, price, and production knowledge) significantly differ in different sectors and countries and affect channel selection in various ways. Generally, the group membership factor is associated with access to information (Girma and Abebaw, 2012; Thamthanakoon, 2019). Ahmed *et al.*, 2016) found that access to market knowledge by small-scale Pakistani breeders had a positive effect on their market decisions, and Jari and Fraser (2012) determined that access to market information by breeders in South Africa had a positive impact on their market choices. Furthermore, breeders who are members of the Sheep and Goat Breeders Association benefit from government support. The opportunities provided by these supports to the breeders affect the choice of market channel. In their study, Girma and Abebaw (2012) reported that government subsidies increased the financial resources required for the breeder to operate more efficiently, and this situation considerably determined the breeder's decision regarding the market channel.

When the reasons for the breeders to choose the marketing channels were examined, it was determined that they made their decisions mostly due to cash payment and necessity. De Bruyn *et al*. (2001) reported that small businesses preferred cash payment because they needed ready money. Tsourgiannis *et al*. (2008) determined that the speed of payment had a significant effect from the viewpoint of sheep and goat breeders

in Greece when selecting local milk processing plants, cooperatives, and large national dairy companies as their marketing channels. Hobbs (1997) found that fast payment was an important factor in selecting channels for cattle marketing. Similarly, in our study, it was determined that payment terms had a significant effect on the choice of marketing channel.

In Turkey, breeders are forced to sell their livestock because they have no competitive power and they need cash, and they hand over their animals to the first broker they meet (Dağdemir et al., 2003). Therefore, necessity was identified as another significant factor affecting channel choice.

The effect of the gender factor was found to vary in several studies. In some studies, gender was pointed out as a significant factor (Benedek et al., 2014; Girma and Abebaw, 2012). In some other studies, on the other hand, gender was not defined as a significant factor in marketing channel selection (Mutura et al., 2015; Srinivas et al., 2014; Kumar et al., 2011). Similarly, in our study, the gender factor was not found to be effective on channel selection.

Another factor that affects the breeder's choice of marketing channel is education. The effect of the level of education is realized by giving the breeder access to market information, and thus, they take more risks (Mutura et al., 2015; Kumar et al., 2011) found that more educated small-scale dairy farmers in Kenya were more likely to sell through cooperatives due to their ability to understand and interpret market information. In some other studies, on the other hand, the education factor was not found to be influential. The authors suggested that this fact could be explained by the slight differences between the educational levels of the breeders since the highest level of education among the respondents was secondary school (Soe et al., 2015). Similarly, in our study, the effect of education was not found to be significant.

The bargaining (negotiation) power of the breeder must be high in order to be the party that is influential on the sales price, in other words, the party that determines the price. In the previous studies, bargaining power is defined as an influencing factor in terms of decision making on channel selection. Bargaining power was found to have a significant impact on the marketing channel decisions of sheep and goat ranchers in the eastern Macedonia region of Greece (Tsourgiannis et al., 2008). In our study, the effect of bargaining power was not found to be significant.

Access to market information guides the decision of channel selection. It is important for breeders to obtain information about the market prices, the time of sale, and the point of sale so that they can choose the most appropriate channel for them (De Bruyn et al., 2001). In the study conducted in Ethiopia, it was reported that farmers' membership in agricultural cooperatives and the ability to easily access to market information reduce the likelihood of sales to local traders, increasing their direct access to consumers (Girma and Abebaw, 2012).

Market information can be accessed from different sources. Srinivas et al. (2014) identified government officials and other breeders as the main sources of market information. The sources most frequently used in our study were direct visits to the marketplace and the other breeders. However, the sources for gathering market information were not found to be effective on the marketing channel selection.

5. Conclusion

As a result of this research, the channels preferred by sheep breeders in sheep marketing, and the factors affecting their channel selections were explained. 37.7% of the breeders stated that they preferred to choose brokers in marketing their products, 22.6% final consumers, 20.8% retailers, and 18.9% more than one channel. It was determined that 71.7% of the breeders sold only livestock, and these people preferred brokers more. This situation causes the breeders to miss the opportunity of earning income by processing the products resulting from their production activity and their income to be limited. Besides, when assessing the breeders' marketing channel preferences according to their association memberships, their marketing channel decisions were more in favor of brokers in both breeder groups that were members and non-members of the association. Sheep breeders took into account

the cash payment when choosing the marketing channel, or they sold their livestock to middlemen due to necessity. In the study, it was determined that the cooperative membership rate of the breeders was as low as 18.9%. According to these results, it can be concluded that the majority of the breeders do not have a marketing organization, they need cash, and therefore they have limited opportunities to choose dealers and to compete. The case is that the breeders cannot get organized economically regarding marketing channels, or the existing cooperatives are quite inadequate. Through the active operation of the cooperatives and increasing the numbers of cooperative memberships, it will be possible to achieve efficiency in the marketing of livestock and other products and improve the profitability of the enterprises. In this context, it is important to implement policies that encourage producers to organize and also ensure the development of marketing and financing opportunities.

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A holistic approach in explaining farmers' intentional behaviour on manure waste utilization

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Abstract

This research examined livestock farmers' intention to move manure waste to an allocated landfill and the impact of financial support by municipalities on farmer's behaviour. The theoretical framework was developed using the Theory of Planned Behaviour and tested the validity of the model. The survey was carried out with 336 farmers in Bursa, Turkey, where animal husbandry is the primary livelihood source. Research results have shown that the developed model proved to be satisfactory in predicting farmers' intentions. The attitude (β=0.38; p<0.01) variable was the most important determining factor on farmer behaviour, followed by subjective norms (β=0.30; p<0.01). Local governments' financial support was a strong mediator effect between attitude (β=0.62; p<0.01) and farmers' behaviour. This study emphasizes that local governments should employ more proactive environmental measures, raise financial support initiatives in animal waste management to ensure farmers' participation in these practices and sustainable agriculture.

