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Water and soil conservation techniques and food security in the northern region of Burkina Faso

Sita Sanou[1*], Augustine Ayantunde[2] and Aimé Joseph Nianogo[3]

[1]Institut de l'Environment et de Recherches Agricoles (INERA), Animal Production Department, Ouagadougou, Burkina Faso.
[2]International Livestock Research Institute (ILRI), Ouagadougou, Burkina Faso.
[3]Nazi BONI University (UNB), Institute of Rural Development, Bobo-Dioulasso, Burkina Faso.

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Food insecurity is a major challenge facing the rapidly growing population in the sub-Saharan Africa and it is a common feature in the northern region of Burkina Faso. The focus of this study was to investigate the prevalence of food insecurity in the northern region of Burkina Faso after many years of implementation of water and soil conservation techniques. A survey was carried out in six villages in the Northern Region of Burkina Faso involving 300 households to assess water and soil conservation techniques, and to examine the prevalence of food insecurity. The study was conducted between June and July 2015. Data collected was analyzed using logistic regression to identify factors influencing food insecurity in the study areas. The results also showed a high level of food insecurity affecting a large proportion of the population even during the post-harvest period when food was supposed to be available. Results showed that water and soil conservation techniques and household head education level were important factors in determining household food insecurity status. Despite the application of these techniques, food insecurity is still persistent, which raised questions about the efficiency of current agricultural production systems. In addressing food insecurity in the study area, it is necessary to reinforce the practice of combining stone bunds and inter-row ridges techniques along with proper use of fertilizer and manure. Given the persistent problem of water scarcity in Burkina Faso, and the relationship between water and food security, there is need to increase investment in water management infrastructures.

Key words: Mixed crop-livestock systems, water and soil conservation techniques, food security, Burkina Faso, Sahel.

INTRODUCTION

Water and soil conservation techniques are commonly practiced by farmers in the northern region of Burkina Faso in coping with the problem of land degradation. After several decades of application of these techniques, studies had proven their effectiveness by enhancing regeneration of the vegetative cover, improvement of

*Corresponding author. E-mail: zouwiss@yahoo.fr. Tel: +226 70 73 80 33.

water infiltration in the soil, and increasing crop yields (Zougmoré et al., 2003; Zougmoré et al., 2004; Kiema, 2008; Zougmore et al., 2002; Liu et al., 2015).

In years of average rainfall, crop yields could increase by 63-74% on farms using stone bunds (Sawadogo, 2011). The increase in crop productivity should normally lead to an improvement in household food security in the region –as higher yields often improve household food security (Sawadogo, 2003; Sinyolo et al., 2014). Most cereal crops (80-85%) were produced for domestic consumption, as cereals account for up to 67% of the calorie content of the Burkinabe's diet in the rural areas (Sawadogo, 2011).

Water and soil conservation measures had been advocated in the past 40 years in Burkina Faso to improve cereal production and consequently food security (Douxchamps et al., 2014). However, there was little or no data on the effect of the application of water and soil conservation techniques on food security in the northern region and on the factors that influence the prevalence of food insecurity. In Burkina Faso, many households experience chronic seasonal and transitory food insecurity (Sawadogo, 2011). A study conducted by the Ministry of Agriculture and Water Resources in 2008 (MAHRH, 2009) showed that 57.7% of the households in northern region were at risk of food insecurity. The availability of information on the determinants of food insecurity can better inform identification of strategies and targeting of interventions to address this challenge. The present study was conducted to partly address the knowledge gap by focusing on the prevalence of food insecurity in households practicing water and soil conservation techniques.

MATERIALS AND METHODS

Study site

The study was conducted in the northern region of Burkina Faso (Figure 1). The six villages involved in this study were part of the "climate smart" villages of the CGIAR Climate Change, Agriculture and Food Security (CCAFS) program (Somda et al., 2014). The climate of the region is Sahelo-Soudanian with a long dry season aggravated by a Saharan wind, the harmattan (Roose et al., 1995). Average annual rainfall ranges from 400 to 800 mm. Its spatial and temporal distribution is uneven, with heavy rains at the onset of the season causing soil erosion (Sawadogo, 2011). The soils are in a state of advanced degradation because of the imbalance of nutrients and organic matter caused by the extensive cropping and overgrazing of rangelands (Roose et al., 1993). In addition, these soils are often intensively used with little application of animal manure, resulting in low crop yields (Ouedraogo and Ripama, 2009).

