Perceptions of climate variability, current exposure of households to shocks and coping in semi-arid lands: a case study from the Central Plateau region in Burkina Faso

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Perceptions of climate variability, current exposure of households to shocks and coping in semi-arid lands: a case study from the Central Plateau region in Burkina Faso

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This report has been produced as part of a series of preliminary papers to guide the long-term research agenda of the Pathways to Resilience in Semi-arid Economies (PRISE) project. PRISE is a five-year, multi-country research project that generates new knowledge about how economic development in semi-arid regions can be made more equitable and resilient to climate change.

The findings, interpretations and conclusions expressed in this paper, as well as any errors or omissions, are entirely those of the author.

Front cover image:
A woman in Bob-Dioulasso, Houet Province, Burkina Faso.

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Abstract

This paper elicits household perceptions on a changing climate and its perceived effects. It contrasts these perceptions with the actual risks and shocks households in rural Burkina Faso face and the coping mechanisms employed. The analysis is based on qualitative interview data and a unique household survey conducted in the semi-arid community of Ziniaré in the Central Plateau region of the country. The analysis shows households in the study area are aware of a changing climate and concerned about increasing dryness affecting agricultural production, livestock and health. As a matter of fact, however, the most frequent shocks households currently face are health shocks, followed by environmental shocks. The current shocks cause substantial losses in household assets and revenues. The analysis further highlights that shocks are not uniformly distributed. Different types of households are more likely to be exposed to different shocks triggering also different coping strategies. Such differences in characteristics and capabilities need to be taken into account when designing adaptation and safety net mechanisms aimed at reducing household vulnerabilities – current and in the future.

1. Introduction

Experts see climate change as one of the defining challenges of our time because it is expected to affect all areas of human life and wellbeing (see Field et al., 2014; Stocker et al., 2013; World Bank, 2015). Even though there is still a lively debate on the precise implications of climate change, there is consensus that developing countries and particularly countries in the semi-arid belt of Sub-Saharan Africa are expected to suffer considerably from a changing climate because of their high agricultural dependence and limited capacity to adapt (see Collier et al., 2008; World Bank, 2015).

Agriculture in many Sub-Saharan African countries is based on water-constrained, rain-fed production systems. While there is a large dispersion in predicted changes in yields, studies almost consistently expect a negative impact from warming (Kurukulasuriya and Mendelsohn, 2007; Müller et al., 2011; Roudier et al., 2011). Together with an increasing variability in rainfall, it is expected to cause low and unstable production,[1] which in turn contributes to increasing volatility in food security, prices and incomes (see, e.g., Dercon, 2002; Wheeler and von Braun, 2013). Because prices tend to move in the opposite direction to fluctuations in crop production, such a development is expected to buffer agricultural incomes but increase food insecurity and poverty of poor (net) consumers (see, e.g., Alem and Söderborn, 2012; Ivanic et al., 2012; Schmidhuber and Tubiello, 2007; Wodon and Zaman, 2010).

Beyond the increasing volatility in food security and agricultural production, air quality and drinking water are also expected to worsen as the climate changes, giving rise to an exacerbation of diarrhoea, malaria, malnutrition and other health problems in the region. Tanser et al. (2003), for example, predict a climate-induced increase in vector-borne diseases such as malaria for most of Sub-Saharan Africa.

The likelihood and severity with which all these risks will manifest themselves in the future also depend on the extent to which countries and individuals are able to mitigate and adapt to these risks. Adaptation, however, is not an automatic process. It first requires noticing a change before a conscious decision for or against a certain measure is taken (Maddison, 2007). Realisation and adaptation can be a lengthy process (see World Bank, 2015). In simulations, Szafran et al. (2013), for example, show it can take up to 86 years for the majority of the population to adjust their views and actions – too long for interventions aimed at reducing the negative consequences of climate change. A study by Grothmann and Pratt (2005) also indicates long response times to climate change. The authors show farmers in Zimbabwe stick to their crop portfolio even when a shift could improve yields under current rainfall forecasts. Thus, even if farmers realise the climate is changing, this may still not automatically lead them to adjust or change agricultural practices. Barbier et al. (2009), investigating farmers' vulnerability to climate variability in northern Burkina Faso, for example, show farmers have changed their agricultural practices in the past few decades. However, the main reason for the change in practices is not climate change but increasing land scarcity as a result of increasing population pressures and decreasing soil fertility.

On the other hand, households in developing countries may not respond to potential future threats simply because they already face a myriad of risks and shocks on a day-to-day basis resulting in high income variability and uncertainty. To deal with this current situation, households have developed a range of risk management strategies such as informal or self-insurance. These mechanisms tend to be incomplete, however, particularly in situations where households are suffering from common shocks like weather variations (see, e.g., Deaton, 1991; Rosenzweig and Wolpin, 1993). In such a situation, alternative safety net and adaptation mechanisms are needed to mitigate the potential negative effects on the productive and human capital of affected households resulting from a failure to cope with income volatilities and shocks (see, e.g., Dercon, 2002; 2008). With the prospect of climate change, coping with the increasing uncertainties and shocks will become more and more important. In many countries in Sub-Saharan Africa, large-scale formal insurance and safety net mechanisms are still rare, if not fully absent, and informal arrangements such as family networks take on an important function of covering costs and losses when negative (idiosyncratic) shocks occur.

The vulnerability of the agriculture sector to both climate change and variability is well established in the literature. However, in addressing current and potential future vulnerability, one needs a better understanding of the risks and risk

[1] Precipitation can partially mitigate the effect of increased warming but in many regions experts are still unsure if rainfall will increase or decrease. Carbon fertilisation is expected to have a less significant effect for staple crops such as maize, millet and sorghum (see, e.g., Hertel et al., 2010).

management at the household level (see Alwang et al., 2001; Chambers, 1989). The challenge to vulnerability research is to develop robust and credible measures to incorporate diverse methods that include perceptions of risk and vulnerability and research on the mechanism that mediate vulnerability and promote adaptive actions and resilience (Adger, 2006). Tschakert et al. (2013) also argues for a greater need in understating the interrelation between climate change and vulnerabilities more explicitly. While still focused at the micro level, this study aims to bring the potential climate and current vulnerabilities closer together by understanding current perceptions and shortcomings and reviewing the actual exposure to shocks and risks households are facing. The importance of current risks versus perceptions is that both shape current and potential future actions, whereby research on climate change adaptation has shown actions are rather staggered. Hence, risks to climate change will be realised only if current risks are sufficiently covered.

Against this background, this paper provides new insights on current household perceptions on a changing climate and contrasts these views with the actual risks and shocks households face and the coping mechanisms they employ. More specifically, we are analysing the degree to which households in the rural community of Ziniaré, located in the Central Plateau region of Burkina Faso, are exposed to climate variability and shocks and which coping mechanism are currently used to deal with these events. The analysis in this paper is based on a unique household dataset collected in 2013 and complemented by qualitative interview data obtained in 2014.

The study shows households are very much aware of a changing climate and concerned about its implications for agricultural production, livestock-rearing and health. However, households are not yet actively addressing these concerns. This could partly be explained by households already struggling enough in addressing current risks. Indeed, currently households most frequently face health shocks, followed by environmental shocks. The current shocks cause substantial losses in household assets and revenues. The analysis further highlights that shocks are not uniformly distributed. Different types of households are more likely to be exposed to different shocks triggering also different coping strategies. Such differences and characteristics need to be taken into account when designing appropriate safety net and insurance mechanisms to reduce household vulnerabilities.

The remainder of this paper is structured as follows. Section 2 provides a brief overview of the study setting. Section 3 presents current perceptions on a changing climate, its effects and potential mitigation mechanisms from local farmers in the study region. Section 4 presents the data and key variables used in the multivariate analysis determining the importance of current shocks and coping strategies in the study region. Section 5 outlines the empirical strategy. The results are discussed in Section 6. Section 7 concludes.

Family scene, - Gaoua, Burkina Faso.

2. The setting

2.1 Climate and agricultural production in Burkina Faso

Burkina Faso is located in the heart of West Africa. It is landlocked and shares borders with Mali and Niger in the west, north and east and Côte d'Ivoire, Ghana, Togo and Benin in the south. The country covers three agro-climatic zones (see Figure A1 in the Appendix): the Sahel in the north, characterised by low rainfall, dry soils and low agricultural productivity; the sudo-sahelian, semi-arid area in the centre and the more productive, arid region in the south.

