The Role of Social Capital in Adaptation to Climate Change Shocks: Ethiopia's Experience

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Abstract

Ethiopia, like many sub-Saharan African countries, frequently experiences climate change-induced shocks, particularly droughts and floods. These events severely impact the well-being of people, especially in rural communities. While the country struggles to recover from these shocks, studies consistently highlight the importance of access to critical resources in building climate resilience and strengthening adaptive capacity. This study focuses on social capital, an often overlooked yet crucial resource, and its role in mitigating the effects of climate change shocks and facilitating adaptation in Ethiopia. Utilizing a probit regression model based on data from 4951 households in the 2015/16 Ethiopian Socioeconomic Survey, the study found that households with greater social capital (measured by *iddir* membership, borrowing, and transfers) are less likely to be affected by drought shocks. Furthermore, stronger social capital is associated with reduced vulnerability to climate shocks and increased adaptive capacity. These findings suggest that social capital can serve as an alternative approach to supporting climate change responses in Ethiopia, especially where access to formal insurance schemes is limited. However, further research is needed to explore the specific mechanisms through which social capital fosters resilience and adaptation.

Keywords: Adaptation, climate change, climate change shocks, Ethiopia, social capital

1. Introduction

Climate change presents a profound challenge to humanity worldwide, impacting livelihoods through severe weather events, rising sea levels, erratic rainfall, and higher temperatures (IPCC 2014; IPCC 2019). Particularly vulnerable are the rural poor, whose situation is exacerbated by factors such

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as agricultural dependence on rainfall, recurrent droughts, poverty, population growth, and low adaptive capacity (Kurukulasuriya et al. 2006; West et al. 2008; Hassan 2010; Boko et al. 2018; Yaméogo et al. 2018). This vulnerability is most pronounced in low-income countries like those in Sub-Saharan Africa (SSA), where a lack of resources and adaptive capacity intensifies the impacts of climate change (Dodman and Mitlin, 2013).

Ethiopia, situated in SSA, faces frequent climate change shocks, particularly droughts, severely affecting rural communities' welfare (Baptista et al. 2022)). These shocks deteriorate farmers' livelihoods and hinder their recovery efforts (Admassu et al., 2013). With a heavy reliance on rainfed agriculture, which contributes significantly to the national GDP, exports, and employment, Ethiopia is highly vulnerable to climate change (Gezie 2019). Consequently, agricultural production and smallholder farmers' livelihoods suffer from adverse climate effects (Hilemelekot et al., 2021; Belay et al. 2022).

Adaptation to climate change is crucial in Ethiopia, where environmental shocks hinder poverty alleviation efforts (Zeleke et al. 2021). Rural households' ability to adapt depends on access to various forms of capital, including financial, human, physical, natural, and social (Mekonen and Berlie 2021). The provision of formal insurance to the poor is absent in Ethiopia as the country's insurance penetration stands at a mere 0.4 % (see, Wordofa, 2023). In the absence of formal insurance, rural communities rely on social capital, such as mutual support networks, to buffer against shocks (Di Falco and Bulte, 2009; Endris et al., 2017; Wuepper et al., 2018).

The scholarly and seminal works by Bourdieu (1986), Coleman (1988) and Putnam (1993) have inspired the basic line of inquiries on social capital as a cause, outcome and process of economic development and adaptation to various forms of shocks. Social capitals as defined by these scholars and others plays a crucial role in economic development and adaptation to shocks (Aldrich et al. 2016; Kerr, 2018). In Ethiopia, community-based organizations like *iddirs* harness social capital to facilitate climate change adaptation (Dercon et al., 2012). These institutions, grounded in trust, reciprocity, and shared norms, offer support to vulnerable households

(Kebede, 2018). They not only provide financial assistance but also facilitate access to resources, technology adoption, and collective actions for climate adaptation (Di Gregorio et al., 2012; Tumbo et al., 2013).