Household survey

This study was conducted in six villages in Northern region of Burkina Faso between June and July 2015. Fifty households were randomly selected in each village giving a total sample size of 300 households. A semi-structured questionnaire was administered to characterize socio-economic profiles of the households, and water and soil conservation practices. The questions focused mainly on the use of water and soil conservation techniques and the effect on household food security. In addition, a section of the questionnaire included household food security status. Only household heads were interviewed because all important decisions are often taken by them (Abdullah et al., 2017).

Measurement of food insecurity

The food security status was measured using Household Food Insecurity Access Scale (HFIAS). The method is based on the idea that the experience of food insecurity (access) causes predictable reactions and responses that can be captured and quantified through a survey and summarized in a scale found to be universal across cultures (Tshwene and Oladele, 2016). Household food insecurity access scale was based on measure of severity of food insecurity. For this measurement, the respondents were directly asked about their experience regarding food access during the four past weeks (Table 1). For this study, we used a food insecurity scale based on the work of Coates et al. (2007). This scale of nine indicators provides valid and reliable estimates of the severity of food insecurity for the concerned population, through response to nine questions on access to adequate food. For each answer, a score was assigned (Table 1). From the score of response to the different questions, respondents were classified into different degrees of food insecurity: severe food insecurity, moderate food insecurity, mild food insecurity and food security (Coates et al., 2007). To perform the logistic regression analysis, the groupings were merged into two categories – food secured and non-food secured (MAHRH, 2009). The different levels of food insecurity were obtained by consulting the scores according to Coates et al. (2007) in the following way.

(i) Severely food insecure: this class corresponds to people who answered "yes" to the last three questions (7, 8 and 9) or who answered "often" to questions 5 and 6 in Table 1.
(ii) Moderately food insecure: this class is for those who answered “rarely” or “sometimes” to questions 5 and 6 or who answered “sometimes” or “often” to questions 3 and 4.
(iii) Mildly food insecure: this class refers to those who answered “rarely” for questions 3 and 4 or who answered "sometimes" or "often" for questions 1 and 2. Some authors considered this class as the food security line.
(iv) Food secure: people are considered to be food secure when they responded negatively or "rarely" to question 1.

Statistical analyses

The data was analyzed using the SPSS Statistics software version 22. Frequency analysis was done to describe households and to highlight the most common water and soil conservation techniques used in the study area. Cross tables and Pearson Chi-square tests were conducted to observe the relationships between the prevalence of food insecurity and household socio-demographic and economic characteristics (age of the household head, household size, household formal education level, households domestic asset index, income from sources such as livestock, artisanal gold mining, vegetables growing and money transfers, land areas, household income per capita, off-farm income, livestock and water and soil conservation practice). These variables have been chosen because some studies indicated a relationship between households socio-economic characteristics, agricultural

Table 1. Household food insecurity access scale.

Number	Questions	Response	Score
1	In the past four weeks, were you worried that there will not be enough food for the household?	No Rarely Sometimes Often	0 1 2 3
2	In the past four weeks, did you have someone in the household who could not eat the kind of food he / she would like?	No Rarely Sometimes Often	0 1 2 3
3	In the past four weeks, had you had at least one member of the household who had fewer balanced diets because of lack of means?	No Rarely Sometimes Often	0 1 2 3
4	In the past four weeks, did you have at least one member of the household who had to eat food that he did not really want because of lack of means to have others?	No Rarely Sometimes Often	0 1 2 3
5	In the past four weeks, had you had at least one member of the household who had to eat less food than he needed because there was not enough food?	No Rarely Sometimes Often	0 1 2 3
6	In the past four weeks, did you have at least one member in the household who had to eat less food during the day because there was not enough food?	No Rarely Sometimes Often	0 1 2 3
7	In the past four weeks, has there been no food of any type to eat in the household in the household because there was no way to get food?	No Rarely Sometimes Often	0 1 2 3
8	In the past four weeks, was there not someone in the household who slept without eating because there was not enough to eat?	No Rarely Sometimes Often	0 1 2 3
9	In the last four weeks, was there not someone in the household who spent the whole day and the evening without eating something because there was not enough to eat?	No Rarely Sometimes Often	0 1 2 3

Source: Coates et al., 2007.

technology practice and food security (Fengying et al., 2010; Li and Yu, 2010; Sinyolo et al., 2014; Frayne and McCordic, 2015; Abdullah et al., 2017; Nyantakyi-Frimpong et al., 2017).