Burkina Faso is a low-income country, with an economy heavily dependent on subsistence agriculture. The agriculture sector accounts for 35% of the total gross domestic product (GDP) of the country and absorbs about 90% of the labour force (FEWSNET, 2012; Oxfam, 2011). Most of the food consumed in Burkina Faso is produced locally and hence the agriculture sector also plays a crucial role for food security.[2]

Agriculture in Burkina Faso is mainly rain-fed; agricultural production and productivity are thus highly dependent on rainfall amounts and distribution. The typical rainfall season in Burkina Faso runs from May/June to September/October but in recent years duration and levels of rainfall have become more volatile. Rainfall over the past decades has been developing in a quite cyclical manner, with a decline in the 1980s and a recovery in the 1990s (FEWSNET, 2012; see also Figure 1a). Since 2000, the recovery has stalled and rainfall levels in the country are now about 15% below the historic average of 1920-1970 (FEWSNET, 2012). Together with the overall drop in rainfall, the average temperature in Burkina Faso has been increasing by about 0.6°C since 1975 (FEWSNET, 2012; see also Figure 1a). The general trend with an increase in temperature and a drop in rainfall gives rise to increasing risks of drought and desertification in the country. However, the long-term weather trends in the Sahel region overall show the region has been experiencing several of these multi-decadal drought periods in the past. Hence, it is still uncertain whether the current climate trends are just another normal episode or a result exacerbated by a changing climate (Collier et al., 2008).

Despite the unfavourable trend and climatic conditions, crop yields in Burkina Faso have been increasing since the 1960s (FEWSNET, 2012). The yields of the staple crops millet, sorghum, maize and rice have also continued to rise in the 2000s, but at lower rates (FAO, 2014). Despite the climatic adversities, these increasing yields suggest the productive potential of the agriculture sector in Burkina Faso has not yet been reached.

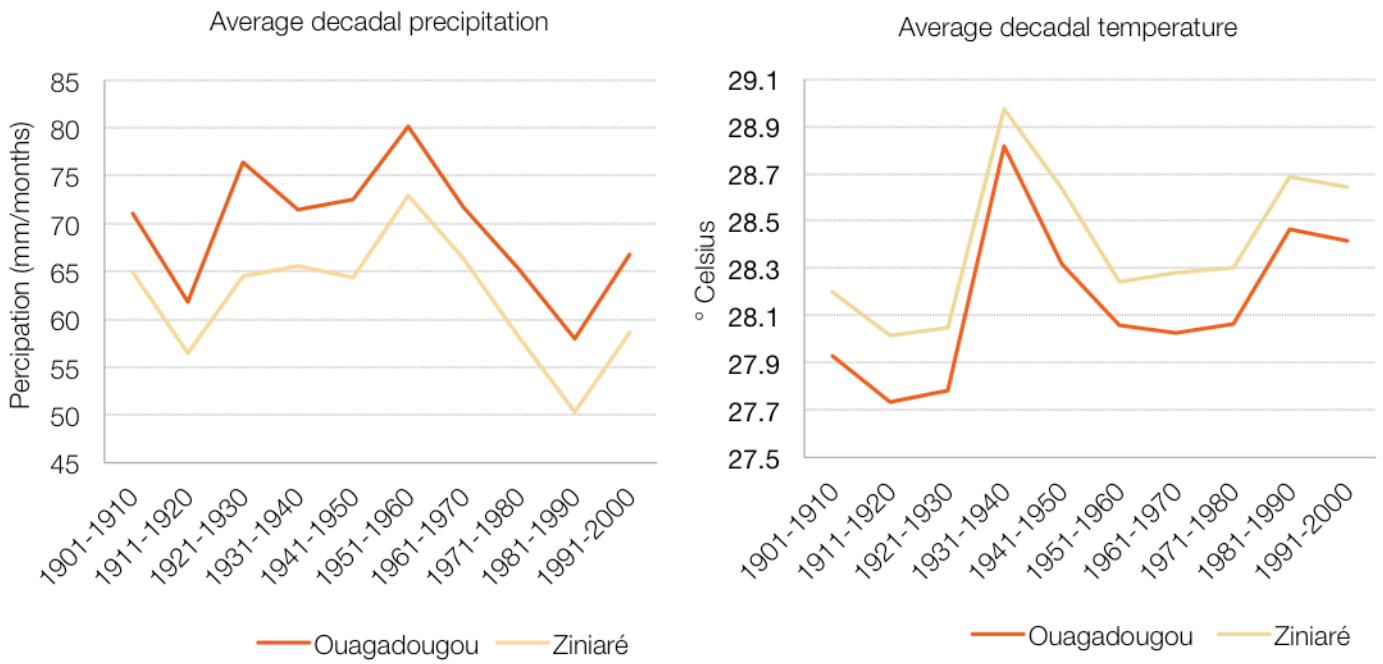
2.2 Climate and agricultural production in the study region – the rural community of Ziniaré

The community of Ziniaré is located in the province of Oubritenga in the Central Plateau region, northeast of Ouagadougou – the capital of Burkina Faso. The community of Ziniaré lies in the semi-arid zone of the country (see Figure A1 in the Appendix). Figure 1a depicts the long-term trends in precipitation and temperature in the study area. The decadal averages indicate a pattern similar to the average climate pattern reported for the country (see Section 2.1 above) – that is, an overall downward trend in precipitation with a recovery in the 1990s. Similarly also, the temperature in the study region has been increasing over the past century. Overall, the rainfall level in Ziniaré is a bit lower and the temperature a bit higher than in Ouagadougou. Figure 1b depicts more detailed rainfall and temperature data for the past 13 years. The past decade indicates a slight decrease in average yearly rainfall, paired with a 0.1°C increase in average temperature. Thus, the trend towards a drier climate seems to continue in the area. Rainfall over the past decade has also been quite volatile. The average yearly rainfall data show distinct year-to-year fluctuations, with below average rainfall in 2003, 2010/11 and 2013 and spikes in 2007 and 2012. This volatile rainfall has direct implications for agricultural production and incomes in the area because over 90% of the households in the community and covered in this study are engaged in agriculture and livestock-rearing as a primary and largely sole activity. Households in the area own on average about 3.3 ha of agricultural land on which they typically grow millet, sorghum and maize (see Table A1 in the Appendix). Rice is less common because of a lack of irrigation. The most important cash crops grown in the region are green beans, groundnuts and sesame. In the past agricultural season (2013), the average household produced about 350 kg of millet, 145 kg of maize and 140 kg of sorghum. The reported outputs are sensitive to rainfall, however, or at least

[2] Millet, sorghum, maize and rice are the staple crops grown in Burkina Faso, making up about 90% of the diet (FEWSNET, 2012; Oxfam, 2011).

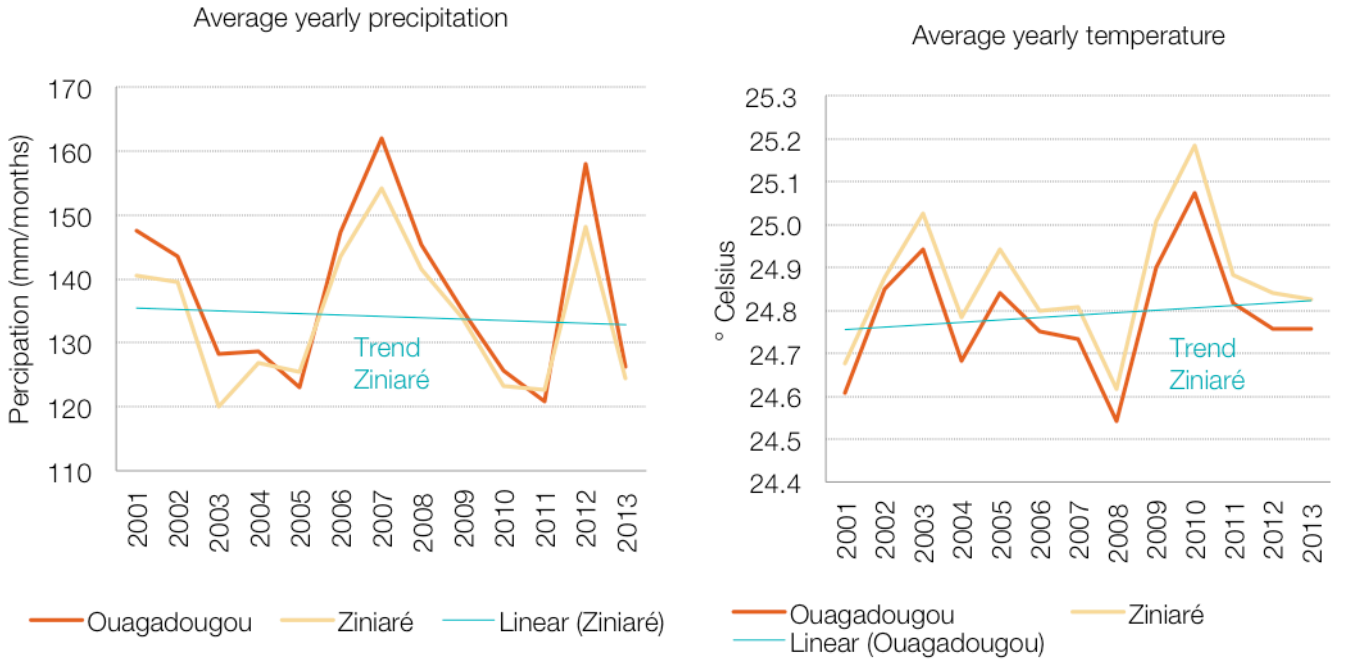
perceived rainfall. Households in villages that reported lower than average rainfalls in the 2013 agricultural season also reported lower output levels for millet and sorghum in particular (see Table A1 in the Appendix).