Keywords: *Waste Management, Peri-urban farming, Theory of planned behaviour, Structured equation modelling, Environmental sustainability.*

1. Introduction

Agricultural policies have various goals: increasing the yield, farmers' welfare, ensuring price stability, improving consumer welfare through the cheap food supply, and ensuring self-sufficiency in agriculture, rural development, and sustainable agriculture. The adverse effects of conventional agriculture on the world's environment have placed and emphasized sustainable agriculture. Sustainable agriculture ensures sustainability in livestock production. Sustainable livestock farming requires system thinking. Systems thinking takes animal production a holistic approach to animal health, welfare, breeding, nutrition, housing, and manure management as interconnected system components.

Population growth, urbanization, changing diets and rising per capita income increase the demand for meat and dairy products. The policies aimed at increasing the number of animals increased the number of livestock enterprises. Consequently, more waste was generated from enterprises. Therefore, waste, particularly manure management, is becoming increasingly critical for human and animal health. The shifting of settlements towards rural areas and

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the inclusion of villages within the municipal boundaries, through Municipal Law 6360, increased this importance.

The Metropolitan Law No. 6360, entered into force in 2014 in Turkey, has made significant changes to local governments' administrative structure. The metropolitan municipality borders have been expanded and overlapped with the province borders (Official Gazette, 2012). Law No. 6360 resulted in converting villages in the 30 metropolitan districts to the 'neighbourhood', meaning that the people in the new neighbourhood became subject to the district and metropolitan municipality law and subject to municipal services (Koca, 2016).

The law has brought about fundamental challenges for livestock farmers. Primarily, the law required livestock farmers to obtain project and development permits and licenses to comply with minimum technical and hygienic requirements, as with all other food-dealing businesses in cities. The design and construction of the existing barns are usually done as the need arises and through experience or other farmers' advice, not within a plan and project. Manure storage is often neglected. Research shows that 80% and above of the examined livestock enterprises do not have manure storage buildings (Atilgan *et al.*, 2005; Boyaci *et al.*, 2011; Cayir *et al.*, 2012). Impermeability cannot be achieved in the existing manure storage units. Manure that leaks pass into the surface runoff with precipitation mix with the surrounding surface waters and cause soil and water pollution (Cheng *et al.*, 2015). These structures faced with the problem of obtaining licenses and obtaining these licenses brought an additional financial burden on farmers.

The authors argue that the approach to promoting environmentally friendly behaviour is tripartite through volunteerism, incentives, and regulation and that the balance between these approaches fluctuates over time. The pressure on government resources is increasing. Governments are trying to create more cost-effective agro-environmental incentives (Hodge, 2013) and are keen for farmers to turn to low-cost options arising from their voluntary activities. However, regulations remain an essential policy instrument to encourage farmers for environ-

mental production. The authors stress that environmental benefits resulting from regulations require an ongoing flow of payments and compliance checks. If the support is taken out, there is a danger that those benefits will vanish (Yavuz and Gürbüz, 2001).

Numerous studies investigated farmers' willingness to accept subsidy payments for agri-environmental subsidy schemes. Some of these studies question the benefits of state support and the level of acceptance by farmers. Those authors present evidence that some farmers have been far less interested in agri-environmental subsidy schemes (AES) (Christensen *et al.*, 2011). Authors argue that current support, particularly the environmental supports, is too low to attract most farmers (Hennessy and Wolf, 2018; Pröbstl-Haider *et al.*, 2016). They claim that sector if farmers are willing to take up state subsidies if they are financially adequate. The main reasons for the failure of such support are inadequate compensation, excessive administrative effort, too long/too short support periods (Pröbstl-Haider *et al.*, 2016), delayed payment (Wang *et al.*, 2020) and farmers' unawareness of the subsidization policy.

On the contrary, many other studies have presented evidence that farmers are willing to take up state support, which is significant in farmers' behaviour. Xiong and Kong (2017) show that 87.80% of Poyang Lake Wetland farmers are willing to accept ecological compensation. Wang et al (2020) found that hog farmers revealed a strong preference for the scenario with specific and direct subsidies. Thu *et al.* (2019) conducted with 1287 small-scale tea producers in Vietnam. They found that the 50% price subsidy given to farmers increased their use of organic fertilizers by 25.7%. Ntakirutimana *et al.* (2019) investigated how the local government's financial support in China's Guangxi province affects farmers' behaviour of using green manure planting. Their study showed a 1.6-fold increase in the rates of farmers' participation in green manure planting compared to farmers using rotation fallow. Pongkijvorasin and Teerasuwannajak (2019) questioned the extent to which the incentive scheme effectively reduced the highland maize production of Thai farmers in the Sopsai watershed. The incentive scheme pro-

vided by 'Pidthong Lungpra' foundation and implemented in the Nammeed Basin in Malaysia's Nan region showed compelling results in changing farmers' highland farming behaviour.

2. Literature review

Efficient collection and disposal of manure waste and minimizing its effects on human and animal health and the environment requires assessing farm and livestock characteristics and considering, understanding, and analyzing farmers' attitudes, intentions and the social environment (Gurbuz and Ozkan, 2019b). There is a considerable number of research examining farmers' perceptions (Bonadonna *et al.*, 2019; Case *et al.*, 2017), intentions (Jiang *et al.*, 2018), attitudes (Meena *et al.*, 2009; Mondal *et al.*, 2014; Simha *et al.*, 2017; Strazzera and Statzu, 2016) and behaviour (Blackstock *et al.*, 2010; Power *et al.*, 2013) on various issues. One setback to these studies is that they focused on biomass waste, agricultural waste, crop waste and food and not on specifically animal waste.

The common characteristics the aforementioned studies that the effect of attitude, intention or social environment on behaviour was examined individually and independent of other factors. Many other intrinsic and extrinsic factors affect human behaviour. These factors either affect human behaviour directly besides attitudes or perceptions or indirectly by affecting attitudes and perceptions. Although the mentioned studies are precious, Ajzen's Theory Planned Behaviour (1985), which is explained in detail below, offers a more comprehensive and holistic approach in explaining farmers' intentional behaviour on the research matters; in this particular research on manure waste assessment.

