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Foreword

Jeder, Abdelhamid and Salah investigate farmers in the south-east of Tunisia to determine the factors influencing adaptation strategies. All actions aimed at improving the resilience of agriculture in Tunisia's arid regions to climate change, emphasize mainly the strategies adopted by farmers in terms of water management, technical choices and the adopted production systems combined with the experience and local know-how.

The paper of *Özsayin and Korkmaz* aims to determine the participation tendencies in organic agriculture activities of women living in rural areas of the northwestern part of Turkey. According to the results of the participation index score, rural women's participation of in organic farming activities was highest in the fertilizer application stage and the least in the marketing stage. As a result, the findings of the study are expected to make significant contributions to rural development, province economy and further emphasizing the importance of rural women in organic farming activities.

Rjili and Jaouad try to identify strategies and levers mitigation and adaptation to climate change developed by breeders on based on available factors. The results reveal that age of breeder, herd size, agricultural area, member of an association, subsidies and well ownerships are the most factors which significantly influence the adaptation choices of breeders to cope to climate change. The results proved too that adaptation to climate change was inhibited by many factors such as luck of workforce labor, lack of water and financial resources as well the degradation of the rangelands.

Food waste, its perception, food purchase and store behaviors of the consumers were investigated by *Özçiçek Dölekoglu et al*. The results show that households wasted about 7.5 tones food during the month surveys carried out. Only 180 families out of 1155 had no food waste and this number is higher in Erzurum. The highest food waste was observed in Adana where it was 823 kg per week while it was 652 kg in Erzurum and 393 kg in İzmir.

The author *Ahmed* tries to assess the relationship between Egyptian wheat spot prices and future wheat prices in Paris (MATIF) and USA (CBOT). Results suggest a high volatility regime observed, especially during the extreme market events of the food crisis and following the two revolutions in Egypt in 2011 and 2013 and the time of the economic reform in 2016. This leads to an unstable market and negative impacts on consumers' welfare and food affordability, meaning that futures markets failed to hedge spot wheat market against

price volatility. In addition, results from impulse response functions indicate that a 1% shock in futures markets will lead to a positive shock in the wheat spot market, while for the low volatility regime no significant effect.

Essakkat et al. investigate the intention of young consumers to shift their diets towards the Mediterranean Diet to prevent climate change. Using the Theory of Planned Behavior, the objective is to identify whether attitudes, subjective norms and perceived behavioral control guide such a behavior. Our findings highlight that young consumers' perceived behavioral control have the highest influence on the intention, followed by their attitudes.

Zhllima et al. explore the determinant factors of farmers' intentions to engage in organic farming in Albania. Results show that subjective norms, perceived behavior control, favorable attitudes toward organic farming conversion, as well as awareness of risk from conventional farming accompanied with information awareness are positively associated with the probability of converting to organic farming. Farmers' perceptions of EU policy opportunities and attitudes towards environment protection are negatively associated with farmers' tendency to convert.

Smallholder farmers' perceptions and adaptation strategies to mitigate the effect of climate change in the oases of South-Eastern Tunisia

Houcine Jeder*, Amira Abdelhamid**, Ahmed Salah**

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Abstract

Climate change is expected to have serious environmental, economic, and social impacts on arid regions such as Tunisia country. This research uses a "bottom-up" approach, which seeks to gain insights from the farmers themselves based on a farm household in the south-east of Tunisia. Econometric analysis and Main Component analysis were conducted in this research. Finally, probit binary models were estimated to determine the factors influencing adaptation strategies. All actions aimed at improving the resilience of agriculture in Tunisia's arid regions to climate change, emphasize mainly the strategies adopted by farmers in terms of water management, technical choices and the adopted production systems combined with the experience and local know-how. Others Government policies and national adaptation programs should focus on education facilitate farmers' access to extension, information and specialized training needed.

Keywords*: Climate change, Perception, Adaptation strategies, Agricultural households, Econometric analyses, South-Eastern Tunisia.*

1. Introduction

Agriculture lays a heavy burden on the environment in the process of providing humanity with food and fibers (IPCC, 2007). However, agriculture and food systems as well as the rural economies in the Maghreb and North Africa regions have been experiencing major drastically reduced agricultural production through extreme weather events, such as recurrent droughts and floods in these recent decades (Hassan and Nhemachena, 2008; Deressa *et al.*, 2008). In these regions, the climate variability causes severe impacts on agriculture through long drought periods. Recurrent droughts often affect entire countries over multiyear periods and can result in serious social problems caused by water scarcity and the intensive demand of water for agriculture. Impacts anticipated under projected climate change such as increasing rainfall variability, increasing temperature, increasing evaporation rate and water deficit pose a significant challenge to the Maghreb region. Mean temperatures of Morocco, Algeria and Tunisia are expected to rise by between 2 and 4°C until 2100.

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Already by 2020, rainfall is expected to drop by between 5 and 20% (METT, 2002). Tunisia is one of the Maghreb countries and is very vulnerable to the water shortage. Most of the water resources have medium to poor quality, and the salinity is often high. Water deficits and droughts are ongoing risks for Tunisian agriculture The agricultural sector that provides approximately 13% of the national annual GDP (2004) to Tunisia is therefore particularly vulnerable to climatic changes also due to poor soils, limited ground and surface water, low rainfall and recurrent droughts particularly in the arid regions of Tunisia In these regions, the consumption of irrigation water in irrigated areas and oases continues to increase to ensure the sustainability of the farming activity and guarantee the income of several households agricultural (Mougou *et al.*, 2011).

For example, in the arid regions of South-Eastern Tunisia, the Gabes oases is known since antiquity for their vegetable crops that historically conserved the seeds, their greatest source of resilience facing difficult climate conditions (dry land). However, since the past few decades, the oases are getting much damaged (over-exploitation of resources, urbanisation…) as well as multiple factors have been behind this degradation (Marshall *et al.*, 2014). The majority of young people and women are not interested in agriculture and the older populations that are, are turning to more profitable field crops. Producing local seeds is forsaken for the benefit of improved hybrid seeds that are often combined with the use of chemical fertilizers (highly polluting the soil). The lack of valorisation of local indigenous seeds, the absence of a seed market or even laws restricting the commercialisation of local seeds. This all explains why farmers are discouraged and have difficulties guaranteeing their own production. The risk is that future generations that loses their capacity to adapt to climate change and no longer is able to guarantee food security for the population surrounding the oases (Abdedaiem and Veyrac-Ben Ahmed, 2013). Faced with climatic risks on agricultural activity in oases of irrigated perimeters, reviewing the concept of adaptation through a multidimensional vision touching different economic, social, agronomic, hydrological and political aspects is important to know and detect the main intervening factors in adaptation strategies. The adoption of a bottom-up approach that focuses on autonomous adaptation behavior seems to me more adequate to draw recommendations for adaptation strategies appropriate to oasis production systems in South-Eastern Tunisia, case of the Metouia oasis in the governorate of Gabes.

Therefore, this article aims to study the perception and choice of appropriate measures among smallholders in the oases of South-Eastern Tunisia for adaptation to climate change. The rest of the article is structured as follows: Section two describes the theoretical framework. Section three presents the methodology. Section Four discusses the results and Section Five provides conclusions and policy recommendations.

2. Theoretical and methodological framework

Farmers' behavior towards adaptation to climate change is shaped by socio-economic, physical and behavioral factors (Doerr *et al.*, 2011). Institutional arrangements for the farmers and their working environment, development for access to markets and climatic factors are useful in shaping the behavior of smallholders (Devereux 2000; Deressa *et al.*, 2008 and 2010). The study of behavior adapting to climate change has many angles of analysis. There is both theoretical and empirical analysis. Some questions are positive, many others are prescriptive. There are microeconomic issues and more macroeconomic problems. Within this diversity, several approaches have been developed in particular: integrated assessment approaches, empirical (econometric) analysis, economy-wide simulation with models and decision support tools. Each of these approaches can help shed light on different aspects of the adaptation problem (Fisher-Vanden *et al.*, 2013).

For the problem of adopting certain strategies or measures to adapt to climate change in agriculture, the behavioral study of the perception or the choice of strategies requires understanding the reaction of economic agents to current climate and weather events. Much of this evi-

dence is provided by often interdisciplinary studies (Penning-Rowsell *et al.*, 2013; Ranger and Surminski, 2013). However, more and more researchers are using large data sets at the household or farm level to explore how economic agents adapt fully and rationally. The evidence is particularly rich for the agricultural sector.

Such an economic approach in relation to adaptive behavior such as "the econometric approach to climate" has been reviewed by Dell *et al.* (2014) and Hsiang (2016). These two works mainly focus on assessing the impact and effect of climatic factors on economic variables such as labor productivity, production and growth, rather than on the benefits, costs or extent of the economy adaptation. However, many of the ideas of Hsiang and Dell *et al.* also apply to the econometrics of adaptation.

Several researchers have sought to identify climatic effects both in transversely and chronologically, by comparing the impacts and / or adaptation behaviors across different climatic regimes by measuring the impact of particular meteorological events, such as floods, over time. Increasingly, they have access to panel data. Cross-sectional studies are closely associated with the "Ricardian approach" developed by Robert Mendelsohn (Mendelsohn *et al.*, 1994; Kurukulasuriya *et al.*, 2011; Seo and Mendelsohn 2008; Wang *et al.*, 2010). Given the great diversity of climates around the world, these studies provide ample evidence of adaptive behavior. The approach of nominal and ordered econometric models can simultaneously model the influence of all the explanatory variables on each of the different adaptation practices, while allowing the potential correlation between the unobserved disturbances as well as the relationship between the adoptions of different adaptation practices (Belderbos *et al.*, 2004). Consequently, an agricultural household is confronted with the decision to adopt or not an adaptation strategy taking into account the parameters perceptions of climate change. Necessarily, this decision to adopt or not depend on the characteristics of agricultural households explained using an "ad-hoc" approach through several factors: socio-economic, climatic, endowment of available resources (land, water and labor) and policies related to extension services as well as access to information at optimal time. Principal Component Analysis Method and the ordered and binary probit econometric model were mobilized in this work to study the behavior of small farmers in the Methaoui oasis in South-Eastern Tunisia in the face of the challenges of climate change.

2.1. *Justification and choice of econometric models*

When the dependent variable in a regression model is binary, the analysis could be conducted using linear probability or logit or probit models (Pindyck and Rubinfeld, 1981). The determinant factors were identified by employing seemingly unrelated ordered or binary probit (Equations 1 and 2 below) which is variant of probit model. Mitchell and Carson (1989) advocated the use of robust estimators as a way to control the problem of non-normality and outliers and the potential bias associated with these sources. This form of regression is also used to reduce the problem of heteroscedasticity. The normal density function is appealing to statisticians in the sense that it allows the non-zero correlation, while the logistic distribution does not. This model provides information on what variables are crucial for each of the responses to perceptions and adaptation. To develop a model that will predict household perception and adaptation to climate change, economists assume that there exists some underlying, unobservable (latent) variable and utility index, such variable is determined by certain variables including the characteristics of the household.

2.2. *Econometric models*

Several studies have used various methodological approaches to analyze the determinants of adaptations to climate change and the choice of adaptation strategies. Most commonly used analytical approaches in the literature include discrete choice regression models like binary probit or logit (Acquah-de Graft and Onumah, 2011; Fosu-Mensah *et al.*, 2010), multinomial probit or logit and multivariate probit (Hassan and Nhemachena, 2008; Deressa *et al.*, 2008; Sofoluwe *et al.*, 2011; Nzeadibe *et al.*, 2011; Tazeze

et al., 2012). Other empirical studies used principal component analysis (Mandleni and Anim, 2011) and the Ricardian model (Kurukulasuriya and Mendelson, 2006). Thus, the decisions of perception and adaptation to climate change are intrinsically multivariate and the attempt at univariate modeling excludes the useful economic information contained in the interdependent and simultaneous adoption decisions. On the basis of this argument, the study adopted the econometric technique of ordered and binary probit models to simultaneously model the perception and the influence of the set of explanatory variables on the main adaptation strategies (Belderbos *et al.*, 2004; Lin *et al.*, 2005).

2.3. *Ordered and binary probit models*

Ordered probit model is widely used approach to estimate models of ordered types. The ordered probit model is built around a latent regression in the same manner as the binomial probit model (Greene, 2003):

$$y_i^* = \beta' x_i + \varepsilon_i \quad (1)$$

For the latent variable (farmers' perceptions) in this study exhibits itself in ordinal categories which were coded as 0, 1, 2…j. The response of category j is thus observed when the underlying continuous response falls in the j-th interval as:

$$y\,(farmers' perceptions) = \begin{cases} 0 & if\ y_i^* \le \delta_0 : low\ perception \\ 1 & if\ \delta_0 \le y_i^* \le \delta_1 : moderate\ perception \\ 2 & if\ \delta_1 \le y_i^* \le \delta_2 : high\ perception \end{cases} \quad (2)$$

Where, Y* (i = 0, 1, 2) are the unobservable threshold parameters that were estimated together with other parameters in the model. When an intercept coefficient is included in the model, Yo* is normalized to a zero value and hence only j-1 additional parameters are estimated with Xs. As binary data models adopt or not adopt (0/1) adaptation strategies, the probabilities for each of the observed ordinal response, that is, farmer's perception to climate change in this study had 3 responses which could be low, moderate and high with ordinal values of 0, 1, 2.

For adaptation of such a strategy j, the latent variable in this case is a binary dependent variable with yi = 1 to adopt strategies j or yi = 0 not adopt strategies j. Binary probit models can also be motivated by an underlying continuous latent variable yi * which depends on β'xi and an error term εi (for i = 1,…, n) as in the case of equation 1. If the latent variables would be observable, this would lead to linear regression models. However, latent variables are not observable. But they can be related to the observed binary dependent variables yi:

$$y\,(Farmer's\ strategies) = \begin{cases} 1\ if\ y_i^* \ge 0\,, adopt\ strategies\ j \\ 0\ if\ y_i^* < 0\,, not\ adopt\ strategies\ j \end{cases} \quad (3)$$

The farmer's perceptions of climate change and the adoption of an adaptation strategy are specified as follows:

$$Y* = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_3 x_3 + \beta_4 x_4 + \\ + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 \quad (9)$$

Y* (Farmer's perceptions) = 1 (no perception), 2 (average perception) or 3 (good perception (Ordered probit model).
Y* (Farmer's strategies) = 1 (adopt strategies j), 0 (not adopt strategies j) (Binary probit models)
x_1 = Ages of farmer (years), continuous (in number)
x_2 = Level of education (ordered), 1 (literate), 2 (primary), 3 (secondary), 4 (university)
x_3 = Main agricultural activity, binary (1 if agriculture, 0 other)
x_4 = Place of residence, binary (1 if on the farm, 0 outside)
x_5 = Farm size, continuous (in hectare)
x_6 = Type of agricultural production system, ordered (3-stage system, 2 classic system, 1 otherwise)
x_7 = Agricultural land owner, binary (1 if farm owner, 0 other)
x_8 = Membership of the Agricultural Development Group, binary (1 if yes, 0 no).

2.4. *The study area*

The Métouia oasis is one of the coastal oases of the governorate of Gabès. It is located 12 km north of the city of Gabès (South-Eastern Tunisia) and covers an area of approximately

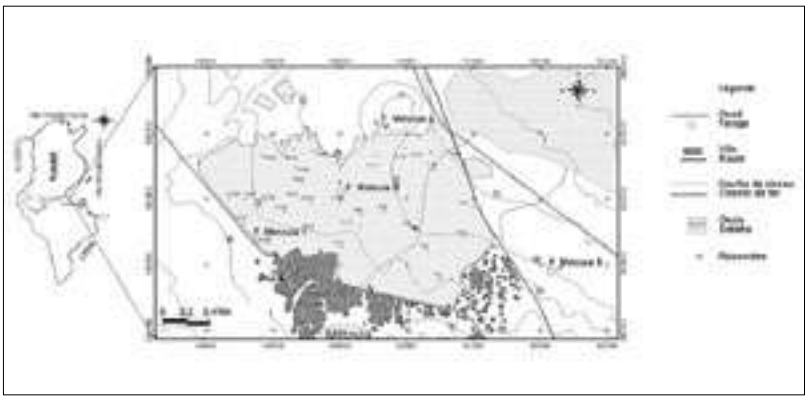

Figure 1 - Location map of the Métouia oasis, South-Eastern Tunisia.

270 ha (Figure 1). The Métouia oasis is characterized by low rainfall. The monthly distribution of precipitation is characterized by a period without rain (June, July and August) and a period with rainfall irregularly distributed over the other months and an annual water balance which is highly deficient. The oasis farms cover very small areas of around 1.5 ha on average. The crops are staged there in height, the palm trees are on the first floor, the pomegranate trees are on the second floor and alfalfa and market gardening are on the third floor. The drainage network is ineffective and moderately maintained. The Métouia oasis is characterized by the presence of a very shallow water table which closely conditions the evolution of the soil throughout the oasis (Grira *et al*., 2002; Hatira *et al*., 2002).

2.5. *Sample size and sampling procedures*

For a quantitative research, the probability sampling technique is appropriate as compared to a non-probability sampling technique because samples drawn by using probability sampling techniques are more representative than non-probability sampling techniques. Accordingly, a multi-stage random sampling technique was implemented to select sample from population. For a quantitative research, the probability sampling technique is appropriate as compared to a non-probability sampling technique because samples drawn by using probability sampling techniques are more representative than non-probability sampling techniques. Accordingly, a multi-stage random sampling technique was implemented to select sample from population. Finally, 50 sample households were selected on the basis of a probability proportional to size and they are representative of oasis farmers in the region. In this study, a simplified formula is used to determine the required sample size at 95% confidence level, 0.5 degree of variability and 10% level of precision.

$$n = \frac{N}{1 + N(e)2}$$

Where n is the sample size, N is the population size (total of households), and e is the level of precision. Hence, the desired sample size is equal to:

$$n = \frac{101}{1+101(0.1)2} = 50$$

2.6. *Data type and sources*

Data used in this analysis were collected from a household survey conducted in Métouia oasis of the governorate of Gabes on South-Eastern Tunisia. Primary quantitative data was collected along with a face-to-face interview. Discussions with farmers were also organized as part of the data collection method for qualitative primary data. In addition, quantitative data was collected using a structured questionnaire. Data were gathered at the household level on socio-economic characteristics, agricultural production system characteristics, extension institutions and climate change perceptions (Table 1).

Table 1 - Summary of household characteristics.

Variable (type variable)	*Description*	*Number (%)*	*Means*
Perception (Ordered variable)	**Climate change perceptions**	50 (100%)	
	No perception Average perception Good perception	6 (20%) 5 (17%) 19 (63%)	
Age (discrete variable)	**Ages of farmer**	50 (100%)	50
Education (Ordered variable)	**Level of education**	50 (100%)	
	Literate = 1 Primary = 2 Secondary = 3 University = 4	3 (6%) 37 (73%) 0 (0%) 10 (20%)	
Main activity (Binary variable)	**Main agricultural activity**	50 (100%)	
	if agriculture = 1 other = 0	25 (50%) 25 (50%)	
Residence (Binary variable)	**Place of residence**	50 (100%)	
	if on the farm = 1 Outside = 0	45 (90%) 5 (10%)	
Farm size (Continuous variable)	**Farm size**	50 (100%	4.46
Agricultural system (Binary variable)	**Type of agricultural production system**	50 (100%)	
	If stage system = 1 If other system = 0	14 (26%) 36 (74%)	
Land owner (Binary variable)	**Agricultural land owner**	50 (100%)	
	if farm owner = 1 If other = 0	18 (26%) 32 (74%)	
Membership (Binary variable)	**Membership of (GDA)**	50 (100%)	
	If membership = 1 If no = 0	23 (26%) 37 (74%)	

Source: Data survey: 2018-2019.

3. Results and discussions

3.1. *Perception of climate change for oasis farming households*

The objective of this section is to identify the determining factors of perception of climate change for the oasis farming households. The ordered probit regression model was used to find out the contributing factors implicitly (ad-hoc) to the perception of the phenomenon of climate change and which can play in the development of adaptation strategies. The results of the ordered probit regression model are presented in Table 2.

The results of the probit regression model ordered in Table 2 show an overall significance of the model at the 1% level (Prob> chi2). The positive contribution and the level of significance of the independent variables also determine the importance of these variables in the functioning of the oasis production system. Indeed, a significance level of 1% for the residence variable (RESID) clearly reflects that the farmer, who is installed in the oasis, felt the change of the environment and the deterioration of the oasis agricultural systems from day to day other than a farmer who is outside the oasis. The other variable that is significant at the 1% level is membership of an agricultural development group (MEM-

Table 2 - Results of ordered probit regression model for perception of climate change.

	Coef.	*Std. Err.*	*P>|z|*
X1 : AGE	.0365002	.0389419	0.349
X2 : EDUC	.8085056 *	.4372247	0.064*
X3 : AGR	.6920667	.7731876	0.371
X4 : RESID	3.364506 ***	.7327965	0.000***
X5 : SIZE	.6119345**	.193433	0.002**
X6 : SYSTEM	.4673846	.5445639	0.391
X7 : OWNER	1.512966 *	.7885448	0.055*
X7 : MEMBERSHIP	1.991799***	.7236316	0.006***
	Number of obs. = 50 Wald chi2(8) = 504.42 Pseudo R2 = .3538	Prob > chi2 = .0000	

*Notes: *** significant at 1%, ** significant at 5%, * significant at 10%.*
Source: Model results.

Table 3 - Adoption of adaptation techniques to climate change by oasis farmers.

	Not Adopt		*Adopt*	
Adaptation techniques to climate change	*Workforce*	*Percentage %*	*Workforce*	*Percentage %*
CDSEMI	7	14	42	86
IRRIG_COMP	21	42	29	58
VENT_AN	40	80	10	20
ADPOT_AC	43	86	7	14
INTERVE_ETAT	27	54	23	46
ACCES_CREDIT	40	80	10	10
ACHAT_IRRIG	27	54	23	64

BERSHIP) which is responsible for the activity of agriculture in the oasis, among other things the distribution of irrigation hours. Being a member of this group means ease of access to information and extension and staffing of main irrigation hours or additional hours. Therefore, we can deduce that these two variables are of the first order from the point of view of perception of climate change among oasis farming households. Then, in second order, we find the variable area of the agricultural holding (SIZE) significance at the 5% level. This variable shows that the perception can be perceived at the level of large farms whose activities require a lot of production inputs such as water, labor, etc. In third order, at the level of positive significance of 10%, we find variables like the level of education (EDUC) as well as the property of the land (OWNER) which plays an important role in the understanding of the phenomenon of climate change and their impact on oasis systems when the farmer owns their agricultural land. The land ownership variable (OWNER) also reflects a socio-cultural aspect among some farmers, beyond that oasis activity is a source of agricultural income, but it is also a natural heritage characterizing the region which must be preserved for biodiversity, sustainable development and for future generations.

3.2. *Adaptation strategies on oasis farming households*

The results of the ordered probit regression model showed the positive and significant contribution of some key variables. These variables can be used on the one hand to understand the behavior of oasis households faced with the phenomenon of climate change and on the other hand, help us to find points of reflection to develop appropriate adaptation strategies. A set of adaptation techniques to climate change that are practiced by oasis households according to their responses to the questionnaire asked during the survey (Table 3). Among these techniques, the following may be mentioned as: CSD: change of sowing date; ADD_IRRIG: additional irrigation; PURCH_IRRIG: purchase of additional irrigation hours; SAL_AN: sale of animals to finance agricultural activity; ADOPT_CROP: adoption of other crops; POLITICAL_INSTR: State intervention through subsidies and incentives; ACCES_CREDIT: Access to credit to invest and finance agricultural activity.

These techniques can be classified into three adaptation strategies reflecting the behaviors of oasis farming households which are deduced by the survey questionnaires and these strategies are also confirmed by local actors, whether they are experts or agents of the agricultural extension service. Adaptation techniques like (ADD_IRRIG, PURCH_IRRIG and ACCES_CREDIT) can be interpreted as *Strategy 1: Adaptation strategy in terms of water saving policy*. Adaptation techniques like (SAL_AN and POLITICAL_INSTR) can be interpreted as *Strategy 2: Incentive strategy for autonomous adaptation and adaptation*. Adaptation techniques like (CSD and ADOPT_CROP) can be interpreted as *Strategy 3: Technical strategy and system of production*.

3.3. *Determinants of adaptation strategies to climate change in the Methouia oases*

The results of ordered binary probit models in the Table 4 show that the overall significance of a level 5% (Prob> chi2) for the *Strategy 1* and *Strategy 2*; at level 1% (Prob> chi2) for the *Strategy 3* reflecting acceptance of the choice of adaptation variables to describe the strategies identified. The results also show the significant contribution of certain variables to express adaptive behavior among farmers in the oasis of Methouia.

The positive and significant contribution at the 1% level for variables such as age (AGE) and land ownership (OWNER) and also other variables that are significant at the 5% level as the main activity variable which is agricultural activity (AGR) and the variable member of an agricultural development group (MEMBERSHIP). These variables explain and justify the adoption of Strategy 1 (*Adaptation strategy in terms of water saving policy*) for some farmers in the oasis of Methouia. Indeed, an oasis household head who owns a farm, his main activity is agriculture and member of an agricultural development group where their access to water is possible, all these conditions allow him to access credit to invest in water saving for the purchase of drip irrigation or to build a water basin to store rainwater or additional irrigation water.

For Strategy 2 (*Incentive strategy for autonomous adaptation*), the results of the binary probit models in Table 4 show the positive and significant contribution at the 1% level for the classification variable of the production system (SYSTEM), at the level of 5% for the variable (AGR) and at the level of 10% for the two variables (OWNER and MEMBERSHIP). This strategy explains that when agriculture is the main activity for the oasis household head who is also the owner of a farm and member of an agricultural development group for access to irrigation water, contribute to the choice of orientation of oasis agricultural production system. This orientation towards a new oasis production system can be interpreted as a kind of strategy of adaptation to climate change which is carried out for the benefit of the activity of the breeding in particular the cattle breeding which has known a significant deterioration due to of their significant cost. This autonomous adaptation strategy is achieved through the sale of heads of cattle to finance agricultural activity and also through the incentive procedure of public actors to encourage investment in profitable crops with high added value such as pomegranate trees. This

Table 4 - Binary probit models results.

	Strategy 1: Adaptation strategy in terms of water saving policy		*Strategy 2: Autonomous adaptation incentive strategy*		*Strategy 3: Technical strategy and production system*	
	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|
X1 : AGE	.2594575***	0.003	.0657398	0.250	.155476**	0.027
X2 : EDUC	.5832071	0.147	.5041755	0.114	.3956855	0.380
X3 : AGR	1.863913**	0.045	1.299478**	0.047	1.747972***	0.008
X4 : RESID	1.828314	0.191	-1.177553	0.430	-2.879703	0.060
X5 : SIZE	.0507614	0.795	.0446131	0.854	.0756938	0.755
X6 : SYSTEM	-1.033163	0.186	1.767906 ***	0.003	1.731461***	0.001
X7 : OWNER	2.345358***	0.001	1.366003*	0.069	.8416214	0.249
X7 : MEMBERSHIP	2.47279**	0.016	1.617083*	0.079	2.051047**	0.034
Constante	-19.64239	0.002	-8.700323	0.052	-13.74039	0.015
	Wald chi2(8) =16.15 Prob > chi2 = .0403 Pseudo R2 = .3881		Wald chi2(8) = 23.02 Prob > chi2 =0.0033 Pseudo R2 = 0.4138		Wald chi2(8) = 30.83 Prob > chi2 =0.0002 Pseudo R2 = 0.4689	

*Notes: *** significant at 1%, ** significant at 5%, * significant at 10%.*
Source: Model results.

strategy implicitly reflects the transformation and the dynamics of the functioning of oasis agricultural households in the South-Eastern region, in particular in the oasis of Methouia.

For Strategy 3 (*Technical strategy and production system*), the results of the binary probit models in Table 4 show the positive and significant contribution at the 1% level of the principal active variable (AGR) and the production system orientation (SYSTEM), and at the 5% level for age (AGE) and member of an agricultural development group (MEMBERSHIP) variables. In fact, in recent years, we have noticed a change in the classic oasis production system in three stages (palm, arboriculture, market garden and fodder crops) associated with the activity of cattle and goat breeding towards a new production system oasis in two stages (arboriculture, vegetable and fodder crops) associated only with goat farming. This strategy is imposed by the phenomenon of urbanization, the change in lifestyle of oasis households and also the degradation of natural resources due to climate change. This positive contribution explains that these variables together play an important role in the strategy of technical adaptation and orientation of the production system, whether through the change of the date for certain vegetable crops thanks to the experience of older farmers although the orientation towards less costly agricultural production systems that consume less water.

3.4. *Results of marginal effects of probit models*

The results of the marginal effects of the socioeconomic variables explaining the adoption of adaptation strategies to climate change are presented in Table 5 confirm the previous results obtained explaining the degree of adoption of these adaptation strategies linked to oasis households and the positive contribution of some variables such as age, main activity, landowner and membership. Indeed, the probit regression models estimated for the marginal effects are globally significant for all the strategies at the 5 and 1% threshold. Based on the coefficients of the correct prediction rates obtained from the estimate, it is possible from the models to make simulations on the different adaptation options, depending on the socio-economic characteristics of agricultural households, with a probability to

Table 5 - Marginal effects of the explanatory variables of the probit model of adoption strategies to climate change.

	Marginal effects		
	Strategy 1: Adaptation strategy in terms of water saving policy	*Strategy 2: Autonomous adaptation incentive strategy*	*Strategy 3: Technical strategy and production system*
X1 : AGE	.1034571 ***	.0260804	.0611735 **
X2 : EDUC	.2325503	.2000174	.1556862
X3 : AGR	.6484015 **	.4818018 **	.6113212***
X4 : RESID	-.5316013	-.4183861	-.6675605
X5 : SIZE	.0202408	.017699	.0297824
X6 : SYSTEM	-.3813734	.6011986***	.6000944***
X7 : OWNER	.7406773***	.5041336*	.3256564
X7 : MEMBERSHIP	7830936 **	.5805983*	6925651**
Log likelihood	-12.682487	-12.032145	-10.722229
Wald chi2	16.15	23.02	30.84
Prob > chi2	0.0403	0.0033	0.0002
PseudoR2	0.3881	0.4138	0.4689
Observations	50	50	50
Correct prediction rate (%)	51.25	54.20	56.60

*Notes: *** significant at 1%, ** significant at 5%, * significant at 10%.*
Source: Model results.

have a prediction ranging to 51.25%, 54.20% and 56.60% certainty, respectively for adaptation strategies 1, 2 and 3.

For the different adaptation strategies and their determining factors which are identified by the binary probit regression model, for example, the variables: age, agriculture is the main activity, owner of agricultural land and membership of a development group agricultural, reflect the adaptive behavior of oasis households in Methouia. The motivation for this adaptive behavior is based almost on four key terms: experience for autonomous adaptation and orientation of production systems, the owner of agricultural land for access to credit and membership in a group of agricultural development for access to water and information and an extension service. The perception of oasis households of climate change in the study area was consistent with the findings of other researchers around the world. Indeed, the regression analysis of the ordered probit model revealed that certain variables such as education, agricultural area, residence, owner of agricultural land and membership of an agricultural development group have influenced the perception of climate change by Farmers. The same interpretations for these variables are justified by the work developed in the central agricultural zone of the state of Delta, Nigeria (Ofuoku and Chukwuji, 2012). Likewise, other results also confirm the same determinants of farmers' perception of sustainable agriculture in Turkey: the case of Mersin province predicts whether farmers will adopt sustainable farming practices or whether they have applied them. Therefore, it is necessary that further research should be conducted to find out whether farmers are likely to do this or if they really have done so by appealing to the importance of agricultural programs on television and radio as well as the use of credit and having cooperative partnerships (Gul *et al.*, 2018). The path to disaster risk reduction in arid and semi-arid regions in Jordan is possible through actions like information, education and technology transfer can make the difference due to their enormous potential mit-

igation of the implications of climate change (Alrusheidat *et al.*, 2016). These same key adaptation terms also summarize the adaptation of farmers' livelihoods to environmental changes in the case of the Minqin oasis, northwest China (Chen *et al.*, 2018).

4. *Conclusion and recommendations*

The study aimed to assess the perceptions and adaptation strategies of farmers to climate change in the oasis of Methouia in South-Eastern Tunisia. It was found that the perception was raised among the majority of oasis farmers who were well aware that the climate was changing. The majority of farmers noted that there was an increase in temperature, decrease in rainfall, changes in the timing of rains and an increase in the frequency of droughts.

The most common adaptation strategies among farm households were: crop diversification, change of production system, increase in water conservation practices, adjustment and management of livestock, the abundance of cattle breeding for the benefit of oasis agriculture and the increased use of irrigation technology through access to credit.

The results of the study also show that certain variables such as level of education, residence on the farm, agricultural area, land owner and membership in the agricultural development group are crucial factors in influencing the probability oasis farmers to perceive climate change. Likewise, factors such as the age of the head of household, education, the system of the land owner and membership in the agricultural development group, facilitate access to credit and also to extension and information on change climate. These variables can be considered as factors to trace the most adequate adaptation strategies for oasis farmers of Methouia to climate change. Any policy aimed at strengthening the adaptive capacity of farmers in the study area should consider the use of the factors mentioned above in developing adaptation strategies. The importance of these socio-economic and technical factors of production in the perception and strategies of adaptation to climate change in the case of agriculture is justified by several studies in the world (Chen *et al.*, 2018 and 2016; Abid *et al.*, 2016; Alam, 2015; Sofoluwe *et al.*, 2011; Smith *et al.*, 2011; Nhemachena and Hassan, 2007; Maddison, 2006). Indeed, this study was an example to show that the bottom-up approach going from the individual scale for the case of the farmer to the global (community or society) to forecast the perception and ideas of the autonomous adaptation. This approach can be interpreted as the most effective methodological process in the design of adequate adaptation strategies which takes into account all the economic, social and ecological characteristics of a given region. Today, it is time to rethink the development of adaptation strategies to climate change by strengthening the adoption of the bottom-up approach on scientific and participatory bases with the actors concerned, first and foremost the farmer and their concerns for the internal and external environment of their activity.