Household domestic asset index which estimates the total asset owned by the household was calculated with respect to animal asset, domestic asset, transport asset and productive asset. Each

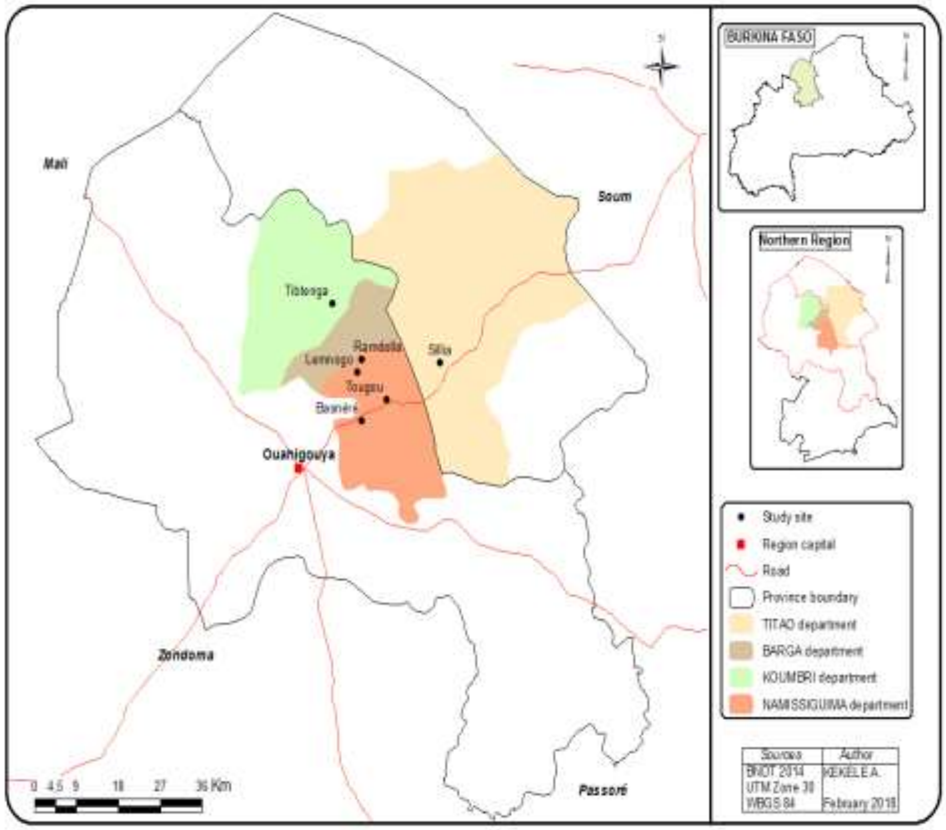

Figure 1. Map of study sites location.

of the assets was assigned a weight according the description in Njuki et al. (2011). Household income was measured as the sum of income received from all sources over the last 12 months by a given household (Frayne and McCordic, 2015). Household income was then divided by the size of a given household to have per capita annual income which is commonly used for this kind of studies (Li and Yu, 2010; Mahmoud and Thiele, 2013; Anwar and Cooray, 2015). The total livestock count was obtained by converting livestock number into Tropical Livestock Unit (TLU) using the method of Schwartz et al. (1991) described in Ng'anga'a et al. (2016): 1 TLU = 10 sheep or goats; 1 TLU = 0.7 bovine; 1 TLU = 0.5 donkey.

Based on the results of the Pearson Chi-square tests, we performed binary logistic regressions to establish the relationships between our variable of interest (prevalence of food insecurity) and the others variables. The prevalence of food insecurity had two possible values: 1= food insecurity and 0=food security. First time, we used a model which examined the relationship between household food insecurity and water and soil conservation techniques only. In the second run of the regression analysis, we added other variables to the model.

For the purpose of analyses, the variables were categorized. The age categorization of respondents was based on a report by Diiro et al. (2016). Variables such as household size, livestock capital and cultivated area were categorized by frequency distribution and these categories are in line with the data reported by Amole and Ayantunde (2016) in similar sites in Burkina Faso. Household domestic asset index was categorized by frequency distribution. Household per capita income was categorized in two groups considering per capita annual average annual per capita expenditure which was estimated at 150 086 FCFA (INSD, 2015).

