ICARDA

Science for Better Livelihoods in Dry Areas

Biophysical and Econometric Analysis of Adoption of Soil and Water Conservation Techniques in the Semi-Arid Region of Sidi Bouzid (Central Tunisia)

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PLAN OF THE PRESENTATION

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- Objectives of the study
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- Methodology
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  - Model specification and estimation
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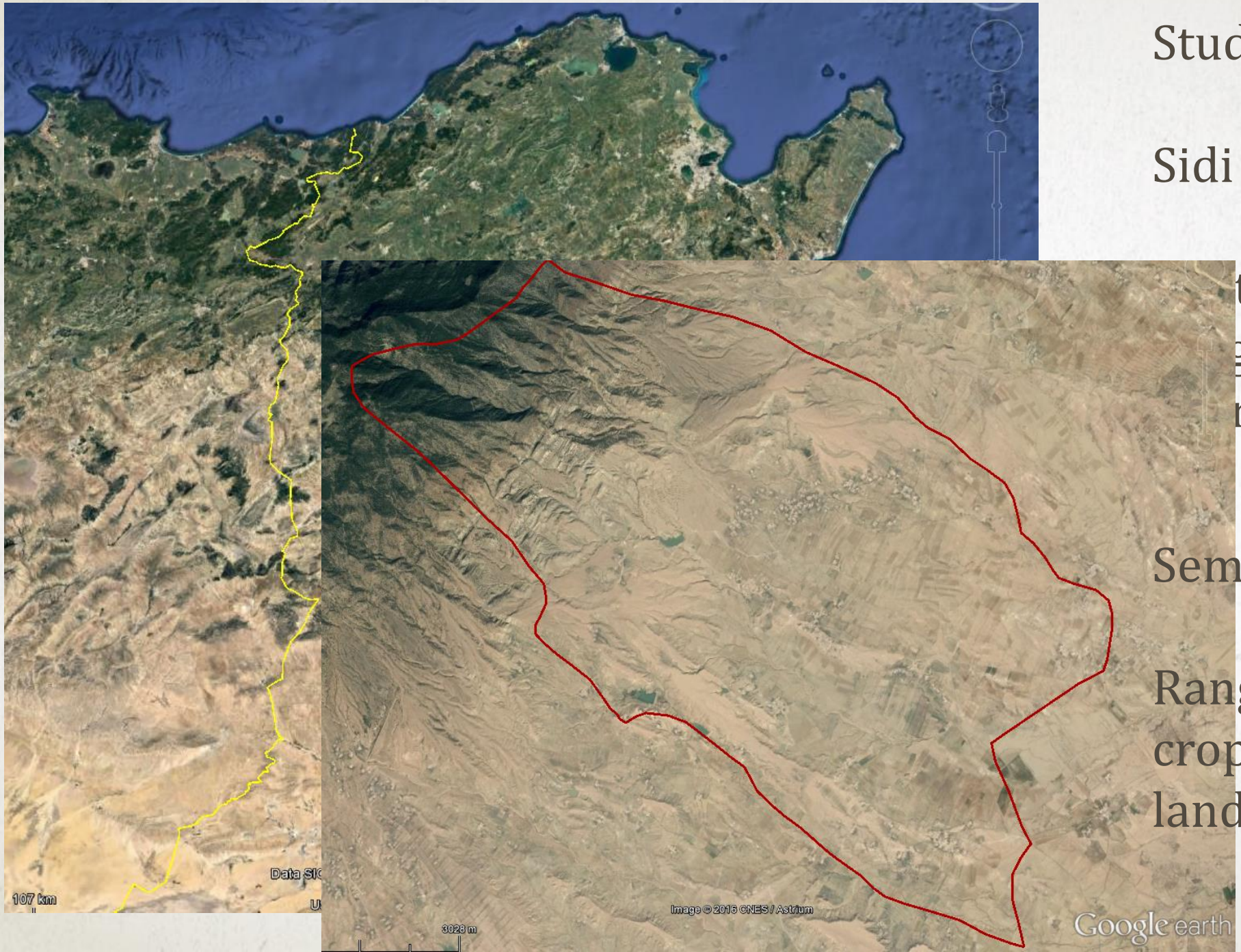
- Conclusions and policy implications

INTRODUCTION

- Land degradation and depletion of natural resources is a major challenge to the sustainability & development of the agricultural sector in Tunisia
- Soil and water conservation technologies (SWCT) are of pressing interest to researchers and policy makers given their role in enhancing soil health and agricultural productivity
- Despite notable (environmental) success, obtained through large scale initiatives undertaken nationally, broad (farmer) uptake has been less than desired
- Relatively poor adoption rates can be ascribed to a number of reasons, but for SWCT, causality is not well identified
- The need to economically examine incentives to adopt SWCT is of immediate importance, in so far as evaluating the impact of adoption within environmentally sensitive areas of Tunisia