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Role of rural women in organic farming: A case study from Turkey

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Abstract

In this study, it was aimed to determine the participation tendencies in organic agriculture activities of women living in rural areas of the northwestern part of Turkey. The data were collected from 183 rural women by simple random sampling method. The survey was conducted from March to May 2020. The data were evaluated by descriptive statistics, a participation index score and multiple regression analysis. According to the results of the participation index score, rural women's participation of in organic farming activities was highest in the fertilizer application stage and the least in the marketing stage. The results of multiple regression analysis showed that there was a statistically significant relationship between the participation level of rural women in organic farming activities and socio-economic characteristics (age, education level, household size, organic farming experience, household income, agricultural land asset and participation in agricultural training programs). As a result, the findings of the study are expected to make significant contributions to rural development, province economy and further emphasizing the importance of rural women in organic farming activities.

Keywords*: Canakkale, Multiple regression, Organic farming, Participation, Rural women*

1. Introduction

Organic agriculture is a production system that is carried out without the use of synthetic chemicals and inorganic fertilizers. This system reduces the risks concerning human, animal and natural resources through maintaining biological diversity (Deepak and Senthil, 2018; Nishi *et al.*, 2019). Organic farming activities that improve by starting from the 1930s in the world, began by a small group of producers in Turkey in 1985 (Turhan *et al.*, 2017). Organic farming practices in Turkey has gained acceleration in terms of the number of producers and production areas since 2008, especially. Organic agriculture activity which was carried out by 14,926 producers on 166,883 hectares in 2008, reached 74,545 producers and 545,870 hectares in 2019 (TURKSTAT, 2019).

Women play an important role in management and use of natural resources. Therefore, women's exclusion from decision making bodies represent a missed opportunity in terms of sustainable management of available resources and economic development (Sisto and Furst, 2019). In Turkey, women living in rural areas take an active role in agricultural production activities as well as housework and childcare. They are

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involved in selecting and improving local plant varieties, seed exchange and management. Also, they grow and collect food, manage and use natural resources to fulfill the daily needs of their household (Sisto and Furst, 2019). Sustainable agriculture techniques (such as organic produce production, rotational grazing) vitalize women in rural areas, and provides spaces of empowerment for them. These techniques emphasize labour intensive work, and the majority of field work (planting, cultivating and harvesting) is performed through hand by the women farmers (Trauger, 2004; Adinolfi et al., 2020). Therefore, organic food production, which is one of the sustainable agriculture techniques, is of great importance in terms of being an alternative income generating tool that can be developed for evaluating the labour force potential of women producers (Korkmaz and Tüfekçi, 2007). With the development of organic agriculture, which is a labour intensive production system, the significance of rural women has also increased in this production activity. Because, women play a significant role from land preparation to post-harvest operations in this production activity (Santhi and Kalirajan, 2019).

Northwest Turkey is an important part of the country with a high potential and variety of agricultural production (TURKSTAT, 2019). Çanakkale province, which is located northwestern part of Turkey, is one of the provinces of Turkey come into prominence in terms of the quantity of agricultural production in certain products (olive and grape) and production value. This province is the second city (like İstanbul) which has lands in both Asia and Europe on Gallipoli Peninsula on the northwest coast of Turkey and Biga Gallipoli, the prolongation of Anatolia (Anonymous, 2019). Çanakkale province, which have an important place in terms of agricultural production and product variety, has also shown itself in organic farming practices. A total of 97 different organic products (primarily olives and grapes) are grown in this province. In Çanakkale province, the organic farming activity which was carried out on 7,290 hectares with 115 producers in 2002, reached 594 producers and 48,877 hectares in 2019. The population of the province dealing with agricultural activities is 180,185 people and its ratio to the total population is 33.2%. The proportion of female population in the total agricultural population is 48.9% (Anonymous, 2019). Therefore, in spreading organic farming activities, it is important to increase tendencies of women towards these production activities and to contribute for their support in this activity area.

In literature, there are many studies on women empowerment in organic farming. However, there is limited literature with regard to women's participation level in organic farming activities and factors affecting their participation level. As there are few studies about this topic, it has been compared the results of this study with those available. Some previous studies indicated that women generally are more likely to adopt natural products and environmentally friendly production techniques in organic farming activities than men (Chiappe and Flora, 1998; Urena *et al.*, 2008; Jansen, 2000). In a study conducted in Zimbabwe, it was found that organic farming was the major source of income for the female farmers (Svotwa *et al.*, 2009). Roy and Mondal (2015) explained that 70% of women in the Samsung district of North-East Thailand had medium and high level of involvement in organic (vegetables) farming. In a study conducted in Odisha India, it was investigated that the effects of organic farming on the empowerment of women and found organic farming had potential to achieve sustainable development not only in better food and nutrition management but also women empowerment (Altenbuchner *et al*., 2017). Karaturhan *et al*. (2018) found that being farmer of rural woman's father's occupation, education level, the number of children in the family, the participation in farming practices, taking part in professional trainings, following development projects oriented in women, being open-minded towards innovations, being of awareness about organic farming and being of own income had an effect on probability of women's adopting organic farming on their family farms. In a study conducted in Bangladesh, it was determined that majority (52.1%) of rural women had medium participation in organic farming activities and this participation was highest in land management while

it was lowest in marketing the product (Nishi *et al.*, 2019). Nath and Athinuwat (2021) found that women had medium level of empowerment in organic farming, and age, education, farming experience were the effective factors on women farmers' empowerment. In this literature review, there were various studies evaluating women's empowerment in organic farming and their participation level in this activity. However, it has not been coming across any studies that examine the participation level of rural women in organic farming activities in Çanakkale province, which has a favorable location for organic agriculture. Also, the number of studies conducted in Turkey about this issue is also very limited. Therefore, this study may be a contribution for both the Turkish and international literature.

This study focused on rural women in order to eliminate the lack of information about the participation tendencies in organic farming activities of women in the study area. In this context, it is thought that the present study will fill a gap regarding this issue in the relevant literature. Therefore, the present study aimed to determine the socio-economic characteristics of women living in rural areas of Çanakkale province and their participation tendencies in organic farming activities. The findings to be obtained from this study are expected to contribute to province economy and the further emphasizing of the importance of rural women in organic farming activities as well as researchers and policymakers.

2. Material and methods

2.1. *The study area and sample size*

The primary material of the present study was composed of answers obtained from interviews with rural women who participated in organic farming activities in Ayvacık, Gökçeada, and Ezine districts of Çanakkale. In choice of Çanakkale province located northwestern part of Turkey in this study, it was taken into consideration features such as being has a strategic importance of this province about organic farming and being of no study that is conducted in the province concerning this study topic. In the determining the total number of farmers who engaged in organic

Figure 1 - Map of study area.

farming in Çanakkale province, 2019 records of Çanakkale Directorate of Provincial Agriculture and Forestry were used (Anonymous, 2019). Ayvacık, Gökçeada, and Ezine districts selected as study areas were districts that best represent Çanakkale province in terms of being of intensive organic farming production in these districts and being actively engaged in women's organic farming activities (Figure 1).

Since women have a significant role in organic farming activities like in conventional agriculture, the research population of this study composed of answers obtained from interviews with rural women who participated in organic farming activities. The survey was conducted from March to May 2020. The data were gathered by face-to-face interview technique. In the selection of rural women to be surveyed from the sample population, the land size that is applied organic farming activity was taken into consideration. A simple random sampling method was used to determine the number of rural women participating in organic farming activities (Cochran, 1977).

$$n = \frac{N * \sigma^2 * t^2}{(N-1) * D^2 + \sigma^2 * t^2}, \qquad D = \frac{d^2}{t^2} \qquad [1]$$

where, n=number of the women representing the population, N=total number of the farmers in the population (432), σ=standard deviation of the population, d=acceptable error limit in population mean ($\bar{X}$ x 0.05), $\bar{X}$=average land asset (hectares), t=desired confidence level (1.96 for 95%). Thus, the number of rural women to be surveyed was determined as 183 (Table 1).

Table 1 - Sampling size of study.

Province, country	*Selected districts*	*The number of rural women*
Çanakkale, Turkey	Ayvacık	61
	Gökçeada	61
	Ezine	61
Total		183

The survey questions in the current study were prepared inspired from some previous studies conducted about rural women's involvement in organic farming activities (Urena *et al.*, 2008; Jansen, 2000; Svotwa *et al.*, 2009; Roy and Mondal, 2015; Altenbuchner *et al*., 2017; Karaturhan *et al*., 2018; Nishi *et al*., 2019; Nath and Athinuwat, 2021). In the first section of the survey questions, there was information regarding socio-economic characteristics (age, education, household, etc.) of rural women who participated in organic farming activities. In the second section, consumers were asked some questions regarding these practices in order to measure the participation level of rural women in organic farming activities (land, seed, fertilizer, etc.).

2.2. *Data analysis*

Data analysis was performed in three sections. In the first section, descriptive statistics (mean, standard deviation, etc.) were used to determine the socio-economic characteristics of rural women who participated in organic farming activities. In the second section, 6 general aspects, including 20 organic farming activities, were taken into account to measure the participation of rural women in organic farming activities. These activities regarding organic farming practices were prepared with inspiration from some previous studies (Sakiluzzaman *et al.*, 2018; Nasrin *et al.*, 2019; Nishi *et al.*, 2019; Nath and Athinuwat, 2021). Participation level of rural women in organic farming activities were determined according to their participation scores in organic farming activities. Thus, the level of women's participation in organic farming activities were divided into three groups as low participation (≤20), medium participation (21-40), and high participation (≥40). A four-point rating scale that is assigned as 'frequently', 'sometimes', 'rarely' and 'never' was used for 3, 2, 1 and 0 scores, respectively in order to determine the degree of women's participation in organic farming activities. According to this scale, the scores of rural women in these activities was ranged from "0 (0= 0 × 20) to 60 (60= 3 × 20)". The 0 score indicates no women's participation in organic farming activities while the 60 score indicates the highest women's participation in organic farming activities. Also, the score for extent of participation of rural women in each aspect of organic farming activities was ranged from "0 (0= 0 × 183) to 549 (549= 3 × 183)". The "0" score indicates no women's participation in each aspect of organic farming activities while the "549" score indicates the highest women's participation in organic farming activities.

The participation index score (PIS) is the score obtained by an activity against all respondents (Nasrin *et al.*, 2019; Nishi *et al.*, 2019; Nath and Athinuwat, 2021). To compare the extent of rural women's organic farming activities participation in terms of 6 general aspects as well as 20 organic farming activities, a participation index score (PIS) and a participation extent (PE) for each of the 6 general aspects were calculated by using the following formulas:

$$PIS=(N_{ne} \times 0)+(N_{ra} \times 1)+(N_{so} \times 2)+(N_{fr} \times 3) \quad [2]$$

where, PIS is a participation index score, N_{ne} is number of rural women participated never, N_{ra} is number of rural women participated rarely, N_{so} is number of rural women participated sometimes and N_{fr} is number of rural women participated frequently.

$$PE = OPS / PHPS \times 100 \quad [3]$$

where, PE is a participation extent, OPS is observed participation score and PHPS is possible highest participation score.

In the last section, multiple regression analysis

was used to determine the relationship between the level of the participation of rural women in organic farming activities and their socio-economic characteristics. In this model, the level of rural women's participation in organic farming activities was dependent variable, and their socio-economic characteristics were independent variables. Multiple regression analysis is an extension of simple linear regression. This method is used to measure the degree of influence of the independent variables on dependent variable and to predict the best relationship between dependent variable and independent variables (Kim and Kohout, 1975; Gujarati, 1995; Agha and Alnahhal, 2012). This model is formulated as in the following:

$$Y= \beta_0+\beta_1X_1+ \beta_2X_2+.....+\beta_nX_n+ \varepsilon \quad [4]$$

where, Y is dependent variable, β_0 is constant term, X_n is independent variables, $\beta_1,\beta_2,\ldots\beta_n$ are coefficients of the regression and ε is the error term. This equation can also be written as:

$$Y= f (X_1,X_2,.....,X_n) \quad [5]$$

In addition, the multicollinearity problem and the collinearity diagnostic were calculated for determine to correlation among the independent variables. Because, the strong correlation among the independent variables isn't usually preferred in this regression model. Thus, high tolerance (a tolerance close to 1) and low VIF (Variance Inflating Factor) (VIF<10) values indicate whether or not there is a multicollinearity problem among the independent variables (Hair *et al.*, 2006). These data were analyzed by using SPSS statistical analysis programme (SPSS, 2008).

3. Results and discussion

3.1. *Rural women's socio-economic characteristics*

The socio-economic characteristics of rural women who participation in organic farming activities was explained in Table 2. In the study area, it was determined that the majority of women (72.7%) participating in organic farming activities were between the ages of 31 and 50. The general average age was determined as 39.4. In a study conducted in Aydın province, which is located another region of Turkey, it was determined that the majority of women engaged in organic farming activities were 40 years old and above (Karaturhan *et al.*, 2018). Thus, the findings of this study are in line with the findings of Karaturhan *et al.* (2018). However, these results are different from the findings of Nishi *et al.* (2019), which concluded that 58.6% of the women participating in organic farming activities in Bangladesh were 35 years old or younger. These results in the study area revealed that the majority of women participating in organic farming activities were middle aged and above, and women in this age group participate in organic farming activities more than women aged 30 and under. The fact that middle-aged and older women in the study area are more conscious about the negative effects on the health of chemicals used in agriculture can be shown as the reason for this situation. Hence, it can be expected that women's willingness to tending from traditional agriculture to organic agriculture has increased.

In the study area, it was determined that 41.5% of the women were primary school graduates, 49.8% were secondary and high school graduates, and 8.7% were university graduates. In a study conducted in Aydın province, 34.1% of the women were found to be primary school graduates (Karaturhan *et al.*, 2018). In a study conducted in Thailand, it was stated that 46% of the women engaged in organic agriculture were university graduates (Nath and Athinuwat, 2021). These results in the study area revealed that the majority of women (58.5%) had a secondary school or higher education level. According to these results, it can be said that the ratio of women's primary school graduates in the present study is higher than that of women in Aydın. Also, it can be stated that the ratio of women's university graduates in the study area is much lower than that of women in Thailand. According to these results, it can be said that the increase in the education level of women has a significant effect on their participation in organic farming activities.

In the study area, the average household size of women participating in organic farming activities was found to be 3 persons. Also, the average household size is 3.4 persons in Turkey (TURKSTAT, 2019). These results revealed that the aver-

Table 2 - Socio-economic characteristics of the rural women (n=183).

Characteristics	*Frequency*	*Percentage*	*Mean*	***SD*
Age (year)				
≤30	24	13.1		
31-50	133	72.7	39.4	7.91
≥50	26	14.2		
Education level (year)				
Primary school graduate	76	41.5		
Secondary school graduate	51	27.9	8.0	3.17
High-school graduate	40	21.9		
University graduate	16	8.7		
Household size (person)				
≤2	87	47.5		
3-5	68	37.2	3.0	1.16
≥5	28	15.3		
Organic farming experience (year)				
≤4	28	15.3		
5-9	86	47.0	7.6	2.69
≥9	69	37.7		
**Household income (€ year^{-1})*				
≤€1803.6	54	29.5		
€1804-€3467.7	108	59.0	€ 2499.5	1026.3
≥€3468	21	11.5		
Agricultural land asset (hectare)				
≤25	131	71.6		
26-50	31	16.9	20.0	21.04
≥50	21	11.5		
Participation in agricultural training programs (Number of training)				
≤2	137	74.7		
3-4	30	16.4	1.3	0.63
≥4	16	8.7		

**1 Euro=7.21 TRY (Turkish lira) in March 2020; **SD=Standart deviation; Low income (≤€1803.6), Medium income (€1804-€3467.7), High income (≥€3468).*

age household size of women in the study area was below Turkey's average. In a study conducted in Bangladesh, it was determined that more than half of the women's (52.1%) average household size was 5 persons (Nishi *et al.*, 2019). In this context, it can be said that the size of households of women in the study area is less than the household size of women in Bangladesh, and the majority of them are part of a nuclear family structure.

In the study area, 47% of the women had between 5 and 9 years of experience in organic farming activities. Also, it was detected that women had knowledge about organic agriculture and they gained knowledge regarding this issue mostly from their own experience as well as their relatives. In a study conducted in Bangladesh, it was found that the vast majority of women (59.3%) had 10 years or less experience in organic farming activities (Nishi *et al.*, 2019). In a study conducted in Thailand, it was stated that the majority of women had between 11 and 20 years of experience in organic farming activities (Nath and Athinuwat, 2021). The findings of this study are consistent with those of Nishi *et al.* (2019). Also, women in the study area have fewer experience in organic agriculture activities than that of women in Thailand. Therefore, the increase in experiences regarding women's

organic farming activities may positively affect their possibility to participate in this activity.

In the study area, 59% of the women participating in organic farming activities had an annual household income level between €1804-€3467.7 and 11.5% of them had an income of €3468 and above. In a study conducted in India, it was found that the household income level of women in farms where organic agriculture was carried out in the high-income group (Poyyamoli and Padmavaty, 2011). These results revealed that the majority of women was in the middle-income group, and their household income level was lower than that of women in India. Hence, the increase in the household income level of women can affect on their participation in organic farming activities.

In the study area, it was determined that the majority of women (71.6%) participated in organic farming activities on lands of 25 hectares and less, and the average land size was 20 hectares. In a study conducted in Mardin province, which is located Southeastern Anatolia region of Turkey, it was stated that 50% of the farmers carried out their organic farming activities on lands less than 20 hectares (Acıbuca *et al*., 2018). These results revealed that that the majority of organic farming activities in the study area were carried out on lands of 25 hectares and less. According to these results, it can be said that the size of land in the study area is larger than the land size in Mardin province. In this context, it can be said that the increase in the land size has an effect on the participation of women in organic farming activities. In order word, it is expected that women's participation in organic farming activities will increase and more women will contribute to the labour force due to the increase in land size.

In the study area, 74.7% of the women participating in organic farming activities attented 2 or less than 2 agricultural training programs. In a study conducted in Bangladesh, it was found that 41.5% of the women who participated in organic agriculture activities attend agricultural training at all (Nishi *et al.*, 2019). In the study conducted in Thailand, it was found that 96% of the women received training for up to 30 days (Nath and Athinuwat, 2021). These results revealed that women's participation tendencies for agricultural training programs were low in study area. Also, women's participation tendencies for agricultural training programs are higher than that of women in Bangladesh. Therefore, the increase in women's participation in agricultural training programs is expected to have an impact on their tendencies towards organic farming activities. Because, the subjects regarding organic agriculture activities included in agricultural education programs, also. Furthermore, the women in the study area stated that these training programs contribute to organic farming activities.

3.2. *The participation level of rural women in organic farming activities*

In the current study, 20 organic agriculture activities were defined to determine the participation level of rural women in organic farming activities. These activities were scored according to the level of women's participation. According to these scores, those who had 20 scores or less from 20 organic farming activities were grouped into the low participation category, those who had between 21 and 40 scores were grouped into the medium participation category, and those who had 40 scores and above were grouped into the high participation category. These data were explained

Table 3 - The participation level of rural women in organic farming activities (n=183).

Level of participation	*Score*	*Frequency*	*Percentage*	*Mean*	**SD*	*Min.*	*Max.*
Low	≤20	15	8.2	37.4	7.8	17	50
Medium	21-40	90	49.2				
High	≥40	78	42.6				
Total		183	100.0				

**SD=Standard deviation.*

Table 4 - The rank order of the rural women in case of participation in organic farming activities based on participation index score (PIS) and participation extent (PE) (n=183).

Activities	*Frequently (3)*	*Sometimes (2)*	*Rarely (1)*	*Not at all (0)*	*PIS*	*PE (%)*	*Rank (20-issues)*	*Rank (6-aspects)*
A. Land								
1. Land selection	118	36	10	19	436	79.4	5th	
2. Soil preparation	113	41	11	18	432	78.7	7th	
$\bar{X}$ of A					434			2nd
B. Seed								
3. Seed growing	131	19	14	19	445	81.1	4th	
4. Seed sowing	123	28	9	23	434	79.1	6th	
5. Seed preservation	73	21	10	79	271	49.4	17th	
$\bar{X}$ of B					383.3			4th
C. Fertilizer Application								
6. Organic material collection (animal manure, agricultural residue, etc.)	158	12	2	11	500	91.1	1st	
7. Compost making	146	9	8	20	464	84.5	3rd	
8. Preservation of the compost	125	17	12	29	421	76.7	8th	
9. Applying the compost	123	20	11	29	420	76.5	9th	
$\bar{X}$ of C					451.3			1st
D. Cultural Operations								
10. Soil cultivation	99	44	13	27	398	72.5	12th	
11. Irrigation	149	13	7	14	480	87.4	2nd	
12. Thinning	68	31	12	72	278	50.6	16th	
13. Weed control	112	27	13	31	403	73.4	11th	
14. Past control	22	117	22	22	322	58.6	15th	
15. Crop rotation	66	90	5	22	388	70.7	13th	
$\bar{X}$ of D					378.2			5th
E. Harvest Operations								
16. Picking of product	118	22	13	30	411	74.9	10th	
17. Grading	100	29	17	37	375	68.3	14th	
$\bar{X}$ of E					393			3rd
F. Marketing								
18. Packaging	15	11	4	153	71	12.9	19th	
19. Transporting	8	13	7	155	57	10.4	20th	
20. Selling	17	50	13	103	164	29.9	18th	
$\bar{X}$ of F					97.3			6th

in Table 3. These results showed that women's participation level in organic farming activities ranged from 17 to 50 scores against the possible ranged of 0-60 scores. The mean was 37.4 with a standard deviation of 7.8. Furthermore, 49.2% of the women had a medium level of participation in organic farming activities while 42.6% and 8.2% of them had high and low level of participation in organic farming activities, respectively. In a study conducted in Bangladesh, it was found that women had medium and high participation in organic farming activities (Nishi *et al.*, 2019). The results of the present study are similar with those of Nishi *et al*. (2019). These results revealed that women participate in organic farming activities have medium and high level. This situation can be interpreted as an indication of the importance given by rural women to participate in organic farming activities. Considering that the majority of women (57.4%) participate in organic agriculture activities at a medium and low level, it may be important to increase tendencies of women towards agricultural training programs conducted by the public extension, and agricultural credit supports. Because, these programs and supports are expected to be effective in increasing the participation ratios of women in organic agriculture activities. To measure the extent of rural women's participation in 20 organic farming activities under 6 general aspects, a participation index score (PIS) and a participation extent (PE) were calculated (Table 4). These results showed that the participation extent of women in organic farming activities was ranged from 10.4% to 91.1%. In addition, it was revealed that organic material collection (91.1%), irrigation (87.4%) and compost making (84.5%) ranked 1st, 2nd and 3rd, respectively, among 20 organic farming activities. Also, it was determined that organic farming activity with the least participation ratio of the women was transporting (10.4%). In a study conducted in Bangladesh, it was stated that collecting of the organic product from own residence, collecting of material for fertilizer application and decomposing of compost ranked 1st, 2nd and 3rd, respectively, among all organic farming activities (Nishi *et al.*, 2019). In a study conducted in India, it was found that women participated in organic farming activities by the production of compost and vermicompost (Daniel, 1999). Organic material collection, which is one of the organic farming activities, ranked 1st among the participation extent of women in organic farming activities in the study area. The results are similar with those of Nishi *et al.* (2019), which explained that the collection of the organic product from its own residence ranked 1st among all organic farming activities. However, the findings of this study are not congruent with the results of the study conducted in India, which reported that women participated in organic farming activities by the production of compost and vermicompost (Daniel, 1999).

In this study, it was determined that the participation index score of the women in organic farming activities was ranged from 97.3 to 451.3 as mean value ($\bar{X}$) (Table 4). According to the results of the participation index score, women's participation in organic farming activities was highest in the fertilizer application stage ($\bar{X}$ =451.3) and the least in the marketing stage ($\bar{X}$ =97.3). The other activities participated by women were land ($\bar{X}$ =434), harvest operations ($\bar{X}$ =393), seed ($\bar{X}$ =383.3) and cultural operations ($\bar{X}$ =378.2), respectively. In a study conducted in Bangladesh, it was found that while the participation of women in organic farming was highest in the land management stage, the lowest participation was in the product marketing stage (Nishi *et al.*, 2019). The findings of the present study are not congruent with the results of the study conducted in Bangladesh, which reported that the participation of women in organic farming was highest in land management. In the study area, these results revealed that women's participation in organic farming activities is the least in the marketing stage. According to all results in Table 4, it can be said that the women have successful in being a part of the organic farming system and in contributing to the development of this system. The tendencies of women's participation in organic agriculture activities are high in the study area since organic agriculture is a sustainable source of income and organic products constitute a healthy food source. Also, it can be said that women are conscious about participation in organic farming activities.

Table 5 - Multiple regression estimates of factors affecting the level of the participation of rural women in organic farming activities.

Variables	*Unstandardized coefficients*		*Standardized coefficients*	*t*	*p**	*Correlations*		*Collinearity statistics*	
	B	*[a]SE*	*Beta*			*Partial*	*Part*	*Tolerance*	*VIF*
Constant	32.347	2.167		14.929	0.000				
X_1	-0.310	0.045	-0.314	-6.892	0.000	-0.462	-0.254	0.655	1.527
X_2	0.682	0.095	0.277	7.212	0.000	0.479	0.266	0.924	1.083
X_3	-4.319	0.266	-0.642	-16.235	0.000	-0.775	-0.599	0.871	1.148
X_4	1.660	0.131	0.572	12.631	0.000	0.691	0.466	0.665	1.505
X_5	0.003	0.000	0.368	9.209	0.000	0.571	0.340	0.851	1.174
X_6	0.077	0.014	0.207	5.546	0.000	0.387	0.205	0.975	1.025
X_7	2.785	0.461	0.226	6.045	0.000	0.416	0.223	0.974	1.027

*Dependent variable: Y (the level of the participation of rural women in organic farming activities); Independent variables: X_1(age), X_2(educational level), X_3(household size), X_4(organic farming experience), X_5(household income); X_6(agricultural land asset); X_7(participation in agricultural training programs); R=0.873; R^2=0.762; Adjusted R^2=0.752; The levels of significance=*p<0.05; F(7;175)=79.88, p=0.000*(p<0.001); [a]SE=Standard error.*

3.3. *Factors affecting women's participation in organic farming activities*

In this study, multiple regression analysis was used to determine the factors (socio-economic characteristics) that affect the participation level of women in organic farming activities (Table 5). Partial correlation scores between the variables were found below 0.80. Furthermore, it was found that the variance inflation factor (VIF) values for all variables were smaller than 10. Thus, it was found that there was no multicollinearity problem between the independent variables in this model. The results of ANOVA statistics showed that seven independent variables in the model significantly predicted the dependent variable. In this analysis, it was found that the degree of model that predicts the dependent variable was R=0.873, and the degree of model that explains the variance in the dependent variable was R^2=0.752. The R^2 value of 0.752 showed that 75.2% of the variance in the participation level of rural women in organic farming activities was explained by seven independent variables. Based on the multiple regression analysis results, the regression equation was obtained as follows:

$$Y=32.347-0.310X_1+0.682X_2-4.319X_3+1.660X_4+0.003X_5+0.077X_6+2.785X_7$$

Age is an effective factor in women's participation in socio-economic activities (Yount *et al.*, 2014; Nath and Athinuwat, 2021). Because, the change in women's age may affect their participation in socio-economic activities. Therefore, their participation in organic farming activities may also change depending on the change in the age of women. In this study, it was determined that there was a negative and statistically significant relationship (P<0.05) between the participation level of women in organic farming activities and their ages. Thus, when the age of women increases by one year, their participation in organic farming activities decreases by 0.310. In studies conducted in India and Sri Lanka, a negative relationship was found between age and women's participation in agricultural production (Sireeranhan, 2013; Shamna *et al.*, 2018). The results of the present study are similar with those of Sireeranhan (2013) and Shamna *et al.* (2018). However, these results are not congruent with those of Yusuf *et al.* (2015), which indicated that there was a positive relationship between age and women's participation in agricultural production. As far as is known, farm structure affects the organisation of labour. Therefore, this situation tends to be more complex in organic farms that are usually based on

more activities (Jansen, 2000; Morison *et al.*, 2005; Lobley *et al.*, 2009; Dinis *et al.*, 2015). The studies on organic agriculture stated that organic agriculture is generally as a production system that requires more labour-intensive than traditional agriculture (Jansen, 2000; Sharma and Singh, 1997; Nana *et al.*, 2015; Yılmaz and Yücel, 2017; Merdan, 2018). Furthermore, this system usually requires more labour intensive because it needs more time for managing weeds and monitoring pests. For this reason, considering that the majority of women who participate in organic farming activities in the study area are between the ages of 31 and 50, it can be expected that their tendencies towards organic farming activity, which requires labour-intensive, may decrease or they may face health problems depending on the increase in the age of women. As a result of possible health problems that may arise due to the increase in the age of women, their participation in organic farming activities will also decrease. It can be stated as an expected result that middle age women are more likely to participate in agricultural production activities than older women. Therefore, it is important to increase the participation in organic farming activities of women aged 30 and under in the study area. Because it can be expected that young women are more likely to participate trainings and to adopt innovations regarding organic farming than women in other age groups. This situation can make important contributions to the development of organic farming activities. These results revealed that age has an effect on the participation in organic farming activities of women in the study area.

Education plays an important role in raising awareness in the efficient and productive use of resources. Also, it can be effective in facilitating women's participation in the labour force by strengthening their position in society and households (Cameron *et al.*, 2001). Furthermore, increasing the level of education is also important in terms of adapting and participating in innovations regarding agricultural activities (Paulos *et al.*, 2004). Therefore, depending on the change in the education level of rural women, their participation in organic farming activities may also change. In this study, it was found that there was a positive and statistically significant relationship ($P<0.05$) between women's participation level in organic farming activities and their educational level. Thus, when the education level of women increases by one year, their participation in organic farming activities increases by 0.682. In a study conducted in Bayburt, Erzurum, and Erzincan provinces, which is located another region of Turkey, it was reported that the illiteracy of 41.8% of women living in rural areas had a negative effect on the expansion of the effects of organic agriculture (Kaya and Atsan, 2012). The results of the present study were supported by findings of Hosseini and Ajoundani (2013) and Karaturhan *et al.* (2018), which indicated that there was a positive relationship between the increase in education level and women's participation in organic agriculture activities. Considering that more than half of the women (58.5%) participating in organic farming activities in the study area has a secondary school or higher education, it can be expected that the increase in the education level of women may be effective in gaining experience and increasing their knowledge level. Therefore, increasing the education level of rural women can help them to be more confident and active in their participation in various agricultural activities including organic farming. Consequently, women's tendencies towards new production techniques, agricultural equipment, and production activities may increase. These results revealed that the educational level had an effect on the participation of women in organic farming activities.

Household size is an effective factor in the decision-making process regarding women's labour force participation. Because, the increase or decrease in the number of members in the household may affect women's participation in the labour force. Therefore, depending on the change in the number of members of the household in rural areas, women's participation in organic farming activities may also change. In this study, it was determined that there was a negative and statistically significant relationship ($P<0.05$) between women's participation level in organic farming activities and their household size. Thus, when the number of women's household members increases by one person,

their participation in organic farming activities decreases by 4.319. In Turkey, it is known that the number of household members and women's marital status has an impact on the labour force participation ratios of women (Er, 2013). Accordingly, it can be said that the number of household members has a significant effect on the participation of women in agricultural activities. Considering that the household size of the women in the study area is 3 people on average and the majority of them are in nuclear family structure, depending on the increase in the number of members in the household, it can be stated that the responsibilities of women in home will increase a little more and they will have a higher workload. This situation is expected to negatively affect the participation of women in organic farming activities. These results revealed that the number of household members had an effect on the participation of rural women in organic farming activities.

Agricultural experience can be explained as all of the knowledge and experiences gained by farmers during the period that are interested in agricultural activities. Therefore, the time spent in agriculture is expected to affect the tendencies of farmers to agricultural activities. Accordingly, the agricultural experience can always provide different opportunities to women farmers in order to get the necessary information and solution recommendations about different agricultural problems (Nath and Athinuwat, 2021). Therefore, depending on the change in the organic farming experience of rural women, their participation in organic farming activities may also change. In this study, it was found that there was a positive and statistically significant relationship ($P<0.05$) between women's participation level in organic farming activities and their organic farming experience. Thus, when the organic farming experience of women increases by one year, their participation in organic farming activities increases by 1.660. In a study conducted in the province of Burdur, which is located another region of Turkey, it was found that agricultural experience had a positive effect on women's decision to participate in agricultural activities (Kutlar *et al*., 2013). The results of the present study are similar with those of Kutlar *et al.* (2013), which indicated that there was a positive relationship between women's agricultural experience and their participation in agricultural activities. Thus, it can be said that women gaining agricultural experience in time will make positive decisions about their lives and participation in agricultural activities. Considering that 47% of the women in the study area have organic farming experiences between 5 and 9 years, women's tendencies towards this activity is expected to increase as a result of the increase in knowledge and experience of rural women who have gained organic agriculture experience. Because, it is thought that women who have organic farming experience will plan their production activities more rationally and use their knowledge more effectively. In other words, a certain time period is required for change over from conventional agriculture to organic agriculture depend on produced organic product varieties. Due to the difficulties in the production conditions of organic agriculture, this production process may fail in the first years. Therefore, producers who can continue this production activity can be expected to longer years of activities, on an average. These results revealed that organic farming experience had an impact on the participation of women in organic farming activities.