Figure 1a: Rainfall and temperature trends over the past century (1901-2000)



Source: Author's representation, based on data from IPCC (2013).

Figure 1b: Rainfall and temperature trends over the past decade (2001-2013)



Source: Author's representation, based on data from University of East Anglia Climatic Research Unit et al. (2014).

3. Climate perceptions in the study region

3.1 Perceptions on climate variability and its effects in Ziniaré

The most recent World Development Report describes climate change as 'one of the defining challenges of our time' because it requires to overcome a number of 'biases and illusions' (World Bank, 2015: 18-19). People tend to ground their views on the climate on current conditions about the weather and, with respect to potential risks or threats, also tend to care much more about the present than the future. This poses a problem for policies targeted at mitigation and adaptation to climate change as people might just not respond, given that the most drastic impacts of a changing climate are expected only years from now. For people to react, they first have to notice a change. However, with the present bias when it comes to the climate, the question is whether the perceived change really reflects reality.

In order to obtain a better understanding of the role of climate change, or more specifically climate variability,[3] on the livelihoods of the households in Ziniaré, we conducted 250 semi-structured interviews.[4] The qualitative information aims to assess to what extent households are aware of a changing climate, how it affects agricultural production, livestock-rearing and health and what mechanism would need to be in place to address the perceived threats. Similar exercises investigating farmers' perceptions on climate change in Burkina Faso have been conducted by West et al. (2008) and Zampaligré et al. (2014). Both studies show farmers are highly aware of a changing climate in the region. Comparing perceptions with actual meteorological records, West et al. (2008) find farmers' perceptions corroborated. Zampaligré et al. (2014), however, find only little overlap between farmers' perceptions and actual meteorological information. We do not have access to detailed meteorological data for each village in the study area at this point, but the gridded rainfall and temperature data as shown in Figure 1b at least allow us to verify whether perceptions meet the actual general trend.

A total of 94.8% of farmers interviewed in the study site noted the climate had been more variable in the past 10 years. Inquiring into the nature of the perceived variability, farmers most commonly noted less rainfall (78.3%) and increasing dry spells and droughts (65.5%). A total of 63% mentioned a rise in temperature and 60.4% also noted more volatility in rainfalls. Increasing incidences of floods and stronger winds were noted by 13.6% and 2%, respectively. These perceptions point to an increasing hotter and drier climate over the past 10 years. As already mentioned, the meteorological data available from the past decade (Figure 1b) point to less but highly variable rains and a slight increase in temperature. Such a phenomenon was correctly described by 58.6%, or just over half of the interviewed households. Thus, while households are generally aware of a changing climate, describing and foreseeing the precise nature of these changes is challenging for households. The lack of awareness and understanding of the precise patterns can have implications for decision-making and may be one reason why farmers are showing slow response to adaptation policies and weather information as shown by Grothmann and Patt (2005), for example.

A total of 90.7% of farmers reported that their agricultural production and livelihood systems had been negatively affected, with decreasing and more volatile yields owing to the variable climate in recent years. The latest agricultural season (2014), however, has been more favourable, with long and consistent rains. More specifically, farmers noted production of millet and sorghum was more sensitive to variations in rainfall. Green beans, on the other hand, seem to have been improving in yields in recent years despite volatile rainfalls, and households are increasingly trying to expand vegetable production on their plots as an additional source of income. In some areas, however, this is challenging. Households located around the Ziga Dam, for example, report being prohibited from cultivating along the dam to protect drinking water; some households are considering moving away from the area completely.

In addition to fluctuations in agricultural production, households (68.9%) are concerned about increasing incidence of livestock and crop diseases and a lack of fodder. Households have been

[3] Households in the study area were asked whether they had noted any changes in the climate, temperature, rainfall, winds etc. in the past 10 years. Climate change typically refers to a long-term continuous change in average weather conditions, whereas the term 'climate variability' typically refers to yearly fluctuations around a long-term average. Given the 10-year reference period and households mainly talking about season-to-season variation in weather conditions, we obtained perceptions on climate variability rather than climate change and therefore use this term throughout.

[4] The interviews were conducted in November and December 2014. The 250 households were randomly drawn from the 1,500 households that had been interviewed as part of a larger household survey in 2013 (see Section 4 for details).

reporting fungal infestations of millet and diarrhoea and cramps of their livestock (particularly goats and sheep but also pigs) in recent years, for which they have no explanation and with no knowledge of the cause or treatment.

Likewise, 63.9% of interviewed households reported having observed increasing incidence of health problems and illnesses. For example, households reported that malaria was no longer seasonal and respiratory infections were increasing because of winds and dryness. Households also reported more cardiovascular problems with higher temperatures.

The interview information highlights that households are concerned about increasing risks and vulnerabilities arising from a changing climate but also that little is actively being done yet in order to address these concerns. Furthermore, households are also lacking information, particularly in terms of understanding and treating 'new' livestock and crop diseases. This latter aspect requires a more detailed analysis into the precise nature of these diseases and their implications.

Burkina Faso, Bobo-Dioulasso, Houet Province.

3.2 Perceptions on mechanisms to address climate concerns

Following the discussion on climatic changes in the past 10 years and their effects, we asked farmers about the type of interventions and policies that would benefit them in terms of addressing the climate-related concerns they had raised. Responses range from agricultural and soil protection to social protection mechanisms. Clearly, farmers have an increasing need for information: 27.7% of interviewees said they would benefit from training in better farming practices, sensitisation on environmental degradation and disease prevention. A total of 22.5% wished for better, more heat-resistant, seeds.

Reforestation and soil protection measures were mentioned by 21.2% of households and 12.3% of households requested better irrigation and water management systems. With deforestation an important driver of anthropogenic climate change, reforestation and improved irrigation are also expected to slow down future anthropogenic climate change.

In addition to measures directly linked to their economic livelihoods, 17.9% of interviewed households mentioned the need for a basic social protection package. A total of 10.6% wished for health insurance. Furthermore, 8.1% asked for increased financial help and access to credit.

While health insurance was mentioned as one mechanism to address the health shocks experienced, farmers were sceptical of the use and suitability of weather insurance to address income volatilities from agricultural production. The tools requested were instead much more concrete, indicating a clear need for better water management, dams and soil conservation measures. In addition, farmers would welcome and be willing to experiment with new, faster-growing or more resistant crops. However, access and costs of high-performing varieties are seen as a clear constraint in the area. Finally, interviewees mentioned an increasing willingness and need for income diversification, particularly moving to agro-food processing or into off-farm sectors.

4. The household survey

Following on from the debate on the perceptions of climate-related risks and potential coping mechanisms, we now turn to outline households' exposure to shocks in the study area. This analysis is based on quantitative data from an extensive household survey conducted in the rural community of Ziniaré at the end of 2013 (see Figure A2 in the Appendix).

