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Factors affecting Willingness to Accept compensation for crops conversion programs: a farm level study in Tunisia

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Abstract

Offering a case study of Northeast of Tunisia, this study identifies socio-economic factors that affect the willingness to accept compensation for the conversion of their current cropping patterns towards more water-saving ones.A survey questionnaire was used for collecting data. A logistic regression model was used to analyze the data.Results showed that a majority of the farmers self-identified as having accepted a compensation for crops conversion program. Empirical results of the logistic regression model showed that eight factors surveyed, age, farm size, cereal area, parcel number, cattle fattening activity, groundwater salinity, owned area, and rental area were significantly related to a willingness to accept compensation for crops conversion programs.

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1.Introduction

Globally, the agricultural sector is the largest user of groundwater resources (GWP, 2012). In arid and semi-arid regions, where rainfall is scarce, groundwater has become a primary source of irrigation; it is mostly used as a supplementary source of irrigation. In Tunisia, around 43 percent of this resource is being used for irrigation purposes (MARH, 2007). Since the early 70s, the development of irrigated agriculture in this country has generated significant increases in food production and farm income. However, it has also led to intensive exploitation of water resources which is especially manifested by the overexploitation of groundwater and the degradation of its chemical quality. Around 26 percent of groundwater aquifers in Tunisia are overexploited at an average rate of 146 percent, most of them are at serious risk of salinization due to their coastal location (TICET, 2009). The case of the Cap Bon (Nabeul Governorate, northeast of Tunisia) is a good illustration of this overexploitation problem.Some aquifers have been overexploited and their water resources have been contaminated by seawater intrusion as it is the case of Grombalia, El Haouaria, and Korba aquifers (all located in the Cap Bon region). The expansion of irrigated areas during the last two decades in this region has led to increased irrigation water requirements (Around 60% of total arable areas in the region are currently irrigated). Meanwhile, surface water resources have not been further developed and pressure on groundwater has been increasing significantly. Therefore, a potential water imbalance is triggered since the agricultural, urban, and touristic sectors of the region are in strong competition especially during the summer. In many irrigated areas of Cap Bon, farmers are suffering from quantity as well as quality water scarcity.

Korba aquifer, the object of our study, is located in the Eastern part of the Cap Bon governorate. It constitutes the main source of irrigation in the region. However, since the early 90s, the level of the water table has experienced a decline as well as a degradation of its quality due to intensive widespread irrigation. Intensive pumping of groundwater from Korba aquifer reduces the freshwater outflow to the sea and creates several drawdown cones and lowering of the water table up to 12 m below sea level. This is especially relevant for the irrigated areas of Diar El Hajjej and Tafelloun villages, where saline intrusion in wells is a significant phenomenon (Kouzanaet al, 2009, Zghibiet al, 2013). The most contaminated wells are located mainly between Diarr El Hajjej, MenzelHorr, Taffelloun and Lebna villages. Currently, the salinity of groundwater varies between 5 and 8 g/l (Groupement de Developpement Agricole de Diar El Hajjej (2010)).The Regional Council on Agriculture Development of Nabeul(“CommisariatRégional de Développement Agricole”(CRDA), 2009) reports having deserted several wells, while some other wells are still being exploited even though their salinity exceeds 3g/l.Korba aquifer can actually be considered as the most overexploited aquifer of the governorate.Taking into consideration the problem of overexploitation of Korba aquifer and the consequences resulting from it, the public water agency proposed since 1992 to increase the surface water in the region through a further transfer of water from the northern part of the country via Medjerda-Cap-Bon canal. This project was implemented in 1998. In the same period, artificial recharging programs of this aquifer from treated sewage water and surface water were also implemented to better preserve groundwater.This operation consists in injecting water into the wells of the farmers. However, the recharge of the Aquifer was insignificant compared to the excess of groundwater pumping (Zghibi et al, 2013). In addition, the government encouraged farmers to adopt a more efficient type of irrigation technologies, such as drip irrigation, for which specific subsidies programs have been designed (60 percent of total cost of technology). Likewise, this policy didn’t have a significant effect on reducing pressure on groundwater (Bachta and Elloumi, 2005, Frija, 2009; Frija et al, 2015; Al Atiri, 2004). On the contrary, subsidies of irrigation technologies induced the planting of more water-intensive crops on already irrigated land as strawberries (Kerrou, 2008). This result was confirmed by Pefeifer et al, 2009; 2014.