Household income is an important factor in women's participation in agricultural activities. Depending on whether the household income level of women is high or low, their tendencies towards agricultural activities may also change. Thus, the women with high household income level may also a high tendency towards alternative farming methods have except for traditional agriculture (such as organic agriculture). Therefore, depending on the change in household income of women, their participation in organic farming activities may also change. In this study, it was found that there was a positive and statistically significant relationship ($P<0.05$) between the participation level of women in organic farming activities and their household income. Thus, when the household income of women increases by one unit, their participation in organic farming activities increases by 0.003. In a study conducted in Pakistan, it was found that an annual farm income had a positive

effect on women's participation in agricultural activities. Also, women's participation tendencies in agricultural activities also increased as farm income increased (Zahoor *et al.*, 2013). The results of the present study are similar with those of Zahoor *et al.* (2013), which indicated that there was a positive relationship between an annual farm income and women's participation in agricultural activities. Considering that more than half (59%) of the women participating in organic farming activities in the study area have middle-income groups, the increase in household income will increase their participation tendencies in organic farming activities. In this context, it is considered that households who have high-income will have financial resources in oder to provide employment for more female labour force since organic farming activity are labour intensive model of a production and requires more female labour force. This situation is expected to positively affect the participation tendencies of women in organic farming activities. Furthermore, women's tendencies to innovations regarding organic farming activities may increase depending on increase in household income and they can buy land or utilize from their existing lands in order to increase their organic farming activities. Also, their willingness to maximum participation engagement in product-related activities may increase in order to further increase the current income level. These results revealed that the household income had an effect on the participation of women in organic farming activities.

Agricultural land assets can be seen as an important advantage for producers engaged in agricultural production activities including organic agriculture. Because the increase in agricultural land assets of women participating in agricultural production activities may affect their tendencies towards production activities. Therefore, the participation of women in organic farming activities may also change depending on the change in agricultural land assets. In this study, it was found that there was a positive and statistically significant relationship ($P<0.05$) between the participation level of women in organic farming activities and their agricultural land assets. Thus, when the agricultural land assets of women increase by one hectare, their participation in organic farming activities increases by 0.077. In a study conducted in Pakistan, it was determined that having agricultural land assets had a positive effect on women's participation in agricultural activities. The results of the present study are similar with those of Ejaz (2007), which indicated that there was a positive relationship between agricultural land assets and their participate in agricultural activities. Considering that the majority of women (71.6%) participating in organic farming activities in the study area have land of 25 hectares or less, the increase in land assets is expected to increase their tendencies to participate in organic farming activities. Because, the increase in the agricultural land assets of women participating in organic farming activities will positively affect their production amount and their desire for more revenue generation. By this means, the tendencies of women to participate in organic farming activities will also increase. These results revealed that the agricultural land assets had an effect on the participation of women in organic farming activities.

One of the most important functions of organic agriculture has positive effects on human health. In other words, it is one of the most important parts of a healthy and balanced nutrition. For this reason, it is important to raise awareness about organic agriculture especially for women in rural areas. Because, raising the awareness of women about organic farming activities may positively affect their participation in organic farming activities and the awareness of members in the household indirectly about organic farming. Therefore, rural women participating in agricultural training programs may have higher tendencies towards different agricultural methods (such as organic agriculture). Consequently, depending on the change in the number of their participation in agricultural training programs of women, their participation in organic agriculture activities may also change. In this study, it was found that there was a positive and statistically significant relationship ($P<0.05$) between the participation level of women in organic farming activities and their participation in agricultural training programs. Thus, when the number of women participating in agricultural training pro-

grams increases by one unit, their participation in organic farming activities increases by 2.785. The results of the present study are similar with those of Singh *et al.* (2015), which indicated that there was a positive relationship between participation in informative agricultural activities and women's participation in agricultural production. Considering that 74.7% of women participating in organic agriculture in the study area joined in 2 or less than 2 agricultural training programs, it is expected that the increase in the number of women's participation in agricultural training programs will positively affect their participation in organic agriculture activities. The fact that women tend to participate more than 2 in agricultural training programs can be interpreted as an indication that they are more open to innovations and desire to gain more experience in agricultural production. For this reason, it is thought that agricultural education programs are important in terms of expanding the perspective of women and providing them with the ability to carry out agricultural activities more effectively. These results have revealed that the number of participations in organic agriculture programs affected the participation of women in organic agriculture activities.

3.4. *Limitations and recommendations*

The present study had some limititations. First limitation was the selection of sample. Because, it was focused on women who participated in organic farming activities in Çanakkale province, which is located northwestern part of Turkey. It just represented Çanakkale province. However, due to the limited literature about this issue in Turkey, the findings obtained from this study may contribute to compare the results of study that will be conducted in different regions with regard to this topic. Second limitation was the method used in data collection. The face-to-face survey method was used in this study. It is considered that this method is more reliable than online or internet survey as researchers conducting face-to-face survey can evaluate whether persons who answered survey questions are being trustworthy or not and explaine questions that is misunderstood in questionnaires. It is not as easy and cheap as online or internet survey. Due to time and budget constraints, the scope of this study was not able to expanded more generally in Turkey. Thus, in future studies, the determining the participation levels of women participating in organic farming activities in different regions is expected to be useful in comparing their role in organic farming.

4. Conclusions

In the study area, the tendencies of women to participate in organic farming activities is high because organic agriculture is a sustainable source of income. However, the majority of women participating in organic farming activities are middle-aged and above. For this reason, encouraging women aged 30 and under to increase their participation in organic farming activities is important in terms of the development of organic agriculture. Since the majority of women (57.4%) participated in organic farming activities in medium and low level, increasing women's tendencies towards both agricultural training programs conducted by the public extension organizations and agricultural credit supports may be effect to enhance their ratio of participation in organic farming. In the study area, women's participation in organic farming activities was different extent. Women mostly participated in activities such as organic material collection, irrigation, compost making and seed growing. Age, educational level, household size, organic farming experience, household income, agricultural land asset and participation in agricultural training programs showed a statistically significant relationship with women's participation in organic farming activities. In this context, these socio-economic characteristics have effect on women's participation tendencies in organic agriculture activities. As a result, from the essence of the findings explained above, it can be concluded that participation level of rural women in organic farming activities is not satisfactory and so adequate support should be provided to take the necessary steps related to expanding this activity to increase their participation in organic farming activities. Furthermore, the results

of this study can helpful for development strategies of action that will motivate to adopt organic farming of rural women by agricultural extension workers and researchers.

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Facteurs affectant les stratégies d'adaptation des éleveurs aux changements climatiques : Cas des parcours d'El Ouara au Sud Tunisien

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Abstract

Climate change is a global environmental threat to all economic activities, especially the livestock activity. The South of Tunisia, where animal husbandry is a fundamental element of the domestic economy, is more influenced by these negative effects due to the arid climate. The objective of this study is to identify strategies and levers mitigation and adaptation to climate change developed by breeders on based on available factors. For this purpose, a survey conducted among 73 breeders on the rangelands of El Ouara, in the South of Tunisia. Results emerges that breeders use various adaptation strategies principally, supplementation, integration agriculture-livestock and conduct's mode through different types such as association. The result of the model reveals that age of breeder, herd size, agricultural area, member of an association, subsidies and well ownerships are the most factors which significantly influence the adaptation choices of breeders to cope to climate change. The results proved too that adaptation to climate change was inhibited by many factors such as luck of workforce labor, lack of water and financial resources as well the degradation of the rangelands.

Keywords: *Logistic regression model, Livestock, Strategy, Rangelands, Climate change.*

1. Introduction

Le fonctionnement des systèmes agricoles est directement lié au climat (Belay *et al.*, 2017). Les pays de l'Afrique du Nord et la région de la Méditerranée orientale sont les zones les plus vulnérables au changement climatique (Karas, 2006). Particulièrement en Tunisie, le secteur d'élevage est fortement confronté aux effets négatifs du changement climatique qui se manifestent par des sècheresses et un manque de la pluviométrie. Il est catégorisé parmi les pays les moins dotés en ressources en eau et les zones les plus vulnérables aux impacts des changements climatiques dans la Méditerranée (MARE et GIZ, 2011 ; MEE, 2013 ; Fouzaï *et al.*, 2019). En fait, les projections futures du GIEC ont montré qu'une diminution des précipitations (-30%) est attendue d'ici 2050 au sud Tunisien contre une hausse prévue des températures (2,1 °C) sur la même période (GIEC 2018 ; Ozturk *et al.*, 2015). Les changements climatiques globaux vont conduire à une aridité croissante dans les régions sèches provoquant la dégradation du couvert végétal (Nedjraoui *et al*., 2009) et conduisant par là même à un processus de dégradation des parcours arides. Même si les études

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se différent concernant la valeur de la superficie des parcours (5.5 millions d'ha pour Elloumi *et al.* (2011) et 4.5 millions d'ha pour Rhouma and Souissi (2004), mais tous confirment sa situation alarmante aujourd'hui (Jemaa *et al.*, 2012 ; Huguenin *et al.*, 2012). En conséquence, se pose la question sur le devenir du système d'élevage dans les parcours arides. Leur devenir en termes de mode de conduite et en matière d'utilisation des ressources naturelles.

L'adaptation au changement climatique devient aujourd'hui un sujet d'intérêt important tant pour les producteurs que pour les décideurs (GIEC, 2018 ; Pierre *et al.*, 2012). Sans adaptation, les moyens de subsistance des agriculteurs sont menacés. Ainsi, « l'adaptation en agriculture est plutôt la norme que l'exception » (Rosenzweig et Tubiello, 2007). Des études antérieures montrent que les éleveurs s'adaptent au changement climatique existant de diverses manières, tels que la mobilité du troupeau, l'intégration de l'agriculture à l'élevage, la réduction de la taille du troupeau, l'utilisation de résidus de récolte et des autres aliments de complémentation, le recours aux fourrages cultivés, l'installation des parcelles fourragères, le stockage des résidus de récolte, la diversification du cheptel, la migration, la pratique d'activité extra-agricole (Abraham *et al.*, 2019 ; Idrissou *et al.*, 2019 ; Zampaligré *et al.*, 2014 ; Snaibi 2020 ; Vodounou et Onibon Doubogan, 2016).

Malgré cet amenuisement des ressources naturelles et la nette diminution de la contribution des parcours dans la ration alimentaire des animaux (Ibidhi et Ben Salem, 2018), l'élevage reste la principale source des revenus de la population dans ces espaces ruraux ainsi que dans la création de la valeur ajoutée de la production agricole d'une manière significative même à l'échelle nationale. Il représente 4% du PIB du pays et contribue à hauteur de 41% à la production agricole totale (INS, 2018). Dans cette conjoncture, afin d'assurer la durabilité des systèmes d'élevage, la mise en place des mesures d'adaptation s'avère nécessaire aujourd'hui pour réduire les effets des incertitudes climatiques.

Diverses études dans les régions du centre et du sud de la Tunisie sur les impacts économiques du changement climatique sur le secteur agricole (Jeder *et al.*, 2013 ; Nefzi, 2012) montrent que ces impacts peuvent être considérablement réduits grâce à l'adaptation. D'ailleurs, Elloumi *et al.* (2006), Cialdella (2005) et Jemaa *et al.* (2016) constatent les réponses des agriculteurs aux différents changements (climatiques, politiques, socioéconomiques). Les éleveurs ont appris alors, au cours du temps, à développer des stratégies adaptées et variées en concordance avec leur contexte d'aridité (Nasr *et al.*, 2000). Des flexibilités multiples dans la gestion des effectifs ont été forgées par ces éleveurs et des stratégies d'adaptation diversifiées ont été développées pour faire face aux multiples changements d'ordre environnementaux et socioéconomiques dans ces zones difficiles.

La présente étude complète ces analyses en explorant et analysant les déterminants et les contraintes des mesures d'adaptation mis en place par les éleveurs dans les parcours arides au Sud Tunisien. Notre analyse est différente des autres études d'adaptation en ce sens que nous considérons également le choix entre plusieurs mesures d'adaptation simultanément prises par les éleveurs et nous explorons les déterminants de ces choix. Cela dit, les objectifs de cette étude sont multiples : premièrement, identifier et analyser les mesures d'adaptation des éleveurs au changement climatique et deuxièmement déterminer les facteurs clés influençant ces décisions d'adoption. À la fin, cette étude explore les principales contraintes que les éleveurs rencontrent pour s'adapter aux perturbations climatiques.

Meilleure compréhension des stratégies d'adaptation des éleveurs au changement climatique fournit des orientations claires et des considérations importantes aux décideurs politiques. Le diagnostic des différents facteurs et barrières de ses choix adaptatifs paraît important afin d'améliorer la résilience et la pérennité du secteur dans les parcours arides tunisiens au changement prévu du climat futur.

Le texte est composé de 4 sections. Dans la première section nous passons en revue de littérature sur le sujet. La deuxième section nous présentons la méthodologie utilisée dans notre recherche avec un accent particulier sur la zone

d'étude, les données collectées et le modèle empirique qui a été utilisé. Dans la troisième section, nous exposons les résultats et la discussion et dans la section 4 nous concluons nos résultats et présenter quelques implications politiques de l'étude.

2. Analyse documentaire

L'adaptation est un processus complexe qui comprend des interactions avec les ressources, les institutions et l'environnement (Adger, 2006). Sans adaptation, les moyens de subsistance des éleveurs sont menacés. Toutefois, les décisions d'adaptation des exploitants ont lieu au niveau local et dépendent de divers contextes socio-environnementaux perçus (Grothmann et Patt, 2005 ; Mitter *et al.*, 2019). En effet, il existe un certain nombre des facteurs qui influencent les stratégies d'adaptation développées par les exploitants au changement climatique tels que les caractéristiques sociodémographiques, les caractéristiques structurelles de l'exploitation et les sources de financement d'investissement (Deressa *et al.*, 2009 ; Hassan and Nhemachena, 2008).

Concernant les facteurs sociodémographiques la littérature décrit à la fois les impacts positifs et négatifs du réseau social sur les stratégies d'adaptation. Le niveau d'instruction et la taille des ménages ont le plus d'influence sur l'adoption des mesures d'adaptation (Zampaligré *et al.*, 2014). Selon Jiri *et al.* (2017) une taille des ménages importante entraine le renforcement de la capacité d'adaptation par l'augmentation éventuelle de l'effectif employé dans l'exploitation. Alors que dans d'autres études telles que celle de Gbetibouo (2009), les familles nombreuses peuvent avoir besoin de plus d'activités hors ferme pour obtenir plus de revenus et réduire leur pression de la consommation. D'autres tel que Tambo (2016) révèlent, à l'aide d'un modèle probit multivarié, que l'âge, le genre et le contact avec les vulgarisateurs sont des déterminants significatifs dans le choix de l'outil d'adaptation des exploitants aux changements climatiques. Dans certaines études de recherche comme ceux de Nhemachena *et al.* (2014) et Maddison (2007), le signe de paramètre du modèle associé à la variable âge de l'exploitant se montre négatif en lien avec la stratégie d'adaptation. Mais dans d'autres il est plausiblement positif (le cas des études de Jiri *et al.*, 2017 ; Deressa *et al.*, 2009 ; Hassan and Nhemachena, 2008). Cependant, la variable âge de l'exploitant, peut parfois être totalement non significatif dans certains contextes (Di Falco *et al.*, 2012 ; Esham et Garforth, 2013).

Les facteurs structurels, exprimées par certaines variables telles que la taille du cheptel, la superficie agricole et la possession d'un puits, augmentent normalement le niveau de richesse cumulée et affectent donc positivement l'adaptation des stratégies au changement climatique (Jiri *et al.*, 2017 ; Chengappa *et al.*, 2017). Des études empiriques récentes en Afrique (Zampaligré *et al.*, 2014) ont montré aussi que la superficie cultivée, la taille du troupeau des ruminants constituent les déterminants les plus importants des stratégies d'adaptation adoptées par les éleveurs.

En ce qui concerne les facteurs financiers, l'accès aux subventions est considéré comme l'un des déterminants les plus importants de l'adaptation au changement climatique. Selon Deressa *et al.* (2009), les revenus non agricoles, à l'instar de l'utilisation de l'apport migratoire reçu de la part d'un membre de la famille migrant, rendront les exploitations agricoles moins dépendantes de l'activité agricole. Par conséquent, les subventions agricoles et l'apport migratoire sont des variables qui influencent positivement les stratégies d'adaptation au changement climatique.

3. Matériels et méthodes

3.1. *Région d'étude*

La zone d'étude couvre les parcours d'El Ouara qui se partagent entre les deux gouvernorats, Médenine et Tataouine (Figure 1) au Sud Tunisien. La région est l'une des zones les plus vulnérables aux impacts du changement climatique en raison des faibles précipitations et des températures élevées (Sghaier et Ouessar 2013). La pluviométrie était irrégulière dont la moyenne n'a été pas dépassée le 200 mm sur la période 2000-2020. Sur la même période, la température moyenne

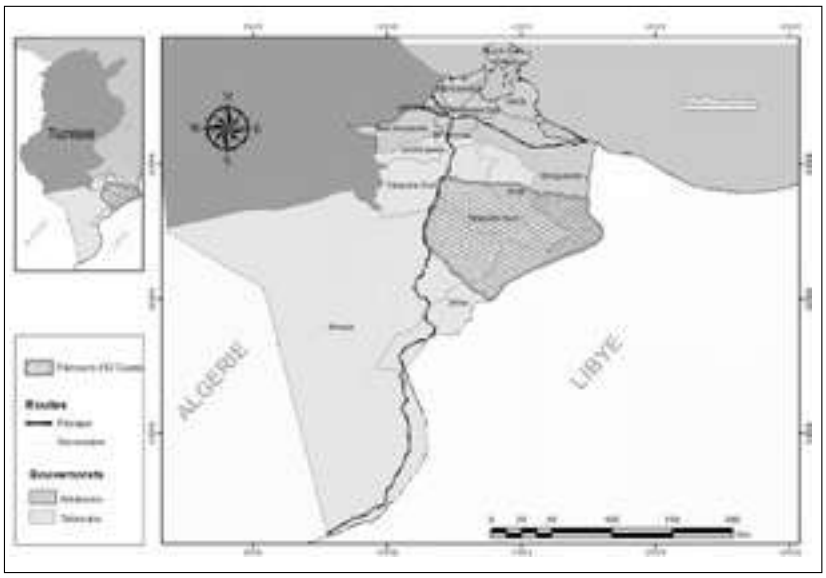


Figure 1 - Localisation géographique des parcours d'El Ouara au Sud Tunisien.

annuelle était de 21,1 °C dont le plus élevé enregistré en août (30,6 °C) et le plus bas en janvier (8 °C) (Association Infoclimat, 2020). Outre les ressources naturelles limitées, un grand nombre de population tire l'essentiel de leur revenu familial des systèmes d'élevage extensif basés sur l'exploitation des vastes parcours.

Le choix des éleveurs enquêtés a été raisonné à partir des études sur les systèmes d'élevage dans ces zones. Un échantillon de 120 éleveurs a été sélectionné au hasard, soit 29% d'une liste nominative des éleveurs exploitants les parcours d'El Ouara qui sont répartis sur les deux gouvernorats que compte la région d'étude. Au final, on est arrivé à contacter et enquêter 73 éleveurs : 32 éleveurs dans le gouvernorat de Médenine (région de Benguarden) et 41 éleveurs dans le gouvernorat de Tataouine. Les données collectées sur une période de deux mois (janvier et février 2019), moyennant un questionnaire détaillé afin de comprendre les différentes composantes du système et quelles stratégies adaptent pour faire face aux différentes contraintes et sur quels leviers ou composantes se basant pour développer leur système. Pour assurer une progression cohérente, le questionnaire a été structuré en six sections : caractérisation sociodémographique d'éleveur et des ménages ; historique, composition des systèmes et aspects économiques ; aspects institutionnels et organisationnels ; contraintes, stratégies adoptées et perspectives des systèmes ; hydraulique et infrastructure pastorale ; perception des politiques de développement.

3.2. *Méthodes*

3.2.1. *Justification du choix et principe du modèle*

Afin de comprendre les stratégies qui permettent aux éleveurs de développer des flexibilités multiples, plusieurs méthodes d'analyse peuvent être appliquées dont notamment l'utilisation des modèles économétriques. Puisqu'il s'agit d'une modélisation du comportement des éleveurs suivant plusieurs alternatives en termes des stratégies d'adaptation aux changements, les modèles logit sont donc les plus appropriés (Ouédraogo *et al.*, 2010) dans la spécification des relations entre la probabilité d'adoption et les déterminants de celle-ci. Le modèle logit a été utilisé alors pour analyser les facteurs influençant la décision des éleveurs de s'adapter au changement climatique. Le modèle considère la relation entre une variable dépendante binaire (Y) et un ensemble des variables indépendantes (X_i). Dans sa forme réduite, le modèle logit est exprimé comme suit :

$$Y_{ij} = X_{ij}\beta_j + \varepsilon_{ij}$$

Où
- Y_{ij} est la valeur latente de la stratégie j adoptée par l'éleveur i ;
- X_{ij} désigne les variables explicatives indiquant les facteurs qui influencent la stratégie adaptée ;
- β_j sont les vecteurs des paramètres compatibles ;
- ε_i exprime les termes d'erreur aléatoire.

Dans ce cas, la variable dépendante (Y_{ij}) est dichotomique :

$$Y_i = \begin{cases} 1 \text{ si } Y_i^* > 0 \text{ ; Stratégie est adoptée} \\ 0 \text{ sinon ; i=1,2,…n ; Stratégie non adoptée} \end{cases}$$

Ainsi, l'éleveur i choisira la stratégie j pour s'adapter aux changements (Y_{ij}=1) si cette stratégie sera bénéfique pour lui (Y*ij >0).

Le plus souvent, les éleveurs adoptaient simultanément plus d'une mesure d'adaptation. Ce comportement a rendu l'utilisation de l'approche multinomial logit (MNL) inappropriée car ce modèle suppose que les choix s'excluent mutuellement (Bryan *et al.*, 2013). Pour ces raisons, nous utilisons le modèle logit binomial pour examiner les facteurs qui influencent les décisions des éleveurs concernant l'adoption de stratégie d'adaptation spécifique. L'adéquation globale du modèle est évaluée à l'aide des tests de Hosmer et celui du rapport de vraisemblance. Dans le modèle logit, les signes des coefficients (β_j) rapportés dans la régression résultante nous informent sur la plausibilité de relation entre la variable d'intérêt qui est la stratégie en question et les variables explicatives introduites dans le modèle. Le degré de dépendance entre les variables est mesuré à l'aide de l'odds ratio (OR). Ce dernier, est défini comme étant le rapport des probabilités qui mesure le lien entre la caractéristique X et la survenance de l'évènement Y = 1. En conséquence, si OR = 1, l'évènement y et la variable X sont indépendants. Si OR > 1, le lien entre Y et X est positif (respectivement négatif, si OR<1). Il s'écrit :

$$OR = [(P(y = 1|X = 1)/P(y = 0|X = 1)] / [p(y = 1|X = 0)/p(y = 0|X = 0)]$$

3.2.2. *Choix des variables explicatives utilisées*

Quant au choix des variables explicatives dans le modèle, la démarche consiste en la recherche systématique de toutes les variables statistiquement liées à la variable dépendante. En d'autres termes, ces variables sont, dans notre cas, les attributs du système qui sont appelés les « déterminants de l'adaptation » et qui sont susceptibles d'influencer la stratégie d'adaptation (Smit *et al.*, 2000 ; Alam *et al.*, 2017) et qui nous permet par la suite d'analyser le processus local d'adaptation. Le modèle comprenait huit variables explicatives et représentait les facteurs censés influencer les décisions d'adaptation prises par les éleveurs dans la zone d'étude (Tableau 1). Ces variables étaient :

-TMEN : C'est une variable quantitative. La variable taille des ménages peut avoir une in-

Tableau 1 - Liste des variables explicatives du modèle.

Variable	*Description*	*Type de la mesure*	*Valeur moyenne*	*Signe attendu*
TMEN	Taille des ménages	Nombre	6	(+) / (-)
AGE	Age éleveur	Années	65	(+) / (-)
TCHEP	Taille du cheptel possédé par l'éleveur	UGB	58	(+)
SUPAGR	Superficie agricole possédé par l'éleveur	Hectares	12,8	(+)
PUITS	Possession d'un puits par l'éleveur	1=oui	32%	(+)
		2=non	68%	
ADORG	Adhésion de l'éleveur à une organisation	1=oui	17,8%	(+)
		2=non	82,2%	
SUBV	Accès aux subventions	1=oui	10,9%	(-)
		2=non	89,1%	
AMIG	Apport migratoire	1=oui	5,5%	(+)
		2=non	94,5%	

fluence négative ou positive sur l'utilisation des stratégies d'adaptation.

-AGE : C'est une variable quantitative. L'âge de l'éleveur est un indicateur qui peut avoir un impact négatif ou positif sur les stratégies d'adaptation.

-TCHEP : C'est une variable quantitative. Cette variable mesure le nombre des têtes de bétail. Les propriétaires de bétail avec une taille élevée de troupeau ont une plus grande propension à adopter des stratégies d'adaptation que les petits propriétaires de bétail.

-SUPAGR : C'est une variable quantitative. Les exploitants ayant les plus grandes superficies agricoles sont plus susceptibles de s'adapter au changement plus tôt que les petites exploitations.

-PUITS : C'est une variable qualitative. La possession d'un puits augmente normalement le niveau de richesse cumulée et affecte donc positivement l'adaptation.

-ADORG : C'est une variable qualitative. L'adhésion à une organisation peut aider les éleveurs à avoir des informations sur les stratégies d'adaptation et à avoir également plus d'opportunités pour les adopter.

-SUBV : C'est une variable qualitative. L'accès aux subventions peut être un agent démotivant à l'éleveur de chercher d'adapter une stratégie face au changement climatique. Il peut alors influencer négativement l'adaptation au changement climatique.

-AMIG : C'est une variable qualitative qui fait la référence aux sources du financement extra-agricole, affectons positivement l'adaptation des stratégies au changement climatique.

4. Résultats et discussion

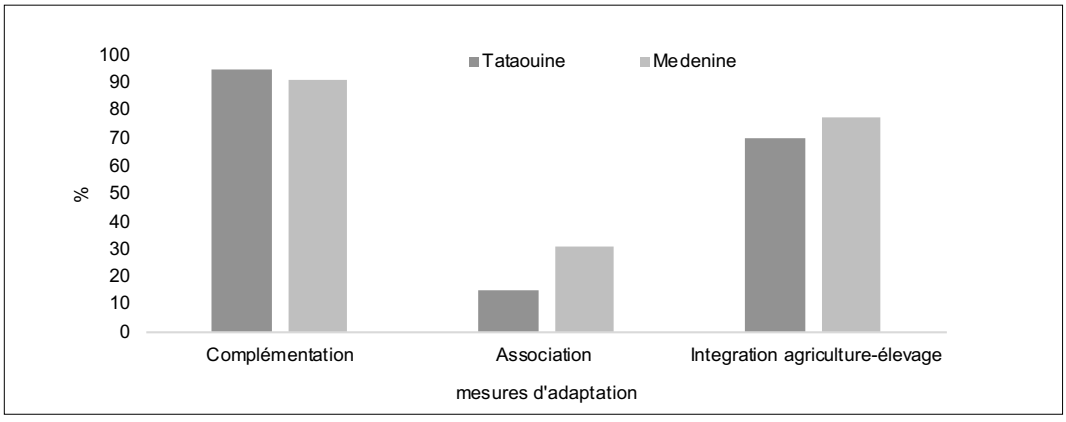
4.1. *Stratégies adaptées par les éleveurs dans les parcours d'El Ouara*

Les résultats de notre étude ont révélé que les éleveurs adoptent différentes mesures d'adaptation, simultanément dans certains cas, pour faire face au changement climatique (Figure 2). Les mesures d'adaptation les plus importantes employées par les éleveurs des parcours d'El Ouara sont comme suit :

Stratégie I : la complémentation du cheptel. Les éleveurs adaptent les systèmes d'alimentation pendant la période de sècheresse et fournissent des aliments complémentaires pour maintenir l'état des animaux ou pour pallier à la dégradation des pâturages fortement conditionnés par la disponibilité saisonnière. Ces apports alimentaires sont faits en saison sèches et ciblaient certaines catégories d'animaux et aider les jeunes et les animaux faibles à passer les périodes de soudure de la saison sèche.

Stratégie II : la mise en association du cheptel ou d'une partie du cheptel chez un autre éleveur. Il s'agit d'un mode de conduite collectif en extensif. Des troupeaux collectifs dans lesquels les animaux appartiennent à plusieurs propriétaires différents et dont la gestion est confiée à une personne, qui peut être l'un des propriétaires. Ces animaux qui représentent plusieurs cheptels vont

Figure 2 - Pourcentages des éleveurs selon les stratégies d'adaptation pratiquées par gouvernorat.



chercher les conditions meilleures de l'utilisation des pâturages plus loin et ne reviennent qu'exceptionnellement au siège de l'exploitation dont il revient. Cette pratique de mise ou encore prise en association du cheptel peut être saisonnière ou pratiquée toute l'année. Les éleveurs suggèrent par ailleurs que les causes de ces mouvements des cheptels sont multiples et qu'ils en attendent des bénéfices variés. La recherche de pâturages plus productifs, représente la cause majeure, vue les conditions de milieu aride dans la zone d'étude.

Stratégie III : l'intégration agriculture-élevage. Ce type de pratique permet aux éleveurs d'obtenir une forme assez accomplie d'association entre alimentation, traite, reproduction et conduite qui seront gérées à l'exploitation. La succession des années de sécheresse avec la sédentarisation des éleveurs a conduit à l'intégration de l'agriculture à l'exploitation d'élevage. L'extension de l'arboriculture pluviale a été remarquée depuis les années 1980 avec la naissance du politique de privatisation des terres. Cependant, la pratique de la céréaliculture pluviale sur les terres collectives est une ancienne pratique qui est non liée à la superficie en appropriation. Le choix de cette stratégie est justifié par sa réduction des charges d'élevage. En effet, la paille, l'orge et les chaumes de la céréaliculture ainsi que les déchets de l'oléiculture lui procurent une source d'alimentation pour ses bétails.

Ces trois stratégies semblent être les plus utilisées dans la région d'étude afin de réduire les effets négatifs de ces changements. En effet, c'est la complémentation du cheptel qui constitue la stratégie d'adaptation la plus utilisée par les éleveurs (93% de l'échantillon) (Figure 2). Les éleveurs déclarent qu'ils utilisent généralement diverses stratégies d'adaptation simultanément. Le recours aux aliments de complémentation était une pratique courante pendant la sècheresse et de nos jours elle demeure une pratique usuelle pendant toute l'année dans le Sud Tunisien (Ibidhi *et al.*, 2018), aux parcours des plateaux du Nord-Atlas du Maroc (Chattou, 2014) et également dans tout le Maghreb (Bourbouze et Quarro, 2000).

La pratique de la mise en association du cheptel est perçue comme l'un des moyens les plus utilisés pour réduire les charges du système l'élevage en années difficiles. 21.7% des enquêtés adoptent cette forme d'association avec d'autres éleveurs. Quant à l'intégration de l'activité agricole dans les exploitations d'élevage en extensif, il y a lieu à mentionner à cet égard que dans la zone d'étude, 74% des éleveurs ont développé leurs activités agricoles. Principalement, pour subvenir à leurs besoins vivriers que l'élevage ne permettait plus de combler, les éleveurs, bénéficiant des conditions plus propices à l'agriculture, accroissent leur production agricole traditionnelle. L'élevage est caractérisé par une grande mobilité dans l'utilisation des ressources naturelles et par un déplacement des animaux en saison des pluies vers des régions où la pression agricole est moins intense. Dans cette stratégie, où l'espace est plus disponible on assiste encore à l'association d'un élevage extensif et d'une agriculture consommatrice d'espace. De nos jours, on note l'existence de certaines dynamiques qui tapissent vers une intégration plus poussée des activités agricoles et pastorales, valorisant au mieux les synergies possibles. Ceci est confirmé par Snaibi (2020), qui a prouvé que la pratique d'un système mixte est parmi les mesures d'adaptation suivies par les éleveurs face à la variabilité climatique. Cependant, cette extension des cultures sur les parcours qui est largement observée conduisant à une dégradation des ressources naturelles et à une dynamique d'appropriation des espaces pastoraux collectives (Guillaume, 2009 ; Bourbouze et Quarro, 2000 ; Snaibi, 2020), c'est qui peut influencer les pratiques d'élevage dans les parcours telle que la transhumance.

4.2. *Modèle et qualité de l'ajustement*

L'analyse de la signification et l'exactitude des prévisions des modèles logistiques peuvent être testées des plusieurs manières. Dans notre cas, nous avons utilisé le test de Hosmer pour analyser la validité du modèle. Les tests de Hosmer ne rejettent pas l'hypothèse nulle d'indépendance des stratégies d'adaptation au changement climatique à un niveau de risque 5% (χ^2 variait de 4.58 à 7.79, avec des valeurs de probabilité allant de 0.55 à 0.86). Alors, la spécification logit binomiale est appropriée pour modéliser les stratégies d'adaptation des éleveurs au changement climatique. Des pourcentages plus élevés

Tableau 2 - Importance et qualité de l'ajustement du modèle.