2.1. *Theory of Planned Behaviour*

The TPB model

The Theory of Planned Behavior (TPB) first developed by Ajzen in 1985 and is widely used in understanding farmers' behaviour in a wide range of fields, and defines motivation and ability as the determinant of behaviour in a particular situation. TPB explains that people's conscious decisions to take specific actions are determined by their attitudes towards action, subjective norms and perceived behavioural control (Ajzen, 1985). The theory assumes that human intent has three independent determinants.

In the TPB, the main element is the individual's intention to perform a certain behaviour. Intention includes motivational factors that affect behaviour and indicate how much the individual wants to perform the behaviour. The stronger the intention, the more likely the behaviour will occur. Attitude is one of the most critical determinants of intention. Supposing that the individual has a positive attitude about doing a particular behaviour, he has a higher degree of intention about realizing that behaviour than the person who has a negative attitude. The second important determinant of intention, according to TPB is the subjective norm. Ajzen (1991) defines the subjective norm as "perceived social pressure to do or not do certain behaviour" or "other important persons' disapproval or disapproval of the individual's doing a certain behaviour". Some behaviour requires the availability of non-motivational factors such as facilities or resources (time, money, skills, etc.). TPB stresses that if an individual think that the resources and opportunities needed to realize behaviour are lacking, there will be no firm intention for that behaviour to occur. In cases where the person has control of the situation, the behaviour is estimated by the person's intention to do act in a certain way. Even if the person intends, if he cannot control his will, that behaviour may not occur. Thus perceived behaviour control (PBC) affects intention and the relationship between intention and actual behaviour (Ajzen, 2012).

Extension of the TPB model

In cases where the basic model cannot explain the behaviour, Ajzen has suggested including additional variables to the model. Therefore, some researchers have included additional variables to the original model of TPB to increase the theory's predictive power. As seen in the above examples, adding variables to the TPB model increases the model's explanatory power, but determining what these variables will be re-

quired an in-depth analysis of the critical factors affecting farmers' behaviour.

Some authors have introduced intrinsic factors. Rezaei *et al.* (2018, 2019), Bagheri *et al.* (2019) and Maleksaeidi and Keshavarz (2019) included moral norms and knowledge variables in the original in the TPB model. They aimed to predict the factors affecting farmers' intention to engage in on-farm food safety, apply personal protective equipment, estimate farmers' intention to use pesticides, and conserve on-farm biodiversity. Wang *et al.* (2019) added threat appraisal (perceived severity and perceived vulnerability) and coping appraisal (self-efficacy, response efficacy, and response cost) variables in the work they analyzed the environmental behaviour of farmers about non-point source pollution control and management.

Others introduced extrinsic factors. For example, Daxini *et al.* (2018) examined the factors influencing farmers' intentions to adapt to nutrient management planning in Ireland. They added perceived resources variable along with farm and farmers' characteristics (e.g. age, formal education, agricultural education, discussion groups, policy, and agricultural advisor, farming systems). Their improved model predicted 90.20% of the responses (Pseudo $R^2 = 0.45$). Chaudhary *et al.* (2017) examined the relationship between several variables using TPB with added variables such as personal norms, demographic factors, and past behaviours to use good irrigation practices among Florida home landscape irrigation users. R^2 in the original model was 0.251. The addition of demographic variables increased the overall R^2 by 1.7%. However, sociodemographic variables may not always have the same explanatory power. Meijer *et al.* (2015) examined the tree planting behaviour of smallholder farmers in Malawi. They also included socio-economic variables (district, gender, age, education level, membership farmers group, kinship, household size, farm labour, land size, income, and food security). However, they found that only membership of farmers groups increased R^2; none of the other variables had a statistically significant effect.

Due to Turkey's social structure, almost all participants are male in studies with farmers' participation. The Majority of farmers in the country are lowly educated and have a meagre income compared to the national average. Non-Governmental Organisation membership is not widespread; farmer cooperatives have not achieved the desired efficiency. Therefore, we concluded that the inclusion of demographic characteristics would not increase the model's explanatory power, as in Meijer *et al.* (2015). In Turkey and all developing countries, financial problems are among the most significant issues faced by farmers. A large part of these problems is structural. Ever-changing agricultural policies, the fact that state policies primarily support industry leaves farmers in a difficult position (Gurbuz and Ozkan, 2019a).

Variability in exchange rates increases input prices, but farmers cannot reflect the cost increases on sales prices. Farmers have difficulty delivering their products directly to consumers, and small profits are collected in intermediaries' hands. The high age of the farmers and the low level of education make it difficult for them to follow technological developments. The support given to farmers is deficient compared to other industries. Furthermore, the state cannot deliver the available financial aid on time. The supports provided are for production purposes. There is no financial support to encourage farmers to adopt more sustainable behaviours or facilitate their fight against agricultural or animal waste.

The current research in the literature revealed that farmers generally view environmental applications favourably (Wang *et al.*, 2019), but they were reluctant in implementing them due to financial constraints. We propose that farmers receive municipalities favourably allocating a specific land that does not threaten water resources and human health and provide farmers with the necessary infrastructure to dump livestock manure there safely and conveniently. Additionally, supposing that municipalities or the state provides financial incentives to cover the cost of transporting the manure to the common disposal point, in that case, farmers' behaviour towards manure's safe disposal will be positively and significantly affected.

This research hypothesis that, within the TPB framework, the financial support to be given to

farmers to dump their livestock manure waste to an allocated area will positively affect farmers' attitudes and behaviour of farmers to establish sustainable livestock manure management. Therefore, we have developed Ajzen's basic theory by adding the financial support variable. Further, the financial support variable might have a mediatory effect on intentions well as its direct effect. We investigated the mediating effect in the third phase of the study.

The hypotheses of the research are as follows:

Hypothesis 1-The TPB model created for the research will be an adequate model for explaining farmers' behavioural intentions to manage animal waste. Attitude, subjective norms, and PBC predict the behaviour of farmers regarding animal waste assessments.

Hypothesis 2-The addition of the financial support (FS) variable will increase the TPB model's explanatory power. The FS variable will positively and statistically significantly affect farmers' intentional behaviour regarding taking livestock manure waste to a central manure disposal area.