In the farming systems of the region, and despite the water shortage context described above, farmers are still cultivating high water consuming crops such as tomatoes (6000 cubic meter per hectare), strawberries (6000 cubic meter per hectare), peppers (7000 cubic meter per hectare), and potatoes (4500 cubic meter per hectare). Based on this observation, our aim was to investigate farmers' preferences to change water-intensive crops by less intensive ones with compensatory payments. This instrument was also proposed by Wang et al, (2015).This program includes payments to irrigators against changing their current cropping allocation plans by cultivating low water-intensive crops on their current irrigated areas. Such programs usually operate on an offer-based contract between the irrigator and the coordinating government agency.

Our study is conducted in the considered Cap Bon area based on a survey of a representative sample composed of 81 farmers of the irrigated scheme of Diar El Hajjej. Farmers' responses to crops conversion programs are influenced by their socio-economic characteristics. We then applied a logit model to identify factors influencing farmers' decisions. This paper focuses on identifying socio-economic factors likely to be influential in willingness to accept compensation for crops conversion programs.

2.Study area

The study area is located in the delegation of Korba (governorate of Nabeul in Northeast of Tunisia). It is the irrigated area of Diar El Hajjej. It covers 800 hectares. It is distributed as follows: 35,66% tomatoes, 17,11% strawberries, 14,26% pepper, 11,41% potato, 10% cereals, 5% fodder, and 5,7% other crops. In this area, the irrigators are cultivating the high water-consuming crops.

The perimeters of Diar El Hajjej are currently irrigated by two water sources:60 percent of water resources come from wells and 40 percent come from the Medjerda-Cap-Bon canal.Irrigators use a more efficient type of irrigation technologies, such as drip irrigation, for which specific subsidy programs have been designed (60 percent of total technology costs).

The increasing demand for water in agriculture has led to an excess in pumping groundwater; representing the main buffer against irrigation water scarcity in the region. Intensive pumping of groundwater from the Korba aquifer reduces the freshwater outflow to the sea and creates several drawdown cones and lowers water table up to 12 m below sea level (Kouzanaet al, 2009, Zghibiet al, 2013). Several wells are contaminated by saline intrusion. Currently, groundwater salinity varies between 3 and 8 g/l (Groupement de Developpement Agricole de Diar El Hajjej (2010)). The Regional Council on Agriculture Development of Nabeul("Commisariat Régional de Développement Agricole"(2009)) reports having deserted several wells, while some other wells are still being exploited even though their salinity exceeds 3g/l. Farmers are suffering from quantity as well as quality water scarcity.

Within this framework, we practically proposed to farmers during our data collection to reduce their solanaceous or strawberries irrigated areas and changing them with other low water–consuming crops, while receiving a compensation. Four hypothetical compensation values were proposed. These values were expressed in Tunisian Dinars (TND[1]) per hectare: 200TND/hectare of potato; 300TND/hectare of strawberry; 400TND/hectare of tomato; 450TND/hectare of pepper. All the values were proposed to the surveyed farmer.

3. Methodology

3.1 Survey design

In this study, data were gathered using a survey questionnaire. In order to refine the survey instruments, focus group discussions were conducted with twenty irrigators. The purpose was to know farmers' attitudes about the crops conversion program. Following the primary interviews, 81 face-to-face interviews were carried out in the study area. The sample was constructed by the method of the routes. It is stratified according to the size criterion. Participants for the survey were selected from six regions of Diar El Hajej: Boukalouk, Bkir, Htouba, Elgaraa, KsarSaad and El Ayaada. The purpose of this sampling approach was to have a large variety of farmers with different attitudes to crops conversion program.

