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Factors Influencing Farmers' Adoption of Soil and Water Control Technology (SWCT) in Keita Valley, a Semi-Arid Area of Niger

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Abstract: The Ader Doutchi Maggia in Niger, as with other Sahelian zones, undergoes a process of climatic deterioration, which combines with the growing social and economic needs of the increasing population and causes a general economic crisis. Land degradation due to biophysical factors requires that priority action is given to land reclamation and soil conservation and to activities intended to increase agricultural production. This paper takes a look at socio-economic and established factors affecting the adoption of soil and water control technology (SWCT) in Keita valley, a semi-arid area in the central of Niger. Well-designed questionnaire survey on key agents was used to gather the indispensable data from farm ménages. The binary dichotomous logistic regression model prognosticated six factors to be affecting the adoption of soil and water control technology in Keita. These variables cover the gender of the respondent, age of the household's head, income evolution within the family, small craft referring to off farm income, training provides by local institutions, use of credit and, possession of full rights on land and its resources. The results revealed that diffusion of adoption from local organized community is a good alternative to increase the adoption of soil and water control technology in Keita valley agriculture system in Niger. Researchers and policy makers should conceive proper strategies and agenda reflecting the farmers' interest, position and restriction in advocating new technologies for greater assumption and adoption by the farmers.

Keywords: acceptance; conservation technology; Keita valley; logistic regression; degradation

1. Introduction

According to 2030 agenda for sustainable development, Billions of people continue to live in poverty and are denied a life of dignity, rising inequalities within and among countries, enormous disparities of opportunity, wealth and power [1]. Following the previous report; Theinter-agency and expert group on SDG Indicators [1] developed and agreed to a framework of 17 Goals and up 230 indicators as a starting point at the session of the UN Statistical Commission in March 2016 [2].

Among the 17 Goals; the second, "end hunger, achieve food security and improved nutrition and promote sustainable agriculture" and the goal 15 "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss"; summarized the case faced by most of Sahel countries, even if the goals are inter-related. It was a long process that leads international community to the sustainable development goals.

To meet international regulations on environment, Niger elaborated many texts, among them, the "strategic framework for sustainable land management (CS-GDT) in Niger and its investment plan 2015–2029," within which, an important place is devoted to the actions and activities to combat against desertification. The implementation of these policies and practices that are designed to the realization of human rights such as the right to food and regarding the recommendations related to the Operational objectives of the UNCCD as solutions that will enable a profound and lasting improvement in food security.

Land degradation, mostly soil erosion, soil nutrient reduction and soil moisture stress, is a crucial problem affecting many zones in Niger. This situation threatens country inhabitants particularly those of rural areas. Agriculture, apart from cash crops, is subsistence farming dominated by rain fed cereal crops, especially millet and sorghum, which alone account for nearly 70% of the area annually sown and employs 85% of the Population. It remains largely dependent on climatic hazards and recurrent shocks (drought, flooding and invasion of crop pests) that increase the vulnerability of populations to frequent cyclical food crises. Erosion in Niger is one of the highest in the world. Thunderstorms with high intensity concentrated over 3 to 5 months, Harmattan winds blowing all the rest of the year, unstructured soils poorly protected by sparse vegetation, constitute the agriculture vagary.

The rare results of water caused field erosion are from 1 to 38T ha^{-1} yr^{-1} in traditional practices with a rainfall of 400 to 500 mm yr^{-1}, 2 T ha^{-1} yr^{-1} on fallow to over 4 T ha^{-1} yr^{-1} in traditional plowing without conservative measures under 300 to 400 mm of rain $year^{-1}$ [3,4]. The potential for agricultural land is estimated at 15,000,000 hectares, which is about one-quarter (1/4) of the total area of the country. Cultivated land accounts for 40% of the AUA: (agriculture used area) or about 6,000,000 ha. The irrigable potential is estimated at 270,000 ha of which 20% is hardly developed. Despite a series of droughts and food crises the country experienced (1973, 1984, 2001 and 2005) derived from lots of factors: climate change, Population growth (3.3%) above agricultural growth (estimated at 2.5%); these assets are under increasing pressure [5]. This situation undoubtedly drives to some changes in ecological balance and land degradation; by generating overuse of land, sometimes beyond the actual capacities of ecosystems, which beget a considerable loss of productive potential [6].