Hypothesis 3-Attitude, Subjective norms (SNs), and Perceived Behavioural Control (PBC) variables have a predictive effect on FS variable.

Hypothesis 4-The FS variable has a mediatory effect between farmers' attitude, positive norm and intentions.

3. Methodology

3.1. *The geographical context of the study area*

The research was carried out in Bursa province, in the town of Yenisehir. The district economy is based on agriculture and animal husbandry, and a sizeable percentage (78.7%) of the total population makes their living from agriculture. Agricultural production is made in approximately half of the district's total area (46.4%), and the average size of an enterprise is 32 decares. There are 32.201 animals in 2123 dairy cattle farms in the district, while there are 5.568 animals in 40 feeder cattle farms. The total number of bovines is 38 thousand. The number of ovine animal

farms is 471, and there is a total of 67 thousand 344 ovines in these enterprises. Yenisehir mainly meets the meat needs of restaurants and eateries in the surrounding districts (Bursa Governorhip, 2019; YCE, 2017).

3.2. *Participants*

The target audience of the study was livestock farmers in 61 villages of Yenişehir district. As of 2017, 2123 livestock farms registered to the Farmer Registration System (FRS) in Yenişehir Province. FRS is an agricultural database developed by the Ministry of Agriculture and Livestock (MFAL). The total sample size (n=336) was obtained using the formula developed by Yamane (1967) (Eq 1).

$$n = \frac{N}{1 - Ne^2} \qquad \text{(I)}$$

Where n= sample size; N= the size of the population; = The error of 5 percentage points.

We obtained the list containing information about farms, owners and addresses registered in the FRS from District Directorate of Agriculture and Cattle Breeders Association. Sample selection made randomly in the second stage.

3.3. *Survey*

Preliminary semi-structured interviews were conducted with five agricultural farmers during February 2019. The interviews' results were analyzed; the survey was developed within the framework of a literature review and information obtained from these interviews. A panel of agricultural and environmental experts verified the facial validity. A pilot test study was performed with a final year students from the Faculty of Agriculture, and the actual research was processed between September and November 2019. The questionnaire forms were filled in one to one interviews with the farm owners. Each interview lasted about 30 to 45 minutes. Additional comments that farmers made were also noted. Besides, various observations and measurements were made on-farm structures, and detailed photographs were also taken with the farmers' permission.

3.4. *Measurement of latent variables*

Firstly, we checked whether the scale developed to measure TPB structures meets the reliability and validity assumptions. Attitude, intention, subjective norms, and perceived behavioural control are latent constructs measured using a scale developed by Ajzen (2012). We measured each of these constructs on a scale of five items. Besides, a 4-item financial support construct was added to the TPB scale. Secondly, exploratory factor analysis (EFA) was conducted to test the construct validity, and whether the items were clustered under the correct construct was assured by checking the factor loads. Factor analysis is a widely used multivariate statistical technique that combines a large number of related variables into a small number of significant and independent factors.

Before performing EFA, a series of standard statistical tests were applied to check the suitability of the statements in the questionnaire. Kaiser Mayer Olkin (KMO) measures whether the sample is sufficient for analysis. The KMO value rages between 0 and 1; the closer it is to 1, the more suitable the sample analysis is. The KMO value must be higher than 0.50. The result of the KMO was 0.908 for the original model (TPB) and 0.915 for the developed model (TPB-FS). Bartlett's sphericity test was also significant for both models (p <0.001). The Bartlett sphericity test assesses the null hypothesis that the correlation matrix is the same as the identity matrix (all correlation coefficients are zero). If the *p*-value is <0.05, the data set is suitable for factor analysis. The Bartlett's test was significant at the p=0.0000 level in both models. Thus, we can say that the data obtained in the study was suitable for EFA.

After achieving valid results from the tests, the EFA was carried out. We used the maximum likelihood extraction method and varimax rotation to characterize components. The eigenvalue is useful for selecting the optimal number of components that are smaller than the total number of items. The eigenvalue measures how much of the variance of the observed variables a factor explains. Any factor with an eigenvalue ≥1 explains more variance than a single observed variable. Based on the above rule of thumb, four components in

the TPB model and five in the TPB-FS model retained. We have preserved statements that loaded onto components above 0.3 (Hair *et al.*, 2010). Factor loading close to -1 or 1 illustrates that the factor strongly influences the variable. In the original TPB model composed, the percentage of total variance explanation was 74,237, while in the TPB-FS model, this ratio was 74,837 with a slight increase. Factor loads of each item ranged between 0.654 and 0.933 (Table 3).

The Cronbach alpha coefficient was calculated to ensure the internal consistency of the original model as well as the extended model and the constructs in the models within the scope of reliability and validity analysis of the conceptual model developed for the research (Nunnally, 1978). The generally accepted value is 0.70 and above. The closer coefficient value to 1 indicates the higher internal consistency of the items in the scale (Hair *et al.*, 2010). We used SPSS software version 23 to perform EFA and descriptive statistics.

3.5. *Statistical analysis*

We used structural equality modelling (SEM) analysis with Amos software version 22.0 to validate and measure the conceptual model. We first built a structural model to investigate whether the TPB model was useful in predicting farmers' 'intentions. After validating the original model, we tested the TPB-FS model, adding the local government support construct to predict whether the support provided by local governments would influence farmers' intention to transport animal waste from their farms to a common disposal point.

We followed a two-stage data processing approach (e.g., measurement model and structural model) following Anderson and Gerbing (1988)'s recommendation. First of all, the research measurement models were initially estimated using Confirmatory Factor Analysis (CFA) to evaluate the models' adequacy (i.e., original and extended TPB models) by assessing the model fit, convergent validity, discriminant validity, and reliability. Further, in the second stage, we used the structural equation model (SEM) to estimate the hypothesized structural relationships between constructs (Bagozzi and Yi, 1988). For this purpose, we used the survey

Table 1 - Benchmarks and values of the model fit indicators.