Community-based institutions structure environmental risks, provide incentive frameworks, and serve as channels for external interventions (Agrawal, 2010). They offer informal agricultural insurances, labor-sharing arrangements, and financial services to rural households (Dercon et al., 2006). Through social networks, farmers access credit, seeds, and other essential resources, easing the financial constraints of adaptation (Bernier and Meinzen-Dick, 2014). Social capital, embodied in community-based organizations can serve as a crucial resource for climate change adaptation in Ethiopia. Harnessing social networks, shared norms, and trust, these institutions support rural households in mitigating the impacts of climate change and building resilience.

Studies (e.g. Hoddinott et al., 2009; Mogues, 2011; Liverpool and Winter-Nelson, 2010; Todo et al., 2011; Degefa 2007; Wossen et al. 2015) demonstrate the pivotal role of social capital in transferring agricultural knowledge, adopting new technologies, risk aversion in the process of technology adoption, maintaining livelihoods and food security, and mitigating income shocks in Ethiopia. Paul et al. (2016) study the effect of social capital (measured by interpersonal trust) on collective and individual adaptation to climate change. They found that social capital increases contributions to collective adaptation measures but it also decreases private adaptation measures. However, the impact of social capital on climate change adaptation decision-making remains understudied (Wuepper et al., 2018). Existing research suggests that social capital can offset large-scale shocks, but its effectiveness varies depending on context and nature (Endris et al., 2017).

Although there is a rich empirical literature on social capital and rural life in Ethiopia, less attention has been given to the impact of farmers' social capital in their climate change adaptation decision-making process. Thus, research is needed to comprehensively understand the dynamics of social capital and its role in climate change adaptation decision-making. This study therefore examines the effect of social capital on adaptation to climate change shocks by applying multiple measures. In this paper, we contextualized social capital in terms of membership in *iddir* (voluntary participation in voluntary association), reciprocity and solidarity in family and community affairs, and giving and receiving gifts and transfers from others. As such, rather than relying on a single measure of social capital, we measure social capital by constructing a social capital index that combines (1) participation in *iddirs* as the most pervasive community based organizations in Ethiopia, (2) the ability of households to rely on family and/or friends at times of crisis measured in terms of incidence of borrowing in the previous 12 months, and (3) receiving transfers or gifts.

2. Methods

2.1. The data

Data for this study came from the Ethiopian Socioeconomic Survey (ESS), an outcome of a collaborative project between the Central Statistics Agency of Ethiopia (CSA, currently known as Ethiopian Statistical Service /ESS/) and the World Bank Living Standards Measurement Study- Integrated Surveys of Agriculture (LSMS-ISA) team. The ESS covered all regional states. It primarily collected information on 290 rural areas 43 small towns, and two city administrations that include Addis Ababa and Dire Dawa. It is part of a long-term project to collect data on rural and small-town households, their characteristics, welfare and their agricultural activities. This study uses data obtained from the third round of the ESS survey collected in 2015/16 (see Table 1).

Table 1. Summary statistics of variables

Variable	Obs	Mean	Std.Dev	Min.	Max.
Gender of household head (1=male)	4,950	0.69	0.461	0	1
Age of household head	4,944	46.35	15.294	13	99
Education in years	4,283	5.46	3.530	0	20
Dependency ratio	4,792	1.36	1.201	0	11
Household size	4,951	4.72	2.379	1	16
***Iddir* membership**	4,951	0.62	0.483	0	1
Borrowing money (1= yes)	4,951	0.039	0.195	0	1
Nonfarm work	4,951	0.294	0.455	0	1
Drought shock (1= exposed)	4951	0.23	0.425	0	1
Flood shock (1= exposed)	4951	0.03	0.171	0	1
Illness shock (1= incidence of shock)	4951	0.23	0.421	0	1
Nonagricultural income (annual in ETB)	1,600	178.65	1148.5	0	35000
Agricultural income (est. annual in ETB)	1,600	1564.6	19947.1	0	780000
Consumption per capita (monthly in ETB)	4,714	637.91	685.01	76.5	28958.5

Source: Authors' computation using ESS 2015/16 data. https://doi.org/10.48529/ampf-7988