In this context, the adoption of soil and water control technologies is imperious to enhance crop yield and ameliorate the livelihoods of farmers [7]. Several efficient soil and water control technologies have been tested through projects and the endogenous knowledge of agriculturists. It is imperative to create favorable conditions so that a greater number of farmers can take advantage of these technologies [8]. Soil and water control technologies can be defined as a reasonable use of land resources, implementation of erosion control systems and practice of suitable cropping patterns to increase soil fertility and reduce land degradation and thereby ameliorate livelihoods of the local communities [9].

The governments of Niger and partners' have initiated, since the beginning of the 1980s, actions to combat the degradation of land and natural resources in the Niger, particularly in Tahoua region. After three decades of implementations, the introduction of new technologies remains lower among farmers. Thus, hence the needs to assess the reasons that explain farmers lack of interest in adoption of SWCT. The study focuses on Keita; this zone attracted national and international opinions during major draughts that hit Niger and, is considered as area who witnessed intense practice of SWCT. The PDR/ADM (Rural Development Project in AderDoutchiMaggia) was a great project, which started after the drought of 1984 and lasted for more than 20 years in AderDoutchiMaggia. They used modern equipment as well as the participation of the local population to try to reverse or at least slow down the effects of desertification in Keita area. The project implemented many activities, especially in the field of fighting against desertification. However, Keita zone still facing food insufficiency issues, despite the huge amount of means invest in the ADM Valley. This is among reasons why we curried out the study.

Commonly, 2 types of conservation methods are found: collective devices which required huge means in terms of financial expenses, human labors and, technical skills to be executed. Thanks to the PDR/ADM (Rural Project of Keita), Keita was able to build plateaus and glacis bunds, windbreak, spreading weirs, dams. The study focused on the individual methods of conservation, which can be performed by farmer alone after few sessions of training, i.e., zaï locally called (tassa), half-moon, fallow, mulching, stone strips, fallow and, tree plantation.

Many studies curried out both by researchers and NGOs concern the assessment of the impact of SWCT in Keita especially on environmental impacts. However, there is no information on appraising the reasons that sustained adoption of SWCT on Keita farmer's livelihood, particularly socio-economic, social and, institutional factors. Considering that fact, this study is intended to revisit sustainable land management technology trough adoption of soil and water control technologies (SWCT) in Keita valley and to investigate how they have improved community livelihood, more particularly on income and food security. Findings on the level to which these aspects influence the adoption of soil and water control technologies can help in the expansion of locally appropriate soil and water control technologies and methods.

2. Conceptual Framework

In countries where natural resources are the principal sources of income, essentially based on an agricultural economy that is largely extensive and where the inputs for the most part are limited to the strict minimum, the overexploitation of natural resources brings about increased poverty among the population, causing immigration to become the only option for survival [10].

Over the past few years, Niger has developed several strategies or action plans among which one of the priorities highlighted concerns the technology of Soil and Water Conservation (SWC). In conjunction with development projects, research institutions and NGOs, the government tests and disseminates techniques and approaches in order to limit the degradation of the environment and minimizing the impacts of climatic constraints on agriculture production by promoting the increase of rainwater infiltration and slow down water erosion [10].

The adoption of the SWCT by the producers is quite weak and generally incomplete (unsuccessful implementation of the measures accompanying the SWC technologies). There are many causes but they often reveal a lack of information on the different technologies available, a lack of technical support to the farmers on the part of the promoters of these technologies, added to inadequate Top-down approaches and insufficient proficiency of the techniques by the technicians and a lack of Appropriate expansion tools.

However, Land degradation and fertility decline are not exclusively caused by population excess and the high use of natural resources [11]. It is a merged effect of anthropogenic and geological factors accompanied by unfitting development programs and policy, technology, as well as a weak comprehension of the possibilities and limitations for adopting soil conservation measures [12], same situations encountered in Kieta.

Adoption of soil and water conservation technology should not be regarded as an end in itself but rather as an iterative decision-making task [13]. Farmers pass through many testing and assessing stages from appreciation of the issue and its potential solutions and eventually choosing whether to adopt or reject the specific technology. Acceptation of new technology usually passes by way of four different steps; include consciousness, profit, appraisal and finally acceptance. At each stage, there are various constraints (social, economic, physical, or logistical) for different groups of adopters. In Niger, the adoption of soil and water conservation technology at farm level is little and it is apparent that there is gaps between what technicians see as necessary and what the farmers are prepared to do in the field [14]. Adoption is complex and commonly requires some income, profit and institutional support.