RESULTS

Socio-economic characteristics of respondents

The majority of the respondents were not formally educated, only 16.7% had formal education (Table 2). Household size was relatively high in general with 78.7% having more than 5 members of which 16.4% had at least 15 members in their household. Overall, 14.6% of the respondents were young adults aged between 21 and 35, and 16.8% of households were headed by elderly people of over 65 years. The largest age group (45.5%) was made of those between 45 and 65 years of age. The main sources of income identified were crop farming (71.1%), livestock rearing (52%), vegetable production (48.7%), small commerce (33.3%), remittances (33%) and artisanal gold mining (17.1%). The results showed a large disparity between households with respect to household domestic asset index. Values ranged from 2 to 811 with an average value of 103.3 ± 93.3. Households were then grouped into three classes: those with a

Table 2. Socio-economic characteristics of respondents.

Variable	Category	Count	Frequency
Sex of the household head	Male	280	93.3
	Female	20	6.7
Age of the household head (Years)	≤35	39	14.6
	36-45	62	23.1
	46-65	122	45.5
	>65	45	16.8
Education level of the household head	No formal education	250	83.3
	Formal education	50	16.7
Household size	≤ 5	57	21.3
	6-9	84	31.3
	10-14	83	31
	≥15	44	16.4
Households domestic asset index	≤ 50	82	30.6
	between 50 and 100	86	32.1
	>100	100	37.3
Main activities	Agriculture	100	33.3
	Livestock	23	7.7
	Agriculture+ Livestock	196	65.3
	Trade	9	3
	Others	37	12.3
Off-farm income	NO	80	29.9
	Yes	188	70.1
Household income per capita (FCFA)	< 150086	258	96.3
	≥ 150086	10	3.7
Farm size (ha)	≤2	41	13.7
	2-3	54	18
	3-4	58	19.3
	4-5	37	12.3
	5-10	90	30.7
	>10	18	6
Income sources	Agriculture	209	71.1
	Livestock	156	52
	Vegetable growing	146	48.7
	Artisanal gold mining	51	17.1
	Trade	100	33.3
	Money transfer	99	33
	Other	12	4

household domestic asset index of less than 50 (30.6%), those with household domestic asset index between 50 and 100 (32.1%) and those whose household domestic asset index exceeded 100 (37.3%).

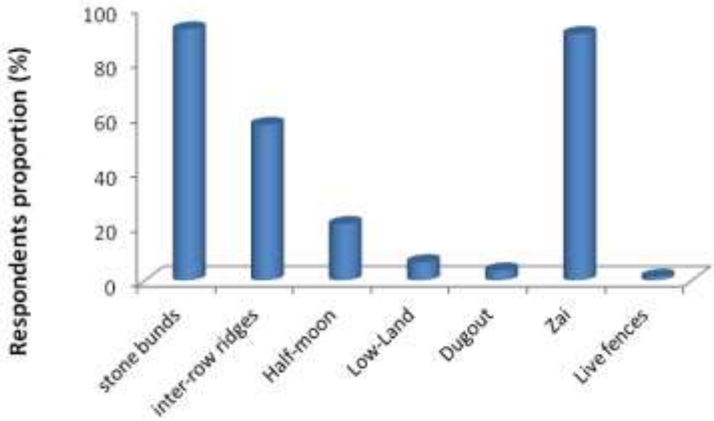

Figure 2. Water harvesting practices in the study sites (n= 300).

Table 3. Prevalence of food insecurity according to the respondents (n=268).

Period of the year	Food insecurity		Food security	
	Count	Frequency (%)	Count	Frequency (%)
Favorable period	223	83.7	45	16.8
Bad period	247	92.2	21	7.8
All year	250	93.3	18	6.7

Water and soil conservation techniques

Figure 2 showed that the most commonly used techniques were stone bunds (92% of the respondents), zaï (90.3% of the respondents) and rainwater harvesting (57% of the respondents). Zaï was a traditional technique used in Yatenga (northern Burkina Faso) during drought years between 1982 and 1984 (Bayala et al., 2011). In this method, small pits are dug at a regular spacing on a field, and about two handfuls of organic amendments such as crop residue, manure, or their composted form, are placed in each pit. It is now widespread in the Sudano-Sahelian zone and is used for recovering encrusted soils. The zaï pits are 20-40 cm in diameter and 10-15 cm deep, dug into the degraded, crusted soil. Decomposition of the organic material releases nutrients required for crop growth. Biological activity, and especially the action of termites, favors the development of soil macro-porosity that improves water infiltration (Fatondji et al., 2009). Besides the supply of valuable nutrients for crop growth, the zaï pits promote better infiltration of water locally. Since this water infiltrates deeper than usual, zaï ensures that a sizable fraction of the water percolates to depths where evaporation losses are reduced. The technique combines water harvesting as well as nutrient management practices, which helps to minimize the diversion of water to where it is unproductive, and ensures that its utilization by the crop is as efficient as possible (Fatondji et al., 2009). The techniques of zaï and stone bunds are presented in Figures 4 and 5. The main combination of options in the area (Figure 3) were practice of stone bunds and zaï (36.3%), stone bunds and inter-row ridges and stone bunds combined with zaï and inter-row ridges (48% of respondents).