	χ^2 *(Chi-squared)*	*p value*	*-2 Log (Vraisemblance)*	R^2 *(McFadden)*	*AIC*	*Model correctness (%)*
Stratégie I	26,13	0,00	10,32	0,765	30,32	91,78
Stratégie II	12,96	0,02	63,81	0,17	75,81	82,19
Stratégie III	54,99	0,00	56,94	0,49	66,94	79,45

indiquent un meilleur ajustement du modèle. Le Tableau 2 montre que le pourcentage global d'exactitude pour tous les modèles est supérieur à 79%, alors les modèles utilisés sont fortement ajustés. Pour confirmer la bonne adéquation des modèles, nous avons utilisé R^2 McFadden qui varie entre 0,17 et 0.76. La valeur élevée de coefficient de détermination (R^2) est signe de la performance du modèle.

De plus, pour tester la signification globale des modèles, nous avons utilisé une approche d'hypothèse nulle globale (Stephenson *et al.*, 2008). La statistique de test est distribuée selon la distribution khi-deux (χ^2) de degré de liberté égal aux différences entre le nombre des variables dans le modèle avec prédicteurs et le modèle d'interception uniquement. Comme le montre le tableau 2, les statistiques du rapport de vraisemblance sont significatives au niveau de 5% ce qui nous permet de rejeter l'hypothèse nulle (H0) et accepter (H1) qu'au moins un des coefficients de régression (β_j) n'est pas nul. Par conséquent, l'analyse confirme le fort pouvoir explicatif du modèle logit dans notre cas d'étude.

4.3. *Facteurs affectant le choix des stratégies d'adaptation*

Le calcul des odds ratios des attributs utilisés dans le modèle, présenté dans le Tableau 3, nous montre respectivement l'influence de ces variables sur le choix des stratégies adoptées par les éleveurs. Les sous-sections suivantes analysent les résultats de nos différentes variables explicatives en fonction de la probabilité d'adopter la stratégie d'adaptation respective.

4.3.1. *Taille des ménages*

Elle a un effet insignifiant sur l'adaptation au changement climatique. La variable TMEN présente un effet non significatif sur les trois stratégies adoptées par les éleveurs dans la zone d'étude. L'augmentation de la taille des ménages alors n'a pas augmenté de manière significative la probabilité d'adaptation. Deressa *et al.* (2009) ont prouvé aussi dans une étude similaire en Ethiopie, la non-significativité de la taille du ménage dans la pratique d'adaptation face au changement climatique.

4.3.2. *Age de l'éleveur*

Une corrélation significativement positive existe entre la variable AGE et la pratique de la stratégie II. Ainsi, l'augmentation de l'âge de l'éleveur augmente la probabilité d'obtenir une forme plus accomplie d'association avec d'autres éleveurs. Aussi, la probabilité de saisir toute sorte de changement environnemental augmente avec l'expérience des années et l'éleveur qui peut observer les changements au fil du temps et les comparer avec les conditions climatiques actuelles pour prendre une décision stratégique relative à la conduite de ces animaux. En ce sens que, l'éleveur plus expérimenté (plus âgé) peut se permettre d'utiliser l'une ou l'autre des stratégies allouées plus qu'un autre éleveur moins âgé (Dhehibi *et al.*, 2018). Il est à mentionner à cet égard que des résultats similaires confirmant l'impact positif de l'âge sur les stratégies d'adaptation ont été démontrés en Afrique du Sud et en Ethiopie (Deressa *et al.*, 2009 ; Nhemachena *et al.*, 2014).

4.3.3. *Taille du cheptel*

Elle présente un effet significativement négatif sur la pratique de la stratégie III ; une éventuelle association entre l'activité de l'élevage et l'activité agricole. Ainsi, pour les éleveurs

Tableau 3 - Résultats des odds ratios de régression logistique des facteurs influençant le choix des stratégies d'adaptation.

Variables explicatives	*Stratégie I*		*Stratégie II*		*Stratégie III*	
	β	*odds ratios*	*β*	*odds ratios*	*β*	*odds ratios*
Constante	0,393	0,890	-3,109	0,110	0,880	0,425
TMEN	-0,122	0,885	0,179	1,196	0,000	0,000
AGE	-0,008	0,992	0,044	1,044***	0,000	0,000
TCHEP	0,001	1,001	0,002	0,099***	-0,002	0,998***
SUPAGR	-0,110	0,896	0,301	1,351***	-1,757	0,172*
PUITS	0,015	1,015	-1,431	0,239**	1,866	6,464**
ADORG	1,177	3,245**	0,000	0,000	0,000	0,000
SUBV	-0,303	0,739	0,000	0,000	-0,989	0,371***
AMIG	1,401	4,059**	0,000	0,000	0,000	0,000

10% de significativité, ** 5% de significativité, * 1% de significativité.*

qui disposent d'un cheptel très grand les autres activités agricoles seront marginales ou inexistantes et donc la probabilité d'associer d'autres activités agricoles serait faible. Pourtant, la taille du cheptel présente un effet significativement positif sur la pratique de la stratégie II. L'ajout d'une unité du cheptel augmente de 9% la probabilité de conclure la conduite du troupeau sur pâturages avec d'autres éleveurs. L'objectif de cette stratégie est de réduire les charges du système, réduire ou du moins partager les coûts de gardiennage et d'alimentation avec ses associés. La possession d'une taille importante de bétail a considérablement amélioré la résilience des exploitations aux changements climatiques (Jiri *et al.*, 2017).

4.3.4. *Superficie agricole*

Elle a un impact positif sur la décision de pratiquer certaines stratégies d'adaptation et négativement dans le cas de la pratique des autres stratégies. À cet égard, la variable SUPAGR est positivement corrélée avec la stratégie II. Tableau 3 visualise qu'une augmentation d'un ha de la superficie augmente de 35% la probabilité que l'éleveur recourt à l'association. Les éleveurs cherchent toujours à s'associer avec d'autres propriétaires des vastes terres afin de pâturer leurs cheptels. Cependant, l'odd ratio du Tableau 3 montre que l'augmentation de la superficie diminue la chance d'adopter la stratégie III de l'intégration agriculture-élevage.

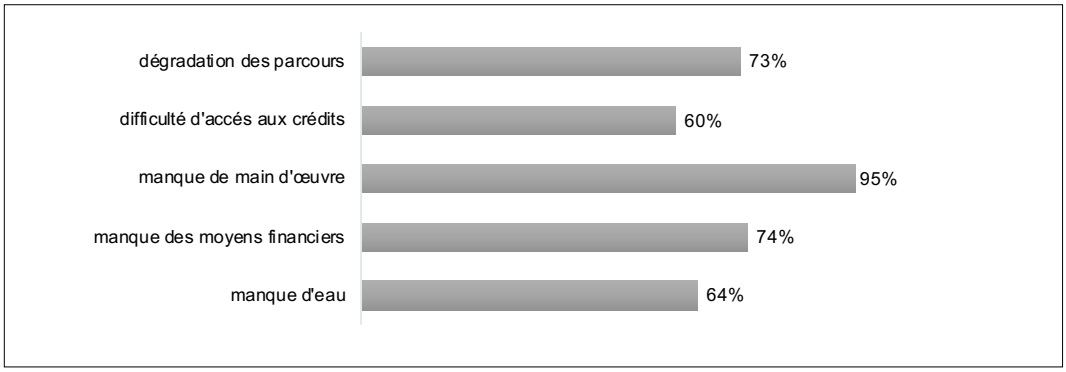
4.3.5. *Possession d'un puits*

Elle est significativement associée aux stratégies des associations pratiquées par les éleveurs que ce soit pour les cheptels ou pour l'intégration des activités agricoles dans l'exploitation d'élevage. En effet, posséder un puits augmente par facteur de six la probabilité de la mise en œuvre de la stratégie III. Ceci dit, les éleveurs disposant d'un puits pour abreuver les troupeaux sont plus susceptibles d'adapter leur système d'élevage pastoral aux changements climatiques puisqu'ils auront l'assurance d'un approvisionnement suffisant en eau pendant la saison sèche aussi bien pour l'abreuvement des animaux que pour l'agriculture. Abid *et al.* (2014) soutenu nos résultats, ils ont prouvé aussi que l'assurance de l'approvisionnement en eau suffisant permet d'effectuer tout ajustement au niveau de l'exploitation en réponse à la variabilité du climat.

4.3.6. *Etre membre d'une organisation*

Le modèle prouve statistiquement une corrélation positive entre la pratique de la stratégie I et l'adhésion à une organisation agricole (GDA : groupement de développement agricole / CG : conseil de gestion). L'odd ratio montre que la probabilité de pratiquer la complémentation du cheptel est multipliée par facteur de trois pour un éleveur membre d'un groupement, comparé à un autre éleveur non associé. Etre membre d'une organisation garanti à l'éleveur l'approvisionnement quotidien des aliments du

Figure 3 - Obstacles à l'adoption des mesures d'adaptation et les pourcentages de chacun selon les éleveurs.



bétail ce qui facilite beaucoup le recours à la complémentation du cheptel.

4.3.7. *Subventions*

L'octroi d'une subvention pourrait avoir, selon le modèle, des effets négatifs sur l'adoption des stratégies d'adaptation, telle la stratégie d'intégration agriculture-élevage. En effet, les campagnes de sauvegarde des cheptels et la subvention des aliments ont été utilisées en Tunisie pendant les années de sécheresse aigues, ce qui a eu un impact négatif sur les autres activités agricoles suite à la dégradation des terres. Selon Briske *et al.* (2015), le maintien du cheptel sur les pâturages pendant la saison sèche peut entraîner une rétention des stocks dépassant la capacité de charge écologique des terres conduisant à la dégradation des terres des parcours.

4.3.8. *Apport migratoire*

Un coefficient positif du variable AMIG indique un impact positif des apports migratoires sur la décision de pratiquer la stratégie I dans la zone d'étude. L'effet de cette variable est statistiquement significatif au niveau de 5%, si l'éleveur reçoit un transfert migratoire alors la probabilité de recourir à la complémentation se multiplie par facteur de quatre de sa valeur initiale. Ainsi, chez les éleveurs du Sud Tunisien, la migration internationale et les transferts qu'ils impliquent constituent des éléments des certaines stratégies de sécurisation. Les fonds des migrants investis dans les activités agricoles deviennent une pratique connue dans le Sud du pays (Ciadella, 2005). Les éleveurs, bénéficient comme l'ensemble des ruraux des phénomènes migratoires. Cependant, ils ne peuvent pas se baser sur eux uniquement comme une source fixe et stable pour construire une entière stratégie de sécurisation à long terme. Egalement prouvé par Azoulay et Ancey (2011) que les transferts migratoires présentent pour les éleveurs pastoraux du Sahel une source de sécurisation mais ils ne sont pas déterminants.

4.4. *Contraintes à l'adoption des stratégies d'adaptation au changement climatique*

Les éleveurs adoptent des stratégies afin d'écarter un risque survenu ou pour réaliser un profit attendu (Gebreeyesus, 2017). Quelle que soit la stratégie choisie, les éleveurs visent à améliorer la résilience de leurs systèmes vis-à-vis des impacts des changements climatiques et à assurer leurs durabilités. Cependant, les éleveurs ne mettent pas en pratique, à leur plein potentiel, la stratégie choisie en raison de l'existence des plusieurs barrières à l'adaptation. Les principales barrières identifiées par la majorité des enquêtés étaient l'insuffisance financière et le manque de la main-d'œuvre suivi par, la dégradation des parcours, la pénurie et la difficulté d'accès aux crédits (Figure 3).

Les éleveurs ont déclaré qu'ils sont devenus obligés à acheter les aliments durant toute l'année à cause de manque de la pluviométrie. De plus, les prix de l'orge et des concentrés sont en augmentation continue à cause de la libération du marché des prix. L'éleveur alors n'est plus arrivé à assurer les besoins alimentaires de leur

troupeau. Le facteur de production « travail » aussi présente un obstacle vu le manque des bergers salariés. Les jeunes n'ont plus orienté à pratiquer le gardiennage (Ciadella, 2005) à cause de la sévérité des conditions dans les parcours. Ces résultats sont cohérents avec les résultats de l'étude de Deressa *et al.* (2009) selon laquelle le manque de financement réduit les formes de sécurisation des modes de vie des éleveurs et les empêche d'adopter certaines stratégies d'adaptation liées aux changements climatiques. La dégradation des terres des parcours a été associée au nombre insuffisant des puits dans l'atténuation de la capacité des éleveurs à s'adapter au changement. L'étude de Jemaa *et al.* (2016) dans des régions au centre de la Tunisie, souligne deux enjeux importants dans les systèmes pastoraux, à savoir la bonne répartition des puits et la qualité des terres des parcours.

5. Conclusion

Les éleveurs essaient d'adapter leurs pratiques à la perturbation des conditions climatiques dans le but d'assurer la pérennité de leurs exploitations. Trois stratégies ont été identifiées dans ce travail. Les stratégies les plus adoptées dans la zone d'étude sont le recours à la complémentation et l'intégration agriculture-élevage. Eu égard à la littérature, ces différentes mesures d'adaptation apparaissent pertinentes. La connaissance des différentes stratégies d'adaptation permet d'identifier des options d'adaptation à la fois réalistes du point de vue de leur mise en œuvre et ambitieuses du point de vue de leurs objectifs. Ces éleveurs ont choisi des options d'adaptation efficaces qui sont fortement influencées par l'âge de l'éleveur, la superficie agricole ainsi que positivement par la possession d'un puits, la taille du cheptel, l'accès aux subventions et l'apport migratoire. Cette étude révèle des contraintes réelles et perçues au niveau du système à l'adaptation au changement climatique. La plupart des contraintes sont le manque des moyens d'investissement, de la main-d'œuvre, et des points d'eau, la dégradation des parcours et la limitation de l'accès au crédit. Par conséquent, pour des adaptations et atténuations efficaces au changement climatique, un plan d'action global sur le changement climatique doit être incorporé dans une politique nationale pour le développement durable de l'élevage.

Ces résultats ont des implications politiques par exemple l'implication de tous les acteurs dans l'élaboration des stratégies d'adaptation d'une part. D'autre part, la fourniture des agents de vulgarisation pour informer et former les éleveurs sur les stratégies d'adaptation convenables au climat local. Il faut également encourager et soutenir les éleveurs dans l'augmentation de ces mesures d'adaptation à travers la fourniture des ressources nécessaires telles que la facilitation de l'accès aux crédits. Malgré la nécessité d'une adaptation spécifique des systèmes d'élevage locaux face au changement climatique, il est nécessaire de mener des recherches supplémentaires au niveau macro. En particulier, les prix des facteurs de production, les ressources, les dotations et les impacts environnementaux dépendent des développements internationaux mais interagissent avec les mesures d'adaptation locales. La mise en œuvre de toute politique sur le changement climatique nécessite des recherches, des preuves des coûts et avantages potentiels d'une telle politique. Par conséquent, la recherche avancée et extensive sur le changement climatique est la clé de la mise en œuvre de la politique climatique régionale, nationale et locale.

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Dimensions of household food waste in Turkey

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Abstract

Food waste creates an increasing concern at the global level and searching methods how to solve food waste is also a significantly increasing. Finding adequate solutions and implementing is only possible through defining the problem. To solve a complicated problem like food waste which interests large population and has different kind of features for each product is a time consuming. At this point, revealing food waste at the different stages is important. The biggest share from the waste is taken by households. This study covers the analyses results of the surveys conducted in 3 big cities in different geographic region in order to identify household food waste's level in Turkey. Totally 1155 surveys were conducted in Erzurum, İzmir and Adana in June 2016 and 2017. In addition to food waste, its perception, food purchase and store behaviors of the consumers were investigated. The results show that households wasted about 7.5 tonnes food during the month surveys carried out. Only 180 families out of 1155 had no food waste and this number is higher in Erzurum. The highest food waste was observed in Adana where it was 3.3 tonnes per month while it was 2.6 tonnes in Erzurum and 1.6 tonnes in İzmir.

Keywords*: Food Waste, Consumer food waste, Probit, Food Waste Turkey.*

1. Introduction

The amount of the world food waste reported by Gustavsson *et al.* in 2011 was 1.3 million tonnes, while it was approximately 931 million tonnes in 2019. Despite the fact that the amount of the total food waste has decreased in the recent years, it remains still important issue locally and gloabally (UNEP, 2021). Waste, with changing production / consumption habits and prosperity, continues to be an important and remarkable issue that humanity still cannot overcome. Many developed and developing countries strive to take immediate measures on the issue. At the same time, successful implementations have been realized with the efforts of non-governmental organizations as well as some the efforts of some individuals. The most concrete example of improvidence experienced in every aspect of life is also revealed with food waste. While this improvidence is dominant, the hunger, poverty and global warming continue to threaten the life. While 750 million people

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suffer from chronic starvation, an estimated 2 million people suffer from malnourishment, vast of food loss and waste should be questioned and examined (http://www.fao.org/3/ca9692en/online/ca9692en.html). Approximately 1,3 billion tonnes get lost or waster every year. This is sufficient to feed three billion people and the waste amounts roughly 940 billion USD per year (www.fao.org/save-food). Each year, 1.4 billion ha of land which represents 28% of the agricultural areas in the world, cannot be used effectively (FAO, 2013). These data sufficiently explain the significance and extent of the economic, environmental, and social effects of food waste and loss, and present clearly if food losses and waste problems cannot be avoided, hunger and malnutrition problems will continue to increase (Niyaz and Demirbaş, 2020). Moreover, recently the Coronavirus pandemic has brought out the fragility of the food systems to shocks, and fragilities that particularly damage the most vulnerable populations throughout the world (Ridolfi *et al.*, 2020) which makes reducing food waste and loss even more important.

Its contribution is emphasized to reduce food waste and loss, ensure food security and reduce hunger, which are among the UN sustainable development goals. As food insecurity and malnutrition constitute a problem for all countries, there will be an increasing need for food as the population grows. One in ten people around the world suffer from chronic hunger (http://www.fao.org/3/ca9692en/online/ca9692en.html). As well as the developing countries, chronic starvation is experienced in the developed countries and the hunger is among the major problems and 15% of the population suffering from malnourishment are living in developed countries. Despite the presence of malnourished populations in developed countries, Latin American countries and high-income countries are responsible for 80% of meat waste. In the USA, 14,6% of population living in poverty in 2013-2019 (PRB, 2019) while the households waste 19% of total food. In total 29% of available food supply were lost from human consumption in 2008 (Buzby and Hyman, 2012). Uneaten food costs an average American family of four 1500 $/year (https://www.globalcitizen.org/en/content/trf-food-waste-could-feed-the-poor/). Reducing food loss and waste will have several positive effects on different aspects of nutrition, economy and rural development through reducing poverty, saving time and effort in farm works, particularly for women, decreasing food expenditures, increasing sources for health, education and other household benefits. On the other hand, reducing waste and loss will also help reduce greenhouse gas emissions by reducing the pressure on the ecosystem and also water pollution pressure on the ecosystem decreases and helps reduce greenhouse gas emissions (Lipinski *et al.*, 2013).

Food waste in medium and high-income countries is remarkable at the consumer level, while in low-income countries, consumer waste is low, but losses in the production process are significant. In the middle and high-income countries, while the rate of consumer-related waste is between 31-39%, this rate is lower in low-income countries (4-16%) (FAO, 2013). It has been reported that the per capita food waste in Europe and North America is 280-300 kg/year while it is 120/170 kg/year per capita in sub-Saharan Africa and South/Southeast Asia (Nahman and Lange, 2013). However, if food waste is reduced through the measures to be taken, the food security will be enhanced. In the UK, 7 million tonnes of food are wasted annually in the households while 4.2 million tonnes of this amount is edible food. That indicates that 6 plates of good are thrown away every week. WRAP (Waste & Resources Action Program), which was established with the public support in 2000 in the UK, rendered positive results in all areas of waste prevention. The total amount of household food waste fell by 15% between 2007 and 2012. This signifies a £470 worth of gain per household (WRAP, 2012). In the UK, before World War II, 1-3% of food in homes went to waste, while in 2009 this rate was 25% (Parfitt *et al.*, 2010).

In addition, there are studies about the practices, policies, and measurements related to food waste. These studies have been focused on which measurement methods will give the right results (Lebersorger and Schneider, 2011; Graham-Rowe *et al.*, 2015; Albisu, 2016; Di Terlizzi *et al.*, 2016; Van Herpen *et al.*, 2019; Langley *et al.*, 2010; Corrado *et al.*, 2019; Elimelech *et al.*, 2018). Many studies on the environmental cost and influ-

ence of food waste, the losses of production factors and the resulting carbon footprint and water footprint were investigated (Buzby and Hyman, 2012; Junguo *et al.*, 2013; Nahman *et al.*, 2012; WRAP, 2012; Refsgaard and Mangussen, 2008; Capagain and James, 2013). Furthermore, there are some common studies conducted for various product groups to demonstrate the waste and loss occurred at every stage of the supply chain (Beausang *et al.*, 2017; Young *et al.*, 2017; Mena *et al.*, 2011; De Laurentiis *et al.*, 2018). The evaluation and disposal of the waste, the researches on consumers that are responsible for approximately half of food waste are carried out in the context of explorative researches. These studies generally examine different aspects of food consumption in households or consumers (Stefan *et al.*, 2013; Bell *et al.*, 2011; Abeliotis *et al.*, 2016; Parfitt *et al.*, 2010; Buzby and Hyman, 2012; Nahman and Lange, 2013; Fami *et al.*, 2019; Van Der Werf *et al.*, 2018; Delley and Brunner, 2017; Ponis *et al.*, 2017; Jribi *et al.*, 2020). As emphasized by De Hooge *et al.* (2017), one of the most important reasons for waste is the thoughts and behaviors of consumers about ugly foods (De Hooge *et al.*, 2017). It is important to determine the perceptions of consumers on this issue. Although empirical research is is scarce and contradictory, recent studies provide important information about consumer preferences (Stefan *et al.*, 2013; Stancu *et al.*, 2016; De Hooge *et al.*, 2017; Aschemann-Witzel *et al.*, 2018; De Meo *et al.*, 2018).

Studies conducted in Turkey about food waste are generally conducted for a product group. *Household Food Wastage in Turkey* is the study conducted by Pekcan *et al.* (2006) about the waste per household and it certainly provided a significant perspective. Yıldırım *et al.* (2016) conducted a survey on food waste in their study they have conducted with 150 people. Aydoğdu and Koçoğlu (2017), Dölekoğlu and Var (2019) are the ones to investigate the wastage in mass consumptions. The other study was conducted by Tatlıdil *et al.* (2013) which was "food losses and waste in Turkey". The aim of the study was to estimate food losses and waste in the food supply chain of different stages for commodity groups (cereals, roots, and tubers, oilseeds and pulses, fruit and vegetables, meat, fish and seafood, milk and eggs). They found that the biggest losses of all commodities turn out to be in the first step of the food supply chain. On the other hand fruit and vegatables was presented as the most wasted. The waste in bread is significant since it attracts considerable attention of the people as the most consumed and most wasted product. Hence, there were many studies conducted on this subject in Turkey. In the research conducted within the context of "Do Not Waste Your Bread" campaign of Soil Products Office (TMO)'s, it has been revealed that 6 million loaves of bread are wasted in Turkey every year. Due to the high size of bread consumption and bread waste in Turkey various studies about bread waste were conducted different cities and regions (Gül *et al.*, 2003; Bal *et al.*, 2013; Dölekoğlu *et al.*, 2014; Mete, 2017; Taşcı *et al.*, 2017; Tepecik and Gümüş, 2017). In the study of the Ministry of Customs and Trade published in August 2017, only waste of bread was taken into consideration. Hence, the studies about food loss and waste in Turkey are limited and it is highly required to conduct studies based on the primary data. Decision makers certainly need regular information on food loss and waste. It is significant for all parties to reveal the level and cause of waste since it influences many dimensions and it is related to the mass consumption.

The biggest responsibility for food waste lies with consumers, the reasons are complex and different in every society. 61 per cent of food waste came from households (UNEP, 2021). The need for consumer studies is high in every community for policy makers and other actors to develop successful campaigns. This research intends to find out the level of food waste in households from different socio-economic groups and geography in Turkey. Furthermore, 1155 surveys conducted in Izmir, Erzurum and Adana provinces were examined in this study in order to contribute to the measures that can be taken by decision makers to reduce waste by determining the factors creating waste and taking into account the variations at the household level. Consequently, the study reveals the factors that cause food waste, the differences in food waste, the types of food that are wasted, and perceptions and attitudes related to food waste.

2. Material and method

2.1. *Study area and sampling procedure*

When creating the sample framework, the annual average usable income of the equivalent households at the level of Turkish Statistical Institute-NUTS (Nomenclature of Territorial Units for Statistics)-1 was taken into consideration. This classification divides Turkey into 12 regions based on the average income and they are classified as low-income, medium-income, and high-income regions. After calculating the average income for each group, the closest sub-region was selected and 3 provinces from these regions were selected as research sites. The cities located in the East, West, and South of Turkey are observed. In the high-income group, Izmir is selected while Adana is selected for the middle-income group. Finally, Erzurum is chosen for the low-income group and the surveys were conducted in May-June 2016 and 2017.

Since each province will be evaluated separately, the number of samples for each province is calculated as 384. 1152 surveys were anticipated in total and in the end, 1160 surveys were conducted. Five of the questionnaires were excluded since there were some missing data on them.

2.2. *Statistical analysis*

In this study, the level of waste was taken as the dependent variable. Food waste per person (kg/month/person) determined physically in households based on the data stated by participants' statements in the surveys is classified as presented in Table 1 and used as the dependent variable. Since there is no classification determined in the literature for the grouping, the criteria used the upper and low category about the waste per capita in the high-level income and low-level income countries, as specified in FAO 2011 were used (Gustavsson *et al.*, 2011).

Low-medium and medium-high categories were calculated considering these two limit values. In the study, the household's waste values of the last week were used. However, since the classification criterion is annual, data and dependent variable criteria are transformed to monthly values and coded as presented in Table 1.

Table 1 - Classification coefficients of household's waste per capita.

Groups	*Yearly Waste Limits kg/year*	*Monthly Waste Limits kg/month*
Very low level	0.01-5,9	0.01-0.49
Low level	6-11	0.5-0.99
Low-Medium	12-52	1-4.3
Medium-high	53-94	4.4-7.8
High	95-115	7.9-9.6
Very High	>116	>9.7

Since the individuals in the family have different needs in terms of energy based on age, gender, and physical activities, they consume different amounts of food. Therefore, if we divide the total waste to the number of persons in the household, this would create a misinterpretation. Accordingly, coefficients have been developed to eliminate this difference in nutrition studies and to be able to express family members using the same unit. In this study, "Consumer Unit" coefficient was used in 1974 that takes into account the age and gender of the Turkish Nutrition Survey. Since the coefficient takes into account the gender and age groups, it provides more sensitive results about individuals (Table 2). All family members are calculated in the consumer unit and expressed in the same unit.

For predicting the factors that lead to food waste in households in Turkey and the relative significance of these factors, the sequential Probit model is used. The sequential Probit model is used when the dependent variable is in sequential form (Maddala, 1987; Long, 1997; Greene, 2002). In this study, household food wastage level was investigated in four groups. This classification is as follows; the households having no waste, the households having a low level of waste (0.01-0.99), the households having a medium level of waste (1.0.-4.3), the households having a high level of waste (4.4+). The values of the dependent variable are as follows; 0, 1, 2 and 3 (0=the households having no waste, 1=the households having a low level of waste, 2=the households having a medium level of waste, 3=the households having a high level of waste). Since the dependent variable is sequential, the

Table 2 - Consumer Unit Weight.

Age Groups	*Male*	*Child*	*Female*
0-1		0.4	
1-3		0.5	
4-6		06	
7-9		0.7	
10-12	0.9		0.8
13-15	1.1		0.9
16-19	1.2		0.8
20-19	1.0		0.8
30-39	1.0		0.7
40-49	0.9		0.7
50-59	0.9		0.6
60-69	0.8		0.6
70	0.8		0.6
Because of pregnancy		+0.1	
For nursing mothers		+0.3	

Source: Köksal, 1977.

Sequential Probit model, based on the assumption that the error term is normally distributed, is designed as follows, considering that there is an unobserved (latent) variable as in the binominal probit model.

$$Y^* = X'\beta + \varepsilon \quad (1)$$

Here, Y* is the unobservable variable. The relationship between the observable Y and the unobservable Y* is provided in the following equation (Long, 1997; Greene, 2002).

$$\begin{aligned} Y = 1 &\Rightarrow Y^* \le 0 (= \mu_1) \\ Y = 2 &\Rightarrow 0 < Y^* \le \mu_2 \\ Y = 3 &\Rightarrow \mu_2 \le Y^* \le \mu_3 \\ Y = 4 &\Rightarrow \mu_3 \le Y^* \end{aligned} \quad (2)$$

μ shows the threshold coefficient that connect Y variable to Y* variable. In the sequential Probit model; based on the assumption that the error term is normally distributed, the following probability gives the possibility of the observation to be classified in j category.

$$\text{Prob}(Y = j|X) = \Phi(\mu_j - X'\beta) - \Phi(\mu_{j-1} - X'\beta) \quad (3)$$

$\Phi(.)$, gives the cumulative normal distribution. 3. It provides the derivatives of the equation based on the independent variables as well as the marginal effects of independent variables on this probability. The estimation of the model is obtained by the maximum likelihood method. The variance of the dependent variable, which is not observed under the normal distribution assumption, is assumed to be 1. However, there may be a problem of heteroscedasticity. The heteroscedasticity is used in the model as the exponential form of the variables that would cause the heteroscedasticity (5th Equation) (Williams, 2010). By dividing the 4th Equation by σ_i, it is assumed that the heteroscedasticity is corrected.

$$\sigma_i = \exp(z\gamma_i) \quad (4)$$

Here; z: shows the vector of explanatory variables that would cause the heteroscedasticity, while γ_i: shows the parameter vector.

The marginal effects are calculated as follows.

$$\frac{\partial P(y=1|x)}{\partial x} = -\Phi(x'\beta)\beta \quad (5)$$

$$\frac{\partial P(y=2|x)}{\partial x} = -\Phi(\mu - x'\beta)\beta + \Phi(x'\beta)\beta \quad (6)$$

$$\frac{\partial P(y=3|x)}{\partial x} = -\Phi(\mu - x'\beta)\beta \quad (7)$$

3. Results and discussion

3.1. *Descriptive analyses of the sustainable indicators*

Food loss and waste are present in various stages of the supply chain everywhere in the world. Foods are wasted in different times, in different sizes because of different reasons. There are fundamental principles for solving this global problem. However, the method and effect of these principles are different based on the dynamics of each country. Hence, it is essential to determine the current situation first. With this study carried out for specifically this purpose, the routines of a large number of participants with different socio-demographic characteristics in 3 cities of Turkey in terms of waste, waste management, waste perception, food purchasing and conversation were analyzed.

Table 3 - Descriptive data.

	Cities			*Total /Average*
	Erzurum	*Izmir*	*Adana*	
Size of the house	4.0	3.4	3.4	3.6
Size of Adult Household	3.3	2.7	2.8	2.9
The number of children under the age of 15	0.8	0.5	0.6	0.7
Household income month/TL and distribution (%)				**3,830.57**
>750	0.3	-	2.1	0.8
751-1500	9.6	11.5	24.5	15.3
1501-2500	20.3	30.7	19.4	23.4
2501-4000	34.5	31.5	28.7	31.6
4001-5500	14.8	15.5	11.1	13.8
5501-7500	12.2	6.3	7.5	8.7
7501-10000	6.0	3.1	5.7	4.9
>10001	2.3	1.3	1.0	1.6
Family type distribution (%)				
One family household	69.9	61.4	57.4	62.9
Extended family	8.1	3.4	3.6	5.0
Family without children	10.1	14.1	19.4	14.5
Lone parents with have at least one resident child	7.5	13.1	9.8	10.1
One person	1.8	6.8	9.0	5.9
Household in which there are more than one bachelor	2.6	1.3	0.8	1.6

The average household size is 3.6 people per household and Erzurum is the province with the biggest household size. The average household size is 3.4 people in Turkey (https://data.tuik.gov.tr/Bulten/Index?p=Statistics-on-Family-2018-30726). The average monthly income is TL 3,830.57 ($1,089.9)[1]. When the sample group was analyzed based on the income levels, the majority is placed in the salary between 2501-4000 TL per month. Erzurum is different from other cities since the families living in Erzurum maintain the traditional family life style. Out of the 1155 families, 58 were living with parents and children and second-degree family relatives. This family type is defined as the extended family. More than half of the extended families live in Erzurum. In Adana and İzmir, the number of individuals living individually is exceptional (Table 3). Family type in our study represent in Turkey's general statistics. According to TURKSTAT proportion of one-family households in Turkey was observed 65.3%; lone parents with have at least one resident child 8.9%; one-person households 16.1% in 2018 (https://data.tuik.gov.tr/Bulten/Index?p=Statistics-on-Family-2018-30726).

It was determined that 1155 families wasted approximately 7.5 tonnes of food in the month when the survey was conducted (Table 4). It was calculated by face-to-face survey and the waste of all fresh, cooked food per meal was recorded. It was remarked that there were no wastes in 180 families. The number of households that did not waste in Erzurum was higher than in other provinces. The highest waste rate was obtained in Adana. In Adana, 823 kg of products per week was wasted, while 652 kg were wasted in Erzurum and 393 kg were wasted in İzmir. It is assumed that the high temperature and humidity rate of Adana compared to the other provinces

[1] It has been calculated according to the effective selling rate of exchange as for 15 June 2017 (3,5145).