Farmers' adoption of SWCT Practices is determined by synergic effects of household socio economic habits, resource handiness, physical features of the land and institutional support provided by the public or NGO sector [14,15]. It is important to appreciate the interconnection between these factors and the procedure of adoption of new technology to increase farm production and sustainable land management. It is known that the farmers will compare the benefits and rightness of different soil conservation technologies, founded on the available assets at their disposal and their chance for profit. Therefore, the conceptual framework of the adoption of SWCT practices in this paper follow the principal of absolute and comparative advantage to farmers in association with some guide of the particular, socio-economical, institutional and biophysical features. The empirical binary logistic regression model explains the elements that affect the choice of farmers to adopt or not the soil and water conservation technologies.

Soil erosion is a crucial issue, leading to environmental degradation, lower yield and ultimately increasing the poverty of keita farmers. This is a plausible scenario and fits well with reports of deforestation and soil erosion in the ADM region. However, the question of whether farmers are aware, especially about erosion on rain fed agricultural land in the Keita hilly zone, demands critical review. Many studies indicate that the amount of soil erosion is important; the greater part of transported sediment comes from stream and riverbank cuttings and erosion from increased runoff associated with roads, footpaths and settlements. What is the effectiveness of soil and water control measures adoption by farmers to reduce soil erosion and what is the level of the adoption?

3. Method and Material

3.1. Study Area

Keita department is 72 km Southeast distant from Tahoua the regional capital of Ader and is composed of 1 urban district (Keita) and 3 rural districts (Garhanga, Ibohamane and Tamaské) as shown in Figure 1. The department covers an area of 4862 km^2 and populated by 323,794 inhabitants. Nearly 298 administrative villages, neighborhoods, hamlets and, encampments made up the 4 districts. A density of 67 inhabitants per km^2, the population rate of growth is 2.4% [16]. The Keita valley represents a border that separates the Sahel and the Sahara Desert. Home of a multiethnic community composed by peasants coming from Southern regions and nomads from the North.