Study site

Sidi Bouzid

tral Tunisia
ghmar and Selta
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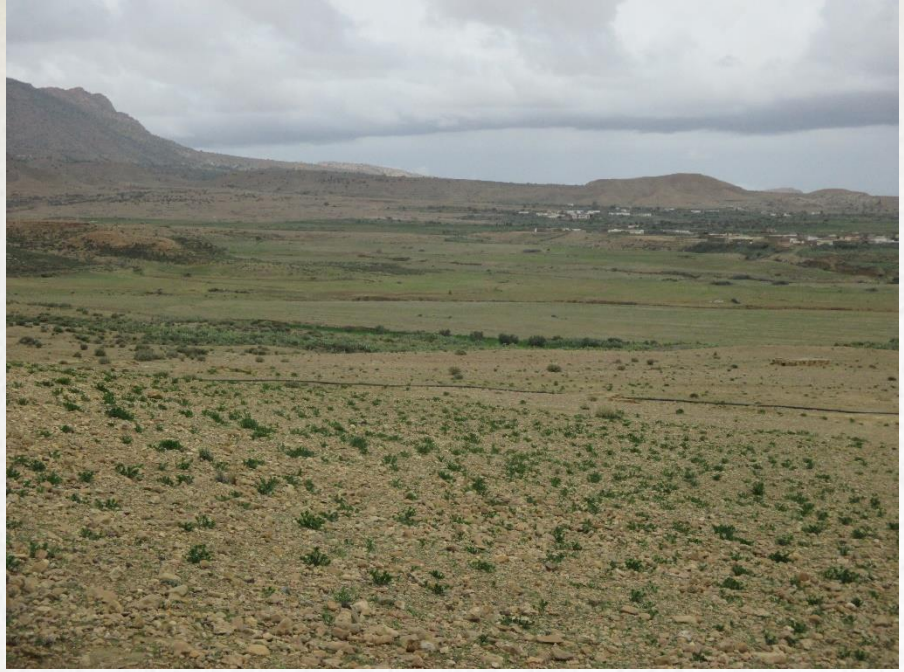