Note: *Agricultural income refers to the nominal income earned from agricultural activities during the survey period. In ESS 3 wave (2015/16), agricultural income was reported to be low and not included in the Report by the Central Statistical Agency of Ethiopia on ESS 2015/16 (see https://microdata.worldbank.org/index.php/catalog/2783/related-materials). The CSA's 2017 report uses median income for 'other income categories and the median agricultural income is 3000 ETB. Since, income variables in the dataset are highly skewed, a logarithmic transformation is performed on the variables.*

2.2. Empirical strategy

This paper analyzed the effect of social capital on climate change shocks using a binary probit econometric estimation model that estimates social capital index as a function of climate change shocks and household and community characteristics. The dependent variables of the model are exposure to climate change shocks and adaptation actions. Following a recent study by Saptutyningsih, Diswandi and Jaung (2020) that analyzed the role of social capital in climate change adaptation in Indonesia's agricultural sector, we used a set of independent variables that include social capital index, household socio-demographic characteristics, location, and illness (see Table 2 for the definition of variables).

The social capital index is a composite index that is computed using a systematic combination of iddir membership, relying on family and/or friends at times of crisis, and receipt of transfer or gifts. These were combined with equal weights to create an index on a scale 0 to 1. This computation followed the process of standardization used in the calculation of vulnerability index (see Hahn et al., 2009).

$$I_v = \frac{I_a - I_{min}}{I_{max} - I_{min}} \quad (1)$$

Where, I_v is the standardized value for the indicator, I_a the value for the indicator I for a particular household a, I_{min} is the minimum value of indicators across all households, and a, I_{max} is the maximum value of indicators across all households. After each indicator is standardized, the component average value was calculated using equation 2.

$$P_a = \frac{\sum I_v}{N} \quad (2)$$

Where P_a is the value for the component in household a, and N is the number of variables in the component. After obtaining values for each of the eight components, the household level the social capital index was obtained by combining these components using equation 3:

$$SCI_a = \frac{\sum_{p=1}^{3} N_p \; P_{a,P}}{\sum_{p=1}^{3} N_p} \quad (3)$$

WhereSCI_a is the Social Capital Index for each householda and N_p is the number of indicators in each profile. In this study, SCI value ranges between 0 and 1 Where 0, denoting the least social capital and 1 denoting the highest social capital.

A similar technique was followed to calculate climate shocks index that combines drought and flood shocks experiences at household level reported in the last 12 months in the dataset.

Table 2. The definition of variables

Categories	**Variable definition**
Social capital index	combines participation in *iddirs* as the most pervasive local organizations in Ethiopia that contribute to resilience, the ability to rely on family and/or friends at times of crisis measured in terms of incidence of borrowing in the previous 12 months, and receiving transfers or gifts
Climate shock index	A combination of drought and flood shocks experience
Household socio-demographic characteristics	Age of household head (year) Gender of a household head (1=male, 0= female) Average number of family size (No.) Education of the household head (in years)
Location	Location of the household (1=rural 0=urban
Idiosyncratic shock incidence	Incidence of illness in the household in the last 12 months
Climate change adaptation	A combination of autonomous and planned adaptation strategies that includes participation in non-farm income earning activities (diversification away from agriculture); engagement in agribusinesses (representing on farm and off-farm diversification); and participation in state-sponsored watershed development representing planned or institutional adaptation option available for households

The standard probit model's main assumption can be expressed by following (Wooldridge, 2002) as:

$$P\left(y_i = 1 \middle| \boldsymbol{X_i}, u_i\right) = P(y_i = 1 | \boldsymbol{X_i}, u_i) = \Phi(\boldsymbol{X_i \beta} + u_i), \tag{1}$$

Additionally, the probit model adds the assumption of normality

$$u_i | X_i \sim \text{Normal } \left(0, \sigma_u^2\right) \tag{2}$$

This assumption entails that u_i and X_i are independent and that u_i has a normal distribution. These assumptions are strong and may not be attainable given the nature of the data used in this estimation. According to Wooldridge (2002; 2010) these assumptions can be relaxed by observing:

$$P\left(y_i = 1 \middle| \boldsymbol{X_i}\right) = P(y_i = 1 | \boldsymbol{X_i}) = \Phi(\boldsymbol{X_i \beta}),$$
(3)

Where $\boldsymbol{\beta}_u = \boldsymbol{\beta} / \left(1 + \sigma_u^2\right)$

Thus, it is possible to estimate $\boldsymbol{\beta}_u$ with direct estimation of the average partial effects with robust standard errors to deal with the requirement of robust inference to account for serial dependence (see Woodridge, 2002: 486).