Fit Indices	Fit Indices	Good Fit	TPB Model	TPB-FS Model
RMSEA	Root Mean Square Error of Approximation	RMSEA < 0.08	0.033	0.014
NFI	Normed-Fit Index	NFI ≥ 0.95	0.962	0.975
NNFI	Non Normed-Fit Index	NNFI ≥ 0.95	0.985	0.997
CFI	Comparative Fit Index	CFI ≥ 0.90	0.989	0.997
SRMR	Standardized Root Mean Square Residual	SRMR < 0.08	0.038	0.034
GFI	Goodness-of-fit index	GFI ≥ 0.95	0.947	0.967
AGFI	Adjusted Goodness-Of-Fit Index	AGFI ≥ 0.90	0.925	0.948
IFI	Incremental Fit Index	IFI ≥ 0.90	0.989	0.999
x^2/df		$0 < x^2/df < 3$	1.415	1.020

data variables obtained from CFA for relationship analysis after the adequacy of the measurement models was verified. SEM successfully tests complex models, performs numerous analyses at once, analyses a large number of linking constructs, and makes it easier to examine the mediation and regulatory effects and take into account measurement errors.

Many researchers have suggested several indices to test the overall fit of the models. Common threshold values less than 0.01, 0.05, 0.08 for Root Mean Square Error of Approximation (RMSEA) indicate excellent, good, and mediocre fit (MacCallum *et al.*, 1996). CMIN/DF < 3 indicates an acceptable fit between the theoretical and data (Kline 2005). A Standardized Root Mean Square Residual (SRMR) value less than 0.10 or of 0.08 are considered a good fit Henseler *et al.* (2014). Goodness-of-Fit Index (GFI), Normed-Fit Index (NFI), Non Normed-Fit Index (NNFI) is higher than 0.95 and Comparative Fit Index (CFI), Adjusted Goodness-of-Fit Index (AGFI) and Incremental Fit Index (IFI) is higher than 0.90, indicate satisfactory compliance (Kline, 2005). Those values closer to 1 represent a better fit for the proposed model. Table 1 list fit indices commonly reported for CFA and SEM.

4. Findings

4.1. *Descriptive Statistics*

A vast majority of the participants in our sample were 46 years and older. The average age of the farmer is 52 in Turkey (Tarmakbir, 2019).

The sample group, therefore, falls within Turkey average values. Almost half of the farmers (41.1%) had only primary education. The average family size was around five people. About half of the farmers have 25 and fewer decares of land and small numbers of animals. Similarly, half of the farmers' income was slightly above the country's minimum income. Just over half of the farms employed only one wage worker, and two-thirds of the households were landowners, and one-third rented additional land for farming. Over 80% of the farmers have solely relied on agricultural income. The main characteristics of the respondent and farm characteristics are shown in Table 2.

The respondents indicated their agreement with each statement with a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) in the 3rd part of our questionnaire. The scale included a total of 24 statements, five statements to measure the attitude, SNs, PBC and intention constructs, and four statements to measure the FS construct. Table 3 shows the descriptive statistics of the TPB and TPB-FS items together with the measurement model results.

The attitude construct ranked highest among all structures in TPB and TPB-FS models. The mean AT score was 4.08 (SD=0.755); considered that the highest score is 5, farmers showed a strong positive attitude towards improving their farms' waste facilities when financial support is provided. Farmers also showed high SNs (M=3.659 SD=0.575) and moderately PBC (M=2.900 SD=0.498) in taking farm waste to a particular collection point. It has also been

Table 2 - The demographic characteristics of the farmers and farm characteristics in (N= 336).

Index	Min-Max/Relative Frequency %	Mean	Sd
Age	20-35(=1) 3.3% 36-45 (=2) 17.3% 46-55(=3) 43.2% 56-65(=4) 31.3% 66+ (=1) 5.1%	3.18	0.889
Education	Literate (=1) 0% Primary (=2) 41.1% Secondary (=3) 27.7% High School (=4) 23.8% University (=5) 7.4%	2.98	0.974
Family Size (persons)	1-2 (=1) 0% 3 (=2) 13.4% 4 (=3) 20.2% 5 (=4) 43.2% 6 +(=5) 23.2%	2.76	0.957
Gross Annual Income (TL)*	0-50000 (=1) 17.6% 50001=75000 (=2) 48.2% 75001-100000 (=3) 17.3% 100001-125000(=4) 11.3% 125000-150001+ (=5) 5.3%	2.39	1.076
Non farming Income	Yes (=1) 19.3% No (=2) 80.7%	1.81	0.396
Land Ownership	Owner (=1) 53.4% Rented (=2) 22.3% Owner + Rented (=3) 24.3%	1.71	0.834
Total Land	0-25 da (=1) 46.1% 26-50 da (=2) 30.1% 51-75 da (=3) 13.7% 76-100 da (=4) 6.0% 101+ da (=5) 4.2%	1.91	1.099
No of Paid Workers	1 (=1) 55.7% 2 (=2) 33.6% 3(=3) 8.0% 4 (=4) 1.5% 5+ (=5) 1.2%	1.59	0.798
Production Type	Livestock (=1) 22.6% Crops+Livestock (=2) 77.4%	1.77	0.419

*Gross monthly minimum wage in Turkey in 2020 was 2,943Turkish Lira (TL). The net monthly wage was 2,324.70 TL

observed that providing farmers with financial support (M=3,881 SD=0.578) can significantly positively affect.

4.2. *Measurement model*

Confirmatory Factor Analysis (CFA) was used to investigate the adequacy of the models. CFA examines the relationship between observed and latent variables. CFA makes use of the correlation and covariance matrix to explore how many groups of independent variables exist in a research model.

The values derived from the TPB model, chi-square value is 221.456 significant at 0.05 significance level, and p= .0013. All other fit indices for the TPB model were calculated as $\chi2/df=1.415$, RMSEA=0.033, NFI=0.962,

Table 3 - Constructs/variables, measuring statements and first-order CFA analysis.