The rural community of Ziniaré consists of 48 villages and a total of 6,798 households. Of the 48 villages, 30 were randomly selected. In each of the 30 villages, households were randomly selected, proportional to the village size. The total sample selected comprises 1,500 households with 10,513 individuals.[5]

The household survey was conducted between October and December 2013.[6] The survey collected detailed information on the demographic characteristics of the household, household assets and wealth, consumption, agricultural production and other economic activities, investment, health care, remittances and risk. In addition, the survey included a detailed module on the shocks households had been experiencing during the 12 months prior to the survey. For the purpose of this study, a shock is defined as an unexpected event that caused severe difficulties in terms of the living conditions of the household.[7] The data allow for distinguishing between four types of shocks: environmental shocks (drought, flooding, landslide/erosion, crop disease), market-related shocks (fall in output prices, increase in input prices, increase in food prices, job loss), health shocks (illness, accident, death) and asset related shocks (housing damage, theft).[8] Moreover, the survey collected detailed information on estimated loss (in assets and/or revenue) and households' actions in response to each shock.

Table 1 presents the descriptive characteristics of the household sample. In our sample, households are mainly male-headed (93%). The average age of the head is 49 years. Education levels in the study area are low, with over 70% of household heads never attending school. Only 7% of all household heads hade completed school. A total 55% of households are Muslim and almost 95% of household heads are married. This is split equally between monogamous and polygamous relationships. Households belong to the dominant ethnic group in the region – the Mossi – and are almost exclusively engaged in agriculture (98% not shown in the table). The average household in the study area has seven members, with on average 1.2 children under five years of age. On average, every third household has at least one elderly member (aged 65 years and above). The average characteristics further indicate that households in the study area consider themselves rather risk-averse, with just under 60% of households tending to take no or generally very low risks in their decisions.[9] In the absence of formal banking institutions, 10% of households interviewed participate in rotating savings and credit associations organised at the village level (so called *tontines*). While mostly female members of the household participate in these, male members and particularly household heads tend to participate in producer organisations. In our sample, about 19% of households form part of such an organisation. In the absence of formal institutions, such organisations may provide important safety net functions and access to financial resources in times of shocks, such as in the case of accidents or death, and when input and output prices fluctuate.

[5] Because of inconsistent information and identification, one interview could not be used, so the total sample size used for analysis amounts to 1,499 households.

[6] A shorter version of the household survey was conducted in 2014 of the 250 households covered by the qualitative interviews.

[7] Some studies are more specific and define shocks more narrowly as events associated with a loss of assets, income or consumption (see, e.g., Dercon et al., 2005; Yilma et al,. 2014).

[8] Other shocks are not reported include livestock loss owing to illness. Only five households noted this type of shock. Livestock loss owing to theft was much more apparent in the study region. This falls under asset related shocks.

[9] Our survey includes a risk-taking module. In this, household heads were asked about their general willingness to take risks and their reaction to a list of different activities, such as drunk driving, gambling etc. For the empirical analysis, we used the head's general self-assessed willingness to take risks as covariate. We tested the quality of this variable against an index of risk aversion derived from the more detailed list of questions using principal component analysis. The results are robust to both measures. The risk aversion measure used is motivated by recent insights in the field. Dohmen et al. (2011) and Hardeweg et al. (2013), for instance, use German and Thai data and find that self-assessed risk aversion questions are performing much better than risk aversion measures derived from lottery questions.

Table 1: Descriptive statistics of the household sample (N=1,499)

Characteristics of the household head	Mean	S.D.
Male (=1)	0.934	
Age of head (yrs)	48.975	15.349
No education (=1)	0.714	
Informal education (=1)	0.127	
Primary started (=1)	0.089	
Primary completed & more (=1)	0.071	
Muslim (=1)	0.553	
Married (=1)	0.946	
Household demographics		
Household size	7.012	3.539
Share of children (0-5 yrs)	0.178	0.145
Share of elderly (65+)	0.054	0.120
Wealth		
Lowest asset quintile (=1)	0.200	
2nd lowest quintile (=1)	0.199	
3rd lowest quintile (=1)	0.199	
2nd highest quintile (=1)	0.201	
Highest quintile (=1)	0.197	
Risk attitude		
Not taking risks (=1)	0.412	
Low risks (=1)	0.170	
Medium risk (=1)	0.217	
High risks (=1)	0.201	
Other characteristics		
Tontine membership (=1)	0.103	
Membership in producer group (=1)	0.190	

Source: Own data, collected in Ziniaré from October to December 2013.

5. Empirical strategy

The quantitative analysis of households' shock exposure is broken down into two parts. We begin by providing a descriptive overview of the type and frequency of the shocks reported in the study area and following from this we examine the characteristics of shock-prone households more systematically. We estimate a probit model to identify household determinants related to the probability of facing a shock. The econometric specification used has the following functional form:

$$\Pr(S_i = 1) = F(\alpha + X_i'\beta + \varepsilon_{ij}) \quad (1)$$

where $\Pr(S_i = 1)$ represents the probability that household i suffered from a shock. The vector X consists of a range of household characteristics including the gender, age, marital status, religion and education level of the household head, the size and the wealth of the household, the households' risk attitude and whether the household participates in village-level organisations, such as savings groups (*tontines*) or producer associations. Investigating potential heterogeneity in the exposure, we are further disaggregating the analysis by looking at different types of shocks, such as environmental shocks, health shocks and asset-related shocks, which are the most common types of shocks experienced in the study region.

In a second step, we provide a descriptive overview of the coping strategies used and provide a more detailed analysis identifying the coping strategies used by which households and in response to which shock. In order to identify the determinants of the coping strategies used, we estimate a probit model of the following specification:

$$\Pr(C_i = 1) = F(\alpha + S_i'\rho + X_i'\beta + \varepsilon_{ij}) \quad (2)$$

C_i represents the coping response that household i has used. The main coefficient of interest is ρ, which provides an estimate of the relationship between the coping mechanism and different types of shocks, S_i'. Likewise, we are controlling for a vector of household socioeconomic characteristics, X. The covariates here include the gender, age, marital status, religion and education level of the household head, the size and the wealth of the household, the households' risk attitude and whether the household participates in village-level organisations, such as savings groups (*tontines*) or producer associations.

The quantitative analysis in this paper is based on cross-sectional data. Hence, the analysis is static. We are only reporting correlations and we are at this point unable to investigate changes over time. Even though we are controlling for a range of variables in our specification, we cannot sufficiently control for the influence of unobserved household specific characteristics that may influence both exposure to a shock and the coping mechanism chosen. In order to test the robustness of our estimates, we are also estimating a village-level fixed-effects specification controlling for unobserved heterogeneity at the village level. The fixed-effects specification has the following form:

$$\Pr(C_i = 1) = F(\alpha + S_i'\rho + \mu_j + \varepsilon_{ij}) \quad (3)$$

with μ_j representing a vector of village dummy variables. The results of this robustness test are presented in Table A2 in the Appendix.

6. Results

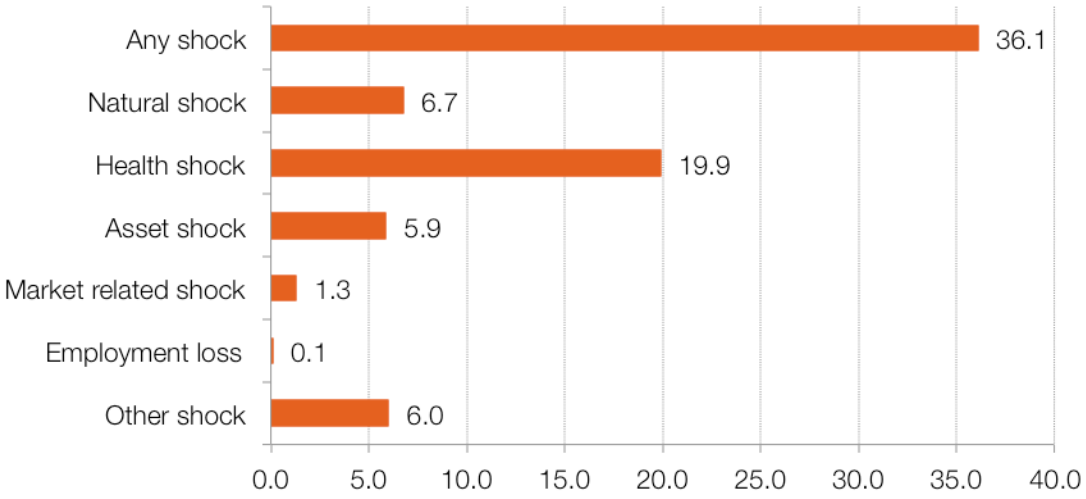
6.1 Incidence and determinants of shocks

Figure 2 presents incidence of shocks experienced by the households in the study region in the 12 months prior to the household survey. The survey information shows about one-third (36.1%) of the households interviewed had experienced at least one shock. Indeed, most households reported having experienced one major negative event in the 12 months preceding the survey; only 3.9% said they had experienced more than one shock. Health shocks are the most frequent shocks experienced. Almost every fifth household in our sample has suffered from severe illness,[10] an accident or death of a household member. Other studies analysing multi-shock modules in different contexts have also noted high incidence of health shocks (see, e.g., Heltberg and Lund, 2009; Wagstaff and Lindelow, 2014). Environmental shocks were reported by a total of 101 households (6.7%); asset-related shocks, such as theft or severe damage of housing and livestock, by 5.9%. In the 12 months prior to the household survey, price fluctuations and job losses appeared to be moderate, with only 1.4% of the households suffering from spikes in input and/or output prices.