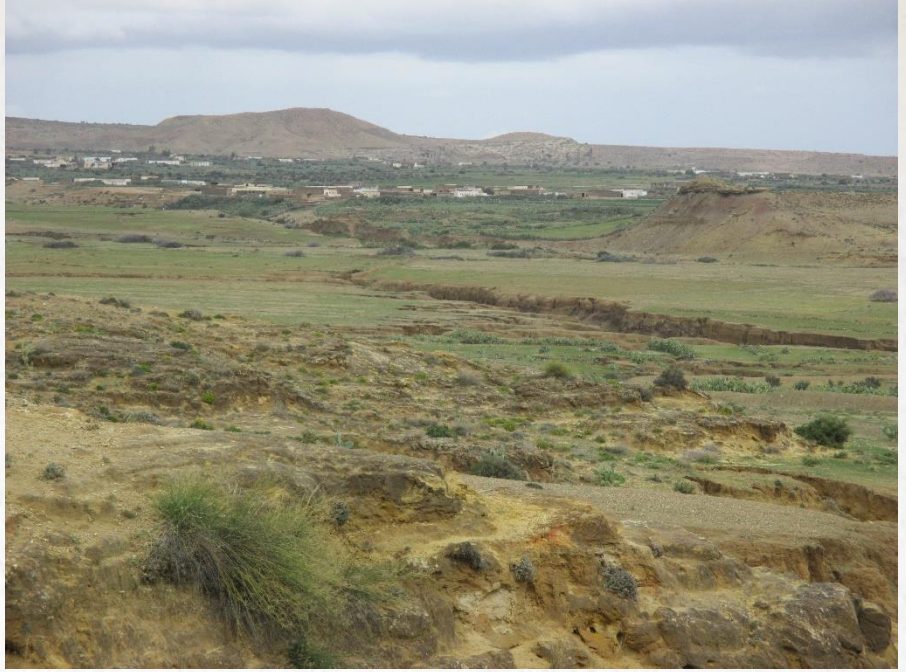
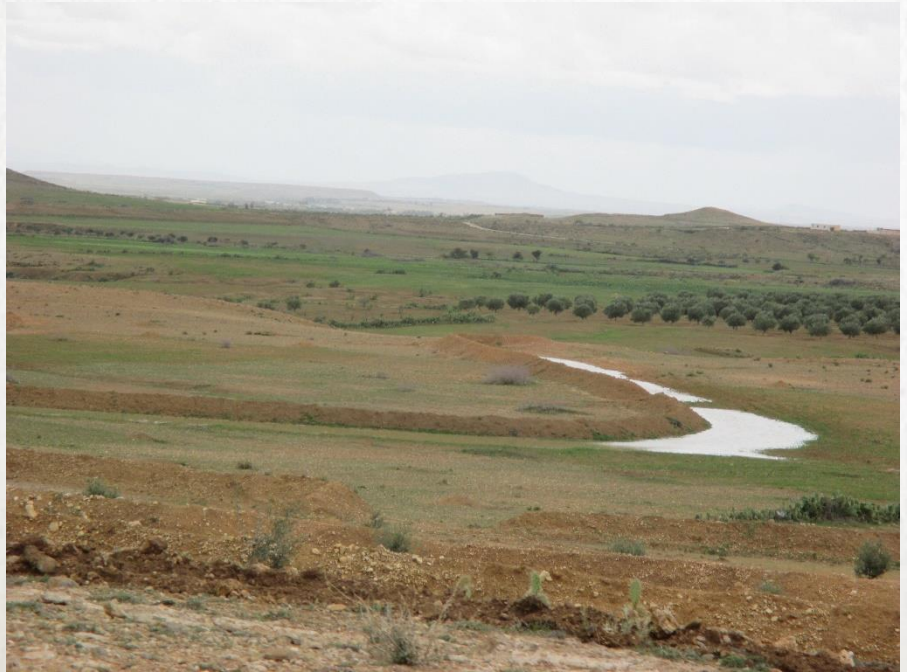
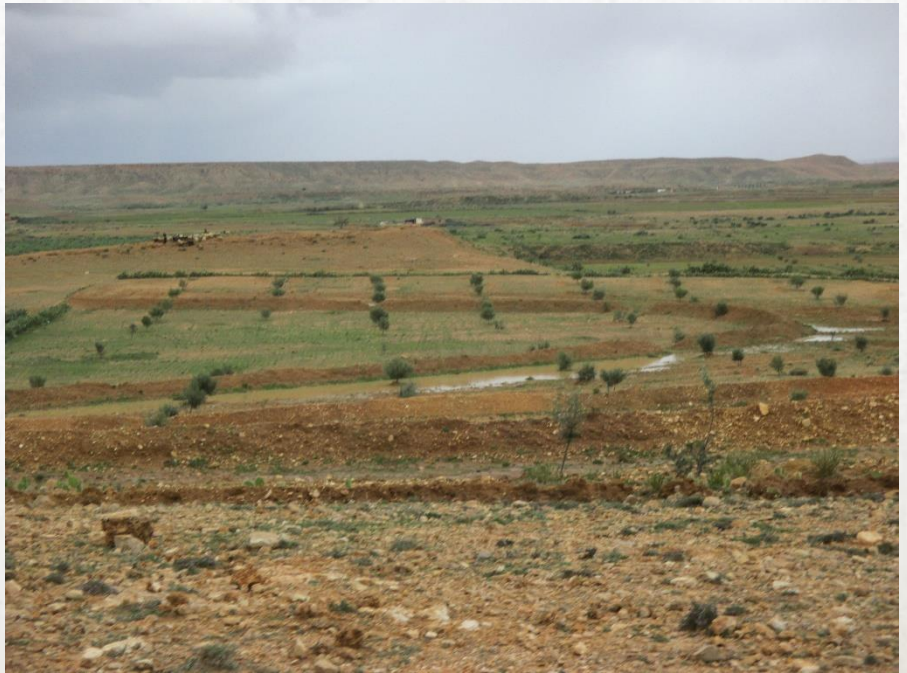
Semi-arid