The questionnaire consisted of four parts. The first part was a set of questions about farm structure and ownership pattern of land. The second part described the characteristics of both irrigation sources (surface and groundwater). The questions were concerned with wells: the wells' ownership, technical aspects, historical trends, water recharge and groundwater quality. Also, the questionnaire included questions about agricultural expenditures over a one-year period and crop yield levels. In the third part, we asked the principal question that consists of asking respondents "if they would or would not be willing to accept a compensation against a change of their water-intensive crops areas toward less water-intensive ones". Finally, the last part of questionnaire gathered information on the socio-economic characteristics of farmers needed for the theoretical analysis.Responses of farmers for this question were analyzed by binary logit regression model.

3.2 Logit model

In a subsequent analysis, a binary logit regression was employed to examine different factors affecting the probability of farmers' willingness to accept compensation for crops conversion program and to test the relationship between factors and farmers' willingness to accept.
The functional form of the logit model can be presented as follows:

$$\boldsymbol{Y} = \frac{\mathbf{1}}{\mathbf{1} + \boldsymbol{e}^{-\boldsymbol{z}}} \qquad (\mathbf{1})$$

Where the dependent variable Y represents the probability of farmers' willingness to accept compensation for the hypothesized crops conversion program. On the right-hand side, z is the

[1] 1TND is equivalent to 0.5401 € (in 2010)

linear combination of the explanatory variables $(x_1, x_2, \dots \dots \dots, x_k)$;

$$z = \alpha + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k;$$

Where $\alpha, \beta_1, \beta_2, \dots, \beta_k$ are the logit regression coefficients.

In this study, the dependent variable willingness to accept compensation was coded with a dichotomous choice of "1 = yes" reflecting a willingness to accept and "0 = no" reflecting a non-willing to accept.The selection of explanatory variables in the regression equation above was made based on the fact that they should not agglomerate more than 90% in a response category and are not collinear.

The estimation of the logit model leads to the derivation of empirical values for the coefficients β of both equations. We can only interpret the signs of these parameters and not their absolute values. For results interpretation, it is also useful to calculate the marginal effect of the explanatory variables on the dependent variable y_i (Greene, 2012) based on the estimated β values. Binary logit regression was estimated using the statistics package STATA version 12.0. Data used in these analyses were collected in 2010.

4.Results

4.1 Descriptive statistics

Descriptive results showed that the average age of farmers in the studied sample is about 44.31 years, with only 9.9% of farmers younger than 30. 42% of farmers have a primary education and only 2.5% have a higher education. As for the production systems, we found that more than 53% of farmers cultivate three crops or more on their farms; with 23.45% cultivating more than four crops. The most cultivated crops are tomatoes (20.6%), strawberries (18.9%), potatoes (14.18%), pepper (12%), various crops(10.47%), and mixed crops(8.1%). Moreover, there are other crops like, fodder (7.77%), cereals (6%), spices(2.36%), and fallow (1.35%). Among 81 surveyed farmers, 46 agreed to accept compensation for crops conversion program, making a rate of participation of 57 percent.

Farmers' willingness to accept compensation is influenced by some Factors. These farmers have a large irrigated area. Their corresponding farms have an average size of 5 hectares. Moreover, 50 percent of irrigated area is in property, 23 percent is in rent and 25 percent is in sharing contract. In addition, 67 percent of wells, of these farmers, have salinity higher than 3g/L. However, Farmers who refused to participate in the conversion program have a small irrigated area. The average irrigated area these farmers are managing is about 3 hectares. The part of this irrigated area in property (31 percent) is below the rented (42 percent). In addition, 26 percent is in sharing contract. Most of the wells (85 percent) of these farmers have salinity higher than 3g/l, this salinity can reach 12 g/l (interview with farmers)(figure 1).The willingness to accept compensation also increases when the irrigated area increases, and when the percentage of the owned irrigated area is high. The salinity of groundwater is also an important factor, but it might be dominated by others.