Table 4 - Waste according to the cities.

	Total weekly waste (kg)	*Total monthly waste (kg)*	*Waste per capita* per month (kg)*
Erzurum	652.56	2,610.26	2.21
Izmir	393.07	1,572.28	1.60
Adana	823.22	3,292.88	3.63
Grand Total	*1,868.86*	*7,475.42*	*2.46*

** Adult equivalent.*

may cause the food to deteriorate more quickly and thus the waste was increased. In terms of the level of waste, there are variations both within the provinces themselves and between the other provinces (Table 5). Nevertheless, in each province, an accumulation was observed in the low-medium waste group.

The highest percentage of total waste was detected in root crops, fruits, and vegetables globally that is roughly 40-50% (https://www.unep.org/thinkeatsave/get-informed/worldwide-food-waste). Also represents the largest group in household food wastes in developing countries is fruits and vegetable, that can vary between 60% and 70% depending on the countries (Esparza *et al.*, 2020). In this study the highest proportion of commodity groups is fruit and vegetables (38.75%). Although there are differences in the other product groups based on the cities, the lowest share belongs to the legumes. This low rate can be explained by the fact that the shelf life of this product is long and this type of product is not frequently purchased (Table 6). A significant part of the waste is due to spoilage

Table 5 - Distribution according to waste levels in cities.

Cities	*Very low level 0,01-0,49*		*Low level 0,5-0,99*		*Low-medium level 1- 4,3*		*Medium-high level 4,4 -7,8*		*High level 7,9-9,6*		*Very high level > 9,7*		*No waste*	
	F	*%*	*F*	*%*	*F*	*%*	*F*	*%*	*F*	*%*	*F*	*%*	*F*	*%*
Erzurum	69	17.9	38	9.9	107	27.8	50	13.0	7	1.8	20	5.2	94	24.4
Izmir	63	16.4	97	25.3	166	43.3	20	5.2	6	1.6	10	2.6	21	5.5
Adana	37	9.6	30	7.8	134	34.6	70	18.1	13	3.4	38	9.8	65	16.8
Total	**169**	**14.6**	**165**	**14.3**	**407**	**35.2**	**140**	**12.1**	**26**	**2.3**	**68**	**5.9**	**180**	**15.6**

X^2 value is 165,291. Sig. value is 0,00<0,05 H_o= rejected.

Table 6 - Quantity (kg) and distribution (%) of household food waste based on the product groups.

Product Groups	*Erzurum*		*Izmir*		*Adana*		*Total*	
	kg	*%*	*kg*	*%*	*kg*	*%*	*kg*	*%*
Grains and products	67.42	10.33	89.73	22.79	111.03	13.49	268.18	14.35
Milk and dairy products	56.76	8.70	40.23	10.22	38.44	4.67	135.43	7.25
Meat and meat products	45.15	6.92	30.79	7.82	61.82	7.51	137.76	7.37
Vegetable and fruit	200.48	30.72	145.57	36.97	378.19	45.94	724.24	38.75
Tuber Plants	79.01	12.11	28.70	7.29	49.56	6.02	157.27	8.42
Legumes	39.63	6.07	2.70	0.69	9.58	1.16	51.91	2.78
Other	164.11	25.15	55.35	14.06	174.60	21.21	394.07	21.09
Total	**652.6**	**100.0**	**393.1**	**99.8**	**823.2**	**100.0**	**1,868.9**	**100.0**

because of the storage conditions. As research sites have various climate and different ecological characteristics, both the consumption habits and the effects of the climate considerably differentiate the amount and rate of waste among the product groups. For example, in Erzurum meat and dairy products are consumed at a high rate due to the fact that animal husbandry is popular in that region and therefore the amount of waste of this group increases. A similar situation is valid for the province of Adana as well. The prevalence of the nutrition based on meat products in Adana province increases waste due to increased consumption in this province. While vegetable production and consumption have similar characteristics in İzmir and Adana, the waste of fruit and vegetable vegetables in these two cities is higher compared to Erzurum. In addition, the difficulty of ensuring storage conditions for cereal group products in hot and humid regions also increases the risk of deterioration in these products and thus, shortens the shelf life of the products. Consequently, the waste rate of the cereals increases in Adana and Izmir. Nevertheless, a common characteristic for all provinces in cereals and products is that bread has the highest share of waste in all provinces within this product group. While the waste of bread consists 60,2% of the total cereals waste in Erzurum, the rate is 88.8% in Izmir and 80% in Adana.

3.2. *Estimation of variables influencing food waste - Sequential probit analysis*

One of the most significant explanatory variables in the model is certainly the logarithm of household total expenditure. This variable was added as an explanatory variable to the model as a sign of purchasing potential since it involves relatively less measurement error. Although it is expected that there will be a reverse relationship between food waste and income, the direction of the effect is surely not clear. Since if we consider the existence of a positive relationship between income and education, we can assume that the income increases when education level will be improved. Smith and Landry (2021) found significantly correlated with education levels and observed food waste, Di Talia *et al.* (2019), Secondi *et al.* (2015), and Lusk and Ellison (2017) emphasized the possible effect of education. Furthermore, it can be stated that the high diversity of the consumption pattern of the high-income consumers will certainly cause food waste. Abeliotis *et al.* (2016) suggested that in terms of leftover, high income households cared less about the waste than households with less income. On the other hand, some studies reported that higher income were more likely to decide to sort food waste (Florkowski *et al.*, 2018). Stefan *et al.* (2013) point out household income correlated positively with food waste. For determining how education level affects the level of food waste, the level of education of the head of the household and the level of education of the household's spouse were divided into 4 groups and used as the dummy variables. The educational level with dummy variables composed of 4 groups; the head of the household is not literate or is literate without having a diploma (reference variable), the head of the household is graduated from the primary school, the head of the household is graduated from secondary-high school and the head of the household is graduated from the university. Since it is expected that the level of food waste changes based on the size of the household, the number of children, the age of the spouse and the family type (elementary family, extended family, a family with a single member, single family living together – this category is taken as the reference value), the size of the household (as the adult equivalent value) and the age of the household's spouse are added to the model as explanatory variables. Many studies showed that results on the relation between family size and household food waste studies (Setti *et al.*, 2016; Jörissen *et al.*, 2015, Di Talia *et al.*, 2019; Williams *et al.*, 2012). Parizeau *et al.* (2015), Florkowski *et al.* (2018), and Abdelradi (2018) found positive correlation between food waste and household size. In order to determine whether food waste varies according to cities where the survey was applied, city dummy variables were created and İzmir was taken as a comparison choice since the waste of Izmir was lower compared to the other cities. Finally, since the waste will vary

Table 7 - Descriptive statistics of the variables used in the model.

Variables	*Average*	*Standard Deviation*
Logarithm of total spending	8.04	0.60
Household size according to the adult equivalent	2.79	1.13
Level of education of household head		
Primary school	0.27	0.44
Middle school/High school	0.57	0.49
University	0.10	0.29
Other	0.06	0.21
The level of education of the household's spouse		
Primary school	0.43	0.49
Middle school/High school	0.40	0.49
University	0.13	0.32
Other	0.04	0.23
The age of the household's spouse	46.22	14.39
If the woman makes the purchase decision	0.33	0.47
The number of children under the age of 15 in the household	1.88	0.77
Family type		
Elementary family	0.58	0.48
Extended family	0.25	0.44
Family type consisting of a single individual	0.11	0.23
Family type consisting of single individuals (more than one)	0.06	0.02
City dummies		
Erzurum	0.333	0.47
Adana	0332	0.47
Izmir	0.335	0.47

according to the individual that makes the purchase of food, the dummy values are added to the model; if the woman takes the decisions to purchase food, 1 value is added to the model, while the other option signifies 0 as the value.

Table 7 presents descriptive statistics of the variables that are used in the sequential probit model. The logarithm of total household expenditure is 8.04 households and the household size are 2.7 according to the adult variable. 57% of the heads of the households and 40% of the spouse of the household head are graduated from middle-high school. Furthermore, the number of children under the age of 15 in the household is 1.88 while in 33% of the households the purchasing decision of food is given by the women and 58% of the families consist of elementary families.

In this study, the determinants of household food waste in Turkey are determined by sequential probit model. Parameter estimations are presented in Table 8. Most of the explanatory variable parameters in the model were statistically meaningful at 5% significance level. At the same time, changing variations were corrected.

When analyzing the marginal effects presented in Table 9, the parameter of total expenditure was determined to be statistically meaningful and positive at 5% significance level for all waste levels. The increase in total expenditure was 7.1% in households having a low rate of waste; 8.2% increase was observed in households having a medi-

Table 8 - Estimates of sequential probit model.

Variables	*Coefficients*	*Z statistics*
Logarithm of total spending	0.257	4.12*
Household size according to the adult equivalent	-0.208	-5.38*
Level of education of household head		
Primary school	-0.575	-2.21*
Middle school/High school	-0.508	-2.06*
University	-0.001	2.21*
The level of education of the household's spouse		
Primary school	-0.263	2.09*
Middle school/High school	-0.299	1.97*
University	0.001	2.01*
The age of the household's spouse	0.043	2.19*
If the woman makes the purchase decision	0.174	5.42*
The number of children under the age of 15 in the household	0.311	4.02*
Family type		
Elementary family	-0.163	-7.49 *
Extended family	-0.363	-6.45*
Family type consisting of one single individual	0.199	2.82*
City dummies		
Erzurum	-0.140	-2.78*
Adana	-0.709	7.39*
Sigma		
Household size	-0.321	2.72*
Loglikelihood	-1041.174	
LR	61.49	
Number of Observations	1155	
Cut1	-0.721	0.121
Cut2	0.585	0.183
Cut3	0.881	0.396

**: 5% significance level.*

um rate of waste; while 6.3% increase was determined in households having a high rate of waste. The effect of household size on waste categories was determined to be statistically meaningful and negative. This negative effect was determined to be higher for the households having a low rate of waste compared to the other households (households having a medium and high rate of waste). In other words, as household size increases, the percentage of households having a low level of waste will be increased by 22.1% while the percentage of households having a high level of waste will be reduced by 18.9%. When the effect of the education of the household head on the level of food waste is examined, it can be observed that if the household head is graduated from primary, secondary or high school, there will be an increase on the household having a low level of waste. On the other hand, if the household head is graduated from the university, the household having a low level of waste will be decreased by 11%. It has been ascertained that the level of household head is graduated from primary, secondary-high school or university and the level of food waste can be decreased in the house-

holds having a medium and high level of waste. It was determined that the households having a medium level of waste will be decreased by 4,6% when the heads of household were graduated from primary school. On the other hand, the percentage of the household having a medium level of waste and the household head graduated from university will be decreased by 12,3%. Similarly, it was determined that the percentage of the households, where the education level of the household head is at the primary school level and having a high level of waste will be decreased by 15,7% while the percentage of household where the education level of the household head is at the university level and having a high level of waste will be decreased by 9,3%. Accordingly, it can be assumed that there will be a decrease when the level of education of the household head increases in the households having a medium and high level of waste. At the same time, in households with low levels of food waste, the conclusion that the level of food waste will be decreased if the education level of the household head increases to the university level, supports the fact that the consumer awareness, and awareness level will be increased with the education and the food waste will be reduced.

It can be asserted that with the increasing level of education of the household head's spouse, the rate of households having a low, medium and high level of waste will be decreased. These findings confirm the idea that education will improve consumer consciousness and awareness and this will lead to a decrease in food waste. As the age of the household head increases, it can be assumed that food wastage will be increased in the households having a low level of waste while it will be decreased in the households having a high level of waste. Since women takes places at every phase of the food processing starting from farm to fork in both developing and developed countries their role in preventing food loss and waste is significant (Lipinski *et al.*, 2013). If the woman takes the decision to purchase food, it can be assumed that there will be a reduction in the food waste rate compared to households, where family members other than the women take the purchasing decisions. This is a significant finding since it shows that if the woman plans the purchasing, there will be less waste because generally, the woman cooks more in the households. The dummy, which was created for the individual making the purchasing decision on food was determined to be statistically insignificant for the households having a low and high level of food waste.

It was ascertained that there would be an increase in food waste according to the number of children under 15 years old. This is consistent with the expectation that the presence of young children will cause food waste. Older consumers stated not wasting food more frequently than younger consumers (Witzel *et al.*, 2019). In many studies, it has been determined that food waste increases in households with children under the age of 18 (Evans, 2011; Jörissen *et al.*, 2015; Parizeau *et al.*, 2015; Ilakovac *et al.*, 2020).

When the level of food waste is examined according to the family type, it is determined that food waste will be increased in the elementary families compared to the households consisting of more than one individual while the food was will be decreased in large families. If the rate of elementary families increases, there will be an increase of 10,1% in the rate of households having a low level of waste, 12,8% in the rate households having a medium level of waste, 9,7% in households having a high level of waste. However, the increase in the number of large families compared to the households consisting of more than one single individual will lead to a reduction in the rate of the household having a low level of waste by 20,6%, while it will lead to a reduction of 12% in the households having a medium level of waste and of 10,3% in the households having a high level of waste. When the city dummies were examined, it has been ascertained that there will be an increase in the households having a low level of waste in the urban areas of Erzurum and Adana, compared to the urban area of Izmir. This increase was observed to be higher with a value of 0.257 for Adana urban area. Furthermore, it is an essential finding in this study to reveal that there will be a reduction in the rate of households having a medium and high-level of waste in Adana's urban areas, compared to the households having a high and medium level of food waste in the urban area of Izmir (Table 9).

Table 9 - Marginal effects.

Variables	*Households having a low level of waste*	*z statistic*	*Households having a medium level of waste,*	*z statistic*	*Households having a high level of waste*	*z statistic*
Logarithm of total spending	0.071	6.04*	0.082	2.16*	0.063	4.27*
Household size according to adult equivalent	-0.221	-2.23*	-0.209	-2.47*	-0.189	-2.13*
Level of education of the household head						
Primary school	0.203	4.21 *	-0.046	-2.51*	-0.157	-4.27*
Middle school/High school	0.143	4.00*	-0.048	-2.92*	-0.138	5.56 *
University	-0.110	-2.16*	-0.123	-2.63*	-0.093	-2.12*
The level of education of the household's spouse						
Primary school	-0.020	-4.40	-0.022	-3.57*	-0.181	3.82*
Middle school/High school	-0.029	-4.54	-0.032	-3.45*	-0.025	4.28*
University	0.014	2.29	-0.015	-2.79*	-0.011	3.79*
The age of the household's spouse	0.012	1.18	0.017	5.29 *	-0.020	3.09*
If the woman makes the purchase decision	0.012	1.12	-0.017	-2.16*	-0.009	-0.923
The number of children under the age of 15 in the household	0.141	3.04*	0.188	4.15*	0.025	2.17*
Family type						
Elementary family	0.101	5.75 *	0.128	2.91*	0.097	3.12*
Extended family	-0.206	-2.32*	-0.120	-2.51*	-0.103	-3.65*
Family type consisting of one single individual	-0.079	-1.43	0.027	1.15	0.081	3.09*
City dummies						
Erzurum	0.048	2.72	-0.062	-1.32	-0.041	-1.78**
Adana	0.051	8.48*	-0.257	-4.23*	-0.192	-9.53*

** 5% significance level, **10% significance level.*

4. Conclusion and recommendations

Food loss and waste constitutes an increasing problem for the whole world. In addition to the loss of quality and quantity in all steps of the food chain, it is also caused by when the edible foods are dumped. This study defines the food waste of households in cities representing the different economic and socio-cultural structures in Turkey. It was determined that 1,9 tonnes of food were wasted in 1155 household per week. Among the cities where the research is carried out, waste is mostly experienced in Adana province and most of the product groups wasted there consist of fresh fruits and vegetables. Children in households are the greatest reason for the waste. It has been ascertained that waste is significantly different in households including the children under 15 years old. Food wastage was determined to be high

in small households that include a married or a single couple without children since they often spend time outside the home. These households consist of single or unmarried young couples that spend more time outside the home.

The most significant finding in the study is certainly the relationship between education and waste. It has been ascertained that the waste will decrease with the increase in the education of the household head and mother. In addition, the mother's decision to purchase food was also comprehended as a factor reducing waste. It is among the most critical factors since the women generally dominate the kitchen and plan the meals accordingly. According to this result, if we start to provide training to the women on waste in terms of activity to fight the waste, the effect will be significant. Participants volunteered to participate in activities related to nutrition, food safety, preservation, and cooking. In this respect, it is anticipated that the fastest and practical measure would be if the public institutions, local governments, and non-governmental organizations prepare an urgent action plan in education and supervision, disclose the significance of the issue to the public with mass communication tools. In fact, starting from the autumn of 2018, the messages on food waste started to be broadcasted in the national channels as public service announcements. However, the announcement is quite long and there are too many public service announcements, it is very hard to remember every one of them. In addition, it is very contradictory when many TV programs, such as reality shows and competitions that encourage waste, are performing the same activity. The other target group in the household should be children. The results of the study reveal that children have a great impact on waste. In this sense, providing waste and nutrition education in schools, including waste management and recycling to the curricula of the schools would be very influential in reducing waste. Particularly, it would be beneficial to explain the consequences of the waste in the school cafeterias, benefit from the resulting organic wastes (the non-edible parts of foods such as crust, kernel, etc.) and present the implementation opportunities as energy sources. It would be a tool for the children to comprehend food production and to respect the food production process when if the children strive to cultivate products in school gardens and use the compost fertilizers made from food waste. The importance of education in food waste reduction strategies has been emphasized in many studies (Kantor *et al.*, 1997; Jörissen *et al.*, 2015; Priefer *et al.*, 2016).

Although the waste of the households was determined to be at the medium level, it was an important issue for Turkey. Cerciello *et al.* (2019) mentioned that consumption habits were rooted in the local culture and were difficult to change in short run, however Stancu *et al.* (2016) and Stefan *et al.* (2013) highlighted, small changes in the routines of the households in terms of food preparation and eating have a significant effect on food waste. The benefits of organizing direct consumer-oriented activities at the micro level have been proved in many countries. Following would be the first methods to implement as the recommendations to reduce the waste; street demonstrations involving celebrity chefs for the evaluation of the wasted food in Turkey and practices, preparation and distribution of meals by using the foods that are considered not presentable by the stores after they are picked by the volunteers, providing a calendar for purchasing, cooking and throwing to the households defined as the focus group. It has been revealed in studies that label information such as expiration date, production date, consumption time after opening is a factor that increases waste (Wilson *et al.*, 2017). For this reason, informing the consumers about the expiration date, as well as having the best before statement on the labels can also reduce household waste.

Food waste signifies an economic, environmental and social problem. Economically, it causes significant losses for retailers and producers, as well as households. Benefits should also place the food that looks unpresentable by taking into consideration the preferences of the consumers, particularly in fresh fruit and vegetables. This practice will highly contribute to change the consumers' perception on the hand. On the other hand, the costs of the seller will be reduced. In addition, retailers should be en-

couraged to hang warning signs that draw the attention of the consumer and legal regulations should be established to ensure that the practice is mandatory at certain times. Including some warnings on the food packages about the food waste as there are warnings on the cigarette packages would be a serious solution for increasing the awareness of the consumers.

It has been ascertained that the studies prove that the warnings in the hotels, restaurants, cafeterias, and cafes certainly drew attention and the consumers tend to avoid the food waste, even for a short time. In these areas, it is essential to cooperate with the professional institutions for using the warnings. Furthermore, it should be encouraged in restaurants that people can take away the leftovers. If the cost of this waste to the consumers in the restaurants is added to the invoice, it is a method used in some developed countries and it is highly deterrent. This practice may be perceived as unrealistic for Turkey, there may be some volunteer enterprises that may implement this practice. It is not reasonable to implement these micro-practices following the recommendations of the teachers. Various initiatives should be put in place by the relevant public institutions. Enterprises with high environmental sensitivity should be considered as pilot projects. Certainly, there are enterprises in Turkey striving to get the label of green hotels, green restaurants, green cafes. It is possible to launch sample practices with these enterprises.

The implementation of the measures relating to food loss will exclusively be possible if all stakeholders are aware of the magnitude and seriousness of the problem. There is a serious need for encouraging practices to disclose the recording of the foods for all the actors of the food chain in Turkey. It is feasible to encourage the manufacturers to keep the documents regularly regarding the waste processes on sales. For example, a discount on stoppage or additional support can be provided. Similarly, the municipalities can also monitor the records of the enterprises and it is possible to offer some discounts or exemptions to the tradesmen of the market such as middlemen, wholesalers if they manage the process correctly.

Since food waste is not very visible for the society and it is not considered as significant as other social issues such as smoking, infectious diseases, the increase of non-communicable diseases, renewable energy, violence, and abuse, the food waste significantly increases in the society. However, the difficulties encountered in the food supply and the economic and environmental damages of food waste are closely related to all these social issues. However, in some societies, it may be simpler to increase the consciousness against the waste by taking into consideration the effects of norms and beliefs on behaviors.

This work fills a gap in the empirical literature on food waste in Turkey. Since this study is the first study in Turkey in this context, ant it will shed light on many studies to reveal the current situation. The future studies can use the findings of the current study for creating solutions in the studies to be conducted with different groups to reduce the waste This wasting problem, which is yet to be recognized, but still challenging to be accepted, will be resolved if there are studies conducted to find a solution to the problem.

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Do future markets protect the spot markets in developing countries? The case of the Egyptian wheat market

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Abstract

Egypt is considered a net wheat importer, with the Egyptian market being vulnerable to future wheat markets because of the effect future market price discovery can have on the stability of spot prices. This study assesses the relationship between Egyptian wheat spot prices and future wheat prices in Paris (MATIF) and USA (CBOT). Markov switching-vector error correction methods are used to estimate two regimes by splitting the sample into high and low volatility regimes. This study also examines the dynamic conditional correlation between the prices considered using the asymmetric DCC-GARCH. Results suggest a high volatility regime observed, especially during the extreme market events of the food crisis in 2007-08 and 2010 and following the two revolutions in Egypt in 2011 and 2013 and the time of the economic reform in 2016. This leads to an unstable market and negative impacts on consumers' welfare and food affordability, meaning that futures markets failed to hedge spot wheat market against price volatility. In addition, results from impulse response functions indicate that a 1% shock in futures markets will lead to a positive shock in the wheat spot market, while for the low volatility regime no significant effect.

Keywords*: Future-spot markets, Food price volatility, Markov switching, Vector error correction, DCC-GARCH.*

1. Introduction

Egypt has been suffering from food insecurity for a long time because of natural resources scarcity, economic instability, political upheaval and an excessive reliance on food imports. After the food price crisis of 2007-08 and a second wave of the crisis in 2010, basic food commodity prices, particularly in developing countries, have increased and been negatively affected by global price volatility. These food price hikes have caused social unrest and a series of revolutions in the Middle East; the so-called Arab Spring began with Tunisia, Egypt, Syria, Libya and Yemen (Ciezadlo, 2011; Bellemare, 2015).

Despite this social outcry, the prevailing economic situation in Egypt is characterized by high food and energy prices, high unemployment rates, unfair wage structures, and a low exchange rate. The GDP growth rates decreased from 5.1% in 2010 to 3.6% in 2017, while inflation measured through the consumer price index grew by 29.8% in 2017 and the unemployment rate remains consistently high at 12.5% (Central Bank in Egypt, 2017). Naturally, the rising unemployment rate worsened the poverty rate,

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which increased from 21.6% in 2009 to 27.8% in 2017, while food insecurity rates increased from 14% of the Egyptian population in 2009 to 16% (15.9 million people) in 2017 (World Food Program, 2019). In 2013, more than 80% of the Egyptian population did not receive enough income to cover consumption needs, and more than 65% of this insufficient income was spent on food, especially wheat (Egyptian Food Observatory, 2013). Inflation measured through the consumer price index increased from 9.1% in January 2015 to 21.9% in December 2017 (Central Bank in Egypt, 2018). Consumers in Egypt have used different strategies to cope with the increasing food prices, such as consuming cheaper food withlower nutrients, reducing their food intake and buying food with credit (Egyptian Food Observatory, 2013). This economic downturn led to structural problems in the functioning of the Egyptian food market. As in Egypt, after the global food crisis and successive crisis, the food markets of these countries suffered evident price distortion, especially for wheat, which was significantly affected by the price volatility.

The economic situation became worse after 2016 with the U.S. dollar appreciated relative to the Egyptian pound by over 100%. This drop hit especially hard in a country that depends significantly on the international market to meet local food demand, making this market specifically vulnerable to food price volatility in international markets. These rising food prices erode consumer purchasing power, exacerbate food security problems and increase the poverty rate. Through the futures market, farmers, traders, and hedgers can protect themselves against market risk and price volatility by looking to lock in delivery prices before making a decision (Wu *et al.*, 2018). The future market was firstly blamed that not protected the developed and less developed countries against food price volatility since the main function of this market is to hedge spot prices against fluctuation (Shawky *et al.*, 2003; Wu *et al.*, 2018; Ahmed, 2021).

The concept of food price volatility is closely related to that of food security. According to the FAO *et al.* (2015), there are food security pillars: food availability, economic and physical access to food, food utilization, and stability over time (vulnerability and shocks). Food price shocks may hit poor countries especially hard and increase the population living below the poverty line, which exacerbates economic instability and political upheaval. Since Egypt is dependent on wheat imports, the Egyptian market is vulnerable to international wheat shocks, which hinders the country's economic access to food. Unaffordability leads to poor access to food, which can lead to nutritional damage, particularly among children. A study by Robles and Torero (2010) found evidence that, following the 2007-08 food crisis, greater reductions in calorie intake were present due to increased food prices. A study by Iannotti and Robles (2011) assessed the negative impact of energy intake associated with food price shocks in Latin America during the 2006 to 2008 period. They confirmed that increases in the prices of basic foods commodities (rice, wheat and maize) negatively affected energy intake, especially for poorer households. Arndt *et al.* (2016) assess the relationship between increases in food prices and child nutrition in Mozambique over the 2008 to 2009 period. They found evidence that increased food prices led to decreased nutritional intake and the prevalence of being underweight, particularly among children. Ivanic and Martin (2008) studied the impact of food crises on household welfare in developing countries of Africa, Latin America and South Asia. Research results indicate that increased food prices lead to more poverty and reduced household welfare. An article by de Brauw (2011) found evidence that a 15% growth in food price inflation in El Salvador resulted in lowered height- for-age among children of the researched households.

Various studies have suggested many causes that may be underlying the recent volatility of food prices around the world. Jacks and Stuermer (2016) conducted a study on the drivers of commodity price booms and busts. They found evidence that commodity demand shocks transmitted into price variability more strongly than commodity supply shocks. Carter *et al.* (2011) investigated the frequency of dramatic commodity booms and busts after the Korean War, specifically, two peaked happened in 1974 and 2008, with their results indicating that supply and de-

mand shocks that coincide with low inventories led to price booms. Roberts and Schlenker (2010) found that 30% of the rise in prices for staple food commodities was due to excess biofuel demand in 2007-08. In 2013, the same researchers analyzed the supply elasticity based on the assumption that past food commodity yield stocks negatively affect inventory levels and futures prices. They found that 20% of the increased prices for staple foods were a result of using one-third of food commodities to produce ethanol.

Using different econometrics techniques, many empirical analyses have studied the causes of food price volatility for crisis periods specifically. Most of these studies found strong evidence that the energy market leads to volatility in agricultural markets (e.g. Du *et al.*, 2009; Meyers and Meyer, 2008; Balcombe and Rapsomanikis, 2008; Serra *et al.*, 2008; De Gorter and Just, 2008). The work by Busse *et al.* (2011) studied the emerging linkages between price volatilities in energy and agricultural in EU market. They assess the price volatility development in food commodities by focusing on the price behavior of rapeseed futures prices, crude oil and related agricultural commodities during the period of the 2006-08 food crisis. Using the dynamic Autoregressive Conditional Heteroskedasticity (GARCH) model, they found evidence for a positive correlation between rapeseed future prices and crude oil prices during the time of the food crisis, which continued to increase afterwards. Furthermore, the crude oil prices showed higher volatility levels than the agricultural commodity prices. Also, the crude oil prices led to volatility in agricultural markets, implying that farmers and consumers will continue to face uncertainty of agricultural prices in the future.

The work by Kakhki *et al.*, 2019 studied the price fluctuation of barley in the Iran Mercantile Exchange, Iran‘s domestic free market, and the World Market. By using the BEKK-GARCH model and they found evidence that the shocks and volatility of the world and Iran free-market are passed to the Iran Mercantile Exchange. Cinar(2018) has also applied the BEKK- GARCH model to study the volatility transmission across the prices of corn, wheat, and barley in the Turkish market. Results indicate that there is a volatility spillover from the corn and barley market to the wheat market. Cinar and Keskin (2018) have analyzed the spillover effect on prices of imported energy and soybean that are widely used to determine broiler prices in the Turkish market. They have used the Vector Error Correction Model (VECM). They have found evidence that increases in energy and soybean prices lead to increases in broiler prices.

The study by Wright (2014) found evidence that, after the fall of 2006, the volatility of futures prices for most of the major crops has been dramatically increased with increases in food prices. The strong evidence of the co-movement between futures and spot prices has been found by Fattouh *et al.* (2013) that interpreted by the common economic fundamentals between the future and cash prices. Research carried out by Prakash and Gilbert (2011) implies that the magnitude of futures markets traders' positions in agricultural commodity markets has considerably increased, which has raised concerns with respect to increased food price volatility due to various factors, such as changes in supply and demand fundamentals, rising expectations and speculation (Baldi *et al.*, 2011). The work by Adjemian *et al.* (2013) studied the non-convergence of the futures and spot prices causes in the grain market (corn, soybeans, and wheat) in the U.S. during the period from 2005-2010. Results imply that the futures prices are settled higher than the cash prices in delivery markets. This reflecting the non-convergence of the futures and spot prices, which is leading to concerns the hedgers, traders, farmers, and policymaker that resulting in less hedging effectiveness and market risks.

The study by Chen *et al.* (2016) to assess the relationship between spot and futures oil prices. They examined the impact of structural breaks on cointegrating relationships, market efficiency under the expectation hypothesis and the no-arbitrage rule, causalities, and forecasting performance of futures oil volatility. Results indicate that the structural break, that detected by authors, endogenously resulting in an influence on these four critical issues.

There are several studies found evidence that future markets lead to stabilizing spot prices in developed countries, and makes the food markets working efficiently (Dower and Anderson,

1977; Danthine, 1978; Streit, 1980; Gupta and Mayer, 1981; Theissen, 2012; Kim and Lim, 2019), while this study explores the efficiency of future markets in food commodities in Egypt as one of the developing countries.

A study by Hull (1997) assessed the linkage between futures and spot prices, finding that futures and spot prices move together in the long-run. There are many other studies that have studied the relationship between futures and spot prices (e.g. Baklaci and Tutek, 2006; Baldi *et al.*, 2011; Giot, 2003; Garcia and Leuthold, 2004; Hernandez and Torero, 2010). Studies on the causal relationship between futures and spot prices have found evidence for relationships between futures and spot prices because of price discovery in the futures market and the flow of information available on the spot prices, indicating that futures prices lead the spot prices (Brooks *et al.*, 2001; Yang *et al.*, 2001). Other studies, on the other hand, have found evidence that spot prices lead the futures prices (Kuiper *et al.*, 2002; Mohan and Love, 2004). The link between futures and spot prices at different levels has been examined by Hernandez and Torero (2010), Baldi *et al.* (2011) and Sendhil and Ramasundaram (2014). Wu *et al.* (2018) studied asymmetric price transmission between futures and spot prices in the grain markets. They found evidence that there is asymmetric price transmission between futures and spot prices in the grain markets. The corn spot price is likely to be adjusted more quickly to prices increases in the futures market than the prices decreases. In contrast, the soybean market adjusts more quickly to futures price decreases than price increases. The study by Adämmer and Bohl (2016) to assess the impact of food futures contracts in Europe on food prices. They have used future and spot and futures prices for canola, wheat, and corn for their analysis. Results indicate that the influence of the futures price on the spot prices is higher in the period of the first food crisis from 2007 to 2009 and in the second wave of the food crisis from 2010 to 2013. While this influence has vanished during higher trade activity in futures markets.

Some empirical analyses have addressed the volatility impact of futures markets on spot prices using the GARCH model (Yilgor and Mebounou, 2016; Baklaci and Tutek, 2006; Bohl and Stephan, 2013; Bozic and Fortenbery, 2015).

Worldwide, Egypt is considered a net importer of grain and top importer of wheat, with most of its wheat imported from former Soviet Union countries, the USA and France. Wheat is the most commonly consumed grain in Egypt and the key to household economies in rural areas, since most Egyptian farming households are net buyers of wheat on top of their own production in order to meet their consumption needs. Hence, the impacts of wheat price spikes on poor households are particularly impactful. Bread is the largest food staple and plays a central dietary role among Egypt's population of more than 100 million people. Egyptians call bread "Aish baladi": Baladi means traditional or authentic in English, while the word "Aish" means life, indicating the importance of bread in Egyptian heritage. Bread is considered a commodity that Egyptians cannot live without in their daily diet.

Egyptian wheat prices reflect price discovery information occurring in wheat future markets. For this purpose, this research article contributes to the literature by assessing the link between futures and spot prices in the Egyptian wheat market. To date, many other studies have focused on US and EU markets. In addition, we investigate whether the futures markets facilitating the transmission of information to the spot market reduces market failures and the effectiveness of market performance. Moreover, we examine whether the futures market reduces, increases or stabilizes spot price volatility by using two different methods: the Markov-Switching Vector Error Correction Model (VECM) and the asymmetric DCC-GARCH model.