Rangelands and crops in the low lands









OBJECTIVES OF THE STUDY

- To provide a set of explanations for why many farmers appear hesitant to adopt SWCT
- To identify and analyze the determinants for adoption of SWCT
- To get policy relevant lessons aimed at fostering greater adoption.

RESEARCH HYPOTHESES

The study objectives are based on the following hypotheses:

1. the adoption of the SWCT techniques is influenced by the level of human capital such as age, education, training, membership in farmer's organization and farming experience

2. larger farms are more likely to adopt SWCT

3. the readiness of farmers to adopt soil conservation methods is influenced by the nature of the SWCT (agronomic practices vs physical structures)

RESEARCH METHODOLOGY

Data collection and analysis

- Data were collected through semi structured household interviews in two regions in Sidi Bouzid – Central Tunisia (Zoghmar and Selta), for the 2014-2015 cropping year.

- Sample: 250 producers (97 adopters and 153 non-adopters) located within the chosen regions

- Data was compiled using SPSS (V.20) and analyzed using descriptive statistics and with econometric analyses for the purpose of comparing adoption rates (and factors for adoption) between adopters and non-adopters

RESEARCH METHODOLOGY

Data collection and analysis

Description of the variables specified in the empirical analysis (N=250)

Acronym	Description	Type of measure	Expected Sign
Dependent variables			
ADOP	Whether a farmer has adopted (or not) SWC technology	Dummy (1 if yes, 0 if no)	
Explanatory variables			
#1 – AGE	Household head's age	Years	-
#2 – EDUC	Educational background of the household head	Dummy (1 if the farmer accumulate more than 6 years in education, 0 if less than 6 years)	+
#3 – FSIZ	Number of people within the household	Numbers (#)	+
#4 – FEXP	Household head's farming experience	Years (#)	+
#5 – LABE	Family labor force	Active labor force numbers (#)	+
#6 - TENUR	Status of land ownership	Dummy 1 (1 if fully owned; 0 otherwise)	+
#7 - OFFA	Farmer has an off-farm income generating activity	Dummy (1 if yes, 0 if no)	?
#8 - CRED	Obtained credit / funding	Dummy (1 if yes, 0 if no)	+
#9 - CBOS	Member of a community based organization (CBO)/cooperative	Dummy (1 if yes, 0 if no)	+
#10 - VLIVST	Importance of livestock in the farming system	% of livestock-related income in total farm income	?
# 11 - CONT	Contact with extension	Estimated yearly number of visits of extension agents to the farm (#)	+
# 12 - CapBui	Farmer attendance at training meetings	Dummy (1 if yes, 0 if no)	+
# 13 - LFRA	Land fragmentation	Number of plots owned divided by total land area owned by the farmer (#)	-
# 14 - FSR	Stocking rate	Flock size divided by total land area owned by farmer	-

RESULTS AND DISCUSSION

Soil and water conservation practices within the study area

Soil and water conservation techniques (N=250)

Soil and Water Conservation Practices	Adopters - of at least 1 practice (N=97)*		Non Adopters (N=153)	
	N	%	N	%
Agronomic practices				
Manuring	16	6	234	94
Crop rotation	47	19	203	81
Minimum tillage	3	1	247	99
No tillage	1	0	249	100
Physical structures				
Terraces	35	14	215	86
Soil bunds	3	1	247	99
Stone bunds	3	1	247	99

** 10 farmers adopted two different practices in at least one of their plots, and one farmer adopted three practices.*

RESEARCH METHODOLOGY

Model specification and estimation – Binary Logistic Regression

- Conventional regression analysis (Ordinary Least Squares or OLS) cannot accommodate zero (0) observations on the dependent variable (or dummy variables);
  the failure of OLS to deal properly with such data led to the development of estimators built on the principle of maximum likelihood (MLE)

- Limited Dependent Variable (LDV) models are estimated using MLE; among these, the most common used in Adoption literature are the **logit model** (corresponding to a logarithmic distribution function) and the **probit model** (which assumes an underlying normal distribution)

- The choice of which continuous probability distribution to use cannot be justified on theoretical grounds (Anemiya, 1985)
- In this exercise, we used the **Logit model**

RESEARCH METHODOLOGY

Model specification and estimation – Binary Logistic Regression

- In order to identify and estimate farm and farmer determinants for the adoption of the SWCT technology by means of the **Logit Model** :

A binary logistic regression is to be used to regress the **dependent variable**, **Y**, of whether the farmer had adopted SWC Technology or not, against the estimated factors (**explanatory variables, Xi**) affecting adoption of SWC Technology variables (Liao,1994):

Prob (Y) = Prob (Y=1, i^{th} farmer adopted, and Y=0, otherwise)

$$Y = \begin{cases} 1 : \text{adopted} \\ 0 : \text{otherwise} \end{cases}$$

RESEARCH METHODOLOGY

Model specification and estimation – Binary Logistic Regression

- Let **Xi** represents the set of variables including socio-economic, farming, institutional factors, etc. which influence the adoption decisions of the ith farmer.
- For the farmer, the indirect utility function **Zi** derived from the adoption decision is a linear function of **k** explanatory variables (**X**), and is expressed as:

$$Z_i = \beta_0 + \sum_{i=1}^{n} \beta_i X_{ki}$$

Where: β_0 is a constant term, and $\beta_1, .., \beta_i$ are the coefficients associated with each explanatory variable $X_1, \ .., Xi$.