Construct statistics					Statements	
Rnk	CV	Mean (SD)	α	I. No	Item Name	Constrcts (Source)
1	0.185	4.084 (0.755)	0.934	Att1 Att2 Att3 Att4 Att5	Livestock manure should be disposed of by the municipality along with other solid household waste. Farmer's aim should be to maximise production and farm efficiency, not to bother with livestock waste management. In my opinion, livestock manure management is a critical issue, and it is necessary to increase farmers' awareness and knowledge about waste management facilities/practices. Building waste disposal units on my farm will make my farm to be managed more difficult. Building and improving waste disposal units demands high financial investment.	Attitude (Ajzen, 2012; Maleksaeidi and Keshavarz, 2019; Meijer et al., 2015)
2	0.182	3.963 (0.720)	0.855	Int1 Int2 Int3 Int4 Int5	I am planning to improve the waste storage and disposal facilities on my farm. I strongly recommend other farmers to improve their on-farm waste facilities. I intend to improved waste storage and disposal facilities on my farm. I intend to encourage other farmers to improve their waste disposal facilities. I will expend effort in improving waste storage and disposal facilities on my farm.	Intention (Ajzen, 2012; Borges et al., 2014; Yazdanpanah et al., 2014)
3	0.149	3.881 (0.578)	0.896	FS1 FS2 FS3 FS4	I am willing to dispose of my livestock manure to central disposal pit if local government provides financial incentives. I am willing to dispose of crop waste to common pit if local government subsidise. I am willing to set up a composting facility if local government incentive is granted. I am willing to improve my waste disposal facilities if local government subsidise.	Financial Support
4	0.256	3.659 (0.575)	0.936.	SN1 SN2 SN3 SN4 SN5	If more farmers take their livestock manure to a central collection point, I will also try to join them. If the local government provides incentives, I will do my best to join those efforts. The way that other farmers deal with livestock manure is important to me. If I take my livestock manure to a central disposal unit, people who are important to me will approve. Most of the people in my village are willing to use the waste disposal facilities provided by the municipality. Generally speaking, I want to be like the other people in my village.	Subjective norms (Francis et al., 2004):
5	0.167	2.900 (0.498)	0.909	PBC1 PBC2 PBC3 PBC4 PBC5	I can manage the livestock manure waste produced on my farm in a more environmentally friendly way if I want to do so. Disposing of livestock manure is a complex task for me. The decision to improve waste facilities/to join local government initiative is under my control. I have enough money and time to improve waste facilities/to take livestock manure to a centrally allocated disposal unit. I have the knowledge, skills, and experience to employ improved waste facilities on my farm/ to take livestock manure to a centrally allocated disposal unit.	Perceived Behavioural Control (Ajzen, 1991; Francis et al., 2004; Maleksaeidi and Keshavarz, 2019)

Table 4 - Validity and reliability indices of TPB and TPB-FS models.

Construct	Item	TPB-FS Model		TPB Model	
		Validity and reliability indices	Std. loading (tvalue)	Validity and reliability indices	Std. loading (tvalue)
Attitude	Att1	AVE=0.725;	0.894 (22.358)	AVE=0.717;	0.891 (22.048)
	Att2	CR=0.929	0.905 (21.536)	CR=0.927	0.902 (21.329)
	Att3	MSV=0.264;	0.842 (fixed)	MSV=0.289;	0.840 (fixed)
	Att4	ASV=0.48	0.799 (18.618)	ASV=0.37	0.792 (17.445)
	Att5		0.977 (31.604)		0.958 (30.299)
Intention	Int1	AVE=0.580;	0.714 (17.322)	AVE=0.521;	0.689 (16.126)
	Int2	CR=0.847	0.737 (18.276)	CR=0.843	0.755 (16.852)
	Int3	MSV= 0.521;	0.825(22.640)	MSV=0.324;	0.796 (21.292)
	Int4	ASV=0.17	0.928 (fixed)	ASV=0.12	0.917 (fixed)
	Int5		0.849 (18.509)		0.829 (19.723)
Financial Support	FI1	AVE=0.671;	0.853 (fixed)		
	FI 2	CR= 0.891	0.787 (17.105)		
	FI 3	MSV= 0.448;	0.796 (17.102)		
	FI 4	ASV=0.25	0.786(14.888)		
Subjective Norms	SN1	AVE=0.695;	0.887 (fixed)	AVE=0.689;	0.808(fixed)
	SN2	CR=0.918	0.860 (22.173)	CR= 0.916	0.767 (19.753)
	SN3	MSV=0.303;	0.806(15.188)	MSV=0.324;	0.782 (17.760)
	SN4	ASV=0.28	0.903 (20.983)	ASV=0.24	0.901(16.545)
	SN5		0.670 (13.109)		0.645(12.268)
Perceived Personal Behaviour	PBC1	AVE=0.623;	0.621 (9.661)	AVE=0.632;	0.578 (10.480)
	PBC2	CR= 0.891	0.774 (fixed)	CR=0.894	0.735 (fixed)
	PBC3	MSV=0.251;	0.779 (12.146)	MSV: 0.257;	0.826 (14.178)
	PBC4	ASV=0.18	0.697 (12.764)	ASV=0.23	0.745 (13.276)
	PBC5		0.779 (13.789)		0.743 (13.734)

NNFI=0.985, CFI=0.989, IFI=0.989, SRMR=0.0382, GFI=0.947, AGFI=0.925. Likewise, for the TPB-FS model chi-square value is 228.587 significant at 0.05 significance level, and p = .0002. The resulting values showed a better fit (χ2/df=1.020, RMSEA=0.014, NFI=0,975, NNFI=0,997, CFI=0.997, IFI=0.999, SRMR=0,0336; GFI=0.967, AGFI=0.948). Thus, the CFA results of both the original and the developed model met the criteria of reliability and validity (Table 1).