Woodridge (2002) citing Ruud (1986) discusses how to consistently estimate the slope parameters with some restrictions imposed on the distribution of X_i, mainly that at least one element of X_i with non-zero coefficient is continuous. Since we are only interested in estimating the directions and relative sizes of the partial effects, and not the response probabilities, it is possible to consistently estimate $\boldsymbol{\beta}$ up to scale under very weak assumptions using semi-parametric estimators. Model specification tests including goodness of fit statistics, sensitivity and specificity tests are given under Table B, Annexed.

3. Results and discussions

Climate change shocks were mainly captured by looking at exposure to severe climate-related shocks by households. Accordingly, 23.7 % of surveyed households reported being exposed to drought while 3.17 % of all respondents identified floods and heavy rains as the common climatic shocks that they are exposed. In total, close to 27% of surveyed households are exposed climatic shocks (see Table 3).

Table 3. Climatic shocks exposure of households

Climatic shocks	**Freq.**	**Percent**
Drought	1,173	23.7
Flood and heavy rains	157	3.17
Total	1330	26.86

N=4951

Source: Authors' computation using ESS 2015/16 data

Social capital was measured by constructing a social capital index that combines participation in iddirs as the most pervasive local organizations in Ethiopia that contribute to resilience, the ability to rely on family and/or friends at times of crisis measured in terms of incidence of borrowing in the previous 12 months, and receiving transfers or gifts (see Wuepper, Yesigat Ayenew and Sauer, 2018). As can be shown in Table 4, 3,674 (74 %) of the survey respondents indicated having access to some form of social capital, with SNNPR having the largest proportion social capital index followed by Amhara region. This result is to be expected as the SNNPR region is the most ethnically and culturally diverse region having more than 56 groups that share both bonding and bridging social capital and where iddirs are the most prevalent institutions that bring people from all walks of live together. Similarly, the Amhara region is also culturally diverse with iddirs being an integral part of peoples' way of life.

Table 4. Social capital and its regional distribution

Region	**Obs.**	**Social capital**	**Percent**
Tigray	582	295	50.69
Afar	142	43	30.28
Amhara	1,007	837	83.12
Oromia	987	793	80.34
Somali	262	94	35.88
Benshagul Gumuz	125	96	76.80
SNNPR	1,121	1,003	89.47
Gambelia	114	70	61.40
Harari	159	132	83.02
Addis Ababa	247	174	70.45
Dire Dawa	205	137	66.83
Total	4,951	3,674	74.21

Source: Authors' computation using ESS 2015/16 data

As drought is the most frequent and severe climatic shock in Ethiopia, drought shock is used as the first outcome variable to estimate the effect of social capital. Accordingly, the results of the probit estimations show that drought shock incidence has a negative and significant relationship with possession of social capital (Table 5).

Table 5. Effect of social capital on drought shock

	Dependent variable (Drought shock=1)	Probit	Probit marginal effects at the mean
	Social capital (=1)	-0.450***	-0.1134***
		(0.0554)	(0.0137)
Location	Rural residence (=1)	0.762***	0.1922***
		(0.0668)	(0.0163)
Household characteristics	Sex of the household head	0.0198	0.0050
		(0.0586)	(0.0148)
	Age of the household head	0.00834***	0.0021***
		(0.00166)	(0.0004)
	Education in years	-0.0829***	-0.0209***
		(0.00994)	(0.0025)
	Dependency ratio	0.0351*	0.0089*
		(0.0205)	(0.0052)
	Household size	0.0433***	0.0109***
		(0.0113)	(0.0028)
idiosyncratic shock	Incidence of illness	-0.0391	-0.0099
		(0.0564)	(0.0142)
	Constant	-1.277***	
		(0.134)	
	Observations	4,234	4234

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Authors' computation using ESS 2015/16 data.