The frequency of these shocks occurring seems to be constant, at least in the short term. Data from a recent follow-up survey conducted in 2014 with the 250 households covered by the qualitative interviews shows similar incidence rates. In the smaller sample, still about one-third of households (36.9%) reported having suffered from a major shock in 2014. Almost every fourth household (23.4%) had suffered a health shock; 3.1% had suffered drought and pests (environmental shock); 5% had suffered asset-related shocks; and 2.3% had been severely affected by adverse price movements.

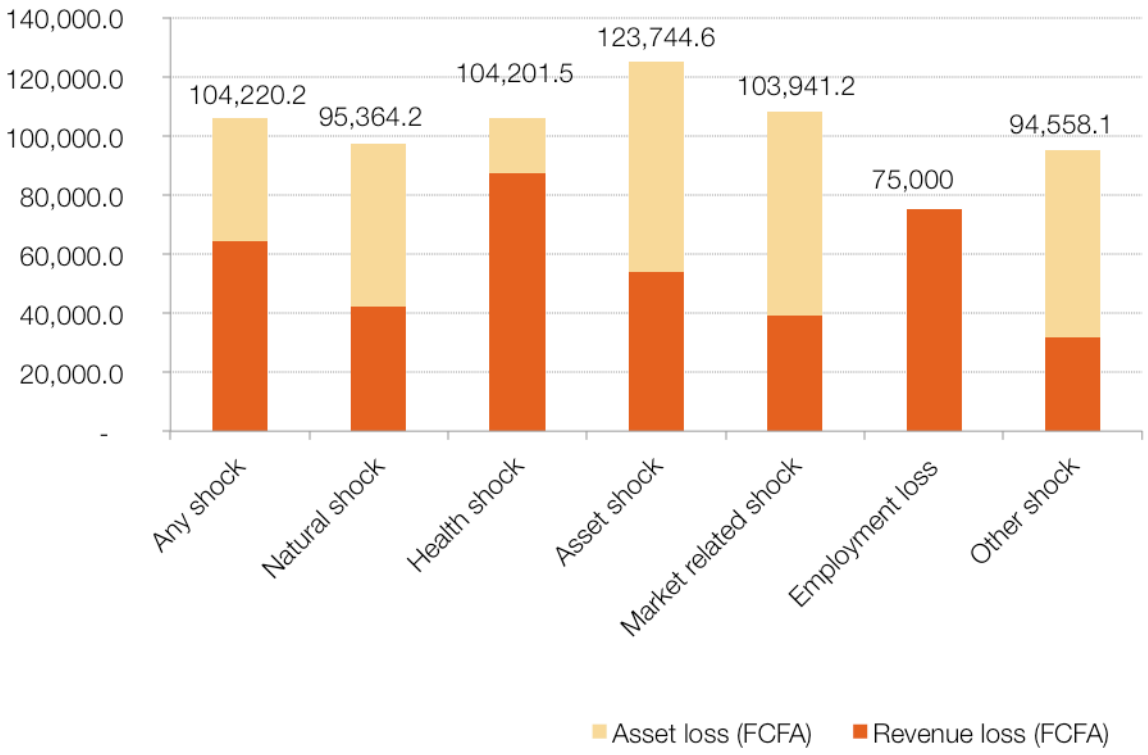
[10] These are typically illnesses requiring expensive medication or treatment, more common illnesses which are experienced more frequently by the household such a malaria or diarrhoea are not reported here.

Figure 2: Incidence of shocks in the 12 months prior to the survey (% of households)



Source: Author's representation based on own data, collected in Ziniaré from October to December 2013.

Figure 3: Distribution of loss owing to shock (FCFA)



Source: Author's representation, based on own data, collected in Ziniaré from October to December 2013.

While incidence of environmental shocks, with 6.7% of households, is low compared with average experiences in other contexts (see, e.g., Dercon et al., 2005; Yilma et al., 2014), such shocks are typically covariate in nature, meaning they affect not only the household in isolation but also households in the surrounding area. Indeed, in our sample, 84.5% of environmental shocks reported had also affected other households in the village or even the entire village. In contrast, health and asset related shocks are largely idiosyncratic, with less than 40% of these shocks affecting other households. The idiosyncratic or covariate nature of shocks has direct implications for potential insurability. Risks of idiosyncratic shocks, for example, can more easily be (informally) insured and shared within a social network.

Despite the lower-than-expected incidence of shocks reported, the average loss households have faced in consequence of these events is substantial; estimated at FCFA104,220 (Figure 3).[11] This is an amount almost equal to the 2009 nominal poverty line in Burkina Faso, estimated at FCFA108,374 (see Grimm et al., 2013). Asset shocks have the highest average effect, at FCFA123,774, followed by an average loss in case of health shocks of FCFA104,201.[12] Average loss as a result of environmental shocks is slightly lower, at FCFA95,364. While environmental and asset shocks lead to an almost equal loss in assets and revenue, revenue loss owing to inability dominates in case of health shocks.

The scope – that is, if shocks are largely covariate or idiosyncratic in nature – as well as the severity of the shock have implications for the coping strategies used. Before we turn to a more in-depth discussion of coping mechanisms, we take a closer look at the characteristics that render households more or less vulnerable to shocks.

Table 2 shows the probability (marginal effects) of experiencing a shock as a function of various characteristics as outlined in Equation (1) (see Section 4). Column (1) presents the results for a shock in general, whereas Columns (2) to (4) show the results for the most common shocks reported – that is, environmental, health and asset-related shocks, respectively.

Generally, households where the head had benefited from informal education were 11 percentage points less likely to experience a shock than households where the head had not received any form of education. In line with expectations, we also find that households with a low to medium readiness to take risks are 7 to 11 percentage points more likely to suffer from a negative event than households that are

[11] This is equivalent to around GBP126. The average loss in 2014 is slightly higher, at FCFA144.185 (equivalent to GBP174).
[12] The loss due to asset shocks is equivalent to GBP149; the loss due to health shocks amounts to GBP126. The average loss of health shocks in 2014 was around FCFA175.491 (equivalent to GBP 212).

more risk-averse. Other covariates such as wealth and household composition do not seem to play a role overall.

If we are considering the different types of shocks individually, however, the picture becomes a bit more nuanced. While environmental shocks are generally assumed to be random, we see that households with a male head and following the Muslim religion are less likely to be negatively affected by floods, droughts or crop diseases. Because of the small number of female-headed households in our sample, we cannot conduct a detailed gender-differentiated assessment, but a closer look at the plots which female-headed households cultivate suggests they are more distant and of worse quality, which could have implications for their sensitivity to natural and weather conditions, making them more prone to environmental shocks.

Education matters in the case of health shocks. Consistent with the positive association between health and education found in the literature (see, e.g., Ross and Wu, 1995), households where the head has received at least informal education are 8 percentage points less likely to have been affected by severe health shocks than households where the head has not received any education. At higher education levels, we find no significant differences that can be related to the low incidence of households having obtained primary schooling. The results further indicate that households with a low to medium readiness to take risks are more likely to suffer from health shocks (7 percentage points) than households with a generally risk-averse head. Assuming readiness to take risks translates directly into health behaviours, this finding is not surprising.

While environmental and health shock are not influenced by the demographic composition and the wealth status of the household, asset-related shocks such as theft are more likely to occur to larger and to wealthier households. Households in the second and third asset quintile are 4 to 5 percentage points more likely to be affected by asset-related shocks than households in the poorest quintile. Households in the two wealthiest quintiles in turn appear to be unaffected by asset-related shocks. This could be the result of a reporting bias; for example, a richer household may not perceive the theft of a goat to be a severe negative event whereas it is drastic for poorer households. Otherwise, it could owe to better quality of and thus more stable housing and also better protection against theft.