This paper is organized as follows: in the following section, we provide a brief description of the wheat market in Egypt. In section three, the methodological approach is described. The fourth section is devoted to the empirical analysis implemented to assess the relationship and the continual volatility correlation between futures and spot prices in the Egyptian wheat market. The last section of this article offers concluding remarks and policyrecommendations.

2. An overview of Egypt's wheat market and policy implications

Bread is considered a necessary staple in the daily meals of Egyptians. Egyptian bread is mainly produced with wheat, making Egypt dependent on wheat imports amounting to around 12.5 million metric tons (MMT) in 2018 represent 20% of all agricultural imports, which is expected to increase by 0.8% in 2019. Egypt is considered the biggest wheat importer in the world, and wheat is the largest grain imported by Egypt. Wheat represents the largest food staple for the Egyptian's population of more than 100 million people. It is also the largest grain crop produced in the country, representing 10% of the total agricultural production value in 2017 (FAOSTAT 2017).

According to USDA-FAS (2019) report, 28 import tenders for 6.64 million metric tons (MMT) of wheat in the 2017-18 marketing year were issued by The General Authority for Supply Commodities (GASC) compared to

5.85 MMT in the previous year. The most of the wheat were imported from Russia, Romania, Ukraine and France (5.2 MMT, 1.06 MMT, 355,000 MT, and 60,000 MT, respectively). During the 2018-19 marketing year, GASC purchased 8% more when compared to the year before, and the largest wheat exporters to Egypt were Russia, Romania, Ukraine, France, and the United States in amounts of 3.9 MMT, 960,000 MT, 480,000 MT, and 300,000 MT, respectively.

Wheat is extremely important for African economies, which devoted 10.4 million hectares to produce 27.2 million tons in 2017, roughly a quarter of the cereals produced in Africa (FAOSTAT, 2017). Wheat is the most commonly grown grain in Egypt, which is Africa's largest wheat-producing country. Jointly, Egypt, Morocco, Algeria and Tunisia represent 71.5% of the total African wheat production (FAOSTAT, 2017). In 2018, Egypt's wheat consumption was 20.1 MMT, which increased by 1.6% compared to the previous year as demand for this commodity for both household and industrial consumption, as well as animal feed, rose. With the population growing at 2.4% per annum, wheat consumption is expected to continue increasing by 1.5% in 2019 (USDA-FAS, 2019). The Egyptian government allocates annually 4.8 billion USD to its bread and food subsidies program. However, this subsidized system is working inefficiently and enabling bakeries and grocery stores to resell subsidized bread on the black market, leading to price distortions between the free and subsidized markets.

There are 450 private, public and public-private mills in Egypt. The milling capacity of both the public and public-private mills ranges from 50,000-55,000 metric tons per day, while the milling capacity of private mills is 20,000 metric tons per day. 81 of the public mills and 75 private mills produce 82% high extraction wheat for subsidized baladi bread production. The private sector mills produce 72% extraction wheat that's sold to around 20,000 private bakeries. They could stop producing this kind of wheat and instead make 82% extraction wheat if they had government contracts to produce subsidized baladi bread. Wheat is a very sensitive product for the Egyptian policy, with more than 40% of the population living under the poverty line, guaranteeing availability and access to food with low prices is rather challenging for the Egyptian government that to assure the food security for those people, meaning that wheat policy is one of the highest priorities for the Egyptian government.

Farmers have two outlets to sell their wheat. The first is to sell their wheat to the government, which was an attractive option to farmers because they received support prices that were 50% higher than international prices. However, after the economic reform in 2016[1], the government decided to decrease the subsidy to just 5% more than international prices. The second is to sell to private traders at the farm gate. Farm-

[1] In 2016, Egyptian government has requested a loan from the World Bank at a low interest rate to support the transformational economic reform agenda of the government. To qualify for this loan the World Bank has asked for the reduction of subsidies on fuel and food.

ers do not sell all their production; they keep part of it for the next season's seeding, feed and personal consumption (USDA-FAS, 2014). Before 2018, the Egyptian government was receiving the wheat the farmers with subsidized prices and deliver it to the bakery to sell bread to poor consumers at subsidized prices with 5 piasters while it cost more than 25 piasters. In 2018, the Egyptian government decided to extremely reduce the number of beneficiaries of its food subsidy program, adding complex criteria regarding who can receive the food subsidy (USDA-FAS, 2019). As a result, most poor consumers in Egypt suffer from increased food prices particularly wheat. Moreover, the wheat value chain in Egypt, is also still in need of better mechanisms to increase performance and production efficiency (USDA-FAS, 2019).

Subsidized wheat has been supplied to farmers and end consumers in Egypt countries for many years. Nevertheless, the governments have decided to lift subsidies as mentioned above. Thus both farmers and consumers have become exposed to international wheat price developments. Given the experience with serious harvest shortfalls in the Black Sea region and skyrocketing world market prices, budget constraints and repeated wheat export restrictions by the Black Sea exporters, the Egyptian government should intervene to increase grain self-sufficiency by boosting the development of the domestic grain sector. Besides large wheat import dependency, still, large amounts of wheat are stored in jute bags in open fields, with storage losses adding up to more than 15%. In addition, the frequent fumigation to control insects may reduce farmers' income and increases consumers' expenses, as wheat losses during storage may translate into lost income for farmers and higher food end consumer prices (Abouhussein and Sawan, 2010). Egypt generates large amounts of lignocellulosic waste annually. For example, agricultural waste in Egypt amounts to around 33.5 million tons annually with a wheat straw of 6.9 million tons the most abundant residue, while the farmers can use these by-products as inputs (e.g. fertilizers) to reduce the farmer's cost and improve the wheat productivity.

3. Methodology

This paper studies the price linkages, which requires knowledge of the joint distribution of the prices considered. The Markov Switching Vector Error Correction (MS-VEC) model and asymmetric DCC-GARCH model have been used for this purpose. Many empirical analyses have studied the links between two or more variables using regime shift approaches, having found evidence that ignoring structural breaks when using econometric applications can lead to biased estimation (Perron, 2006; Hansen, 2009). Following Balcilar *et al.* (2015), the nonlinear MS-VEC time-varying model has been used in this study to assess the links between two pairs of prices: futures wheat prices in the US–Egyptian wheat spot prices (*CBOT*, *spot*) and futures wheat prices in France–Egyptian wheat spot prices (*MATIF*, *spot*).

The MS-VEC model is widely used to assess dependence between prices to characterize non-stationary and co-integrated data and inform on both their short and long-run dynamics. The Markov Switching (MS) models were introduced in the literature by Hamilton (1990) as nonlinear time-series models using univariate Markov switching autoregressive models. MS models were developed and extended to multivariate MS-VAR and MS- VEC models by Krolzig (1997, 1999). Several studies have addressed structural breaks using MS-VEC models toassess how prices are transmitted (Brümmer *et al.*, 2009; Rezitis *et al.*, 2013; Busse *et al.*, 2012; Ihle and von Cramon-Taubadel, 2008). This paper contributes to the literature by examining the dependence between prices using a MS-VEC model to capture the co-integration efficiently with time-varying that reflects regime switching. This model has the structure to assess permitted asymmetric inference for impulse response function (IRF). Our research uses the MS-VEC model based on the Bayesian Monte Carlo Markov Chain (MCMC) method and estimates the IRF by relying on the regime-dependent IRFs (RDIRF) approach (Balcilar *et al.*, 2015).

By focusing on modeling bivariate distributions, let F_{xt} and F_{yt} be the bivariate distribution functions of 2 random variables (x, y) with the

time series vector X_t and $_t \in \{1,2, \dots . T\}$ that represent the time period, which can be captured as follows: $X_t = [F_{xt}, F_{yt}]\not\in$. And let

$$\Im_t = \{X_\tau | \tau = t, t-1, 1-p\},$$

where p is a nonnegative integer. According to Balcilar *et al.* (2015), there exists a probability density function that can be expressed as

$f\{X_t|\Im_t, \theta\}F_{xt}$ where θ is the parameters, and $\theta_0 \in \Theta$, which refers the true value of θ where Θ is the parameter space. The MS-VEC model can be defined as:

$$\Delta X_t = \mu_{s_t} + \sum_{k=1}^{p-1} G_s^{(k)}{}_t \Delta X_{t-1} + \bar{P}_{s_t} X_{t-1} + \varepsilon_t, \quad t = 1,2, \dots\dots, T \tag{1}$$

Where $S_t \in \{1,2, \dots , q\}$ and S_t is the stochastic variable or regime variable with q, as the Markov process states. P is the order of the MS-VAR model, $\{X\tau|\tau = t, t-1, 1-p\}$; ε_t is the error term. According to the Markov process, the regime variable follows a q, with a transition probability matrix that can be formalized as follows:

$$P = \begin{bmatrix} P_{11} & P_{12} \cdots & P_{1q} \\ \vdots & \vdots & \vdots \\ P_{q1} & P_{q2} \cdots & P_{qq} \end{bmatrix}, \quad \sum_{j=1}^{q} P_{ij} = 1 \; for \; i, j = \{1,2, \dots\dots, q\} \tag{2}$$

Where P_{ij} is the probability of the regime j and i at time t and $t-1$, respectively. The unique feature of this model is that all parameters considered in the analyses depend on the regime variable S_t.

The long-run relationship between the variables can be described as follows:

$$\prod s_t = \alpha_{st}\ \beta', \tag{3}$$

Where $\prod s_t$ is the matrix capturing long-run relationships between the variables expressed in equation (1), which can indicate switching in three different ways: switching the in the regime dependent adjustment weighting matrix ($\boldsymbol{\alpha}$), the long-run independent co-integrating vector (β') or both. In this regard, the biggest advantage of the MS- VEC model described in equations (1) to (3) is the speed at which variables considered are adjusted to the long-run equilibrium varied cross breaks. The macroeconomic time series characterized by the extreme events (crisis time) and crisis-recovery (Balcilar *et al.*, 2015; Durland and McCurdy, 1994; Diebold *et al.*, 1994; Kim and Yoo, 1995; Filardo and Gordon, 1998). For this purpose, our analysis relies on two regime models that divided the series into high and low regimes depending on the spot's and future's prices variance-covariance matrix that analyze the short-term time-varying interactions of the prices considered and assesses the response to disequilibrium from this parity.

Our paper contributes to the literature by examining the regime-switching behavior of the price series using a dynamic MS-VEC model. A key advantage intrinsic to this model is that it can study the dynamic interactions between two or more variables over the full sample at unknown periods based on the parameter switches in the time series. Also, this model can estimate probabilistic inferences about the time breaks that can happen during extreme market events (regime occurs) and determine the dates of the regime changes. This model can be applied to assess the regime dependence impulse response functions (IRF).

The MS-VEC model can be estimated through a two stage estimation process. The first stage consists of estimating Johansen's procedure (1988, 1991) to determine the number of co-integration analyses that could drive the equilibrium errors $z_t = X_{t-1}\beta'$. The MS-VEC is estimated in a second stage, either through a maximum likelihood (ML), expectation maximization (EM) or Bayesian MCMC parameter estimation based on the Gibbs sampling methods. We use the latter, which consists of drawing the regimes given the model parameters and transition probabilities[2]. The IRFs of the MS-VEC model have been used to study how a given shock in one variable could be transmitted to another variable in the model over the time period.

Our analysis relies on regime-dependent IRFs (RDIRF) that can determine the response of the variable to a certain shock over the time variation. The RDIRF function can be expressed as:

$$\theta_{ki,h} = \left(\frac{\P E_t X_{t+h}}{\P u_{k,t}} \middle| s_t = \cdots s_{t+h} = i \right) \quad \text{for } h \geq 0 \tag{4}$$

[2] For more details, please see Balcilar et al. (2015) and Fruehwirth-Schnatter (2006).

Where $\theta_{ki,h}$ is the k-dimensional response vector which predicts the response of endogenous variables at time $t+h$ after one standard deviation shock and $h = 1,2, \ldots, H$ is the propagation of the shocks with $k-t$h initial disturbance at time t, conditioned on regime i. $u_{k,t}$ represents the structural shock to the $k-th$ (Balcilar *et al.*, 2015; Ehrmann *et al.*, 2003).

Following Balcilar *et al.* (2015), we combine the MCMC integration with the RDIRF analysis to study the dynamic response of the shocks occurring during extreme market events or crises-recovery periods. We also make this combination to investigate the prediction of future prices considered in our analyses by using the simulations of the artificial histories for the variables[3] after determining the structural shocks by using a Gibbs sampler, through which we can obtain the RDIRFS posteriors. The standard deviation confidence bands have been estimated using MCMC integration with Gibbs sampling of 50,000 posteriors with a burn-in of 20,000.

Time-varying and clustering volatility, another common characteristic of time-series, is typically modeled through generalized autoregressive conditional heteroskedasticity (GARCH) models. In this study, we apply Asymmetric-DCC GARCH models.

This analysis uses Asymmetric-Dynamic Conditional Correlation with Multivariate Generalized Autoregressive Conditional Heteroscedasticity (ADCC-GARCH) techniques to characterize the time-varying conditional correlation, which allows the parameters to change with changing environments across time. An ADCC-GARCH model can be estimated through a two stage estimation processes. The first stage consists of estimating marginal models that filter information contained in univariate distributions, enabling standardized, independent and identically distributed ($i.\ i.\ d$) residuals to be derived; we have used an ARMA model for this purpose. The ADCC-GARCH were estimated in the second stage. The maximum likelihood method has been applied on the uniform residuals to estimate the ADCC-GARCH. Since the theory of ADCC-GARCH applies to stationary time-series, tests for unit roots are run on considered data. Results support the presence of a unit root in all series used in the analysis. Univariate ARMA (p_a, q_a) marginal models capture univariate first difference of logged price patterns with p_a representing the number of autoregressive parameters of the ARMA model; q_a is the number of moving average components.

Following Gardebroek and Hernandez (2013), we applied this model:

$$r_{it} = \gamma_0 + \sum_{j=1}^{p} \gamma_j\, r_{it} + \varepsilon_{it}, \tag{5}$$

$$\varepsilon_{it} = \sqrt{H_{it}}.\,\varphi_i, \text{ with } \varepsilon_{it} \sim N(0, H_t) \quad and\ \varphi_i \sim N(0, I) \tag{6}$$

Where r_{it} is the 4 × 1 stochastic vector of price returns for WH, WOP, WWP, and EXCH; γ_0 is a 4 × 1 vector of long –term drifts; γ_j is the 4 × 4 parameters matrices with j= 1,.., p; and ε_{it} is a 4 × 1 vector of ordinary residuals. H_{it} is a $N \times N$ corresponding variance covariance matrix and φ_i the standardized residuals. The conditional variance-covariance matrix H_t for the DCC model could be defined as follows:

$$H_t = D_t R_t D_t \tag{7}$$

Where R_t is a time-dependent conditional correlation matrix, $D_t = diag\,(h_{11,t}^{\frac{1}{2}} \ldots\ldots h_{NN,t}^{\frac{1}{2}})$ and $h_{NN,t}$ is a conditional variance GARCH (1,1) that could be specified as:

$h_{NN,t} = \omega_i + \alpha_i\, \varepsilon_{i,t-1}^2 + \beta_i h_{ii,t-1},\ i = 1, \ldots\ldots, 4.$

The dynamic conditional variance can be defined as:

$$Q_t = (1 - \alpha - \beta)\,\bar{Q} + \alpha u_{t-1} u'_{t-1} + \beta Q_{t-1} \tag{8}$$

Where Q_t is the 4 × 4 symmetric unconditional variance matrix between the series, α and β are the non-negative adjustment parameters satisfying $\alpha + \beta < 1$; these parameters are estimated using an autoregressive moving average model (ARMA). $\bar{Q}$ is the 4 x 4 unconditional covariance between the u_t, and $u_{it} = \epsilon_{it}/\sqrt{\mathrm{h}_{iiiiit}}$.

[3] The artificial histories could be estimated by using the estimated value instead of parameters used in the model, and then we can calculate the variance covariance matrix to obtain the residuals, lastly we can estimate the endogenous variables.

The dynamic conditional correlation can be expressed as:

$$R_t = diag(Q_{ii,t}^{-1/2})\, Q_t diag(Q_{ii,t}^{-1/2}) \quad (9)$$

According to Engle (2002), the DCC model is estimated through maximizing the log-likelihood for the dynamic conditional variance, as follows:

$$L(\alpha,\beta) = -\frac{T}{2}\ln(2\pi) - \frac{1}{2}\sum_{t=1}^{T}(2ln|D_t| + \varepsilon_t'(D_tD_t)\varepsilon_t) - \frac{1}{2}\sum_{t=1}^{T}(ln|R_t| + \varepsilon_t'(R_t^{-1}{}_t)\varepsilon_t) \quad (10)$$

To capture the maximization of the dependency changes over time, we maximize the value in the previous equation, as shown in the equation below:

$$L(\alpha,\beta) = -\frac{1}{2}\sum_{t=1}^{T}(2.ln|R_t| + \varepsilon_t'(R_t^{-1}{}_t)\varepsilon_t) \quad (11)$$

The limitation of the symmetric dynamic conditional correlation is that this approach does not respond to positive and negative price shocks (Cappiello *et al.*, 2006). Most of the food price research to-date has found evidence that price time series may be asymmetric to reflect market shocks. Thus, estimating the DCC-GARCH model ignoring the asymmetric effect could lead to inaccurate results.

Evidence of asymmetries within the food and energy marketing chain is abundant. These asymmetries tend to be more pronounced as we move to extreme tails of the distribution (i.e., when price increases or declines are larger), which we capture through ADCC as proposed by Cappiello *et al.* (2006). This allows for asymmetric dynamic conditional correlation in any direction and nests symmetry as a special case. The ADCC is an extension of the dynamic conditional variance, which can be specified as:

$$Q_t = (1-\alpha-\beta)\bar{Q} - g.\bar{\Psi}_t + \alpha u_{t-1}\acute{u}_{t-1} + \beta Q_{t-1} + g.(\xi_{t-1}\xi'_{t-1}) \quad (12)$$

Where $\bar{\Psi}_t = E\,[\overline{\xi_{t-1}\,\xi'_{t-1}}]$ and $\overline{\xi_{t-1}} = (I\,[\overline{u_t} < 0]o\,\overline{u_t})$ implies the element by element Hadamard product (o), and g - denotes the asymmetric term. Thus, if $g = 0$, $[\alpha_{ij}] = [\sqrt{\alpha}]$, $[\beta_{ij}] = [\sqrt{\beta}]$, the model tends to be symmetric DCC, while if $[g_{ij}] = [\sqrt{g}]$, $[\alpha_{ij}] = [\sqrt{\alpha}]$, $[\beta_{ij}] = [\sqrt{\beta}]$, the model tends to be ADCC. G expresses periods where both series experience negative shocks (bad news) and $[\xi_{t-1}\,\xi'_{t-1}] = I_t$.

4. Empirical analysis

The empirical application aims to examine the relationship between nominal domestic prices of wheatin the Egyptian market and futures prices associated with Chicago, USA (CBOT) and Paris, France (MATIF). The Egyptian market mainly imports either soft wheat or milling wheat; for this purpose we have selected a CBOT-traded soft red winter wheat and an MATIF-traded milling wheat. The analysis is based on monthly price series and expressed in US dollar per ton observed from January 1998 to December 2017, yielding a total of 240 observations. The futures prices were obtained from the Agriculture and Horticulture Development Board (AHDB) (https://cereals-data.ahdb.org.uk/archive/), while the Egyptian wheat spot prices (farm gate prices) were obtained from the Central Agency for Public Mobilization and Statistics (CAPMAS) (https://www.capmas.gov.eg/HomePage.aspx).

Prices are expressed in U.S. dollars per ton and studied in pairs. The period of analysis is of interest because it includes the first and second wave of the food crises in 2007-08 and 2010, the Egyptian revolutions in 2011 and 2013 and the time of the economic reform in 2016. Thus, this period is likely to reflect the impacts of political and economic instability. The summary statistics for the first differenced logged price series illustrate evidence of a non-normal price series characterized by skewness, kurtosis and ARCH effects. Standard unit root tests were carried out, indicating that the series are non-stationary and contain unit roots; for this reason, we havetaken the first difference of the price series before estimating ARMA and ADCC-GARCH models.[4]

The Johansen (1988, 1991) and Stock-Waston (1988) cointegration tests were conducted to assess the existence of an equilibrium relationship between the pairs of prices studied. Test results suggest that there is a long-run relationship be-

[4] Details from summary statistics and unit root testing are available from the authors upon request.

Table 1 - Johansen λ_{trace} test and Stock-Watson for co-integration and co-integration relationship.

Johansen co-integration tests for (EGYPT - CBOT)					
Cointegration Vector					
H_0	H_a	Eigenvalues	λ_{max}	$P-Value$	Trace 95%
$r = 0$	$r > 0$	0.056	13.794	0.024	15.410
$r \leq 1$	$r > 1$	0.013	3.264***	0.312**	3.840
Cointegration equation					
Egypt − 0. 439** CBOT − 4. 043** = ECT (-3.167) (-7.441)					
Stock-Watson co-integration tests for (EGYPT - CBOT)					
H_0: $q(k, k-r)$	Statistic	Critical values			
		1%	2%	3%	
$q(2, 0)$	-10.752***	-3.960	-3.410	-3.120	
$q(2, 1)$	-10.774***	-3.960	-3.410	-3.120	
Johansen co-integration tests for (EGYPT - MATIF)					
Cointegration Vector					
H_0	H_a	Eigenvalues	λ_{max}	$P-Value$	Trace 95%
$r = 0$	$r > 0$	0.082	20.321	0.005	15.410
$r \leq 1$	$r > 1$	0.014	3.328**	0.145**	3.840
Cointegration equation					
Egypt − 0. 634** CBOT − 2.628** = ECT (-4.364) (-3.661)					
Stock-Watson co-integration tests for (EGYPT - MATIF)					
H_0: $q(k, k-r)$		Statistic	Critical values		
			1%	2%	3%
$q(2, 0)$		-10.705***	-3.960	-3.410	-3.120
$q(2, 1)$		-10.728***	-3.960	-3.410	-3.120

*Note: r is the cointegration rank. ** denotes statistical significance at the 5% level.*

tween spot prices and futures markets (Table 1). Linear VEC and MS-VEC models with two lags are fit to spot and futures prices. Using the Bayesian Monte Carlo Markov Chain (MCMC) method, the MS-VEC model has been applied with Gibbs sampling by employing 50,000 posterior draws and 20,000 burn-in (following Balcilar *et al.*, 2015). The number of lags (one lag) is chosen through the Akaike information criterion (AIC) and the Bayesian information criterion of Schwarz's (BIC).

The first stage of estimating DCC-GARCH consists of estimating marginal models (ARMA) that filter information contained in univariate distributions and enable deriving standardized, independent and identically distributed (*i.i.d.*) residuals from the filtration. From estimating the mean model across the future (CBOT and MATIF) and spot prices, we can observe that Egyptian wheat spot prices are positively affected by CBOT price levels only, while the CBOT prices are influenced by MATIF price levels. The current price levels of the MATIF future market were positively influenced by price levels during the last month.

Turning to the conditional variance-covariance equation, from estimating the Wald test, we found that the adjusted parameter $\alpha + g$ is

Table 2 - Result for the MS-VCM model for price pair ($EGYPT$ - $CBOT$).

Variable	*EGYPT*	*CBOT*
C	0.002 (0.004)	0.001 (0.004)
$\Delta EGYPT_{t-1}$	0.016 (0.064)	-0.037 (0.065)
$\Delta CBOT_{t-1}$	0.071** (0.025)	0.163** (0.067)
EC_{t-1}	-0.054**(0.016)	0.009 (0.017)
Transition probability matrix:		$\begin{bmatrix} 0.874 & 0.125 \\ 0.164 & 0.835 \end{bmatrix}$
Regime properties	*Probability*	*Observations*
Regime 1	0.791	189.6
Regime 2	0.351	84.2
Ljung-Box Q(5)	18.250	13.262

*Note: ** denotes statistical significance at the 5% level.*

Table 3 - Result for the MS-VCM model for price pair (*EGYPT- MATIF*).

Variable	*EGYPT*	*MATIF*
C	-0.251**(0.048)	0.8297 (0.782)
$\Delta EGYPT_{t-1}$	0.030 (0.064)	-0.020 (0.0512)
$\Delta CBOT_{t-1}$	-0.006 (0.080)	0.367** (0.064)
EC_{t-1}	-0.060**(0.016)	0.028** (0.013)
Transition probability matrix:		$\begin{bmatrix} 0.786 & 0.145 \\ 0.179 & 0.899 \end{bmatrix}$
Regime properties	*Probability*	*Observations*
Regime 1	0.812	194.88
Regime 2	0.258	61.92
Ljung-Box Q(5)	20.220	10.142

*Note: ** denotes statistical significance at the 5% level.*

equal to zero at the 1% level significance, implying that a dynamic conditional correlation between the future-spot prices in the DCC model is a plausible assumption. The Ljung-Box test results presented in Table 4 allow for the null of no autocorrelated residuals to be accepted. The Lagrange-Multiplier (LM) tests (Table 4) implemented to test for ARCH residuals provide evidence that the DCC model is well specified. The results of the Hosking multivariate portmanteau tests for cross-correlation (multivariate residual autocorrelations) also indicate that there is no cross-correlation in squared residuals. The asymmetric dependence has not been found meaning that extreme increases or decreases in futures prices are likely to be passed to wheat spot prices in Egypt.

The long-run average probabilities of low and high-volatility regimes results are also presented in Tables 2 and 3, indicating that the high volatility regimes occurred on 84.2 occasions, while the low volatility regimes occurred on 198.6 occasions for CBOT-spot price pairs. For the MATIF-Spot price pairs, high volatility regimes

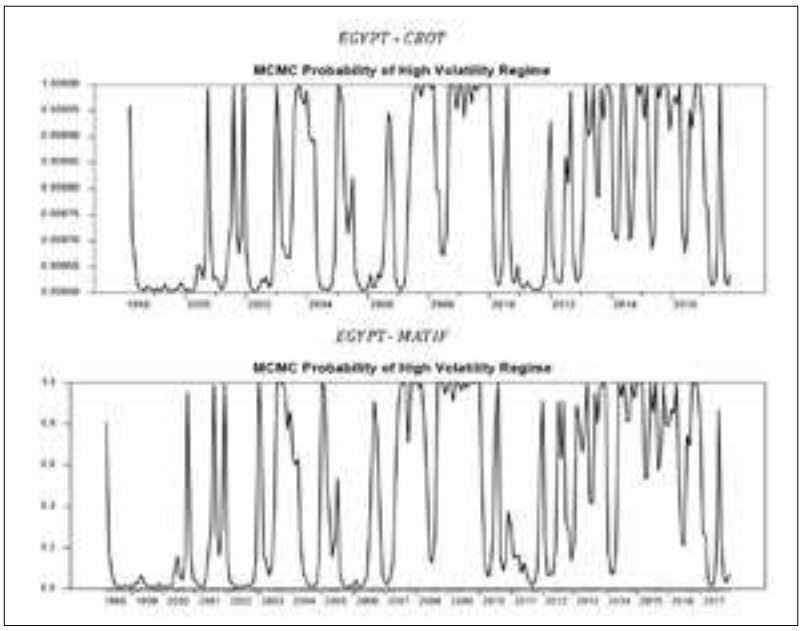

Figure 1 - Monte Carlo Markov Chain smoothed probability estimates of high volatility.

Figure 2 - Impulse responses of CBOT and MATIF future prices to wheat spot prices in Egypt in MS-VEC models.

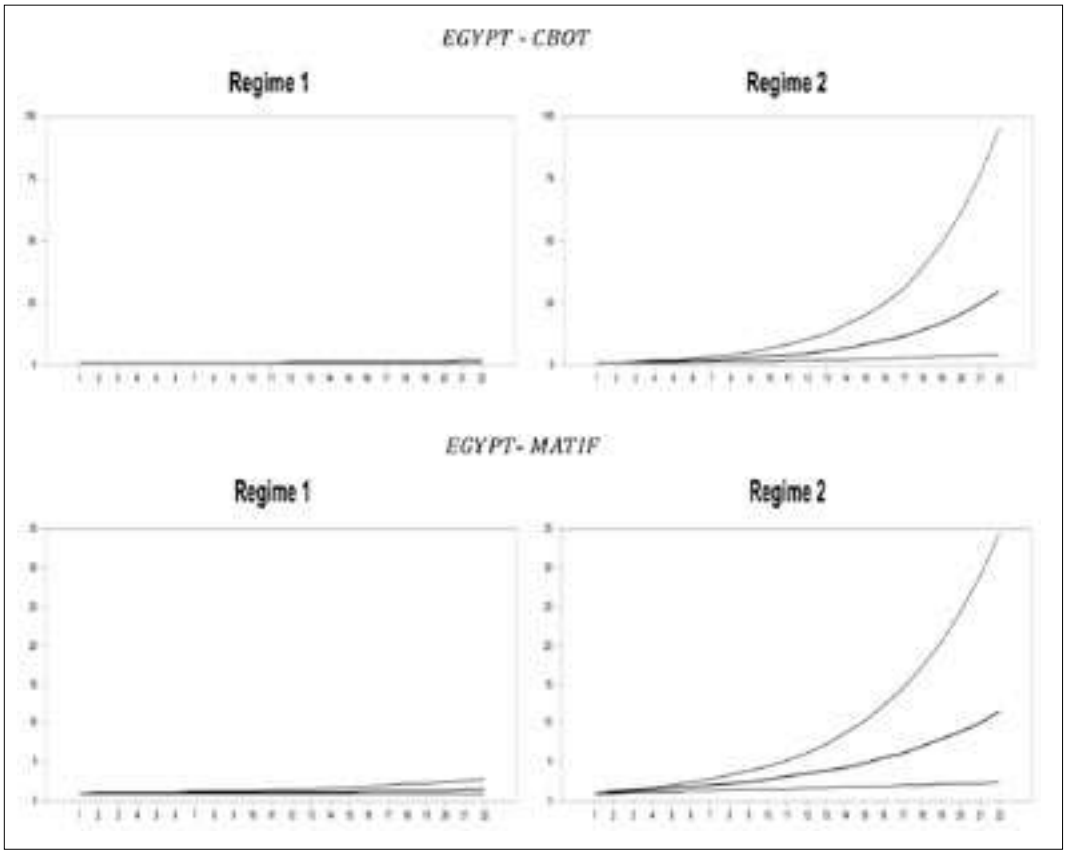

Table 4 - Asymmetric DCC-GARCH model for CBOT future price, MATIF future price, Egyptian wheat spot prices.

Coefficient	*EGYPT* (i = 1)	*CBOT* (i = 2)	*MATIF* (i = 3)	
Conditional mean equation				
Y_0	0.002 (0.004)	-0.001 (0.003)	0.001 (0.002)	
Y_{11i}	-0.019 (0.099)	-0.053 (0.059)	-0.001 (0.044)	
Y_{12i}	0.177** (0.079)	-0.0153 (0.082)	-0.038 (0.059)	
Y_{13i}	-0.110 (0.096)	-0.016** (0.040)	0.362** (0.075)	
Conditional variance equation				
C_i	0.040** (0.001)	0.004 (0.003)	0.009** (0.005)	
α	0.144 (0.116)	-0.040** (0.019)	0.089** (0.028)	
β_i	-0.035** (0.006)	0.186** (0.039)	0.925** (0.028)	
D_i	0.156 (0.204)	0.011 (0.056)	0.110 (0.340)	
$DCC\,(A)$			0.023** (0.010)	
$DCC\,(B)$			0.954** (0.219)	
Wald joint test for all cross-volatility coefficients				
Chi-sq			98.851	
p-Value			0,005	
Ljung-Box test for autocorrelation (H0: no autocorrelation in squared residuals)				
LB (10)	4.857	11.869	10,949	10.637
p-value	0.900	0.293	0,361	0.386
Lagrange multiplier (LM) test for ARCH residuals (H0: no ARCH effects)				
LM (5)	1,750	1,480	1.060	2.410
p-value	0,882	0,914	0,963	0,790

*Note: *(**) denotes statistical significance at the 10% (5%) level.*

occurred on 61.92 occasions, while low volatility regimes occurred on 194.88 occasions.

The smoothed probabilities of the MS-VEC model displayed in Figure 1 shows a high volatility regime between both the spot-CBOT and spot-MATIF price pairs, indicating that high volatility fluctuations were observed in and after the 2007-08 food crisis and supply chock in 2010. These fluctuations increase much more after the 2011 and 2013 revolutions, especially between the spot-CBOT prices, which show higher volatility during this period. This implies that the Egyptian Spot prices are strongly affected by high volatility, especially that which occurs during extreme market events, such as food crises and revolutions.

The impulse response functions were conducted for the futures prices (1 standard deviation) on the spot prices by using the Cholesky factor orthogonalization. The regime dependent impulse response method was used to compute the MS-VEC impulse response that comes from 50,000 posterior draws (Ehrmann *et al.*, 2003;

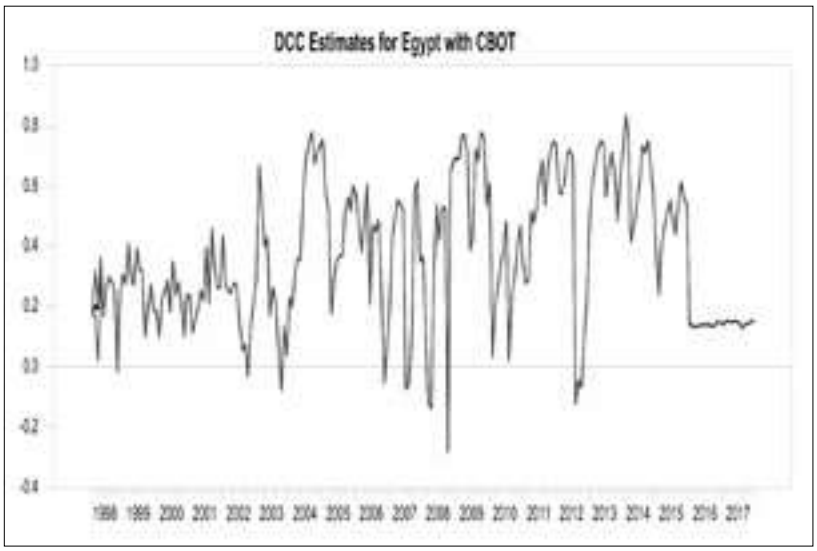

Figure 3 - The dynamic conditional correlation between EGYPT, CBOT.