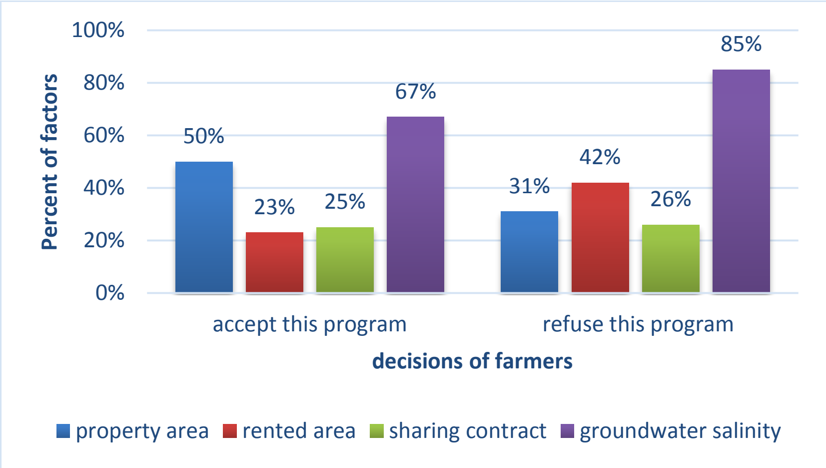

Figure 1 influence of some factors affecting the farmer's decision

The WTA scenarios were presented as follows: respondent was randomly offered one payment from among a set of four different payment ranging from 200 TND (for abandoning one hectare of potato), 300ND/hectare (for abandoning one single hectare of strawberry), 400 TND (for abandoning the cultivation of one hectare of tomato), and 450 TND (for abandoning one hectare of pepper). As the elicitation question was dichotomous, respondents were simply asked to reply either "yes" or "no" to the payment offered them as compensation.

4.2 Willingness to accept (WTA) compensation for crops conversion programs

In order to test the relationship between WTA compensation for crops conversion programs and socio-demographic characteristics of farmers, a logit regression model was constructed. Before the data analysis, we applied a contingency coefficient test in order to identify colinearity and omit independent variables that are strongly correlated to each other. Multicollinearity was observed between age and marital status, age and experience in the agricultural sector, useful agricultural area and irrigated area, useful agricultural area and irrigated area cultivated by strawberries, tomato, pepper, cereals and other crops, irrigated area and reduced area, irrigated area and area cultivated by strawberries, tomato, pepper, cereals and other crops, reduced area and area cultivated by strawberries, cereals, pepper between strawberries and other crops. Therefore, the logit model was run with uncorrelated variables. The description and coding of the variables used in the logistic model are given in appendix A.

Results of the binary logit model are shown in table 1. This model showed a good fit with pseudo R^2 =0.45 and p-value of 0.000.The marginal effects of explanatory variables (dy/dx) are also reported which provide a direct interpretation of the results.

The finding of the regression model indicates that age is negatively and significantly (at 5% level) related to WTA compensation for crops conversion programs. This implies that the probability of WTA compensation for crops conversion programs was higher with younger farmers than with older farmers. The fact that younger farmers are more willing to participate in this program. The similar outcome has found by Acquah (2011) and Quayum et al (2012).

There is a positive and significant (at 5% level) relationship between farm size, number of plot and WTA compensation for crops conversion programs. This implies that farmers with large farm size are more likely to accept compensation than farmers with small farm size.

Farmers accept to reduce irrigated area and to cultivate others crops low water-consuming because of the deterioration of the soil quality. Farmers were also very aware of the impact of irrigation intensification on soil fertility. They indicate that they can diversify and supplement their income and continue their agricultural operations in the face of water shortage. Gbeibouo (2009) explained that wealthier farmers are more interested to change planting practices.