- The probability $\mathbf{P_i}$ of the ith farmer's adoption decision (Yi=1) is defined as follows

$$P_i = \frac{e^{z_i}}{1+e^{z_i}}$$

- (**1-P_i**) is instead the probability that Yi=0. The ***odds*** (Y=1 versus Y=0) can be defined as the ratio of the probability that a farmer adopts (Pi) to the probability of non-adoption (1-Pi), namely

$$\text{odds} = P_i/(1-P_i)$$

- $\boldsymbol{Z_i}$, the natural log of this ratio, gives the prediction equation for an individual farmer (log of the *odds* ratio in favor of adoption)

$$Z_i = Ln(\frac{P_i}{1-P_i}) = Ln\ odds = \beta_0 + \sum_{i=1}^{n} \beta_i X_{ki}$$

RESULTS AND DISCUSSION

Model selection and adequacy

- The statistical analysis used is binary regression of SPSS 20.0

- The Maximum Likelihood method of Estimation (MLE) was used to draw parameter estimates from the binominal logistic regression model

- The Hosmer–Lemeshow statistic is used to estimate the goodness-of-fit model. A P-value less than 0.05 indicates a **poor** fit for the model. Our model adequately fits the data because the significant P-values is **0.496**

RESULTS AND DISCUSSION

Soil and water conservation practices within the study area

Soil and water conservation techniques (N=250)

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RESULTS AND DISCUSSION

Soil and water conservation practices within the study area

Variables	B	S.E.	Wald	D.f	Sig	Exp(B)
AGE	-0.019	0.015	1.553	1	0.213	0.982
EDUC	-0.038	0.292	0.017	1	0.896	0.963
FSIZ	-0.040	0.049	0.646	1	0.421	0.961
FEXP	0.021*	0.014	2.093	1	0.148	1.021
LABE	-0.031	0.083	0.138	1	0.710	0.969
TENUR	-0.037	0.315	0.013	1	0.908	0.964
OFFA	-0.185	0.321	0.331	1	0.565	0.831
CRED	-0.389	0.530	0.538	1	0.463	0.678
CBOS	1.670***	0.635	6.914	1	0.009	5.311
CONT	-0.004	0.091	0.002	1	0.965	0.996
CapBui	-0.790**	0.439	3.245	1	0.072	0.454
LFRA	0.002	0.016	0.012	1	0.914	1.002
FSR	0.222	0.206	1.159	1	0.282	1.248
VLVST	-1.016**	0.515	3.896	1	0.048	0.362
Constant	0.897	0.812	1.221	1	0.269	2.453

a. Variable(s) entered on step 1: AGE, EDUC, FSIZ, FEXP, LABE, TENUR, OFFA, CRED, CBOS, CONT, CapBui, LFRA, FSR, VLVST.
b. LR chi2(15) 85.844
c. Probability > chi2 0.0000
d. Overall % of correct predictions 66.8
e. Log likelihood 308.078
f. Number of observations 250
g. *** Significant 1%, ** 5% and * 10-15% probability level

FEXP: Household head's farming experience

CBO: Member of a community based organization (CBO)/cooperative

CapBui: Farmer attendance at training meetings

VLVST: Importance of livestock in the farm system

RESULTS AND DISCUSSION

- **Farming Experience (FEXP):** farming experience affects SWCT adoption positively (very weak statistical significance)
- **Farmer membership within CBO's/cooperative (CBOS):** being a member of a community based organization (CBO) or cooperative affects the adoption decision of farmers positively and significantly
- **Farmer attendance at training meetings (CapBui):** The variable is significant and negatively related with SWCT adoption. The result is not consistent with the hypotheses that farmers who have participated to trainings should have a higher probability to adopt
- **Livestock holding (VLVST):** The variable is significant and negatively related with SWCT adoption. The observations that livestock producers would appear to be less keen to adopt conservation practices is consistent with a hypothesis that SWC technologies and conventional livestock rearing practices many not necessarily be compatible

CONCLUSIONS AND REMARKS AND POLICY IMPLICATIONS

These results suggest some main considerations and recommendations:

- There is significant scope for improving farmers' income through **increased use of SWCT**
- There is a need to better provide adequate **incentives**, particularly **technical assistance** to farmers aimed at influencing the adoption of SWCT options.
- There is a need to foster a more pluralistic and dynamic **systems of knowledge generation and dissemination**, to promote effective innovation systems
- Extension services should work closely with farmers and make sure that they are **convinced of benefit** of the activities to be undertaken
- Farmers should be encouraged to join **associations**, through which **training** may be more effectively provided, and within which facilitation of inclusive **access to finance** can be provided