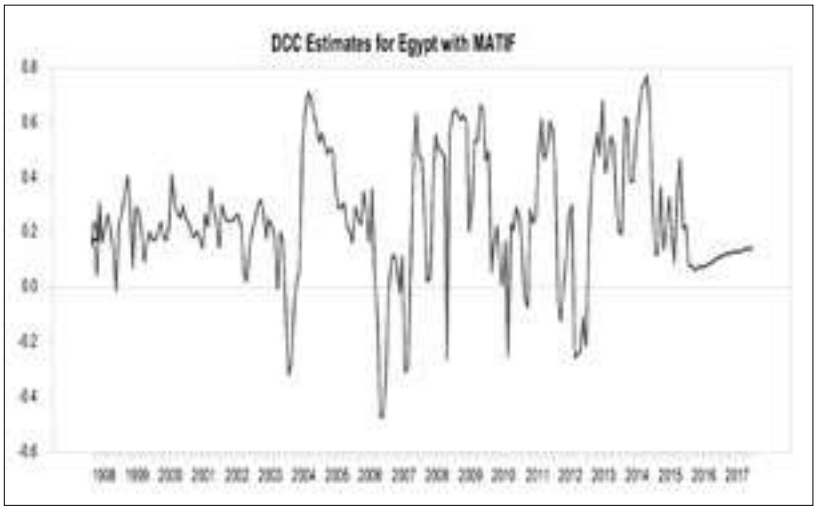

Figure 4 - The dynamic conditional correlation between EGYPT, MATIF.

Balcilar *et al.*, 2015). Figure 2 shows that shock by 1% in the futures markets (CBOT and MATIF) will lead to a significant positive shock in the Egyptian wheat spot prices.

The asymmetric DCC-GARCH model has been estimated to show how the levels of volatility interdependence changes among the pairs of prices considered over time. Given that ignoring the asymmetric price volatility transmission could lead to a biased estimator, we thus applied the asymmetric model to study the positive and negative price shocks together (Table 4).

Estimation results from DCC-GARCH are presented in Table 4 and graphed in Figures 3 and 4 for the CBOT- spot and MATIF-spot price pairs, respectively. The outcomes indicate that dynamic conditional correlation from January 1998 to December 2004 was relatively low and fluctuated in the range from 0 to 0.4. In the period after 2005, the DCC estimates indicate an important increase in the level of the volatility. The dependence increased dramatically from a small or negative that reached values around 0.8 beginning in 2005. Figures 3 and 4 also show a high dependency with very high fluctuations between futures and spot markets, especially one year after the period of the extreme market events, mainly in the range of -2 to 0.8. Such increase in volatility is

likely related to the food crisis, supply shock, and economic downturn resulting the Arab Spring revolutions. Results from nonlinear MS-VEC and DCC-GARCH implying that the futures markets are failed to protect the wheat spot prices in Egypt against price volatility, especially in the time of extreme market events, and ultimately lead to less hedging effectiveness since futures prices drive resource allocation and production decisions.

Our results may be cautiously extended to North African and the Middle East countries, with the most important message being that food marketing chains in developing countries can be far from efficient because of the volatility of futures markets and less hedging effectiveness of spot prices that may lead to concerns hedger, investors, farmers, and policymakers, and resulting in market risks. This result has implications for the effectiveness of food security policies and interventions from governments and policymakers.

5. Concluding remarks and policy recommendations

Egypt suffers from food insecurity, poverty and nutritional deficiencies. While food price volatility in developing economies has been widely assessed by previous research, less attention has been paid to less developed countries, mainly due to a lack of price data. Since the food price crisis of 2007-08, economic research has paid substantial attention to food price behavior, given the significant political, economic and social impacts it has. Our work focuses on examining the relationship between wheat spot prices in the Egyptian market and wheat futures prices associated with CBOT in the USA and MATIF in France. We assess how the price discovery information occurring in the futures markets affects the volatility of spot prices. The study is based on monthly data of CBOT, MATIF and spot prices in the Egyptian wheat market from January 1998 and December 2017. The analysis covers an interesting period that includes the first and second food crisis, two revolutions in Egypt and an economic reform. Thus, this analysis shows how an economic and political crisis can affect the consumer prices and the economic welfare in developing countries.

This paper contributes to the literature by studying price volatility behavior of food staples in less developed countries, thus enlarging an area that is rather scarce due to data limitations because of lack of information flows from futures markets to spot prices. In addition, it does so by using MS-VEC and asymmetric DCC-GARCH models. An attractive feature of the MS-VEC model is that it can estimate the low and high volatility regimes by dividing the sample based on the variance and covariance matrix. A main feature of the DCC-GARCH model, on the other hand, is that it can assess the dynamics of the volatility across the prices considered.

Results from estimating both models indicate that a high volatility regime was observed more frequently during extreme market events, especially during the 2007-08 and 2010 food crises, the two revolutions in 2011 and 2013, and when the government decided to carry out economic reform with devalue the Egyptian pound and extremely reduce the subsidy to the farmers and consumer. A low volatility regime existed before the time of the economic and political crisis. Results also show that symmetries affect short-run price dependencies, with the characteristics of these symmetries depending on the markets studied. This implies that both increasing and decreasing shocks in futures markets affect spot prices in Egypt.

The impulse response functions have been conducted in a nonlinear MS-VEC model, indicating that a shock to the futures markets by 1% will be transmitted to a positive shock in the Egyptian wheat spot market for a high volatility regime, while for the low volatility regime no significant effect of the futures market on the spot prices was implied. Our finding is consistent with the results obtained by Peri *et al.* (2013); Fattouh *et al*. (2013); Adjemian *et al.* (2013); Chen *et al.* (2014), that there are less hedging effectiveness and market risks, and thus futures markets fail to protect the spot prices against fluctuation.

Policies to increase food security are required, such as reducing the dependence on importing food and increase productivity. To increase the wheat productivity could be by the provision of inputs at subsidized prices or the promotion of adopting simple technologies and tools to produce wheat. This could result in lower produc-

tion costs and thereby consumption prices. Using new heat and disease tolerant varieties may increase productivity; these varieties have already been developed by research institutes in Egypt, but they need to be introduced to farmers. Adopting good agricultural practices may also increase farmers' productivity. Increasing the production efficiency of wheat by training farmers on modern agricultural cultivation practices may increase their wheat yields and reduce their dependence on the international market. The government and policymakers should intervene to improve wheat production in Egypt by addressing the existing market and production inefficiencies across the following: wheat storage improvement to reduce the after-harvest losses, and wheat by-product exploitation to use it as inputs (e.g. fertilizer or animal feed to reduce the farmer income, while improving the soil quality and thus increase the wheat productivity). Developing a market information system using an online market to increase the competitiveness among all actors along the supply chain that can also increase farmers' incomes that make them can maintain grow wheat in the coming seasons. In short, food policies should adopt a comprehensive approach along the supply chain to ensure a commensurate impact on the poor consumer in developing countries.

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Youth's potential of adopting the Mediterranean diet lifestyle in response to climate change: Empirical study in Crete, Greece

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Abstract

The Mediterranean diet is considered one of the healthier and most balanced dietary models currently in existence. Different studies suggest that it is environmentally friendly: it combines low greenhouse gas emissions, low demand of soil water and less deforestation. Climate change can be mitigated through what consumers decide to eat. This article addresses the issue of by studying the intention of young consumers to shift their diets towards the Mediterranean Diet to prevent climate change through face interviews, collected in Crete, Greece (N=287). Using the Theory of Planned Behavior, the objective is to identify whether attitudes, subjective norms and perceived behavioral control guide such a behavior. Our findings highlight that young consumers' perceived behavioral control have the highest influence on the intention, followed by their attitudes. As for the subjective norms, it has no significant impact on the intention.

Keywords*: Young consumers, Mediterranean Diet, Climate change, Theory of Planned Behavior, Greece.*

1. Introduction

Food production is an important conductor of environmental pressures, in particular climate change, through greenhouse gas emissions, land use and water use. On the opposite side, climate change has major impacts on food security worldwide: the stability of the food systems can be at risk under climate change because of variability in supply. Hence, climate change and the food sector hold a reciprocal harmful relationship that needs to change in order to ensure fewer negative impacts on both environment and food security. Climate change can be mitigated not only by changing the production and distribution process, but also through what consumers decide to eat. From an environmental perspective, what a person chooses to eat makes a big difference (Marlow *et al.*, 2009). Therefore, a global dietary transformation is urgently needed, this transformation can take the shape of a new dietary pattern. The

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Table 1 - Consumer behavior in an environmental context using pro-environmental behavior, self-determination theory and consumers' attitudes.

Article	*Theory used*	*Main objective*	*Behavioral model*	*Findings*
Exploring the Adherence to the Mediterranean Diet and Its Relationship with Individual Lifestyle: The Role of Healthy Behaviors, Pro-Environmental Behaviors, Income, and Education (Cavaliere *et al.*, 2018)	Pro-environmental behavior	To examine whether there is a relationship between individuals' healthy and pro-environmental behaviors and their level of adherence to the MD and to explore the role of consumer income and education.	Structural Equation Modelling (SEM)	The Mediterranean Diet is part of a sustainability-oriented lifestyle and stress the key role of both income and education in affecting adherence to MD. Future policy aimed at contrasting the gradual disappearance of the MD should emphasize the sustainable dimension of the MD, meanwhile reducing socio-economic disparities among different population segments.
Fostering more sustainable food choices: Can Self-Determination Theory help? (Schösler *et al.*, 2014)	Protection-Motivation theory	To examine whether Self-Determination Theory can be of help in fostering more sustainable food choices by taking a closer look at the relationship between food-related types of motivation and different aspects of meat consumption.	Multi-dimensional scaling (PROXSAL), Principal component Analysis	Self-Determination Theory appeared to be useful for studying why consumers can be motivated to make more sustainable food choices and also why these preferences are not shared by all consumers.
Flemish consumer attitudes towards more sustainable food choices (Vanhonacker *et al.*, 2013)	Consumers' attitudes	Explore the attitudes of Flemish consumers towards more sustainable food choices	Exploratory factor analysis, Bivariate analyses, Cross-tabulations, K-means cluster	Many consumers underestimate the ecological impact of animal production. Well-known alternatives such as organic meat, moderation of meat consumption and sustainable fish are accepted, although willingness to pay is clearly lower than willingness to consume. Opportunities of introducing insects currently appear to be non-existent.

world needs to change current dietary patterns towards one that is more environmentally-friendly. It has been proven that plant-based diets present a great alternative to ensure both a healthy and an eco-friendly lifestyle. The Mediterranean Diet, one of the most famous plant-based diets, can be a great preventative measure against climate change (Meybech *et al.*, 2013). However, the adherence to this diet is considered quite low these last years, especially for young adults (Kyriacou *et al.*, 2015). Globalization has caused the socio-cultural-food habits to become uniform, abandoning the traditional food of the Mediterranean. Thus, it is important to study whether the young generation is ready to shift to the Mediterranean Diet to prevent climate change, and the factors that influence their intention for such a behavior. Understanding sustainable consumer behavior is crucial to any paradigm shifts in how society approaches environmental problems, especially among young consumers, as it is deemed crucial to intervene in the formation and routinization of mainstream unsustainable consumption practices and patterns.

Various theories are applied in order to understand sustainable behavior in an environmental context, as well as the factors behind it as can be seen Table 1 below.

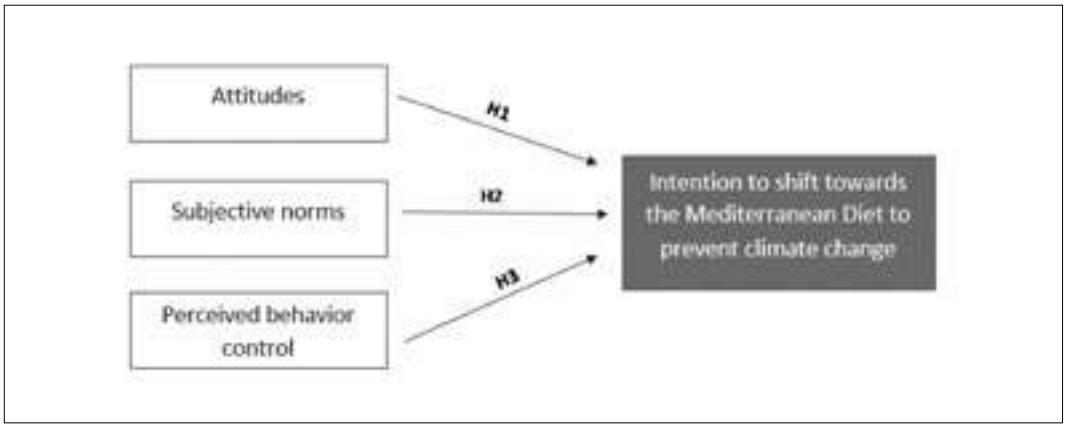
However, the most frequently employed theory is the Theory of Planned Behavior (TPB) as can be seen in Table 2 below. It has been designed to predict and explain human behavior in specific contexts, the central factor of TPB is the individual's intention to perform a given behavior. Intentions are assumed to capture the motivational factors that influence a behavior; they indicate how hard people are willing to try, and how much of an effort they are planning

Table 2 - Consumer behavior in an environmental context using the TPB.

Article	*Main objective*	*Behavioral model*	*Findings*
Factors affecting consumer attitudes towards food products with sustainable attributes (Annunziata and Scarpato, 2014)	Investigate the factors affecting consumers' attitudes towards food products with sustainable attributes.	Principal factor analysis	Only attitude and social norms influenced consumers' intention. However, despite the positive attitude, shown by the consumers to products characterized by sustainability at-tributes, there are still several factors that limit the transformation of this attitude in the real acts of purchase
Predicting green product consumption using theory of planned behavior and reasoned action (Paul *et al.*, 2016)	Validate TPB to predict consumers' green product purchase intention.	SEM	Consumer attitude and PBC significantly predicts purchase intention whereas subjective norm does not.
Climate change issue and theory of planned behavior: relationship by empirical evidence (Masud *et al.*, 2016)	Find out if attitudes toward climate change, subjective norms, and PBC have significant associations with behavioral intention to adapt to climate change and adopt pro-environmental behavior.	SEM	Attitudes, subjective norm and PBC have positive influence on behavioral intention to adapt/mitigate climate change. The result also found mediating effects of behavioral intention between attitudes, subjective norms and PBC and pro-environmental behavior.
Is sustainability knowledge half the battle? An examination of sustainability knowledge, attitudes, norms, and efficacy to understand sustainable behaviours (Heeren *et al.*, 2016)	Examine the relationship of sustainability knowledge to pro-environmental behavior.	Bi-variate correlation	Results indicate that knowledge had a significant correlation with behavior ($r = 0.113$, $p < 0.001$). However, when controlling for TPB variables (attitudes, norms and PBC), knowledge was not a significant predictor of behavior.
Investigation and recommendations on the promotion of sustainable consumption behavior among young consumers in Thailand (Vantamay, 2018)	Investigate sustainable consumption behavior (SCB) and its determinants among undergraduate youths in Thailand.	Descriptive statistics and multiple regression analysis	The three independent variables derived from TPB (Attitude toward the behavior, Subjective norm, and PBC) can co-predict the intention to perform SCB at 31.1 percent and sustainable consumption behavior at 22.3 percent. For intention, PBC had the most influence ($\beta = .382$), followed by Attitude toward the behavior ($\beta = .302$), and Subjective norm ($\beta = .228$), respectively.

to exert, in order to perform the behavior. As a general rule, the stronger the intention to engage in a behavior, the more likely should be its performance (Ajzen, 1991). TPB presents three independent determinants of intention. First is the attitude towards the behavior, which refers to the level to which a person evaluates the behavior in question (favorable/unfavorable). The second factor is a social one, called subject norms; it refers to the perceived social pressure to perform or not to perform the behavior. The third is the degree of Perceived Behavioral Control (PBC) which refers to the perceived ease or difficulty of performing the behavior in question and it is assumed to reflect past experience as well as anticipated impediments and obstacles. As a general rule, the more praising the attitude and subjective norm with respect to a behavior, and the greater the PBC, the stronger an individual's intention to perform the behavior under consideration. The theory of planned behavior distinguishes between behavioral intention and actual behavior. This is important in an environmental context, because intentions do end up with the desired effect on the environment such as carbon dioxide.

Figure 1 - Conceptual framework.



TPB has been shown to be effective when studying intention among young consumers (Annunziata and Scarpato 2014; Paul *et al.*, 2016; Masud *et al.*, 2016; Heeren *et al.*, 2016; Vantamay, 2018). Hence, it will be used for this article to understand young consumers' intention to shift towards the Mediterranean Diet to prevent climate change.

In this article, we have decided to test each of the constructs of the TPB independently to see which one influences young consumers' intention and which one does not.

- Based on the findings of Masud *et al.*, 2016 and Annunziata and Scarpato, 2014, we have established our first hypothesis which states that 'Consumers' attitudes have a significant impact on young consumers' intention to shift towards the Mediterranean Diet to prevent climate change' (H1).
- Based on the findings of Masud *et al.*, 2016 and Annunziata and Scarpato, 2014, we have established our second hypothesis which states that 'Subjective norms have a significant impact on young consumers' intention to shift towards the Mediterranean Diet to prevent climate change' (H2).
- Based on the findings of Vantamay, 2018, we have established our third hypothesis which states that 'PBC has the most important significant impact on young consumers' intention to shift towards the Mediterranean Diet to prevent climate change' (H3).

2. Methods

2.1. *Site selection*

In the "Seven Country Study" that was conducted by Ancel Keys (Keys, 1995), the Greek island Crete's diet is defined as the healthiest Mediterranean Diet, hence, we have chosen to conduct our research in this specific area that is globally known as a reference for the Mediterranean Diet.

2.2. *Target population*

Since the adherence to the Mediterranean Diet by young consumers in Greece has been declining these last years (Kyriacou *et al.*, 2015), we have chosen to focus on this specific group, especially consumers between the ages of 18 and 30 to study the factors that influence their behavior.

Based on the consumers' survey conducted by a national cooperative supermarket chain (SYNKA, 2020), young people in the area of Crete and more particularly in the area of Chania reveal preferences for:

- Fresh local vegetables, tomatoes and cucumbers;
- Dairy products with authentic taste and odor;
- Olive oil, especially organic extra virgin produced locally;
- Wine, all national wine types and brands;
- Energy drinks, with an abundance in consumption.

Table 3 - Reliability check.

Variable	*Item*	*Corrected Item-to-total correlation*	*Cronbach's α*
Attitudes	Att1	0.491	0.711
	Att2	*0.141**	
	Att3	0.378	
Subjective norms	SN1	0.593	0.788
	SN2	0.676	
	SN3	0.621	
PBC	PBC1	*0.283**	0.724
	PBC2	0.447	
	PBC3	0.493	
	PBC4	0.338	
Intention	Int1	*0.107**	0.791
	Int2	0.522	
	Int3	*-0.161**	
	Int4	0.437	
	Int5	0.620	
	Int6	0.577	
	Int7	0.445	

2.3. *Sampling size*

Sample size calculation was carried out based on the assumptions given in the psychometric literature, and the necessary sample size of 190 subjects according to Farmakis (Farmakis, 2009); however, we were able to collect 287 responses, 236 responses among our age range.

2.4. *Questionnaire designing and reliability checking*

A self-constructed questionnaire was used for the survey. Each construct of the TPB had multiple items according to the suggestion by Azjen (1985). A five-point Likert-type scale (1 strongly disagree; 5 strongly agree; 3 neither agree nor disagree) was used to measure the young consumers' responses to the TPB constructs, with higher scores indicating greater intention to shift towards the Mediterranean Diet for climate issues, stronger attitudes to the Mediterranean Diet, greater perceptions of social pressures, and higher perceived control over the behavior. The questionnaire starts with a definition of the Mediterranean Diet, to inform the respondents about its main components. Among the constructs, Intention consisted of items that aimed to measure the students' planned behaviors regarding the shift towards the Mediterranean Diet to prevent climate change, as well as lowering their meat consumption (e.g., I expect to follow the Mediterranean Diet in the future because of its positive environmental contribution); Attitudes included items that aimed to explore the consumers' evaluations of the shift towards the Mediterranean Diet to prevent climate change (e.g., Shifting towards the Mediterranean Diet to prevent climate change is a good idea); SN comprised of items that measured the students' perceptions of the societal responses to their decision of shifting towards the Mediterranean Diet (e.g., approval from the most important persons in their lives); and PBC contained items that expected to reveal the consumers' perceptions of the ease or difficulty related to shifting towards the Mediterranean Diet (e.g., availability and affordability of the Mediterranean Diet). Before conducting the main survey, a qualitative test was carried out asking 10 individuals from the population about the understandability and the question wording to improve the questionnaire. However, it should be noted that the measuring items on the Likert-type scale used in the study were all self-constructed since there were no comparable studies that used the TPB model to explain consumers' related behavioral intentions.

Table 4 - Means, standard deviations, kurtosis and skewness of the factors.

Variables		*Means*	*Standard deviation*	*Kurtosis*	*Skewness*
Attitudes	Att1	3.56	1.160	-.294	-.618
	Att3	3.81	1.132	.184	-.888
Subjective norms	SN1	3.79	1.364	-.456	-.887
	SN2	3.70	1.246	-.299	-.805
	SN3	3.61	1.200	-.377	-.610
PBC	PBC2	3.44	1.303	-.859	-.423
	PBC3	3.32	1.216	-.850	-.237
	PBC4	3.51	1.143	-.851	-.239
Intention	Int2	3.20	1.199	-.793	-.295
	Int4	3.72	1.174	-.481	-.633
	Int5	3.18	1.287	-1.074	-.075
	Int6	3.37	1.397	-1.127	-.410
	Int7	3.79	1.279	-.541	-.735
Variables		*Means*	*Standard deviation*	*Kurtosis*	*Skewness*
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	Int5	3.18	1.287	-1.074	-.075
	Int6	3.37	1.397	-1.127	-.410
	Int7	3.79	1.279	-.541	-.735

We established scale reliability through computation of Cronbach's α using SPSS 23.0. As depicted in the following table, item-to-total statistics revealed that four items (Att2, PBC1, Int1 and Int3) did not meet the threshold value of 0.3 (Nurošis, 1993); thus, they were deleted for further analysis. Excluding these two variables, Cronbach's α of all constructs were found greater than the threshold of 0.7 (Nunnally, 1994) for basic research (Nunnally, 1967).

2.5. *Data analysis: Confirmatory factor analysis model*

The hypotheses were tested with confirmatory factor analysis (CFA) using AMOS version 26.0 (Arbuckle, 2017). Confirmatory factor analysis is useful for simultaneous testing of multiple sets of associations between variables. The hypothetical structural model was tested with CFA using the Maximum Likelihood Method because all variables were normally distributed (skew-

ness and kurtosis were between −2 and +2, see George and Mallery, 2010). There were no missing data. The Table 4 below justifies the normal distribution of our data through highlighting the means, standard deviation, kurtosis and skewness of our variables.

With a chi-square higher than the degrees of freedom, the model is over-identified. Therefore, a confirmatory factor analysis (CFA) can be done. Based on the CFA tests, all three dimensions had adequate model-to-data fit: a normal chi square of 120.797, RMSEA of 0.069 and GFI of 0.925. Therefore, the model is an absolute fit model. As for incremental fit parameters, the model also presents NFI of 0.905, CFI of 0.947 and TLI of 0.927. The model also fits the parsimonious fit with PCMIN/Df less than 5. All the parameters respect the suggested cut-off values. Hence, the CFA proves that this model is accepted.

Table 5 - Socioeconomic characteristics of respondents (N=246).

Variable	*Categories*	*Frequency*
Gender	Male	106
	Female	128
Age	Between 18 and 24	117
	Between 24 and 30	117
Work	Full-time work	19
	Part-time work	82
	Unemployed	27
	Student	106
Education level	High School	45
	Diploma	40
	Bachelor	115
	Master/Doctorate	34
Nationality	Greek	234
Tourists	Local	227
	Domestic tourist	7
	International tourist	0

3. Results and discussions

3.1. *Socioeconomic characteristics of respondents*

Table 3 summarizes the main socioeconomic characteristics of the respondents: 45% of our respondents are male, 55% are female. 50% are aged between 18 and 24, and 50% are aged between 24 and 30. 46% are students, 35% have a part time job, 11% are unemployed and 8% are working full time. 49% have a university degree, 19% have a high school degree, 17% have a diploma and 15% have a master/doctorate degree. They are 100% local Greeks.

3.2. *Hypothesis testing and discussions*

Figure 2 above presents the shape of the diagram after the modifications (two new paths).

Figure 2 - Confirmatory factor analysis model of the impact of consumers' attitudes, subjective norms, PBC on the intention to shift to Mediterranean diet to prevent climate change.

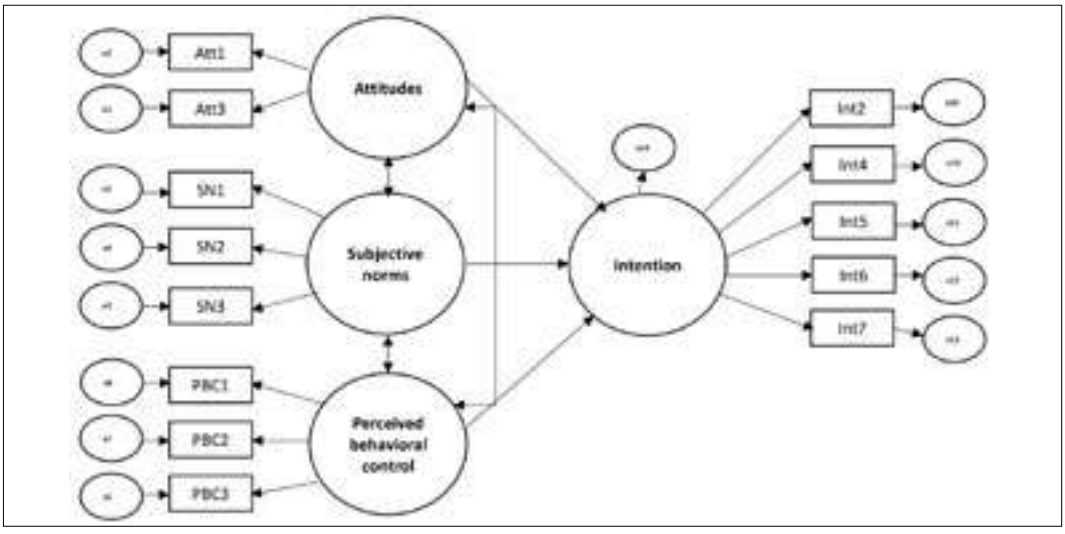

Table 6 - Regression weights of attitudes, PBC and subjective norms on intentions.

Parameter	*Estimate*	*Standard error*	*C.R*	*P-value*
Attitudes	0.413	0.123	3.369	0.000
PBC	0.526	0.204	2.584	0.010
Subjective norms	-0.102	0.063	-1.636	0.102

The figure was elaborated based on AMOS.26 Model for our study. Please note that ovals represent the latent variables, whilst measured variables are indicated in rectangles. The path coefficients of each arrow can be interpreted as common regression weights.

As for the regression weights, for the three main parameters (attitudes, subjective norms and perceived behavioral control) on the intention, the results are as follows.

Based on the CFA[1] results, H1 that states that consumers' attitudes have a significant impact on their intention to shift towards the Mediterranean Diet to prevent climate change is confirmed based on the path coefficients. The latent construct of attitudes is positively related to intention (0.413, CR[2]=3.369, P-value=significant). This result suggests that young Greek consumers who have a strong attitude towards shifting to the Mediterranean Diet for climate issues are more likely to have a greater intention compared to consumers with a weak attitude, which implies that the young Greek consumers who evaluate the shift towards the Mediterranean Diet to prevent climate change as a positive action will likely have a greater intention than those who evaluate it as a negative action. Many factors can influence attitude, such as personal values in food shopping, perceived barriers, and confidence in information (Annunziata and Scarpato, 2014). Our results are in accordance with previous findings that highlight the influence of attitudes on sustainable food behaviors (Chen, 2011; Masud *et al.*, 2016). However, despite the positive attitudes shown by the consumers to products characterized by sustainability attributes, there are still several factors that limit the transformation of attitudes in the real acts of purchase.

We reject H2 which states that subjective norms have significant impact on young Greek consumers' intention to shift towards the Mediterranean Diet to prevent climate change. The latent construct of subjective norms is negatively related to intention (-0.1). Therefore, subjective norm is a non-significant predictor of shifting intention to prevent climate change. Subjective norms had already been identified as the weakest link in intention models by earlier researches, who have used TPB frameworks in general (Ajzen, 1991). Young Greek consumers feel that the support and approval of "referents" is not an important factor that would impact their behavior of shifting their diets towards the Mediterranean Diet to prevent climate change. Their friends/family members/peer group opinions and support are not influential. Our results align with Paul *et al.*, 2016, and misalign with Masud *et al.*, 2016 and Eker *et al.*, 2019 who suggest that value-driven actions motivated by group dynamics rather than health and climate risk perceptions are more efficient.

The results show that H3 which states that "PBC has the most important significant impact on young consumers' intention to shift towards the Mediterranean Diet to prevent climate change" is supported. PBC positively affects the intention level, which means that the intention is highly influenced by consumers' beliefs about the presence of factors that may facilitate or impede the behavior of shifting their diet. The coefficient magnitude shows that the effect of PBC on the intention to shift towards the Mediterranean Diet is stronger than that exerted by attitude (0.526, CR = 2.584, p-value=significant). Our result aligns with Paul *et al.*, 2016 and Masud *et al.*, 2016.

Based on these findings, it can be concluded that PBC and attitudes have a great impact on young Greek consumers' behavioral intention, which

[1] Confirmatory Factor Analysis.

[2] CR: Critical ratio, which divides the regression weight estimate by the estimate that its standard error gives.

might lead to shifting their diet towards the Mediterranean Diet for climate issues. However, there is an urgent need for a better awareness of the role of social adaptation, such as involvement with organizations and associations, as well as information dissemination. This could allow consumers to gain more insights and ensure improvements in order to have a socially acceptable and effective adaptation behavior for climate change (Weingart *et al.*, 2000). Mass media can contribute significantly towards greater public understanding and awareness of climate change issues using "opinion leaders" like celebrities, sports stars etc. in a sequential manner to stimulate intentions for diet shifts. It would be desirable to revise the short-term effects of media campaigns. Climate change is considered a complex issue. Hence, public authorities, policy makers and communicators need to increase public awareness of the environmental footprints of food, encourage appropriate behaviors towards adaptation to climate change, and respond to the information needs of the environmentally conscious consumers.

4. Conclusions

This research aimed to identify the factors that influence young consumers' intention to shift towards the Mediterranean Diet to prevent climate change. Using the Theory of Planned Behavior, a quantitative and qualitative analysis has been conducted on the basis a survey conducted in Chania, Greece. It can be concluded that consumers' Perceived Behavioral Control (PBC) and attitudes are important factors that impact young consumers' intention to shift their dietary plan towards a Mediterranean-style one for climate change reasons. The results indicate that by portraying shifting diets as a positive action, young consumers will likely have a greater intention to perform it, than those who evaluate it as a negative action. Furthermore, beliefs about the presence of factors that may facilitate the behavior of shifting their diets will increase young consumers' intention to perform such a behavior. However, social norms, which implies the approval and support of 'important people' is not very influential in this case.

These findings are important to consider when designing and targeting campaigns that promote the Mediterranean Diet as a sustainable diet, which contributes to preventing climate change. Public authorities, policy makers and communicators should increase consumers' awareness about the presence of such diets, which can benefit their overall health, as well as the environment. Results from our case study provide useful suggestions for policy actions to promote traditional Mediterranean dietary habits, especially among young consumers as it is deemed crucial to intervene in the formation and routinization of mainstream unsustainable consumption practices and patterns. Hence, the Mediterranean Diet can be adopted by school canteens to encourage kids and young population to familiarize themselves with the components of the Mediterranean Diet, and help them create a healthy lifestyle (Cardillo, 2017). Furthermore, there is an important need for information regarding food products by environmentally conscious consumers, which can be satisfied by food labelling that highlights the main content and nutritional quality of the product. Furthermore, local production which is the essence of the Mediterranean Diet, can be more encouraged as it shortens the time between harvest and consumption which results in higher contents and quality of micronutrients, and also has very low environmental impact.

There are some limitations of this study that need to be taken into account. First, the study has been conducted in Crete, Greece, an area that is globally known for the Mediterranean Diet. The young consumers were already familiar with the concept, and most of them knew what this diet advocates. However, in other areas, it might be different, since the young consumers' awareness regarding the Mediterranean Diet will be much lower. Therefore, the generalizability of our findings might be difficult, especially in non-Mediterranean Diet areas that have been following completely different diets for a lifetime. Furthermore, the study is limited to measuring the shifting intention towards the Mediterranean Diet to prevent climate change, there is no measurement of actual shifting behavior. Although previous findings have supported that intention to act is positively correlated with actual behavior, there is a need to incorporate actual shifting behavior along with the intention in future studies.