Cronbach's alpha tests measured internal consistency. Cronbach's alpha values for each measured item varied between 0.855 to 0.936. The Cronbach alpha coefficient of the TPB was 0.906, while the alpha value of the TPB-FS measured as 0.921. Thus, the alpha values of both models provide accepted values. We tested the convergent validity by employing the following three criteria: standardized factor loadings equal to or greater than 0.6, average variance extracted (AVE) equal to or greater than 0.5 (Fornell and Larcker, 1981), and composite reliability (CR) equal to or greater than 0.7. Additionally, to be able to claim the discriminant validity, calculated AVE for each construct should be larger than the average shared squared variance (ASV) and also greater than the maximum shared squared variance (MSV) among all constructs in a measurement model (Hair et al., 2010). The CR values were between 0.843-0.927 for the TPB model and between 847-929 for the TPB-FS model. The analysis result shows that all CR values surpassed the suggested level of 0.70 and higher Both TPB and PB-FS models are provided as AVE ≥0.5, CR ≥0.5 and AVE> ASV for each construct. All

in all, based on the results detailed in Table 4, we can claim that model measurement provides a satisfactory indication for construct validity and reliability.

4.3. *Structural model*

The SEM analysis outcome confirmed that the TPB model set up for the research offered a satisfactory fit. The structural model confirms the direct relationship between the research's dependent variable: the farmers' intention to take animal waste to a common collection point and the independent variables (attitude, SNs and PBC). Findings indicated that the preliminary constructs included in the TPB explained 41% of the variance of the farmers' intention to take animal waste to the common disposal point.

The attitude affected the farmers' intention to adopt a new practice proposed by the municipalities on animal waste, statistically significantly and positively (H1a: $\beta=0.38$; p<0.01). SNs were another strong predictor of farmers' intention (H2a: $\beta=0.30$; p<0.01). On the other hand, PBC had remarkably lower but statistically significant predictive power (H3a: $\beta=0.11$; p=0.04). Therefore, Hypothesis 1 is supported.

The literature lacks research dedicated to animal waste using TPB. We see that similar studies on agricultural waste produce findings parallel with our study (Jiang *at al.*, 2018; Sukhmani and Gupta, 2017). Furthermore, we extended our structural model by adding municipal financial support to be given to the farmers (TPB-FS). This allowed us to discover how the added new variable interacted with each construct in the model, what effect FS construct is on intention, and how this addition contributed to the model's development. Adding the FS variable significantly increased the explanatory power of the model. The squared multiple correlations (R^2) calculated for the TPB-FS model increased from 41% to 62%. Thus the TPB-FS model increased the capability of explaining the model's variance from 41% to 62%. Consequently, Hypothesis 2 is supported.

Local governments' financial support will have a very powerful positive and statistical-

ly significant effect on farmers' intentions (H4: $\beta=0.56$; p<0.01). The addition of the FS variable reduces the predictive power of the attitude (H1b: $\beta=0.15$; p=0.007) and SNs variables (H2b: $\beta=0.16$; p=0.003) by almost half, whereas it does not affect PBC's predictive power (H3b: $\beta=0.11$; p=0.021) on intention.

The TPB-FS model was built on the assumption that FS has the direct predictor power on the intention. However, the FS variable may also have a mediatory power through the TPB model. Thus, the third model was designed, and FS's mediation effect and the significance of this effect were measured. The third research model analysis showed that FS had a strong and significant mediatory power on the farmers' behaviour (H8: $\beta=0.56$; p<0.01). Farmers' attitudes (H5: $\beta=0.43$; p<0.01) were better predictors of the adoption of financial support provided by local governments than subjective norms (H6: $\beta=0.20$; p=0.002). PBC did not have a significant effect on FS (H7: $\beta=0.04$; p=0.453) variable. Thus Hypothesis 3 is partially supported. The FS variance in the third model was capable of explaining 33% of the model's variance. Bootstrap results show that the FS variable has a mediatory effect in the relationship between attitude and behaviour ($\beta=0.62$; p<0.01) and in the relationship between SNs and behaviour ($\beta=0.24$; p<0.01). However, financial support does not provide a mediation effect in the relationship between PBC and the farmers' behaviour ($\beta=0.03$; p<0.275), H8a and H8b are supported, H8c is rejected, therefore Hypothesis is partially supported (Table 5).

5. Results and discussion

There is an increasing amount of research inquiring the underlying reasons why farmers adopt or refrain from pro-environmental attitudes (Blackstock *et al.*, 2010; Donati *et al.*, 2015; Karaca and Ozturk, 2018; Strazzera and Statzu, 2016). Policymakers implement various policies to ensure sustainability in agriculture. The sector continues to be the most leveraged. Guo *et al.* (2005) and Wheeler (2008) have emphasized the government's role in farmers'

Table 5 - SEM estimation and hypothesis test results.

		Unstandardized path coefficient	Standardized path coefficient	SE.	CR.	p	
TPB Model (I)	H1a: AT → IN	0.325	0.380	0.049	6.577	***	
	H2a: SN → IN	0.187	0.296	0.040	4.731	***	
	H3a: PBC → IN	0.069	0.114	0.033	2.091	0.037	
	R^2	0.413					
TPB-FS Model (II)	H1b: AT → IN	0.129	0.146	0.048	2.686	.007	
	H2b: SN → IN	0.105	0.160	0.036	2.937	.003	
	H3c: PBC → IN	0.068	0.109	0.029	2.309	.021	
	H4: FI → IN	0.511	0.562	0.068	7.516	***	
	R^2	0.621					
TPB-FS Model (III)	H1c: AT → IN	0.117	0.132	0.048	2.428	.015	
	H2b: SN → IN	0.116	0.175	0.036	3.191	.001	
	H3c: PBC → IN	0.066	0.104	0.030	2.199	.028	
	H5: AT → FI	0.422	0.434	0.058	7.218	***	
	H6: SN → FI	0.143	0.197	0.046	3.098	.002	
	H7: PBC → FI	0.029	0.042	0.039	2.750	.453	
	H8: FI → INT	0.514	0.563	0.068	7.547	***	
	R^2 (FI)	0.331					
	R^2 (Intention)	0.621					
Moderation Effect	H8a: AT→ FI → INT		0.621	(0.014, 0.098) p=0.001			yes
	H8b: SN→ FI → INT		0.242	(106, 219) p=0.001			yes
	H8c: PBC→ FI→INT		0.025	(-0.022, 0.078) p=0.275			no

*** Correlation is significant at the 0.01 level (2-tailed), ns: Not significant, Bootstrapping based on n = 2000 subsamples.*

*Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.1.*

adoption of sustainable farming practices. Turkey's support payments range from organic agriculture, good farming practices, soil analysis, fuel, fertilizer and purchase to livestock support. Livestock support covers only animal breeding. In 2019, the MFAL provided 50% grant support to livestock farmers who have 10-50 bovines and 100-200 bovines. These grants were allocated for the construction/renovation of barns, the purchase of animals and the purchase of machinery, tools and equipment. As it is seen, there is no support for improving manure storage.