Food status and prevalence of food insecurity

According to the agricultural calendar in the study sites, 51.7, 22.3 and 7% of the respondents stated that food was sufficient during post-harvest period, in the late dry season and during the rainy season, respectively. In addition, the average number of daily meals consumed by the surveyed households was 2.72 ± 0.6 (mean ± standard deviation) during the post-harvest period; 2.56 ± 0.6 in the late dry season and 2.52 ± 0.6 during the rainy season. The results of the food insecurity prevalence showed that food insecurity is actually real in our study area. Even during the favorable period, 83.7% of respondents were food-insecure. Across the sites, 93.3% were food-insecure (Table 3).

Determinants of food insecurity

The results of the cross tables and Pearson Chi-square

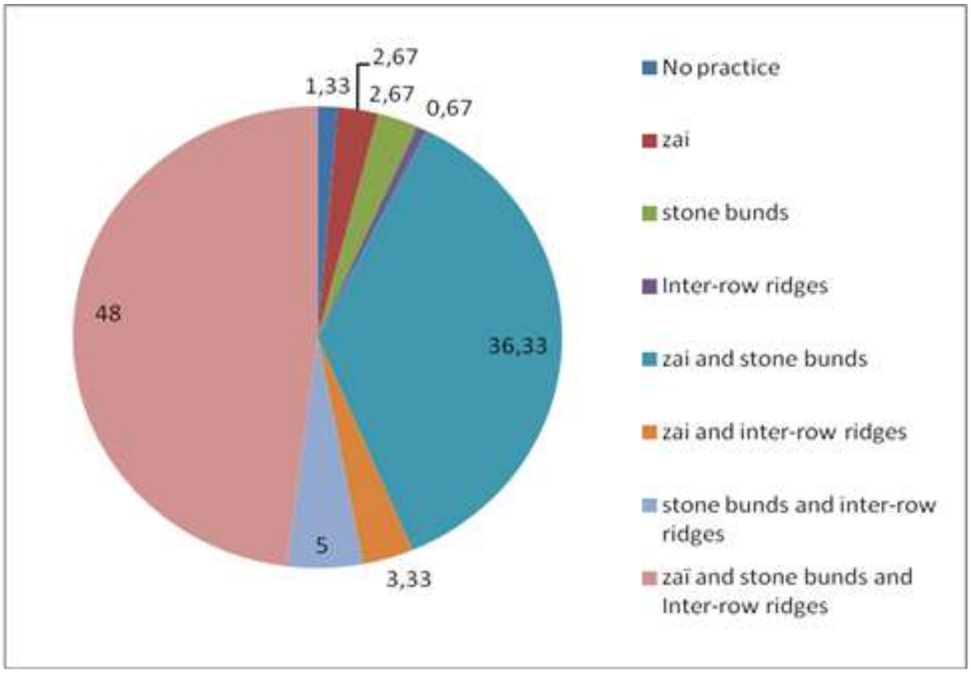

Figure 3. Proportion (%) of respondents by type of association of soil and water conservation techniques.

tests conducted are summarized in Table 4. These results showed that the prevalence of food insecurity was not associated with the sex of the household head, group membership, off farm income, household income, land area cultivated, sources of income from small commerce or sale of agricultural products. Instead, there was significant correlation between prevalence of food insecurity and the age and formal education level of the household head, household size, income sources such as sale of livestock, artisanal gold mining, remittances, vegetable production, livestock asset, the practice of water and soil conservation technique and the household domestic asset index. In our survey, 95% of household heads who were not formally educated were food insecure against 86% of households headed by those who received formal education. Also, 99% of the households who used stone bunds in association with zaï were food insecure as compared to 73% of those who practiced stone bunds in combination with the inter-row ridges. The first model (Table 5), which tested the effect of water and soil conservation techniques on the probability of food insecurity, revealed a very significant difference between households practicing stone bunds in combination with inter-row ridges or by incorporating the zaï technique, and the households that practiced a combination of stone bunds and zaï (reference category). After comparing the practice of water and soil conservation techniques with other independent variables, the logistic regression resulted in a significant model (Chi-square = 53.90, df = 17; P = 0.000, Nagelkerke R^2= 0.47; percentage correct= 93.6%). The model predictors explained 47% of the total variance of the probability of a household to be food insecure. Despite the introduction of other variables, the practice of water and soil conservation techniques remained a significant variable (odd ratio= 0.04, $P < 0.05$) for likelihood of prevalence of food insecurity in the surveyed households. The second variable which contributed significantly to explain the likelihood to be food insecure in the study area was the formal education level of the household head (odd ratio=0.18, $p<0.05$). The combination of the stone bunds and the inter-row ridges technique and formal education reduced the probability of household food insecurity (Table 6).