The result from the probit marginal effects at the mean indicate that those with social capital (*iddir* membership, borrowing, and transfers) are less likely to be affected by drought shocks, i.e. those with social capital are 11.3 % less likely to be affected by drought shock impact compared to those who do not have social capital (**Table 5)**. This result provides initial evidence on the positive contribution of social capital in reducing climate induced shocks consistent with the theorized role of social capital and collective action in climate change adaptation (see Adger 2010) and corroborates the findings from other studies (see Wuepper *et al*. 2018).

Similarly, using climate shock index that combines drought and flood shocks, we assessed the effect of social capital. The results indicate that having social capital is more likely to reduce climate shock's impact by up to 10 %, highly statistically significant at less than 1% level (Table 6).

Table 6. The effect of social capital on climate change shock

	Dependent variable (climate change shock index)[1]	**Probit**	**dy/dx Marginal effects at the mean**
	Social Capital (=1)	-0.379***	-0.1010***
		(0.0546)	(0.0143)
Location	Rural residence (=1)	0.718***	0.1911***
		(0.0637)	(0.0164)
Household characteristics	Sex of household head	0.0425	0.0113
		(0.0571)	(0.0152)
	Age of household head	0.00897***	0.0024***
		(0.00162)	(0.0004)
	Education in years	-0.0774***	-0.0206***
		(0.00961)	(0.0025)
	Dependency ratio	0.0340*	0.0090*
		(0.0202)	(0.0054)
	Household size	0.0459***	0.0122***
		(0.0111)	(0.0029)
Idiosyncratic shock	Incidence of illness	-0.0180	-0.0048
		(0.0548)	(0.0146)
	Constant	-1.309***	
		(0.131)	
	Observations	4,234	4234

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Authors' computation using ESS 2015/16 data

It is important to note that people are not only a passive victims of climate change related shocks but largely react to the changing climate by taking autonomous and planned adaptation actions. In this sense, it should be highlighted that social capital can be ineffective against covariate shocks that affect a community and overwhelm its capacity to coordinate and take action. In this regard, Paul *et al.* (2016, p.126) note that "Social capital does not necessarily have universally positive effects or serve as insurance mechanisms against adverse shocks. Social capital may be ineffective if there is a general lack of resources or knowledge of effective solutions. In this sense, the community may be the inappropriate scale of action necessary to adapt; rather, adaptation could depend primarily on choices made by the individual household (e.g., migration) or by the state (e.g., aid programming)”. Thus, following this argument, we constructed a simple adaption index that captures the choices made by individual households and opportunities created by the state that constitute participation in non-farm income earning activities (diversification away from agriculture)(Weldegebriel and Prowse 2013); engagement in agribusinesses (income diversification); and participation in state-sponsored watershed development.[2] The index ranges between 0 and 3 with 0 representing very low adaptation and 3 very high adaptations. The mean adaptation index for the whole sample is 0.76.

As can be shown from **Table 7**, the effect of social capital on climate change adaptation by households is positive, i.e. having social capital is likely to increase adaptive capacity by up to 9.8 %, statistically significant at less than 1%. As expected, adaptation is more likely to increase with the gender of household head being male, education and household size while it declines with age, dependency ratio and illness shock. These results corroborate with studies on social capital and climate change adaptation in Ethiopia by Paul *et al*. (2016) and Wuepper et al. (2018) and elsewhere in Indonesia by Saptutyningsih et al. (2020).

Table 7. The effect of social capital on climate change adaptation actions

	Dependent variable (climate change adaptation index)	**Probit**	**dy/dx Marginal effects at the mean**
	Social Capital (=1)	0.321*** (0.0496)	0.0982*** (0.0150)
Location	Rural residence (=1)	0.358*** (0.0535)	0.1095*** (0.0161)
Household characteristics	Sex of household head	0.436*** (0.0482)	0.1332*** (0.0143)
	Age of household head	-0.012*** (0.00150)	-0.0037*** (0.0004)
	Education in years	0.0324*** (0.00778)	0.0099*** (0.0024)
	Dependency ratio	-0.0448** (0.0197)	-0.0137** (0.0060)
	Household size	0.0662*** (0.0107)	0.0202*** (0.0032)
Idiosyncratic shock	Incidence of illness	-0.0882* (0.0500)	-0.0270* (0.0153)
	Constant	-0.0191 (0.114)	
	Observations	4,234	4234