Article 7 of the Municipality Law 6360 states that: "Metropolitan and district municipalities can perform all kinds of activities and services to support agriculture and animal husbandry". Elias and Marsh (2020) give an example of mu-nicipal governments pursuing partnerships with peri-urban farmers and breeders to protect fertile land together, refrain ecosystem services from harmful development, reach greenhouse reduction targets and generate economic value. The partnership of Santa Clara County and the Open Space Authority for Santa Clara Valley in 2018 was successfully set up in the heart of Silicon Valley. Another example the authors cite was the California government's role in creating innovative programs to promote the protection of working landscapes and sustainable farming engagement, splitting investment costs and funding ecosystem services.

The municipalities in Turkey began to actively engage in agriculture as a result of a legal obligation. They provide support to the farmers by

donating seeds, tiller, and fertilizer. They buy the harvest from the farmer and increase the number of farmer markets. Municipalities have also started to assist farmers in waste-related issues in line with their responsibilities in waste management. For example, Tekirdag Metropolitan Municipality is conducting a feasibility study to determine the amount of agricultural (such as grain, sunflower, corn and paddy) and animal waste and build bioenergy biogas briquettes, pellets and compost facilities. The purpose of the municipality is to recycle organic waste in the region as biomass energy instead of disposing of them to harm the environment. Antalya Metropolitan Municipality has planned to implement a recycling project aiming to reduce the farmer's production cost by collecting the greenhouse and orchards waste. Mersin Metropolitan Municipality has started the project to set up an oyster mushroom compost facility from agricultural wastes.

The use of animal waste can reduce the adverse effects of these wastes on the environment and ensure the recovery of the resource that would otherwise go idle to the economy. However, establishing compost or biogas plants requires high investment, technical knowledge and experience, and goes beyond small-scale farmers' capabilities. Therefore, such facilities are established by large companies with the inducement of local and central governments. A central collection point to be provided by local governments will help prevent the detrimental effects and in providing inputs to compost and biogas facilities.

The cooperation of farmers is essential for such an initiative to be implemented. To pursue the cooperation of farmers, financial support should be provided to them. The possible effect of providing this support on their attitudes and behaviour should be investigated and understood. The support offered should be easy for the farmer to understand and apply, and there should be no excessive paperwork. The complexity of the legislation and the late arrival of the support cause the farmers to look at such supports with suspicion.

The research result again underlines that farmers have a positive attitude in the management of wastes even tough participate in this initiative would not actually increase their yields and would even bring them additional labour and time burden. Besides, the financial support to be provided to them will significantly increase the likelihood of displaying this positive behaviour. Authors further argue that farmers altered their behaviour as a result of not only monetary but also moral values and social pressure. Since farmers live in smaller communities, they are significantly affected by information networks, such as relatives, neighbours and fellow farmers (Genius *et al.*, 2006; Läpple and Kelley, 2013; Wollni and Andersson, 2014). Therefore, the effect of the subjective norm variable on behaviour has been observed to be close to the attitude variable. The effect of the subjective norms exceeds attitude when financial support becomes a mediatory variable.

6. Conclusions

This study aimed to analyze the farmers' behaviour in assessing manure waste disposal using the TPB model. We also examined the direct and moderating impact of local governments' financial support on farmers' manure handling behaviour. The TPB model created within the research framework has proven to be adequate to understand farmers' animal waste assessment behaviour. The addition of the financial support dimension increased the explanatory power of the model.

Financial subsidies are pricey and strain the limited public funds in developing countries that often face high budget deficits. Devising financial support requires determining the right price level. Farmers will be willing to collect and transport livestock manure and determine whether the price will be an acceptable input cost for a likely biogas or compost production. Examples cited, however, have shown that local government-farmer collaborations work and lead to significant progress in achieving environmental sustainability in rural and urban settlements over several years, as long as they are well designed and farmers are not overwhelmed by bureaucratic obstacles.

It is essential to note that some limitations should be considered in this study. First, the outcomes of this analysis carried out in Turkey may

differ from other cultures and regions. The results of research conducted in different continents and countries with different levels of development may differ. This research was applied to all livestock farmers without making any distinction between dairy and fattening livestock. Farmers in these two sub-sectors may face different problems and maybe different factors affecting their behaviour. We have not taken into account whether farmers have received any other financial aid in the past, their level of satisfaction and effectiveness from those financial aids if they have received it. The satisfaction level and effectiveness of a received aid may affect the trust in the institutions that provide that aid positively or negatively. Therefore, we propose further studies to undertake a new study, including these factors. We included only the financial aid construct in the classical TPB model. However, the model can be further enriched by adding additional factors to gain more in-depth insight, such as experience with financial aids, knowledge levels about available aids and the adequacy of information received by extension agents.

Despite the limitations mentioned above, this research may inspire local and central governments, private or public institutions, policymakers and entrepreneurs who want to produce compost or biogas from animal waste. Policymakers should support local and central governments' attempts to ensure the proper disposal and re-economize of animal waste, sensitively review and update inadequate environmental processes, laws and regulatory tools, and put an end to practices that prevent businesses from adopting environmentally friendly practices. Local administrations should now be invited to participate in public environmental policies in the agriculture and agri-food sectors. Local governments need to instil environmental values in farmers' behaviour and better anticipate the legal environmental and economic factors.

Supplementary data

Supplementary data to this article can be found online at https://doi. org/ 10.17632/2r7s-bwv3sk.5.

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