Tableau 1 Binary logit regression

	Parameter estimates	*Standard Error*	*Delta-Method*		*Z*	*p > |Z|*
			dy/dx	Standard Error		
Age2	-0.0007	0.000345	-0.000164	0.000071	-2.16**	0.031
Family labour*	-1.6402	0.9117	-0.1985	0.1009	-1.80*	0.072
size farm	0.6695	0.2952	0.1480	0.0612	2.27**	0.023
Distance	0.3588	0.2523	0.0793	0.0538	1.42	0.155
Exploitation capital	-1.3473	0.8540	-0.1631	0.0971	-1.58	0.115
Access to credit	-1.3457	0.9624	-0.1629	0.1113	-1.40	0.162
Potato area	-1.3386	0.7964	-2.96	0.1694	-1.68*	0.093
Cereal area	-1.6607	0.7759	-0.3673	0.1672	-2.14**	0.032
number of plot	0.9488	0.4276	0.2098	0.094	2.22**	0.027
Study region*	0.3721	0.2154	0.045	0.02416	1.73*	0.084
Other activity	-1.3493	1.2365	-0.1633	0.1449	-1.09	0.275
cattle fattening activity*	2.2029	0.9553	0.2666	0.099	2.31**	0.021
Groundwater salinity*	-2.9204	1.1169	-0.3535	0.111	-2.61***	0.009
Property area	4.2052	1.4580	0.93013	0.3054	2.88***	0.004
Rental area	-3.6919	1.296	-0.81	0.285	-2.85***	0.004
Constant	-1.0419	-				
Log likelihood of the non-constrained model			-30.0557			
LR chi2			50.68			
Prob>chi2			0.0000			
Pseudo R^2			0.4574			

*Source: survey data. *significant at level 10%, ** significant at level 5%, *** significant at level 1%.Notes: marginal effects are calculated for the medium point of continuous explanatory variables and for discrete variables that change from 0 to 1 of the indicator variables (noted *)*

There is a negative and significant (at 5% level) relationship between cereal area and WTA compensation for crops conversion programs. Specifically, results show that increasing size of cereal area decreases the probability of farmers' WTA compensation. These farmers were reluctant to join compensation schemes because they have an irrigated area cultivated by cereals.

There is a positive and significant (at 5% level) relationship between cattle fattening activity and WTA compensation for crops conversion programs. This implies that the probability of WTA compensation is greater for those who have cattle. These farmers have interest to cultivate other crops (like fodder) for their cattle.

The regression model results explain that groundwater salinity is negatively and significantly (at 5% level) related to WTA compensation for crops conversion programs. However, the negative sign of this relationship is contradictory to our initial hypothesis. This negative sign indicates that with increasing groundwater salinity, the probability of WTA compensation decreases. Prior to this study, it was expected that the sign of the variable groundwater salinity would have a positive sign, the logic being that increase in salinity of aquifer makes available more interest to reduce the pumped quantity and to accept compensation. The salinity of aquifer seems to be one of most decisive factors for WTA compensation for the crops conversion programs. This paradox can be explained by the fact that the salinity variable is dominated by other variables such as the size of an irrigated area. In an attempt to identify reasons for the negative relationship, we estimated the marginal effect of salinity on the probability for various values of irrigated areas (table 2), we notice that it differs widely. It is about 31 percent for an irrigated area equal to one hectare, whereas it is about 11 percent for an irrigated area equal to 11 hectares.

The result of the logistic regression shows that owned area is positively and significantly (at 1% level) related to WTA compensation for crops conversion programs, while the rented area is negatively and significantly related to the decision of the farmer. This implies that the probability of WTA compensation was higher with owner farmers than with tenant farmers. It is obvious that owner farmers have incentive to accept compensation, and renter farmer does not see the necessity to accept compensation, while the owner integrates the durability of the groundwater in his decision because his future incomes depend on it. This finding is consistent with work done by Ma et al, 2012; Sattler and Nagel, 2010; and Yeboal et al, 2015 who also found that landowners accept to participate in conservation programs. Meanwhile, groundwater salinity has a negative relationship with WTA compensation for crops conversion programs.

Tableau 2 Marginal effect of salinity on the probability of participation in the mechanism in question according to the irrigated area

area under salinity constraint	*Slope:* $\frac{dy}{dx}$	*t-ratio*
1 hectare	-0.3105	-3.40
3.5 hectares	-0.3079	-3.33
4 hectares	-0.2940	-3.26
7 hectares	-0.2125	-2.59
11 hectares	-0.1156	-1.57

5. Conclusion

There is a considerable enthusiasm amongst policy-makers to change water-intensive crops by less intensive ones in Tunisia. However, the design and implementation of this program is a complicated process and the authority is devoted to the financing of this program.