DISCUSSION

Food security situation in the study sites

Food insecurity is common in rural areas of Burkina Faso with the northern region among the most vulnerable regions in the country in terms of food insecurity. Considering the high rainfall variability and the poor soil fertility in the Northern region, the results of this study were not surprising. These results are in line with the observations of Fengying et al. (2010) who argued that food insecurity is common in rural areas where natural

Table 4. Food insecurity prevalence according to the household characteristics (n=268).

Variables	Categories	Prevalence of food insecurity (%)		Chi-square results
		Insecurity	Security	Values
Sex of the household head	Male	93.2	6.8	0.04
	Female	94.4	5.6	
Education level of the household head	No formal education	94.7	5.3	4.28*
	Formal education	86	14	
Group membership	1-2 groups	93	7	0.75
	3-5 groups	93	7	
	Plus de 5 groups	100	0	
Practice of the water conservation options	Stone bunds + zaï	99.1	0.9	16.61*
	Stone bunds + the inter-row ridges	73.3	26.7	
	Stone bunds + the inter-row ridges +zaï	91	9	
Income control	Male	93.8	6.2	3.46
	Female	100	0	
	Jointly	90.8	9.2	
	Foreign person	100	0	
	Children	100	0	
Income from livestock	No	96.8	3.2	4.62*
	Yes	90.2	9.8	
Income from Agriculture	No	89	11	2.64
	Yes	94.7	5.3	
Income from vegetable growing	No	97.7	2.3	8.39*
	Yes	88.9	11.1	
Income from artisanal gold mining	No	91.9	8.1	4.02*
	Yes	100	0	
Income from trade	No	93	7	0.09
	Yes	94	6	
Remittance	No	95.6	11.5	4.69*
	Yes	88.5	4.4	
Other sources of income	No	93.4	6.6	0.10
	Yes	90.9	9.1	
Off-farm income	No	96.3	3.8	1.60
	Yes	92	8	
Household income per capita (FCFA)	<150086	93.4	6.6	0.93
	≥150086	90	101	

Table 4. Contd.

Age of the household head (year)	≤ 35	97.4	2.6	8.59
	Between 36 and 45	88.7	11.3	
	Between 46 and 65	96.7	3.3	
	>65	86.7	13.3	
Household size	≤ 5	98.2	1.8	12.55
	Between 6 and 9	93.3	4.7	
	Between 10 and 14	94	6	
	≥15	81.4	18.6	
Farm size (ha)	≤ 3	93.6	6.4	1.14
	Between 3 and 5	95.3	4.7	
	>5	91.4	8.6	
Livestock asset (TLU)	≤ 2	97.2	2.8	10.06
	Between 2 and 3	97.9	2.1	
	>3	87.6	12.4	
Households domestic asset index (g)	≤ 50	100	0	13.58
	Between 50 and 100	94.4	5.6	
	>100	86.3	13.7	

*level of significance p < 0.05.

Table 5. Determinants of food insecurity in the first model.

Variables	Categories	B	OR
Practice of the water conservation techniques	stone bunds technique and the inter-row ridges	-3.67*	0.03
	Zaï , stone bunds technique and the inter-row ridges	-2.68*	0.09

B: coefficient; OR : odds ratio ; *level of significance p < 0.05.

and ecological conditions are fragile because of the soil quality and soil water availability which are limiting factors (Wolka et al., 2018). Considering the improved yields achieved following the adoption of water and soil conservation techniques, the expectation was that a high proportion of surveyed households would be less vulnerable to food insecurity; however the reverse was the case. The plausible reason might be that the increase in crop productivity resulting from the use of water and soil conservation techniques was insufficient to offset food insecurity. The effect of water and soil conservation techniques on improving crop yield to an extent as to achieve food security was found to be dependent on rainfall characteristics, types of crop, slope, and soil type (Sawadogo, 2011; Wolka et al., 2018). Then it is suggested to combine the water and soil conservation techniques with other management activities to enhance crop yields. In our study, the food insecurity might be attributed to the low crop productivity (Sawadogo, 2011) which is caused by:

(i) Low coverage of fields by water and soil conservation techniques;
(ii) Low level of the use of improved seeds;
(iii) Low level of the use of fertilizers;
(iv) Rainfall variability.