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Understanding farmers' intentions to adopt organic farming in Albania

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Abstract

Organic agriculture in Europe is expanding, yet is still in the early stages in less developed areas of Europe. Understanding the factors of converting to organic agriculture is a key component for both policy design and attaining effective support for the organic sector from the government, donors, or the private sector. Therefore, the study attempts to explore the determinant factors of farmers' intentions to engage in organic farming based on primary data collected through a farm survey in Albania. Results show that subjective norms, perceived behavior control, favorable attitudes toward organic farming conversion, as well as awareness about risk from conventional farming are positively associated with the probability of converting to organic farming. Farmers' perceptions of EU policy opportunities and attitudes towards environment protection are negatively associated with farmers' tendency to convert. The study findings call for the use of financial and non-financial policy instruments for supporting conversion to organic farming and the need for increased information on opportunities and costs expected from the integration into the EU single market.

Keywords*: Organic farming, Conversion, Farmers' behavior, Exploratory factor analysis, Albania.*

1. Introduction

Recently, organic agriculture has been developing worldwide. This is a positive development in Europe (see Willer *et al.*, 2018) which, beyond the advantages of environmental protection and improved human health, has also been spurred by consumer awareness and concerns regarding food safety and quality (Rana and Paul, 2017) and concerns emerging from the use of conventional methods (Biao *et al.*, 2003). In developing countries, organic agriculture provides a promising approach to reducing poverty and resource degradation (Wollni and Andersson, 2014; Qiao *et al.*, 2018).

The adoption of organic agricultural techniques is seen as an important aspect of moving farmers towards a more sustainable agriculture, while creating added value in the sector (Seufert *et al.*, 2019). Therefore, understanding the factors that lead farmers to adopt organic agriculture is a key component for policy design necessary for the sector's development. Examining farmer's decisions regarding production methods helps in obtaining effective support for the organic sector by the government, donors, or the private sector. Considering these key elements of research in exploring the potential of organic agriculture, the paper's objective is to provide a scientific understanding

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Table 1 - Key data of organic sector in selected SEE countries (2017).

Indicator	*Albania*	*Serbia*	*Macedonia*	*Montenegro*	*BiH*
Organic agricultural area (ha)	549	13,423	2,900	2,797	659
Organic share of total agricultural land (%)	0.08	0.39	2.9	1.09	0.03
Organic forest/wild collection (ha)	380,612	n.a.	500,000	143,451	n.a.
Organic land in conversion (ha)	66	5,895	1,226	1,035	n.a.
Total No. of organic operators	150	434	650	308	n.a.
No. producers	131	333	650	308	n.a.
No. processors	98	123	119	3	n.a.
No. exporters	54	48	7	n.a.	n.a.
No. importers	n.a.	50	6	n.a.	n.a.

Note: An operator can belong to more than one category.
Source: Cakraj (2019)

of the factors influencing farmers' decision to adopt organic farming.

In Albania, but also in other South-Eastern Europe (SEE) countries, the organic sector is still in the early stages of development and can be considered a small niche market. In terms of cultivated area, only around 550 ha of land was certified as organic in Albania during 2017, which is significantly lower when compared to other countries in the region (Table 1). However, while the cultivated land occupies a significantly smaller area, the organic sector in Albania is dominated by forest and wild collection areas with a total of 380,612 ha (Table 1).

Official data regarding land in conversion indicate a potential growth of the sector in the near future. The total number of organic operators was 150 in 2017 where majority of them were producers (Table 1). Moreover, medicinal and aromatic organic plants (organic MAPs) make up the majority share of organic production and exports of Albania (Bernet and Kazazi, 2012). In 2017, wild MAPs accounted for 72% of the total production, while other organic products such as strawberries, herbs and fresh vegetables continue to be produced in modest quantities (Cakraj, 2019). Most of the output is export driven (mainly with European and regional destination countries), while there is very limited domestic demand for organic products despite an explicit preference of consumers for organic products (Imami *et al.*, 2017; Skreli *et al.*, 2017).

Given the need to strengthen the organic sector, the Albanian government supports farmers through subsidies under organic farming schemes and acknowledges organic farming as a diversification activity and promising sector which can withstand competitive pressure from external markets. However, the number of organic operators during the recent decade, while increasing, continues to be limited. The failure of integrating farmers into organic agriculture might be due to limitations in terms of knowledge, input and transition costs, concerns regarding plant protection, or market expectations (Curtis and Quarnstrom, 2019; Mzoughi, 2011; Nelson *et al.*, 2015).

Utilizing empirical evidence drawn from a structured survey with organic and nonorganic farmers in Albania, this paper contributes to the existing gap in the literature on the uptake of organic farming in a post-socialist country which is also under the process of integration toward European Union (EU). In order to contribute to the literature, in addition to the frequently sourced factors from the Theory of Planned Behavior (TPB) (see Yanakittkul and Aungvaravong, 2019) the authors also make use of perception-related factors (e.g., EU agriculture policy opportunities). A few studies, such as Zagata *et al.* (2020), have attempted to provide an overview of the organic agriculture trends in a post-socialist country, and found that organic agriculture is an outcome of policy measures rather than social will. Moreover, similar to

Crisostomo *et al.* (2012), organic farming policy is predominantly driven by EU policies, as it happens even in European Member countries. Albania, being a candidate country, risk to behave similarly to Member countries (Crisostomo *et al.*, 2012), where compliance with EU agriculture policies is a guiding principle for the sector, while national debate emerges generally scarce. To the best of the authors' knowledge, there is no study analyzing factors influencing organic farming adoption by Albanian farmers. Different from the findings of Zagata *et al.* (2020), the Albanian organic sector is driven primarily by foreign market demand rather than policies or social patterns. While the former is important to shift the farmers' perceptions on returns from investments, the latter is important for helping farmers to overcome certification barriers and take the first step toward organic agriculture.

In this paper we explored various factors influencing organic farming adoption, namely: perceived behavior control factors, subjective norms, information awareness, risk perception, attitudes towards protecting the environment, and perceived EU policy opportunities. The results have strong implications for the design of a proper policy environment for promoting organic agriculture. The rest of the paper is structured as follows: the next section describes the theoretical and conceptual framework applied as along with the main hypotheses, section 3 outlines the methodology, section 4 describes the results and, finally, section 5 provides some concluding remarks and discussions.

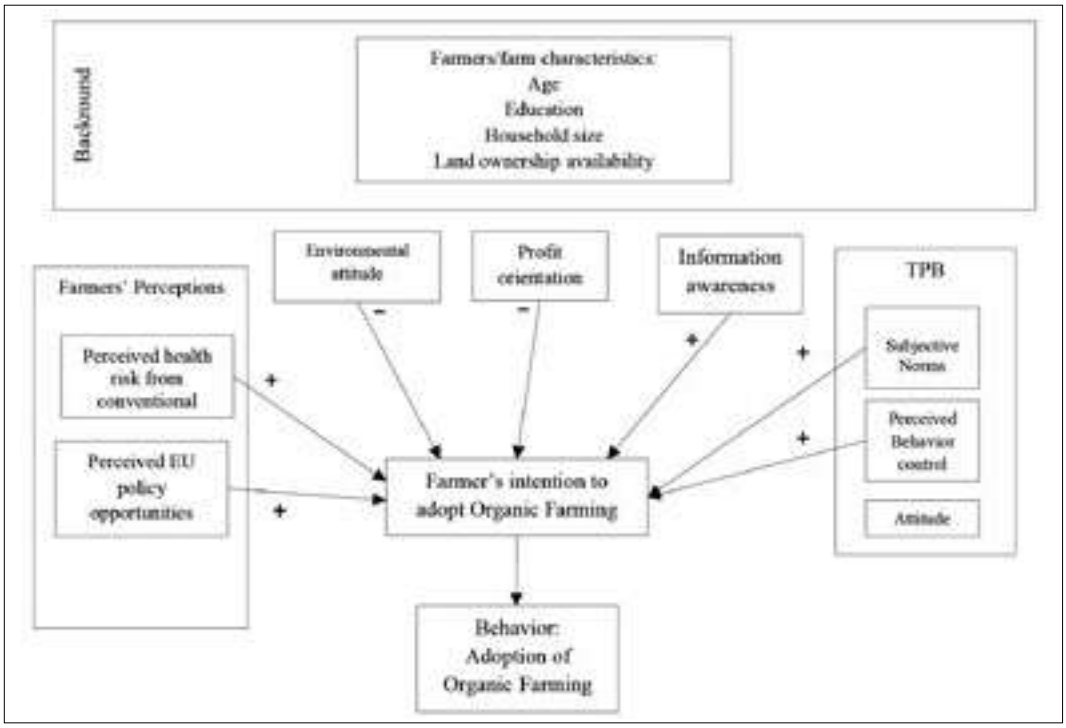
2. Theoretical and Conceptual Framework

Over the last few decades, the behavior of farmers has been explored through various theoretical and conceptual bases (i.e. Theory of Planned Behavior (TPB), Prospect Theory, Value-Belief-Norm Theory, Protection Motivation Theory, and Psychological Distance Theory). Specifically, for exploring and explaining farmers' behavior regarding the adoption of organic farming, different researchers have applied the TPB (see Hattam, 2006; Läpple and Kelley, 2013). Therefore, the conceptual framework of this paper will be based primarily on the main concepts used by Fishbein and Ajzen (1975). Despite the TPB framework, the paper will also employ a variety of background indicators – such as farmers' perceptions, social and demographic characteristics, etc. (see Figure 1).This approach seems to include all possible determinants of performing a particular behavior, as the motivational factors alone (i.e. TPB concepts) may apply to some behaviors while the performance of some other behaviors is determined to some extent by factors such as the required opportunities and resources (see Ajzen, 1988). Thus, as long as the farmer has the required opportunities and resources, and intends to convert to organic farming, he or she should succeed in doing so.

Under the TPB, the core determinants of farmers intentions to adopt organic farming are subjective norms, perceived behavioral control, and attitude towards the behavior (see Hall and Rhoades, 2010; Hattam, 2006; Läpple and Kelley, 2013; Mzoughi, 2011; Yanakittkul and Aungvaravong, 2019). The concept of *subjective norms* is used to indicate the perceived social pressure to convert or not to convert to organic farming, and *perceived behavioral control* is used to indicate farmers' perceptions of their ability to adopt organic farming. On the other hand, the concept of *attitudes* refers to the extent of favoring the conversion to organic. Accordingly, the more favorable the attitude and subjective norms towards organic farming conversion and the greater the perceived behavioral control, the stronger the intention to convert to organic farming.

According to Ajzen and Fishbein (2005: 53) "*When people believe that others would expect them to perform the behavior or are themselves performing the behavior, the subjective norm will exert pressure to engage in the behavior*". Therefore, a farmer's intention to convert to organic farming will be positively influenced if other neighbor farmers will convert as well, and if information and news releases from media is favorable to organic farming conversion (see Table A.1 in the Appendix A). Furthermore, perceived behavioral control is measured through control statements that relate to farmers' self-confidence in regard to carrying out organic farming, certifying, and controlling productivity, as well as being informed about the differences from conventional farming (see Table A.1 in the Appendix A). Thus, one can argue that

Figure 1 - Conceptual framework of the study.



Source: Authors' elaborations based on Ajzen and Fishbein (2005).

having high self-confidence and knowledge in carrying out organic farming is positively associated with farmers' intentions to convert.

Ajzen and Fishbein (2005) suggest that attitudes towards a particular behavior will affect behavioral beliefs and consequently the intention of carrying out that particular behavior. A number of empirical studies have used farmers' environmental attitudes as factors associated with the adoption of organic farming (namely Burton *et al.*, 2003; Canavari *et al.*, 2008; De Cock, 2005; Genius *et al.*, 2006; Haris *et al.*, 2018; Läpple, 2010; Läpple and Van Rensburg, 2011; Mzoughi, 2011; Rezvanfar *et al.*, 2011). Consequently, environmental attitudes of farmers are operationalized with a set of reversed items (i.e., negative environmental attitudes, see Table A.1 in the Appendix A). Specifically, the more favorable (or unfavorable) the attitude towards environmental values of organic farming practices, the stronger (the weaker) the intention to convert.

Other factors are important too. Sarker *et al.* (2009) argue that farmers are assumed to hold specific perceptions regarding certain effects of changing pattern of production and these perceptions can be potential determinants of the adoption decision. Namely, if the farmer perceives that organic farming leads to an improved supply of healthy foods and reduces the impact of agrochemicals on the environment, it is more likely that he converts to organic farming (ibid). Thus, this study assumes that farmer perceptions regarding EU policy opportunities (such as technologies, new market opportunities, decreased costs, etc.) and perceived risks from conventional farming will positively affect farmers' intentions to engage in organic farming (see Table A.1 in the Appendix A).

The indicator "perceptions regrading EU policy opportunities" is an innovative control factor added to the literature of EFA regarding organic farming adoption. The question is not used for assessing farmers' preferences (being hostile to pro-EU integration), but to explore their perception of opportunities (or costs) created from the integration into the single market. Depending on the level of information and type of ex-

periences with the EU market, farmers may be prone to perceiving the benefits, such as price markups. Therefore, we expect a positive relationship with the organic adoption decision. It might also be that the additional rules restricting export to the EU, for instance those related to safety and quality, lower farmers' perceptions of policy opportunities and create a negative association with the decision to convert to organic. However, considering that farmers are not direct exporters, we expect that they see opportunities rather than threats from the EU market. Also, it may be that the relationship is not significant since their ongoing experience with the market (the majority of these farmers are suppliers of organic MAPs for export-oriented value chain) is providing such opportunities currently.

The literature of adoption models suggests that farmers make decisions in order to maximize their expected profits (see Rogers, 1995; Parra López and Calatrava Requena, 2005). For instance, Reimer *et al.* (2012) shows that farmers, concerned most with profitability, were less likely to adopt organic farming. Having said that, it can be argued that the higher the farmers' orientation towards profit, the lower the likelihood to adopt organic farming; since converting would require a high amount of certification costs, information, time, and possibly present problems with production yields.

The adoption of organic farming systems is an information-intensive process; therefore, a factor related to information awareness would complement the study's conceptual framework (see for example from Mediterranean countries: Cukur, 2015; Läpple, 2010; Läpple and Van Rensburg, 2011). By information awareness the study implies the ability to capture, analyze, evaluate, and use information by receiving the highest level of benefit from it. One can argue that the higher the level of information awareness (i.e., information about legislation, rules, requirements, and standards of organic farming - both national and international) the more likely is that farmers will intend to convert to organic.

Lastly, the model also controls for socio-economic factors similar to other Mediterranean countries studies such as age (Genius *et al.*, 2006; Isin *et al.*, 2007), education (see for instance Genius *et al.*, 2006; Isin *et al.*, 2007; Cukur, 2015), household size (see for instance Läpple and Van Rensburg, 2011), and land ownership availability (see for instance Alexopoulos *et al.*, 2010; Genius *et al.*, 2006; Liu *et al.*, 2019).

Based on the discussion made so far, the hypotheses that emerge are:

H1 - The more favorable the attitude and subjective norms towards organic farming conversion and the greater the perceived behavioral control, the higher the farmers' likelihood to convert to organic farming.

H2 - Farmers' perceptions of risks from conventional farming and perception towards EU policy opportunities are positively associated with farmers' tendency to adopt organic farming.

H3 - Conversion to organic farming is positively affected by farmers' information awareness.

H4 - Environmental (non-preferable) attitudes and profit orientation are negatively associated with farmers' likelihood of adopting organic farming.

The complete conceptual framework applied with hypotheses directions are presented in Figure 1.

3. Material and methods

Questionnaire design

A structured farm questionnaire was designed to collect the primary data from conventional and organic farmers in different regions of Albania. The design of the questionnaire was based on the literature review as well as on the organization of three focus groups held with members of Albanian Organic Agriculture Association (AAOA) and other affiliated farmers in April and May 2019, in Malesi e Madhe (Shkoder), Lushnje and Durres, which represent also the main areas were activities of organic agriculture are carried out. The objective of the focus groups was to identify main challenges of the organic agriculture in Albania as well as to prioritize the main factors influencing the farmers' choice to convert. A SWOT analysis was carried with each focus group. The meetings helped the researchers to select the main factors and introduce in the questionnaire through the use of separate con-

structs. In order to guide the discussions a list of factors was presented and discussed with the members in the final phase of the focus group.

The farm questionnaire was designed in four sections. The first section included questions relating to social and demographic characteristics of farmers. The second section included questions on the profile of the farm such as size and main activities. Meanwhile, the third part of the questionnaire included questions that generally relate to information on sustainable agricultural policies and practices and expectations for Albania's potential EU membership. The final section of the questionnaire consisted of questions on incomes that respondents benefit from agricultural activities in general and organic farming.

Data collection

Interviews were conducted in June and July 2019. Interviewers were trained to conduct interviews with farmers.

The area of the survey was selected based on the highest concentration of members of AOAA, namely Tirana, Durres, Malesia e Madhe (Shkoder), Lushnje and Vlora. The survey considered as a population the members of the Albanian Association of Organic Agriculture which have been in the past subject of capacity building activities in the sphere of organic agriculture. Currently, there are no more than 131 farms certified in Albania and a similar number in the process of certification. Considering these farms as well as the number of the members of the AAOA, the overall population is less than 1000 farms. The sample selection was made using a purposive sample, where those farmers who had previously part of trainings and capacity building events with AAOA and attempted to follow organic farming procedures were first asked, and following a *snowball* approach, other farmers were also identified. The representatives of the AAOA supported the surveying activity by contacting the members and carrying the interviews, under to supervision of the group of researchers. A list of members was used by There were no restrictions on the farming activities, therefore the sample includes a variety of farmers belonging to sectors such as olives, vineyards, orchards, vegetables, MAPs, honey, etc.

Data collected through the questionnaire were subject to controlling and revisions. The surveys were validated by tracing back 10% of the farms through phone calls. Data were entered into excel spreadsheets and processed through SPSS and R.

Sample characteristics

In total, 127 Albanian producers were included in the sample (farmers who are undergoing a certification process, certified (organic), and conventional). Table 2 below shows a summary

Table 2 - Socio-demographic characteristics of the sample.

Age	*No.*	*Percent*	*Education level*	*No.*	*Percent*
<30	3	2%	Primary education	26	20%
31-40	9	7%	Agricultural secondary education	43	34%
41-50	21	17%	Other secondary education	40	31%
51-60	44	35%	University	18	14%
61<	50	40%	Total	127	100%
Total	127	100%			
Gender	*No.*	*Percent*	*Employment*	*No.*	*Percent*
Male	122	96%	Employed in the public sector	13	10%
Female	5	4%	Employed in the private sector	9	7%
Total	127	100%	Self-employed in non-agricultural sector	3	2%
			Self-employed in the agricultural sector	71	56%
			Other	31	24%
			Total	127	100%

Source: Authors' elaboration based on survey results.

Table 3 - Definitions of variables included in the model, their operationalization, and hypotheses.

Independent Variable	*Operationalization*	*Hypothesis direction*
Subjective norms	EFA based on 5-point scale items*	+
Perceived behavior control	EFA based on 5-point scale items*	+
Environmental (opposing) attitudes	EFA based on 5-point scale items*	-
Perceived EU policy opportunities	EFA based on 5-point scale items*	+
Perceived risk from conventional farming	EFA based on 5-point scale items*	+
Profit orientation	EFA based on 5-point scale items*	-
Information awareness	EFA based on 5-point scale items**	+
Age	Age in years (number)	Control variable
Land ownership availability	Area in hectares	Control variable
Household size	The size of the farm household (number)	Control variable
Education level	Education level (categories)	Control variable
Primary education	Dummy variable 1=Primary education and 0=other	Control variable
Agricultural Secondary Education	Dummy variable 1=Agricultural Secondary and 0=other	Control variable
Other Secondary Education	Dummy Variable 1=Other Sec. and 0=other	Control variable

*Note: *5-point scale items: Level of agreement/disagreement (1-totally disagree… to 5-totally agree) with selected statements; **5-point scale items: 1-Not at all… to 5-very much.*

of the socio-demographic profile of the surveyed farmers. Only 4% of the sample are women, while 1/3 of them have completed secondary education in the field of agriculture, 56% of them are (self) employed in the agriculture sector (agricultural activities being the main source of household incomes). A comparison with the main characteristics of farmers in the Census of Agriculture Holdings in Albania show that there is no evident sample bias. The figures are similar with the Census of 2012 which show that 88% of the farmers have a primary or secondary education, and that only 6% of farm heads are women (MARD, 2013). The number of farmers with University Education is slightly higher, probably due to challenging characteristics in terms of knowledge required by operators in the organic sector. Moreover, the average age of farms head in the Census is 45 years, which considering the time difference and the intergeneration transfer, represent a similar trend[1].

Data analyses

In order to explore the determinants of the decision for farmers to adopt organic farming, the study makes use of compositions of variables which are constructed through Exploratory Factor Analysis (EFA) (see Table A.1 in the Appendix A). The main variables added are perceived behavior control, perceived EU policy opportunities, information awareness, environmental attitude, farmers perception of health risk from conventional farming, profit orientation and subjective norms influence. In order to develop measures for these variables, all the items representing them are entered in the EFA. As it is shown in Table 3, the EFA revealed 7 factors by using principal component applied to the items of the variables presented above. These 7 factors explain the structure of the data set accounting for 76.891% of the total variation. KMO test of sampling adequa-

[1] The Census of Agriculture Holdings in Albania carried in 2012 represented similar figures. The next Census of Agriculture Holdings in Albania will take place in 2023. Therefore, no comparisons can be made with more recent surveys of Censuses.

cy (0.756) and the Barlett's test of sphericity ($\chi 2$=2258.271: df =300; sig<0.001) confirm the appropriateness of the factor analysis (refer to Field, 2009).

While it is possible to extract as many factors as there are items, it was decided to extract only those factors that fulfilled the Kaiser's criterion for factor retention were extracted. Kaiser (1960) recommended retaining all factors with eigenvalues greater than one, and as s a result, all factor loadings mark values more than Stevens (2012) recommended value of 0.40, providing evidence of constructs convergent validity.

Next, logistic regression is employed to explore the relationships between the developed latent variables and farmers' decisions to engage in organic farming (the model also controls for socio-economic factors such as age, education, household size, and land ownership availability). This model was selected considering the dichotomous nature of the dependent variable (dummy), which is composed of farmers that are in process of certifying and certified as organic (1) versus conventional producers (0). Table 3 presents the operationalization of model variables and hypotheses.

4. Results

The results obtained from the logistic regression model are presented in Table 3. Results reveal that perceived behavioral control, information awareness, subjective norms (H1), and perceived risk from conventional farming (H2) positively affect the likelihood of converting to organic farming. On the other hand, perceived opportunities from EU policies (H2) and non-preferable attitudes towards environmental values of organic farming (H4) were negatively associated with the likelihood of converting to organic farming. Surprisingly, the variable of profit orientation was insignificant.

As the level of information awareness (on legislation/standards of organic production) increases, the likelihood of converting increases as well. Similar results (i.e. positive association with adoption of organic farming) are observed for the variables of perceived risk from conventional farming and subjective norms.

Furthermore, among control variables, farmers and farm characteristics are not significantly related to the likelihood of adopting organic farming, with the exception of land ownership availability and vocational education in agriculture. Thus, those

Table 4 - Regression analyses dependent variable: organic farming adoption/conversion.

	B	*S.E.*	*Wald*	*Sig.*	*Exp(B)*	*H*
Age	0.014	0.027	0.253	0.615	1.014	
Household size	-0.320	0.279	1.316	0.251	0.726	
Land ownership availability	0.037	0.017	4.575	0.032*	1.038	
Perceived behavioral control	0.691	0.257	7.238	0.007*	1.995	√ H1
Perceived EU policy opportunities	-0.643	0.267	5.815	0.016*	0.526	× H2
Information awareness	1.013	0.305	11.046	0.001*	2.753	√ H3
Environmental (opposing) attitude	-1.089	0.306	12.709	0.000*	0.336	√ H4
Perceived risk from conv. farming	0.729	0.274	7.096	0.008*	2.073	√ H2
Profit orientation	-0.061	0.242	0.063	0.802	0.941	× H4
Subjective norms	0.755	0.283	7.111	0.008*	2.129	√ H1
Education level			5.732	0.125		
Primary education	1.443	1.035	1.944	0.163	4.234	
Agricultural Secondary Education	2.131	0.970	4.822	0.028*	8.422	
Other Secondary Education	1.100	0.951	1.337	0.248	3.003	
Constant	-2.562	1.957	1.715	0.190	0.077	

Note: p<0.05 =0.528 (Nagelkerke), 0.389 (Cox & Snell)

farms having a household head with secondary education in agricultural sciences and with higher availability of land ownership, the likelihood of the farmer to convert to organic agriculture rises.

5. Concluding remarks and discussion

During the last decade, the organic agriculture sector has experienced rapid growth due to market-related factors, resource availability, and consumer preferences. For the case of Albania, similar to other developing countries, the organic sector is export-driven and mainly based on primary production. Under these conditions, the most important market in terms of value created is the production and export of wild MAPs. Thus, there is a need to identify and assess the role of various factors influencing the decision to adopt organic farming in Albania, considering its post-socialist transformation and challenges ahead in the context of the integration into EU market.

The results show that the probability of adopting organic farming is positively associated with farmers perceived behavioral control. Similar results were also obtained from other studies (see for instance Hattam, 2006; Läpple and Kelley, 2013; Sharifuddin *et al.*, 2018; Yanakittkul and Aungvaravong, 2020). Perceived behavior control is based on the self-confidence and know-how of the farmer, as well as on the supportiveness of the surrounding environment. Additionally, subjective norms appear to be also positively associated with the probability of converting to organic farming. Similarly, this finding has also been proven by other studies such as Hall and Rhoades (2010), Hattam (2006), Läpple and Kelley (2013), Sharifuddin *et al.* (2018), Yanakittkul and Aungvaravong (2020). Subjective norms are derived from information collected by media advertising and fellow farmers in the village. The influence by the community (i.e., neighbor farmers) or the media are important sources of relevant information and experience sharing for farmers to adopt organic farming. Same as recent studies of Sharifuddin *et al.* (2018) and Yanakittkul and Aungvaravong (2020), results show that farmers' family, community, group norms and influential people affect farmers decision to convert to organic farming.

Information awareness positively affects farmers' engagement in organic farming. Farmers that are informed about organic farming tend to engage more in this type of activity. This is similar to the findings of Genius *et al.* (2006), Hattam (2006) and Cukur (2015). Access to information sources might expand their knowledge on market indices and production technology as the number of agricultural information sources used is a significant factor for adoption of organic practices.

Interestingly, farmers that perceive risk from conventional farming are more likely to adopt organic farming. In addition, farmers who are more prone to attitudes of protecting the environment express a higher probability of adopting organic farming. Consequently, the higher the level of environmental concern the higher the probability to enter into the organic sector. This indicates that Albanian farmers perceive that organic farming is better for the environment. Similarly, studies such as Läpple (2010), Reimer *et al.* (2012) and Haris *et al.* (2018) found a positive association with regard to environmental attitude and organic farming conversion.

Surprisingly, perceived EU policy opportunities are negatively associated with the probability to adopt organic farming. It seems that they are more aware of the strict rules associated with access to this market compared to conventional farming. Moreover, by not being higher up in the export chain, farmers have perceived threats (strict rules on safety which increase their costs and losses) rather than benefits (the positive difference of price margins experienced in the EU market compared to the rest). This is supported by the fact that no significant relationship between adopting organic farming and being a profit-oriented farmer has been found. The lack of distinction within the domestic market puts conventional farmers in a vulnerable position when embracing organic farming and joining an expanding single market with more rules and opportunities, such as the EU single market. Results might also be influenced by the type of information and awareness provided in the past regarding EU policies.

These results are evidence for a needed intervention to improve information / awareness

on EU opportunities. An information campaign in regard to EU legislation and market information would benefit policy makers and the sector operators.

There is no significant relationship between adopting organic farming and being a profit-oriented farmer. This is different from the findings of Curtis and Quarnstrom (2019) and Läpple (2010), but similar with Reimer *et al.* (2012). There are two major reasons which support this finding. First, in the foreign market (mainly in the Medicial and Aromatic Plants which compose more than 95% of the land covered with organic farming) the exporters do not benefit from high margins in the market rather than from more secure market space. Considering that the highest share of producers is related to MAPs production, the farmers find no clear profit pattern in the current market. In the MAPs sector there is no market mark-up, but rather market consistency. Second, the internal market does not provide clear indication to the consumers about the organic attributes due to weak marketing and weak consumers signals. Moreover, lack of quality standards in the market make the organic farm products not clearly distincted in terms of price. Thus, there are no positive market margins available for farmers in the market for organic products. This is similar to the findings of Zagata *et al.* (2020), which find that in post-socialist countries organic agriculture is not driven by activities of a social (organic) nature due to the fragile existence of the institutional environment (i.e. civil society, policy, and consumers).

Farmer and farm characteristics, except for land availability and secondary education in agricultural sciences, are not significantly related with the probability of adopting organic farming. As expected, the probability of being engaged in organic farming is closely linked with the farm head having pursued agricultural vocational school. Lastly, farms owning more land (or being wealthier) have a higher probability of adopting organic farming, same as other study cases from Mediterranean countries such as Greece (Genius *et al.*, 2006; Alexopoulos *et al.*, 2010) or other developed countries such as USA (Liu *et al.*, 2019). Since the majority of organic farming is based on MAPs, the share of owned land increases the security of planting perennial crops and to fulfilling contracts in the future which is of high concern in Albania (Zhllima *et al.*, 2010). This finding is actually not in line with other studies, which perceive limited land availability as a supporting factor for conventional farming. The result is acceptable since structural limitations and high fragmentation is a widespread phenomenon in Albania (Ciaian *et al.*, 2018) make land availability a supporting factor for organic, which is not of concern in EU countries.

In conclusion, the study results are helpful evidence for the need to address current market failures in supporting the increased adoption of organic farming and for establishing an effective agricultural policy for supporting the conversion from conventional agriculture. The results implore an increase of information and awareness vis-a-vis the provision of a more intensive and CAP-oriented policy for promoting organic agriculture. As in the case of Crisostomo *et al.* (2012), organic farming policy in Albania is expected to be predominantly driven by EU policies, therefore compliance with EU agriculture policies should be a guiding principle for the operators, especially those oriented toward exports. A larger focus should be given to overall consumers' knowledge in order to increase knowhow and raise an overall level of civic participation in the national debate. In order to widen organic practices, policymakers might attempt certification in groups, considering the influence of factors related to information and subjective norms. The group approach also makes the diffusion of information and awareness easier. Capacity building activities such as coaching and training should be guided by a precautionary process of identifying farmers and groups of farmers with similar approaches to land resources. Here, the spatial neighborhood effect takes an important role, which supports the findings of Wollni and Andersson (2014).

In overall, access to services, information sources, governmental support policies and continuing trainings are among the key drivers for promoting the sustainable adoption of organic farming. Similar to Papadopoulos *et al.* (2018), attitudes to organic farming are as-

sociated with economic reasons, but to a lesser extent when compared to conventional farming. Therefore, budgetary support policies should act as a guiding signal rather than filling the costs disadvantages compared to conventional farming. Therefore, premium criteria in national support schemes and IPARD programme measures should be introduced in order to incentivize farmers' orientation toward organic farming and enable the sector orientation toward the European Green Deal principles.

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Appendix A

Table A.1. Exploratory Factor Analysis.

Rotated Component Matrix		*Component*						
	α	*F1*	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*
F1. Perceived behavior control	0.903							
Farmers have the self-confidence to carry out OF*.		0.879						
Farmers have self-confidence towards certifying as organic.		0.851						
Farmers know the difference between organic and conventional farming.		0.811						
Farmers know the processes and techniques of OF.		0.767						
Farmers have the self-confidence to control productivity under organic farming.		0.744						
Farmers family members support him to be certified as organic.		0.634						
F2. Perceived EU policy opportunities	0.905							
More information opportunities regarding OF.			0.895					
More opportunities towards technologies.			0.845					
New market opportunities for organic products.			0.835					
Decreased prices of agrochemicals.			0.763					
Clear differences between organic and conventional products.			0.701					
F3. Information awareness	0.865							
Level of information about OF legislation in Albania.				0.878				
Level of information about OF regulations and standards in EU.				0.868				
Level of information about OF policies in EU.				0.792				

Rotated Component Matrix		*Component*						
	α	*F1*	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*
Level of information about OF policies in Albania.				0.735				
F4. Environmental (opposing) attitude	0.790							
The use of chemicals in agriculture makes sense as long as it leads to an increase in profits					0.853			
Maximizing profits is more important than protecting the environment.					0.821			
Chemical fertilizers have no harmful effects, they promote high-quality production.					0.705			
F5. Farmers perception of health risk from conventional farming	0.760							
There is a risk of being exposed to chemicals used in the processes of conventional farming.						0.847		
There is a risk of family members being exposed to chemicals from the consumption of conventional products.						0.744		
There is a risk of higher costs from conventional farming as a result of chemicals used.						0.633		
F6. Profit orientation	0.836							
In order to increase profits, it is important to try new approaches (i.e. techniques of production).							0.885	
It is very important that we secure highest possible profit from agriculture/farming.							0.843	
F7. Subjective norms influence	0.615							
Introduction and news releases from media (TV, radio, or newspapers) lead to OF.								0.858
Other farmers (neighbors) will convert to OF.								0.621

*Note: *OF means Organic Farming; Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.*

NEW MEDIT

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