This paper has provided a review of practical issues relating to the prospects for such changes in water-intensive crops in Tunisia. It has identified the barriers and drivers to willingness to accept compensation. Indeed, the landowner and the farmer who has a large irrigated area are highly interested in this program. However, farmers, who have small areas or else they are a tenant, refused the compensation and do not show any interest in the sustainability of the groundwater. It was proved that level of WTA compensation for this program is significant.

The regression results indicate landowners and those with large lands are more interested in the compensation program. It could be explained to the fact that those farmers have more at stake in the long-run than those who rent land or have small parcels. Water salinity and its impact on land quality are more likely to impact the former than the Latter. Moreover, this program is more accepted by those who raise livestock . In addition, the passage from one region to another is accompanied by an increase in the likelihood of participation in this program. This is explained by the heterogeneity of the farmers.

The fact that the policy tool of compensation on water-conservative crops is accepted by 57 percent of irrigators is a very interesting result. In the future, we will study the relationship between water pumping cost, crop price, and crop patterns, to identify the proper compensation for each type of crop in other areas of the country where farmers use only the groundwater.

Concerning the more water-intensive crops, especially tomato, pepper, and potato, that are not to be planted in this area, they can be planted in other areas of the North-west of Tunisia, where they have a more important yield than in the North East. In fact, in those areas, the average yield of one hectare of tomato is of 80 tones and that of pepper is of 50 tones.

It should be noted that the mechanism of compensation on water conservative crops will be applied temporarily during the period of shortage of water resources from May until September.

References

Acquah, H.D (2011), Farmers' perception and adaptation to climate change effects : A willingness to pay, *Journal of Sustainable Development in Africa*. 13(5), 150 – 161.

Al Atiri, R.(2004). Les efforts de modernisation de l'agriculture irriguée en Tunisie. *Paper presented at : séminaire Modernisation of irrigated agriculture, Rabat, Morocco,* 19-23 April.

Bachta, M.S., Elloumi, M.(2005).*Analyse des politiques hydrauliques en Tunisie : quelques éléments d'évaluation. In : les défis de la terre : l'agriculture en Espagne et en Tunisie face aux défis de la libéralisation* .Ouvrage collectif. F.Elloumi M., Gallardo R., Sai M.B., (s/d). Cérés Editions *et* IRESA, Tunis.

Commissariat régionale de développement agricole, Nabeul. (2009). *Rapport annuel*. Tunisie.

Frija, A. (2009). *Efficiency analysis of the irrigation water management institutions in Tunisia*.(ph.D.thesis). Ghent University, Belgium.

Frija, A., Dhehibi, B., Chebil, A., Villholth, K.G (2015).Performance evaluation of groundwater management instruments: the case of irrigation sector in Tunisia. *Groundwater for Sustainable Development*; 1; 23-32.

Gbeibouo, G.A, (2009). Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability: The Case of the Limpopo Basin, South Africa; IFPRI Discussion

Paper; International Food Policy Research Institute (IFPRI): Washington, DC, USA, . Available online: http://Www.Ifpri.Org/Sites/Default/Files/Publications/Ifpridp00849.Pdf

Greene, W. (2012). *Econometric Analysis*. 7thed. New York University, Prentice Hall.

Groupement de Developpement agricole de Diar El Hajjej (2010). *Rapport annuel de la campagne.* Tunisie.

GWP (Global water partnership) (2012), Groundwater resources and irrigated agriculture making a beneficial relation more sustainable, *available at (*(http ://www.gwp.org/Global/the 20% challenge/Resource 20% material/perspectives 20% paper_Groundwater_web.pdf).

Kerrou, J.(2008).*Deterministic and Probabilistic Numerical Modelling towards Sustainable Groundwater Management: Application to Seawater Intrusion in the Korba Aquifer (Tunisia)*. Centre of Hydrogeology of the University of Neuchatel, Stochastic Hydrogeology Group. Ph.D.Thesis, p, 181.

Kouzana, L., Ben Mammou, A., SfarFelfoul, M. (2009). Seawater intrusion and associated processes: case of the Korba aquifer (Cap-Bon, Tunisia). *C.R.Geoscience*; 341 ; 21-35.