In fact, farmers are not able to apply water and soil conservation techniques over large areas due to varied reasons according to the respondents. Thirty to sixty-two percent of respondents mentioned lack of equipment as a major constraint that limited the use of water and soil conservation techniques. Lack of fertilizer (manure and chemical fertilizer) and lack of manpower were other constraints mentioned by 24 and 13% of the respondents, respectively. This lack of assets (particularly tools for

Table 6. Determinants of food insecurity in the second model.

Variables	Categories	B	AOR
Practice of the water conservation techniques	Zaï and stone bunds technique		
	stone bunds technique and the inter-row ridges	-3.22*±1.57	0.04
	Zaï , stone bunds technique and the inter-row ridges	-1.35±1.26	0.26
Education level of the household head	No formal education		
	Formal education	-1.70*±0.81	0.18
Income from livestock	No		
	Yes	-0.64±0.72	0.53
Income from vegetable growing	No		
	Yes	-0.58±0.83	0.56
Remittance	No		
	Yes	-0.44±700	0.65
Income from artisanal gold mining	No		
	Yes	-18.46±4935.9	1043831.9
Age of the household head (year)	≤ 35		
	Between 36 and 45	-0.55±1.67	0.58
	Between 46 and 65	0.89±1.69	2.42
	≥65	-0.86±1.72	0.42
Livestock asset (TLU)	≤ 2		
	Between 2 and 3	1.64±1.17	5.14
	>3	0.10±0.01	1.1
Households domestic asset index	≤ 50		
	Between 50 and 100	-17.58±3888.30	0.000
	>100	-17.48±3888.30	0.000
Household size	≤ 5		
	Between 6 and 9	-0.47±1.57	0.62
	Between 10 and 14	-0.73±1.58	0.48
	≥15	-2.08±1.61	0.13

B: coefficient; AOR : adjusted ; * : level of significance $p < 0.05$.

installation and labor) constrained ability to use water and soil conservation techniques even with external assistance (Bunclark et al., 2018). Socio-economic factors such as financial capital access to credit, and market access, as well as policy environments have been reported as limiting the potential of water and soil conservation techniques in West African Sahel (Koning et al., 2001). The high labor demand of water and soil techniques is another challenge (Koning et al., 2001). Despite these challenges, land management with water and soil conservation techniques could be a promising solution in addressing food insecurity in Sahelian countries, provided that they cover sufficient areas (GIZ, 2012).

Application of inorganic fertilizer and animal manure is very important in supporting water and soil conservation techniques, especially for zaï technique as it is often applied to degraded land (Zougmoré et al., 2004). So when the manure is not applied in the required quantity, this would limit the benefit of the water and soil conservation techniques. To improve the efficiency of the water and soil conservation techniques it has been

Figure 4. Digging Zai pit (Photo credit: Tunde Amole).

suggested to combine these measures with soil fertility management practices (Zougmoré et al., 2002). Applying compost manure to fields laid with stone bunds increased the yields by 77-130%, according to Sawadogo (2011). In our study, the low effectiveness of water and soil conservation techniques could be explained by the low level of the use of improved seeds. Only 8% of the respondents frequently used improved seeds according to the respondents.

Effectiveness of water and soil conservation techniques on crop productivity has been found to vary depending on the amount and distribution of rainfall (Wiyo et al., 2000; Zougmoré et al., 2014). The rainfall variability tends to negatively affects crop yields because these technologies work by retaining surface runoff within the field to ensure rainwater and soil moisture conservation. So the main purpose of these techniques is to harvest the limited rainwater and store it in crop zone for use during dry spell periods (Wiyo et al., 2000). Past research revealed that tied-ridge is effective in reducing surface runoff and increasing soil water storage (Wiyo et al., 2000). However, in recent years, changes in the climate patterns have led to frequent droughts in many areas (Tietjen et al., 2017). Below 500 mm, rainfall is insufficient to meet crop water requirements with or without tied-ridging (Wiyo et al., 2000) and this water deficit can seriously affect crop production, leading to remarkable reduction in grain yield (Jia et al., 2018). Therefore, it is better to combine water and soil conservation techniques with irrigation in order to provide water for crops at least during the critical period (Jia et al., 2018). The results of Jia et al. (2018) showed that combining ridge-furrow and irrigation at the silking stage provide moisture for crop growth and improve maize grain yield, economic benefit, and water

Figure 5. Stone bunds in half moon shape (Photo credit: Tunde Amole).

use in the semi-arid regions. The use of irrigation system might improve water security as there is a relationship between water security and food security (Sinyolo et al., 2014; Besada and Werner, 2015). This implies that water secure households are more productive than the water insecure (Sinyolo et al., 2014).