Table 2: Probability of experiencing a shock (marginal effects reported)

Characteristics of the household head	Any shock	Environmental shock	Health shock	Asset shock
Male (=1)	-0.083	-0.068*	0.022	-0.045
	(0.062)	(0.038)	(0.063)	(0.040)
Age of head (yrs)	0.002*	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.000)
No education (=1)	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Informal education (=1)	-0.109***	-0.010	-0.078**	-0.011
	(0.042)	(0.026)	(0.037)	(0.021)
Primary started (=1)	0.039	0.023	0.002	0.009
	(0.039)	(0.026)	(0.042)	(0.021)
Primary completed & more (=1)	0.053	-0.009	0.047	-0.005
	(0.041)	(0.027)	(0.037)	(0.021)
Muslim (=1)	-0.055	-0.039**	-0.001	0.004
	(0.039)	(0.019)	(0.023)	(0.015)
Married (=1)	-0.058	0.015	-0.085	0.021
	(0.076)	(0.045)	(0.055)	(0.046)

	Any shock	Environmental shock	Health shock	Asset shock
Household demographics				
Household size	0.003	0.002	0.000	0.003*
	(0.004)	(0.002)	(0.003)	(0.002)
Share of children (0-5 yrs)	0.192	-0.007	0.057	0.019
	(0.119)	(0.067)	(0.084)	(0.053)
Share of elderly (65+)	0.172	0.018	0.123	0.032
	(0.113)	(0.054)	(0.077)	(0.060)
Wealth				
Lowest asset quintile (=1)	(Ref.)	(Ref.)	(Ref.)	(Ref.)
2nd lowest quintile (=1)	0.045	0.015	-0.002	0.0440*
	(0.046)	(0.019)	(0.038)	(0.019)
3rd lowest quintile (=1)	0.067	-0.022	0.036	0.055***
	(0.041)	(0.017)	(0.031)	(0.021)
2nd highest quintile (=1)	0.055	0.006	0.017	0.030
	(0.037)	(0.020)	(0.031)	(0.020)
Highest quintile (=1)	0.037	-0.010	0.026	0.028
	(0.043)	(0.025)	(0.031)	(0.017)
Risk attitude				
Not taking risks (=1)	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Low risks (=1)	0.069*	-0.021	0.073**	0.017
	(0.035)	(0.021)	(0.034)	(0.015)
Medium risk (=1)	0.113***	0.001	0.071***	0.022
	(0.038)	(0.014)	(0.027)	(0.017)
High risks (=1)	0.021	0.003	0.041	0.003
	(0.035)	(0.018)	(0.032)	(0.012)
Other characteristics				
Tontine membership (=1)	0.060	0.016	-0.006	0.029
	(0.051)	(0.018)	(0.045)	(0.020)
Membership in producer group (=1)	0.096***	0.023	0.044*	0.001
	(0.035)	(0.015)	(0.027)	(0.011)
N	1,471	1,471	1,471	1,471
Pseudo R-squared	0.035	0.038	0.02	0.027

Notes: Robust standard errors clustered at the village level in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Source: Own data, collected in Ziniaré from October to December 2013.

This first part of the analysis highlights that, even though only about one-third of households in the study region have been affected by shocks, the loss that has occurred to these households in consequence is substantial. Health shocks are the most common negative events that households are currently struggling with. Furthermore, the analysis also shows different households are at risk of different shocks. While environmental shocks still appear to be largely random, less educated and more risk-seeking households are at higher risk of experiencing health shocks, whereas households in the second and third wealth quintile are more likely to suffer from asset-related shocks. These potential risks and vulnerabilities need to be taken into account when discussing and designing potential safety net and insurance mechanisms targeted at lowering current household vulnerabilities.

6.2 Current coping mechanisms

In order to respond to shocks, households rely on a whole array of mechanisms. In our case, households employ between one and four different mechanisms to cope. Likewise, however, a substantial number of households (between 22% to 53%, see Table 3) are not using any active response. The reasons for not using any coping strategy could be manifold. It could owe to households' inability to respond to shocks or also because the shock experienced is not severe enough. Given the substantial losses in revenues and assets depicted in Figure 2, this latter explanation does not seem likely, though.

Table 3: Coping responses and shocks (% of households using specific coping mechanism)

	Any shock	Environmental shock	Health shock	Asset shock
Dissaving	16.5	6.3	21.7	12.5
Reduced consumption	7.0	6.3	6.2	11.1
Asset sales	27.2	37.9	29.7	18.1
Transfers	40.1	32.6	51.4	20.8
Borrowing	6.7	13.7	7.6	1.4
Additional labour supply	3.2	9.5	0.7	6.9
No response	34.4	36.8	22.0	52.7

Source: Own data, collected in Ziniaré from October to December 2013.

Table 3 presents a descriptive breakdown of the coping mechanisms used in response to different types of shocks. Since households are employing multiple mechanisms in relation to a shock experienced, the percentage values presented in the table do not add up to 100. The cross-tabulation in Table 3 provides first indicative evidence that different coping strategies are more likely to be used in case of different shocks. While asset sales – that is, sales of land, livestock, food stocks and household assets – are more likely in case of environmental shocks, households experiencing health shocks rely predominantly on transfers from other family members and friends. In case of asset-related losses, households tend not to use any active coping mechanism – that is, no immediate replacement. In some cases, particularly when housing has been damaged, they benefit from intra-family transfers.

The differences in coping strategies used are also linked to the insurability of shocks. While health shocks are typically idiosyncratic, they are more easily insured through informal risk-sharing mechanisms within the social network, as other households are less likely to be affected by the same shock at the same time. Weather-related shocks, however, more commonly affect other households likewise. Hence, the network may be less able to address this risk. Therefore, households tend to 'dissave' and sell (productive) assets. This loss of capital can have negative implications for productivity and bears the risk of a downward spiral or poverty trap (see, e.g., Dercon, 2006; Hoddinott, 2006). Because we have only cross-sectional data at this point, we cannot analyse the welfare implications of assets sales in more detail. However, we observe that, in cases where households have been reporting land or livestock sales, their land and livestock holdings have not been depleted completely, and in the majority of cases livestock sales have been complemented by borrowing or transfers from family members. Of more concern are households that have been reporting no active coping response to environmental shocks. These households exhibit no or very low livestock holdings. In this case, the non-response really seems to stem from an inability to respond that makes households a potential target group for a social protection floor.

Table 4: Probability of relying on a specific coping mechanism (marginal effects)

Shocks	(1) Dissaving	(2) Reduced consumption	(3) Asset sales	(4) Transfers	(5) Borrowing	(6) Labour supply	(7) No response
Environmental shock (=1)	-0.107*	-0.050	0.177**	-0.094	0.094***	0.045**	-0.014
	(0.058)	(0.037)	(0.077)	(0.065)	(0.034)	(0.020)	(0.068)
Health shock (=1)	0.038	-0.048	0.106**	0.096*	0.063**	-0.037**	-0.154***
	(0.035)	(0.030)	(0.050)	(0.054)	(0.025)	(0.016)	(0.041)
Asset shock (=1)	-0.056	-0.012	0.019	-0.182***	-0.003	0.020	0.087**
	(0.053)	(0.036)	(0.071)	(0.063)	(0.031)	(0.018)	(0.044)
Characteristics of household head							
Male (=1)	0.112	-0.090	-0.272**	-0.164	-0.006	0.000	0.204
	(0.112)	(0.072)	(0.118)	(0.121)	(0.051)	(0.000)	(0.133)
Age of head (yrs)	0.000	-0.000	0.002	0.003*	-0.001	-0.001*	-0.002*
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
No education (=1)	(Ref.)	(Ref.)	(Ref.)	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Informal education (=1)	0.093	0.052*	0.093	-0.014	0.055*	0.041*	-0.207***
	(0.057)	(0.029)	(0.074)	(0.082)	(0.030)	(0.021)	(0.078)
Primary started (=1)	0.070	-0.042	-0.007	0.009	-0.001	0.005	-0.042
	(0.050)	(0.045)	(0.072)	(0.088)	(0.036)	(0.016)	(0.056)
Primary completed + (=1)	0.057	0.011	-0.013	-0.026	-0.006	0.023	-0.069
	(0.056)	(0.044)	(0.057)	(0.078)	(0.049)	(0.017)	(0.062)
Muslim (=1)	0.037	-0.046*	0.012	0.033	0.009	0.008	-0.031
	(0.031)	(0.026)	(0.047)	(0.041)	(0.022)	(0.014)	(0.039)
Married (=1)	-0.033	0.032	0.194	0.073	-0.036	0.000	-0.080
	(0.094)	(0.076)	(0.144)	(0.165)	(0.054)	(0.000)	(0.116)
Household demographics							
Household size	0.006	-0.000	0.006	-0.005	0.003	-0.003	-0.005
	(0.004)	(0.003)	(0.008)	(0.006)	(0.004)	(0.003)	(0.006)
Share of children (0-5 yrs)	0.233**	-0.091	-0.364**	-0.109	-0.133	-0.029	0.237**
	(0.100)	(0.084)	(0.171)	(0.193)	(0.084)	(0.047)	(0.107)
Share of elderly (65+)	0.126	-0.111*	-0.469**	-0.098	-0.012	0.005	0.170
	(0.126)	(0.059)	(0.186)	(0.172)	(0.085)	(0.082)	(0.143)
Wealth							
Lowest asset quintile (=1)	(Ref.)	(Ref.)	(Ref.)	(Ref.)	(Ref.)	(Ref.)	(Ref.)
2nd lowest quintile (=1)	0.064	0.044	-0.076	0.074	0.013	0.270***	-0.065*
	(0.044)	(0.034)	(0.058)	(0.060)	(0.027)	(0.075)	(0.039)
3rd lowest quintile (=1)	0.031	0.017	-0.030	0.010	0.017	0.238***	-0.070
	(0.061)	(0.032)	(0.053)	(0.069)	(0.030)	(0.069)	(0.068)
2nd highest quintile (=1)	0.030	0.032	-0.018	0.043	-0.005	0.267***	-0.000
	(0.060)	(0.047)	(0.087)	(0.085)	(0.026)	(0.073)	(0.088)