Ma, S., Swinton, S.M., Lupi, F., Jolejole-Foreman,C.(2012). Farmers' willingness to participate in payment-for-environmental-services programmes. *Journal of Agricultural Economics*; 63, 604-626

MARH (Ministère de l'Agriculture et des Ressources Hydrauliques). (2007). *Stratégie nationale d'adaptation de l'agriculture tunisienne et des écosystèmes aux changements climatiques*. Tunis.

Pfeiffer. L, C. Lin.(2014). Does efficient irrigation technology lead to reduced groundwater extraction? Empirical evidence. *Journal of Environmental Economics and Management;* 67 (2); 189 – 208.

Pfeiffer. L, C. Lin.(2009). Incentive-Based Groundwater Conservation Programs: Perverse consequences?.*Agricultural and Resource Economics Update*. Giannini Foundation of Agricultural Economics, University of California, 12 (6); 1 - 4.

Quayum, M.A.; Ali, A.M (2012), Adoption and diffusion of power tiller in Bangladesh, *Bangladesh Journal of Agricultural Research*. 37, 307 – 325.

Sattler, C., Nagel, U.J. (2010). Factors affecting farmers'acceptance of conservation measures- a case study from north-eastern Germany. *Land Use Policy*, 32, 134-144.

Tunis International Center for Environmental Technologies (TICET). (2009). *Institutional framework and Decision-Making practices for water management in Tunisia*. Project Report of the CITET, March.

Wang, T., Park, S.; Jin, H. (2015). Will farmers save water? A theoretical analysis of groundwater conservation policies. *Water Resources and Economics*, http://dx.doi.org/10.1016/j.wre.2015.10.002.

Yeboah, F.K., Lupi, F., Kaplowitz, M.D. (2015). Agricultural landowners ' willingness to participate in a filter strip program for watershed protection. *Land Use Policy*, 49, 75-85.

Zghibi, A., Tarhouni, J., Zouhri, L. (2013). Assessment of seawater intrusion and nitrate contamination on the groundwater quality in the Korba coastal plain of Cap-Bon (North-east of Tunisia). *Journal of African Earth Sciences*; 87; 1-12.

Appendix 1. Explanatory variables

Variables	Codification and description
Study region	1 if the farmer is from Bkir, 2 if he is from Elgaraa, 3 if he is from KsarSaad, 4 if he is from El Ayaada, 5 if he is from Htouba, 6 if he is from Boukalouk.
Age	Number of years
Other activities	1 if the farmer has an activity other than agriculture, 0 if not.
Family labour	1 if the number is ≥2, 0 if not.
Irrigated area	Number of hectares
Distance between the exploitation and the domicile of the farmer	Number of kilometers
Cattle fattening activities	1 if the farmer made breeding cattle for the meat exploitation.
Exploitation capital	1 if the farmer has an exploitation capital, 0 if not.
Access to credit	1 if the farmer buys pesticides from a supplier by credit, 0 if not.
Acceptability of the mechanism	1 if the farmer accepts the mechanism in question, 0 if not.
Willingness to accept	it is expressed in dinars.
Salinity of wells captured the aquifer	0 if the salinity is <3g/l, 1 if not
Owned area	Percentage of irrigated land which is owned.
Rented area	Percentage of irrigated land which is rented.
Crops areas (11 variables)	This is including 11 variables, each relatively describing the irrigated area of different cultivated crops (strawberries, tomato, pepper, potato, cereals, pepper between strawberries, fodder, spices, winter strawberries, other crops, and fallow area.
Number of plot	The irrigated area is divided into several parcels.
Accept the mechanism by receiving 200 TND per hectare of potato	1 if the farmer accepts, 0 if not.
Accept the mechanism by receiving 300 TND per hectare of strawberry.	1 if the farmer accepts, 0 if not.
Accept the mechanism by receiving 400 TND per hectare of tomato.	1 if the farmer accepts, 0 if not.
Accept the mechanism by receiving 450 TND per hectare of pepper.	1 if the farmer accepts, 0 if not.