Determinants of respondent's food insecurity

In our study no relationship has been established between food security and sex of household heads, household size, household income and household off-farm activities using Pearson Chi-square test. However, in some studies these variables have been reported as the determinants of food security (Fengying et al., 2010; Li and Yu, 2010; Sinyolo et al., 2014; Frayne and McCordic, 2015; Abdullah et al., 2017). In areas where geographic and climatic conditions restrict agricultural production, farmers who have invested in non-agricultural activities had a better food status than those engaged solely in agricultural activities, according to Fengying et al. (2010). In our study there was no relationship between food security and off-farm activities which may be due to the fact that off-farm activities are not well developed in the study sites.

Despite the established links by Pearson Chi-square tests between food insecurity and household characteristics like age groups of the household head, household size, income sources such as livestock sale, artisanal gold mining, remittances, vegetable production, livestock asset and household domestic asset index, logistic regression showed no significant relationship with these variables. However, it should be noted that in other studies, the age of the household head, remittances and household size have been identified as determinants of food insecurity (Vandermeersch and Naulin, 2007; Abdullah et al., 2017; Bhalla et al., 2018).

Furthermore, our results showed that the prevalence of household food insecurity varied significantly among different combinations of water and soil conservation techniques. It was found in our results that there was a significant negative correlation between the water and soil conservation practice (which combine stone bunds and inter-row ridges) and household food insecurity. In our study, household combining stone bunds and inter-row ridges techniques were less likely to experience food insecurity as compared to those using other types of association of water and soil conservation techniques. Our findings also suggested a significant relationship between food insecurity and formal education of household head. These results imply that education is important for improving the food security status of farmers as the educated farmers were less likely to be food insecure (Li and Yu, 2010; Bhalla et al., 2018). Previous studies showed that formally educated respondents had a better food security score than those without formal education (Li and Yu, 2010; Bhalla et al., 2018). In fact, the low level of formal education is strongly associated with the probability of experiencing food insecurity (Maxwell et al., 2014).

Possible explanation for the relationship between household level of formal education and food security could be that households with formal education are more likely to adopt new technologies which could increase their productive capacity and improve their nutritional status (Kelebe et al., 2017). According to Smale et al. (2018), formal education is a significant determinant of technology adoption as the ability to read and write can positively affect access and acceptance of new information and production techniques. The relationship between the improvement of the household food security and the formal education level of the household head could also be explained by the increase in earning capacity (Fengying et al., 2010). Education gives knowledge and awareness and increases the chances of obtaining job and people with higher education were more likely to get higher paying jobs (Abdullah et al., 2017). In Burkina Faso, more than 8 out of 10 poor people live in households whose head did not receive any formal education (INSD, 2015). So, education can be a good political tool to fight poverty.

Conclusion

This study aimed at answering the question of whether the practice of water and soil conservation techniques influences the food security situation in the northern region where they are commonly practiced. Our results showed that water and soil conservation techniques help to reduce food insecurity. Prevalence of food insecurity was reduced by stone bunds in combination with the inter-row ridges technique and possession of formal education. Despite the application of these water and soil conservation techniques however, food insecurity is still persistent in the area, which raises questions about the efficiency of current agricultural production systems. Farmers should therefore be encouraged to support water and soil conservation techniques with improved agronomic practices in term of use of improved seeds, fertilizers and irrigation.

RECOMMENDATION

Based on the results of our study, the following recommendations can be drawn:

1. Combining water and soil conservation techniques with inputs such as improved crop varieties and organic manure is necessary for improved food security in the region.
2. Significant increased investment in water management infrastructures is necessary to improve food security situation in Burkina Faso and in other West Africa Sahelian countries. In view of the strong relationship between water scarcity and food insecurity.
3. Improving access to quality education, particularly in rural areas can be a powerful tool to combat food insecurity in the Sahel.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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