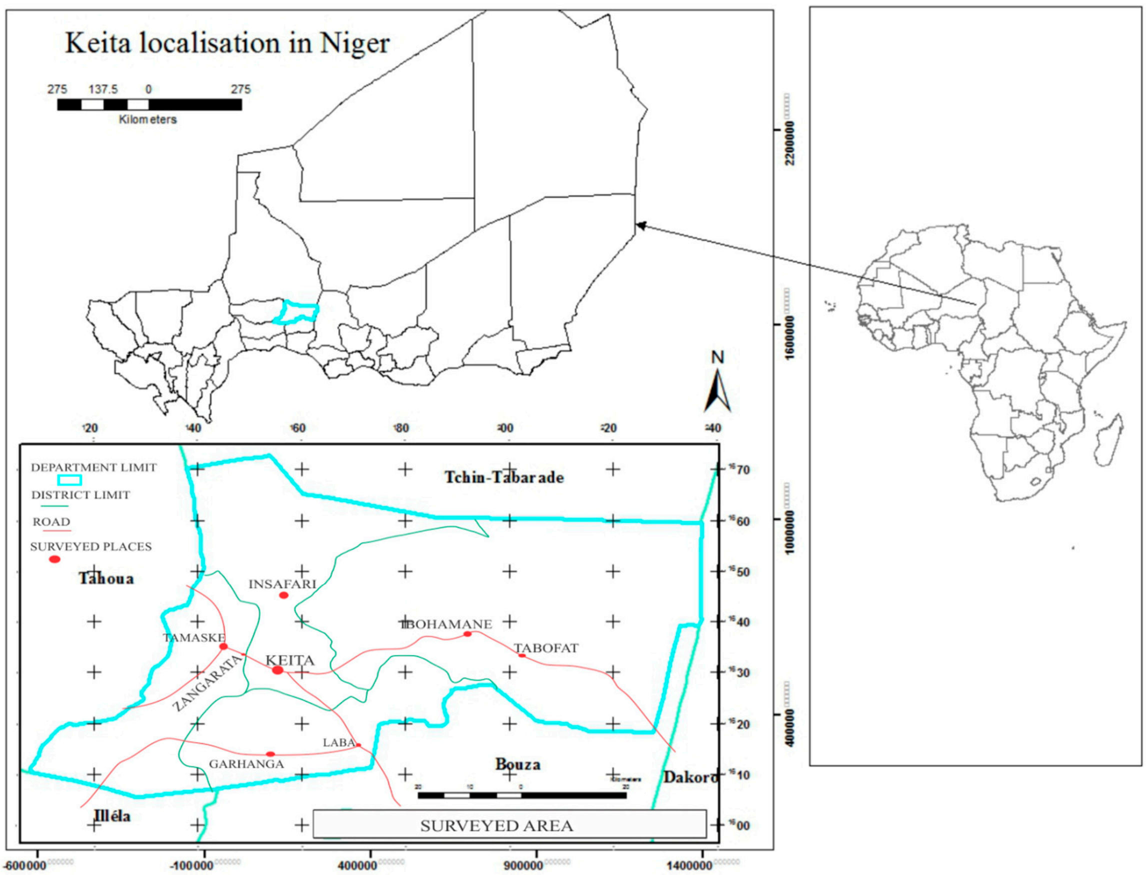

Figure 1. Localization of the study area.

The department of Keita is one of the six (6) departments that form the region of Tahoua in central Niger. Climate typically Sahelian is hot and dry. Located in ADM (AderDoutchiMaggia), Keita is composed of a plateau with rocky slopes and valleys, forming a complex system of watersheds subject to strong winds and water erosion. The Soudan Sahelian climate with a short rainy season (June–September) and a yearly average between 400 and 500 mm represents one of the main limiting factors due to the intra-annual and inter-annual variable rains. Between 1960 and 1990 a decrease of yearly average rainfall was observed, particularly during the month of August, with a latitude shift of 30 km from Northeast to southwest [17].

3.2. Sampling

3.2.1. Data Collection

The study focuses on Keita areas; to have an effective data on SWCT adoption (Keita is one of the areas who benefited of SWCT from government and international funds since the 1984 famine). Most of the households were involved in SWCT implementation; close to them, certain households did not benefit of SWCT on their farms. Primary data collected by employing household questionnaire survey, key informant interviews were all applied to collect detailed information on the adoption of soil conservation technology and cropping patterns by local farmers. Likewise, information about personal characteristics of the farm household head, the knowledge of soil and water conservation technology, farm management practices, crop yield, role of different institutions to improve farming and adoption of improved and indigenous soil conservation technologies, such as half-moon, Zai, stone trips, fallow, dunes stabilization and mulching, were collected through individual interviews by using a structured questionnaire. In this study, the head of the selected households was interviewed using a stratified questionnaire, which covers a personal, social, economical, institutional and land resource management issues in the SWCT practice. Farmers pass through diverse practices and trying out dais from understanding of the problem and its possible solutions and eventually deciding to adopt or refuse the suggesting technology.

3.2.2. Survey Process

8 villages were sampled based on SWCT activities curried out within the department. The historical profile encourages respondents to describe the evolution of a present situation, taking into account its past, the respondents must imperatively know the situation of the village before SWCT activities. About natural resources for example, they are invited to describe the past, the present and, the dynamics of these resources taken one by one: land, vegetation, agriculture, etc. Production systems, food security and, the state of nutrition, local capacities of peasants and their perceptions of the SWCT are factors that could impact adoption or not. Four (4) well trained data collectors carried out the survey. Supplementary qualitative data, such as changes in soil preservation practices and harvesting patterns over time, adoption of indigenous and improved soil conservation technologies and role of local level institutions in the promotion of SWC technologies/practices were collected. Eight key informants were involved (1 per commune or district and 1 per village within the district) to provide general information on surveyed places. About 20 sample respondent households (among them 12 adopters and 8 non-adopters) in Keita, head of urban commune. Follow the rural head of commune with 19 sample respondent households (among them 13 adopters and 7 non-adopters). Subsequently, 18 sample respondent households (among them 12 adopters and 6 non-adopters) in each village within commune were selected by simple random technique interviews. The sample was sized compare to the importance of the population, that why Keita commune has the biggest sample compare to other communes (see Table 1).

Secondary data source includes journal articles, research reports and other publications, including internet sources of information on Keita and the topic.

Table 1. Repartition of sample.