	(1) Dissaving	(2) Reduced consumption	(3) Asset sales	(4) Transfers	(5) Borrowing	(6) Labour supply	(7) No response
Highest quintile (=1)	0.117**	0.068*	-0.074	0.092	-0.076	0.264***	-0.089
	(0.058)	(0.035)	(0.066)	(0.071)	(0.047)	(0.068)	(0.071)
Risk attitude							
Not taking risks (=1)	(Ref.)	(Ref.)	(Ref.)	(Ref.)	(Ref.)	(Ref.)	(Ref.)
Low risks (=1)	-0.119***	0.032	-0.043	-0.004	-0.012	0.287***	0.053
	(0.046)	(0.025)	(0.045)	(0.054)	(0.036)	(0.078)	(0.043)
Medium risk (=1)	-0.112***	-0.075***	0.121***	-0.008	0.006	0.297***	-0.069
	(0.042)	(0.026)	(0.041)	(0.064)	(0.029)	(0.074)	(0.056)
High risks (=1)	-0.180***	0.005	0.179***	0.061	-0.058	0.301***	-0.165**
	(0.057)	(0.037)	(0.028)	(0.068)	(0.037)	(0.076)	(0.074)
Other characteristics							
Tontine membership (=1)	-0.120**	-0.009	0.001	-0.058	-0.078*	0.006	0.054
	(0.060)	(0.036)	(0.074)	(0.070)	(0.045)	(0.013)	(0.061)
Membership in producers' group (=1)	-0.025	-0.059**	0.091**	0.017	-0.009	0.011	-0.061*
	(0.030)	(0.026)	(0.041)	(0.035)	(0.028)	(0.011)	(0.036)
N	535	535	535	535	535	495	535
Pseudo R-squared	0.121	0.117	0.09	0.053	0.116	0.353	0.100

Notes: Robust standard errors clustered at the village level in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Source: Own data, collected in Ziniaré from October to December 2013.

Table 4 shows the probabilities (marginal effects) that a certain coping strategy is used against a set of shocks and household characteristics as described in Equation (2) (see Section 5). The estimates do indeed indicate that, for different shocks, different sets of coping mechanisms are used. The results show environmental shocks are more likely to trigger asset sales (18 percentage points), borrowing (9 percentage points) and additional work (4.5 percentage points) as coping responses. While we see similar associations in the case of health shocks – that is, a higher likelihood of asset sales (11 percentage points) and borrowing (6 percentage points) – health shocks are also more likely to trigger transfers from family or friends (10 percentage points). In contrast, taking up additional work is less likely in the case of health shocks. This is expected, as illness, accident and death reduce the number of able-bodied labourers within the household, even more so if other members have to care for the ill. In case of health shocks, it is also unlikely that no active coping response is used. This can be explained by the often immediate need related to these kinds of shocks: in the case of illness, postponing a response or treatment could have fatal consequences. In the case of asset-related shocks, households are more likely not to use any active coping mechanism to immediately replace damaged or stolen goods and less likely to receive transfers from outside (9 percentage points).

Apart from the difference in coping responses triggered by different types of shocks, our analysis shows the influence of different household characteristics on the coping mechanism chosen. Male-headed households are, for example, found to be 27 percentage points less likely to sell assets in the case of a shock. Households with elder heads are much more likely to receive transfers from outside (0.3 percentage points) and, in line with expectations, also less likely to take up additional work as a coping response. In contrast, households with heads who have at least informal education, compared with no education, are 4 percentage points more likely to take up additional work. These households are also 5.5 percentage points more likely to borrow from friends or family and to reduce consumption if need be.

Households with higher shares of young children and elderly are more likely to use savings but less likely to reduce consumption or sell assets in response to a shock. Further distinct patterns can also be observed with respect to

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households' wealth status. The richest households are more self-reliant when facing shocks and, given their income and asset level, more likely to reduce their savings and consumption. Generally, wealthier households tend to take up additional work in order to cope with a shock, unlike households from the poorest wealth quintile.

The risk attitudes of the households also outline an interesting pattern. More risk-seeking households tend to be less likely to reduce savings. In contrast, these households tend to be more likely to sell assets or take up additional work in the case of a shock.

In summary, the multivariate analysis shows different households have different abilities and use different coping strategies when faced with a shock. Wealthier households are more likely to respond to shocks by reducing savings and consumption. More risk-seeking households tend to respond to shocks with asset sales, whereas households with higher shares of dependants – that is, young children and the elderly – tend to rely on transfers and are less likely to reduce savings and sell assets.

With respect to the coping mechanism used in response to certain shocks, in the case of health shocks households tend to require and rely on solidarity and support in the form of transfers from family and friends outside. However, for environmental shocks, informal risk-sharing mechanisms tend to break down as households in the area are also likely to be affected. Since these shocks tend to trigger sales of productive capital, the single shock can have negative implications for future agricultural productivity. In addition, households that signal an inability to respond to environmental shocks owing to already low asset holdings represent a potential target group for a basic social protection floor.

7. Conclusion

This paper elicits local farmers' perceptions on a changing climate in semi-arid Burkina Faso. More specifically, the paper investigates the extent to which farmers are aware of a changing climate and the potential threats and effects they associate with these perceived changes. In addition, it contrasts the potential threats with the current level of and exposure to shocks these rural households have to deal with on a day-to-day basis and the coping strategies applied. With this, the paper aims to contribute to a better understanding of the current socioeconomic context in semi-arid areas and the threats and opportunities these areas are facing in light of a changing climate.

The analysis in this paper is based on qualitative interview data on farmers' perceptions combined with data from a unique household dataset collected in the rural community of Ziniaré in the Central Plateau region of Burkina Faso in 2013.

The analysis shows households in the study region are generally aware of changes in the climate even though just about half of the interviewed households are in a position to describe the climatic pattern. Despite their awareness, households do not show or report many active responses in adapting to the changing climate. This is driven in large part by a lack of resources and information to better address perceived threats of lower agricultural yields, increasing livestock and crop diseases and health problems. However, farmers in the area are very receptive to interventions such as training on better farming practices and soil protection, better seeds and irrigation. In addition, households are pointing to the need for better social protection measures such as a basic social protection floor and health insurance as a means to cope with potential future threats, given that formal mechanisms of this kind are still fully absent in the study region.