	Adopters of SWCT	Non-Adopters of SWCT	Total
Urban district of Keita	12	8	20
Insafari	12	6	18
Rural district Tamaské	13	6	19
Zangarata	12	6	18
Rural district Ibohamane	13	6	19
Tabofat	12	6	18
Rural district Garhanga	13	6	19
Laba	12	6	18
Total	99	50	149

4. Data Analysis

Quantitative information compiled from household's interviews was analyzed using Statistical Package for Social Sciences (SPSS version 20). Frequency tables for general information, t-tests to compare the mean differences between adopters and non-adopters, Chi square tests to analyze categorical data, correlation and cross tabulation method were used to identify inter dependence among various factors affecting the adoption of soil and water conservation technology and binary logistic regression was applied to check if the degree of relationship between independent and dependent variables impact the adoption of soil and water control technology. Qualitative data gathered from key informant surveys was treated and used to supplement the quantitative information.

Binary logistic regression model was developed to assess the personal, social, economic, institutionalfactors influencing the adoption of SWCT in this study [18]. A regression model and its binary outcomes, helps the researcher to explore how each explanatory variable affects the probability of the occurrence of events [19]. This model helps to explore the degree and direction of the relationship between dependent and independent variables in the adoption of improved soil conservation technology at the household level. The logistic regression model is an appropriate statistical tool to determine the influence of independent variables on dependent variables when the dependent variable has only two groups. In the logistic model, the coefficients are compared with the probability of an event occurring or not occurring and bounded between 0 and 1 [20]. The dependent variable becomes the natural logarithm of the odds when a positive choice is made. The odds ratio and predicted probability of the independent variables indicate the influence of these variables on the likelihood of adoption of improved technology if other variables remain the same. Hence, if the estimated values of these variables are positive and significant, it implies that the farmers with higher values for these variables are more likely to adopt soil and water conservation technology.

The model is specified as [18]

$$\ln(\mathrm{Px}/(1-\mathrm{Px})) = \beta_0 + \beta_1 \cdot \mathrm{X}_{1i} + \beta_2 \cdot \mathrm{X}_{2i} + \ldots + \beta_k \cdot \mathrm{X}_{ki}$$

where, the subscript i is the ith observation in the sample, Px is the probability of an event occurring for an observed set of variables X_i, i.e., the probability that the farmer adopts the improved technology and (1 − Px) is the probability of non-adoption. β_0 is the intercept term and $\beta_1, \beta_2, \ldots, \beta_k$ are the coefficients of the explanatory variables $X_1, X_2, \ldots, X_k$.

4.1. Dependent Variable

The dependent variable for the adoption model indicates whether or not a household has adopted improved soil conservation technology ("adopt" versus "not-adopt").

Adoption of soil and water conservation technology was defined as a binary variable with a value of "1" for farmers who adopted soil and water control technology or adopters; a household who has adopted at least one improved soil conservation technology, either as recommended by extension workers or with some modification, was defined as adopter. These technologies include adoption of

Zai, half moon, stone strips, bunds, fallow, wind break, mulching include, spreading weirs, plantation of shrubs and trees. "0" was assigned to households "non-adopters" who do not use any SWCTs.

Soil and water conservation technology is influenced by personal, social, economic and, institutional factors. These variables were considered as explanatory variables or independent variables in this paper.

4.2. Independent Variables and Expected Impact on Adoption

Acceptance of soil and water conservation technology in Keita valley farming is a perplexed process comparable to the other study in farming technology adoption [21] that may be affected by a series of interrelated personal, social economical, institutional and biophysical factors.

Household characteristic variables include gender, age, education, size of household.

Gender is a dummy variable that particulars the gender of the adopter (1for male and 0 for female). In male lead communities, such as in the rural valley of Keita, it was assumed that male headed HHs are more likely to adopt SWCT than female headed HHs. Education level measures the level of education of the respondent (1 for primary, 2 for secondary and 3 for college). A respondent higher educated is more likely to adopt SWCT than less educated respondent [22], so it was supposed that education level is positively associated to SWCT adoption. Considering the age of the HH head, earlier study reveals the younger the HH head, the higher the expectation of applying SWCT [6]. FHSIZE measures the size of the household (number of persons living in the household). Farming is a highly labor intensive activity [23]. Since family labor is the major source of labor in rural household, wide families would be expected to opt for the SWCT. However, large families are also more likely to face lower per-capita land availability and high dependency ratios for food requirements. They may thus prefer to extend cultivated area to satisfy food demands rather than putting land under trees to the detriment of food crop area. It was supposed that FHSIZE negatively affected the adoption of SWCT [22].

Socio-economic activities include cash crop income evolution in HH (CCNI), LAND AREA corresponds to the size of field area in hectare (Ha), SMALL CRAFT is off-farm income generated in HH, EMIGINCOME referred to income from emigration. We supposed that farmers with income from cash crops (CCNI) are more likely to adopt SWCT. SMALL CRAFT or off-farm incomeis a continuous variable that measures farmer's capacity to invest in sustainable land management, it concerns any household activities without relation to farming. There is a negative relationship between off-farm income and farmer's adoption of SWCT [23]. However, some findings [22], pointed out the fact that, nonagricultural incomes may allow farmers to reach capital costs needed for SWCT adoption. We hypothesized that SMALL CRAFT income encouraged farmer's acceptance of SWCT. SMALL CRAFT is supposed to positively affect the adoption of new technologies.

EMIGINCOME is a variable, which measures evolution of emigration income in dollars ($). Keita valley is an emigration area; during the off farm period, young people emigrate to coastal countries for working or small business, in general they return to village at the beginning of raining season. It is during the time spend abroad that SWCTs are trained and implemented, so their absence is a handicap factor more than a benefice engendered by the money they send to village, which is used to supply households with food. EMIGINCOME may impact negatively the adoption of SWCTs, thus EMIGINCOME is assumed to have negative relationship with SWCTs adoption; Although, HH income implies the ability to invest in technology and to bear the risk associated with its adoption [24].

Institutional characteristic is composed of local organizations (LOCALORG), access to credit (ATC), possession of full rights on land and its resources (LANDRRs) and Farmers Knowledge on SWCT (SWCTKNLGE). Community based organizations are involved in natural resources management and community development in the study area: Local Council of Management (CVGT: conseilvillageois de gestion de terroir) implemented by an NGO, Integrated Project Keita (PIK: Projetintgré Keita). We assumed a positive link between LOCALORG and the adoption of soil and water technologies. ATC is a dummy variable, which measures the credit availability to the Farmers.

Credit availability for farming can help rural HHs increase their production and consumption [23]. Farmers with chance to contract credit are more likely to use it in improving their plot production, that the reason we assumed positive relationship between ATC and the adoption of SWCT.

LANDRRs is a dummy variable used to measure the possession of full rights on land and its resources by farmers. The incentives to invest in productivity of land without the perspective to get some future return from investing in the land are not likely to encourage farmer to invest. Thus, farm owners/users cannot bear the accompanied costs and will not take action [25]. The most notable factors affecting incentives might be the security of tenure. In Niger the Rural Code was set to integrate customary systems into formal laws [26]. It sought to provide land tenure security, to organize and manage rural lands and to plan and manage natural resources [25,27]. We assumed that LANDRRs would positively affect adoption of SWCT.

SWCTKNLGE is farmer's knowledge related to soil and water control technology; some studies found that soil and water conservation are often key component of indigenous farming, non-indigenous observers might not "see" those techniques. In many cases, local users may be aware of certain new technologies, e.g., water harvesting or mulching but might lack incentives or the financial means necessary to apply them [28]. Disincentives may include feelings of exploitation, e.g., through extraction of surplus from landlords or the state, high production risk through price volatility, or other external factors [25]. Thus, SWCTKNLGE would also be expected to exert a positive influence on adoption of SWCT.

4.3. Multicollinearity Test

Before running the logistic regression analysis, the existence of Multicollinearity between the descriptive variables were examine using multivariate correlation analysis to minimize the co-linearity of independent variables; and variables with $r \geq 0.5$ are excluded from the model [17]. Education, family size, income evolution in HH, land area size, income from migration and, farmer knowledge on SWCT were excluded from the analysis because of the high degree of correlation.

Finally, out of 12 descriptive variables (Table 2), six independent variables were identified by the model to be significant to the adoption of soil and water control technology (Table 2).

Table 2. Description and summary statistics of HH (household) used in binary Logistic regression (N = 149).