Contrasting farmers' perceptions with their current exposure to shocks shows environmental shocks are actually not playing the primary role. The most frequent shocks households are currently facing are health shocks, followed by environmental shocks. Even though only every third interviewed household suffered from a severe negative event in 2013, the losses households incurred as a consequence of shocks were substantial, ranging around the level of the nominal poverty line estimated for Burkina Faso in 2009. The analysis further shows shocks are not uniformly distributed. Different types of households are vulnerable to different shocks, which in turn triggers different coping responses. In the absence of formal insurance and safety net mechanisms, environmental shocks are typically overcome by asset sales, borrowing and increased labour supply. This, however, applies only to households that are able to mobilise these resources. Households that signal an inability to respond to environmental shocks owing to already low asset holdings represent a potential target group for a basic social protection floor. In the case of health shocks, households tend to rely on informal solidarity and risk-sharing mechanisms with transfers received from outside. Health insurance interventions, requested in response to the increasing climate-related health concerns, could also already provide an important protective function under current circumstances.

The analysis suggests different characteristics and household capabilities and vulnerabilities have to be taken into account when designing appropriate safety net, insurance and adaptation mechanisms, given the current context and potential future threats. A number of mechanisms perceived to be beneficial to address potential climate-related risks, such as agricultural interventions and better social protection, could also already improve the current livelihoods of households in semi-arid areas and thus also dampen perceived future risks.

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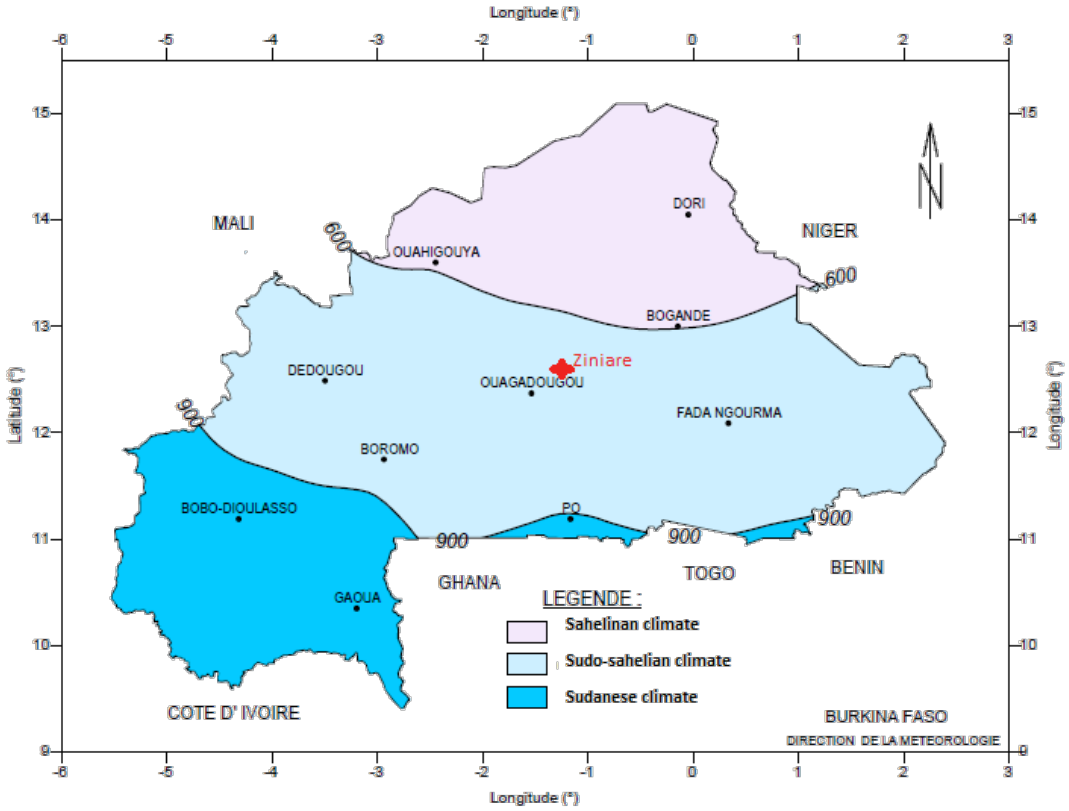
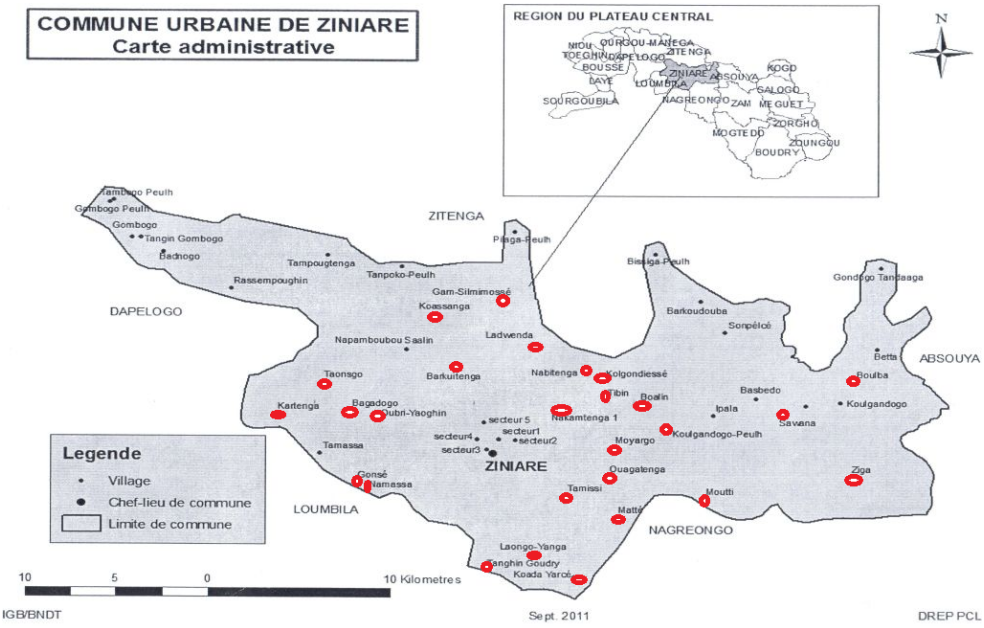
Appendix

Figure A1: Climate zones of Burkina Faso



Source: FAO (2010).

Figure A2: Map of community of Ziniaré and selected villages (September 2011)



Source: Office of the Mayor of Ziniaré (obtained October 2013).

Table A1: Agricultural production by households in villages affected (N=476) and non-affected (N=1,023) by perceived lower rains in the 2013 agricultural season

	Mean (non-affected)	Mean (affected)	p-value	
Fertiliser costs (FCFA)	1,770.00	2,985.00	0.018	**
Agricultural land (ha)	3.24	3.35	0.564	
Planted groundnuts (=1)	0.66	0.72	0.025	
Planted green beans (=1)	0.68	0.68	0.891	
Planted maize (=1)	0.35	0.36	0.750	
Planted millet (=1)	0.68	0.65	0.750	
Planted sorghum (=1)	0.72	0.78	0.037	**
Groundnuts output (kg)	157.40	142.00	0.519	
Green beans output (kg)	93.22	113.70	0.143	
Maize output (kg)	152.50	132.60	0.673	
Millet output (kg)	424.50	212.80	0.025	**
Sorghum output (kg)	151.50	113.70	0.063	*

Notes: P-values test for the equality of means between the two groups; * p<0.10, ** p<0.05, *** p<0.01.

Source: Own data, collected in Ziniaré from October to December 2013.

Table A2: Probability of relying on a specific coping mechanism (village-fixed-effects estimates)

	(1) Dissaving	(2) Reduced consumption	(3) Asset sales	(4) Transfers	(5) Borrowing	(6) Labour supply	(7) No response
Environmental shock (=1)	-0.091*	-0.066**	0.167*	-0.086	0.086**	0.053*	-0.016
	(0.052)	(0.032	(0.087)	(0.065)	(0.034)	(0.031)	(0.074)
Health shock (=1)	0.027	-0.046*	0.110*	0.117**	0.029	-0.037**	-0.166***
	(0.040)	(0.025)	(0.057)	(0.052)	(0.020)	(0.015)	(0.040)
Asset shock (=1)	-0.044	0.007	0.028	-0.162**	-0.006	0.016	0.058
	(0.057)	(0.038)	(0.076)	(0.065)	(0.025)	(0.023)	(0.058)
N	535	535	535	535	535	535	535
adj. R-squared	0.050	0.015	0.062	0.041	0.006	0.055	0.095

Notes: Control variables omitted for convenience. Control variables include sex, age, education level, religion and marital status of household head; size of household; share of children and elderly in household; wealth status; risk attitudes; tontine membership; and membership in a producer group. Robust standard errors clustered at the village level in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Source: Own data, collected in Ziniaré from October to December 2013.

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