Variables	Description	Adopters Frequency	Non-Adopters Frequency	Type of Variables	Significance	Assumptions
ADOPTION	Dependent variable: benefited from Soil and Water Control technology	n = 99	n = 50	Dummy, 1 if adoption, 0 otherwise	–	
HH characteristics						
GENDER	Sex of the HH head Female Male	 49 50	 16 34	1 for male and 0 for female	0.042 ^{b}	+
AGE	Age of the HH head	37	32	Continuous	0.000 ^{a}	+
EDUC	Education level of the household head	2	1	Continuous	0.740	–
FHSIZE	Number of person living in HH	8	4	Continuous	0.927	–
Socio-economic activity						
CCNI	Cash crop income evolution in HH, $	66	44	Continuous	0.806	–
LAND AREA	Area in Ha (hectare)	3	1	Continuous	0.538	–
SMALL CRAFT	Off farm Activities of the household in HH $	66	44	Continuous	0.004 ^{b}	+
EMIGINCOME	Evolution of income from emigration $	66	44	Continuous	0.214	–

Table 2. *Cont.*

Variables	Description	Adopters Frequency	Non-Adopters Frequency	Type of Variables	Significance	Assumptions
Institutional characteristic						
LOCALORG	Whether local organizations provided training in SWCT or not	66%	34%	Dummy	0.001 [b]	+
ATC	Availability of credit to farmers	66%	34%	Dummy	0.000 [a]	+
LANDRRs	possession of full rights on land and its resources	66%	34%	Dummy	0.000 [a]	+
SWCTKNLGE	Farmers Knowledge on SWCT	66%	34%	Dummy	0.000 [a]	+

Continuous variable use *t*-test and Dummy variable use x^2 test at [a] 1% level of significance and [b] 5% level of significance respectively. $1 = 553 XOF (franc CFA).

5. Results and Discussion

This portion is composed of two parts. The first one studies mainly the descriptive analysis considering socio economic aspects of farmers, farmers' acceptance of different improved soil and water control technologies and driving factors to adopt soil and water control technologies. The second part will address econometric analysis (binary logit model), used to determine the main constituents that govern adoption of SWCT in Keita valley.

Socio-Economic Attributes of Farmers and Driving Factors for Adoption

Likewise, chi-square tests revealed that respondent income evolution, access to credit income from emigration were significantly higher among adopters compared with non-adopter farmers (Table 2). Out of 149 households analyzed in this study, 66% were adopters.

Respondents reported some factors as reasons of their adoption of SWCT. Among these can be mentioned sharing of knowledge and watching of surrounding' fields, farm output, accessibility of expert and funding support from NGOs, training provided by local organizations which influenced their decision making on the adoption of soil and water control technologies.

Among farmers who accepted to practice soil and water control technologies, 59% were incited by watching their neighbor's practices and sharing their knowledge about the gains of adoption. It fits the theory on the Innovation Diffusion, which supports that an innovation is communicated through certain channels over time among the members of a social system [29]. During the group discussion, a local woman told, "If new technology can increase farm income and it is easily manageable then I am motivated to adopt the recommended technology." Likewise, up to 11% of farmers answered that the Soil and water control technology raised their farm crop yield and gave useful outcome from the same farm land and therefore they were convinced to practice it. About 30% replayed by saying that the material or financial assistance supplied by the international organizations and NGOs inspired them to practice the soil and water control technologies [30].

The binary regression model [31,32], was used to address factors which significantly affected the acceptance of soil and water control technology in Keita valley, features such household characteristics of the farmers, socio-economic factors such as the resource availability of the farmers and institutional factors (Table 2). These factors are predicted perfectly in the model where the Hosmer and Lemeshow Test: Sig = 0.000 at df 12; percentage of right prediction = 66.4; sample size = 149 (Table 3).

The logistic analysis of our assumption made on gender of the household head, was negatively significant. The variable is significant at ($p < 0.05$) and negatively correlated with SWCT adoption. Thus, the households with male as head are less likely to adopt the SWCT [33], in the majority of villages; almost all able-bodied men had migrated to places where they could find an occupation from which to support themselves and their families. As migration area, most of Keita men move to cities or boarding countries to find jobs. The odds ratio of 1.984 insinuates that, holding all other independent variables constant, the odds of adopting SWCT decreases by a factor of 1.984 as gender increases, which contrasts to our assumption.

Table 3. Analysis of determinants using Binary Logistic model.

Variables	β	Sig.	Exp(β)
GENDER	−0.734	0.044 [b]	1.984
AGE	−0.817	0.000 [a]	1.901
FHSIZE	−0.036	0.886	2.682
EDUC	−0.040	0.738	2.678
CCNI	−0.031	0.860	2.687
LAND AREA	−0.244	0.154	2.474
SMALL CRAFT	1.964	0.009 [c]	5.338
MIGINCOME	10.275	0.999	27.930
LOCALORG	−0.212	0.000 [a]	2.506
ATC	−0.683	0.000 [a]	2.035
LANDRRs	−0.265	0.000 [a]	2.453
SWCTKNLGE	0.007	0.954	0.019

Note: [a] Significant at 0.01, [b] Significant at 0.05, [c] Significant at 1; Hosmer and Lemeshow Test: Sig = 0.000; percentage of right prediction = 66.4; sample size = 149.

Age of the Household Head, the variable is significant at ($p < 0.01$) and negatively correlated with SWCT adoption. The result suggests that older farmers are less likely to adopt SWCT practices. Age had a significant negative effect on adoption. This may be described by the fact that older farmers have a short planning horizon in contrast to younger farmers. This joins the findings of [23,30], who described that older and more experienced peasants were more likely than their younger fellows to identify soil degradation. However, they were less likely than their younger colleagues to face the problems once recognized, as in Burkina Faso and northwestern Ethiopia. The odds ratio of 1.901 suggests that, holding all other independent variables constant, the odds of adopting SWCT decreases by a factor of 1.901 as Age increases. The variable age contradicts our positive prediction of age about on adoption.

In the study, SMALL CRAFT represented off-farm income that household may have for living apart farming activities. The variable is significant at ($p < 0.1$) and positively correlated with SWCT adoption. The positive and weakly significant result of SMALL CRAFT demonstrates that households with SMALL CRAFT as off-farm income are more likely to adopt the technology of SWC. Furthermore, Households with off-farm income can invest higher sums of money in the adoption of soil and water control technology as they have a constant source of income as was found previously [34,35]. The odds ratio of 5.338 indicates that holding all other explanatory variables constant, for every one unit increase in the SMALL CRAFT score, we expect a 5.338 times increase in the log-odds of adoption.

The coefficient of local organizations (LOCALORG) variable is negative and statistically significant at ($p < 0.01$) for soil and water control technology adoption. The results show that farmers who received training from local organizations are less likely to adopt of SWCT. This may be explained by the fact that farmers are more linked to their ancestral practices; consequently, the trend of adoption diminishes. The odds ratio of 2.506 indicates that holding all other explanatory variables constant, for every one unit increase in the LOCALORG score, we predict a 2.506 times decrease in the log-odds of adoption.

Despite its significance at ($p < 0.001$), the coefficient access to credit variable is negative; suggesting that, farmers who had access to credit from financial institutions are less likely to invest in the adoption of soil and water control technology. This situation may be explained by the high risk to invest in SWCT and the borrowed money has to be reimbursed by any means. The odds ratio of 2.035 indicates that holding all other explanatory variables constant, for every one unit increase in the access to credit score, we await a 2.035 times decrease in the log-odds of adoption.

Farmer's full possession of rights on land and its resources is significant at ($p < 0.01$) and positively correlated to soil and water control practices adoption. However, we found that farmers with full possession of rights on their land are less likely to adopt the SWCT. The odds ratio of 2.453 indicates that holding all other explanatory variables constant, for every one unit increase in the LANDRRs score, we predict a 2.453 times increase in the log-odds of adoption.

6. Conclusions

This study defined the factors that influence the adoption of soil and water control technologies and their variants in the valley of Keita, AderDoutchiMaggia zone. The analysis of soil and water control adoption in Keita leads to the following results. Among all the explanatory variables, include in the binary logistic model for which we were expecting positive relationship, only SMALL CRAFT and LANDRRs meet our predictions with the adoption of soil conservation practices. The econometric analysis showed that gender, age, training on SWCT from local organizations, having access to credit do not have any relationship with SWCT adoption thus, farmers' practice of SWCT is no matter concern to those previous variables as indicated by their coefficients. However, adoption is more influenced among farmers with SMALL CRAFT and, farmers who have possession of full rights on their land, although food sufficiency meet our assumption, it is negatively correlated to SWCT adoption.

These findings guide us to the following recommendations towards the authorities and non-governmental organizations involved in rural development. First, assistance staffs should work close with peasants and ensure that farmers are convinced of the benefits of the introduced innovations; second, farmers should be motivated to unit together in organizations through which experience, help and share of knowledge are accessible. In specific, facilitation to farmers access to small credit.

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