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' computation using ESS 2015/16 data

Given the pervasive nature of *iddirs* as the main form of social capital that represents both the bridging and bonding aspects, we conducted a separate analysis to examine its effect on climate change adaptation. Accordingly, the results are very similar with overall social capital index and show that belonging to an *iddir* is likely to increase adaptive capacity by up to 9.9 %, statistically significant at less than 1% (see **Table A**, Annex). This result is indicative of the important roles that such indigenous community based organizations can play in helping individual households and communities to adapt to the adverse effects of climate change. In this regard, Dercon *et al.* (2008) reported that in addition to assisting with funeral services and expenses, *iddirs* provided cash or loans for shocks including fire, loss of livestock, destruction of houses, weddings, illness, harvest loss, or other events. Empirical evidences from developing countries also suggest that social networks and groups provide financial and nonfinancial resources (e.g., emotional, sheltering, and information) during disaster situations. Teshome *et al.* (2015) note that *iddirs* are providing a wide range of services by extending their reach to other economic activities and influence quality of life by increasingly espousing risk pooling arrangements to provide insurance against risks and disbursing credit for their members.

More importantly, membership in *iddirs* usually transcends different socioeconomic stratifications and differences. Thus, unlike bonding SC that strengthens ties within a group, *iddirs* help to foster bridging social capital (Teshome et al. 2015). Bonding social capital describes the horizontal connections between and among individuals who are emotionally close including family members, friends and neighbors. It exists among groups of demographically, geographically, religiously, and/or ethnically similar people with shared norms and expectations. This kind of strong connection is indeed characterized by similarity in available information, demography, and economic and social status where social relationships are based on trust and reciprocity. This type of connection is, however, closed and exclusive in its nature. Access to and benefits of membership are thus limited to those individuals and households who have similarity. This type of social capital is good for providing immediate social assistance in times of shocks. It is thus important in the creation of coping capacity and help households to respond to idiosyncratic shocks.

Bridging social capital, on the other hand, connects those groups and networks that link different segments of the society for cooperative community activities, such as mutual aid associations, burial societies (*iddirs*), and labor reciprocity networks at community level. It connects members across communities or groups, often crossing ethnic lines /boundaries and can aid communities *via* access to resources, new perspectives, and assets, including remittances. *Iddirs* in Ethiopia form bridging social capital and they link people that span different social groups such as ethnic and religious groups, social and economic groups and villages for shared support (Endris et al. 2014).

The information and knowledge shared between social groups, in one way or another, allows the community to benefit from a diversified social endowment accumulation and, therefore, encourages more social capital formation (Pelling and High 2005). When resources are lacking locally, people may use members of *iddirs* and request support, resources, or information, which is important to boosting community resilience to climate change. Thus, *iddirs* are important in the creation of adaptive resilience capacities of individuals and households, involving incremental adjustment in income for better adaptation. *Iddirs* are especially effective for addressing covariate shocks. As argued by Bernier and Meinzen-Dick (2020) *iddirs* demonstrate a commitment to learning, innovation, and flexibility, having evolved in their mandate to offer insurance products for their consumers. In addition, they exhibit effective rules and regulations, with their enforcement and accounting mechanisms. However, *iddirs*, as they rely exclusively on local assets and capacities, do little to build the transformative capacities of communities, households, and individuals. There is, yet, potential for transformative capacity in the very nature of their governance and in the experience of having effective local institutions to work with and to build upon (Bernier and Meinzen-Dick 2020).

The forgone analysis and findings confirm that social capital could serve as an alternative approach to supporting climate change responses in Ethiopia where social capital has a strong presence in the lives of communities. Thus, in Ethiopia, where access to formal insurance schemes are often lacking, self-insurance through informal risk sharing mechanisms are among the most common strategies that households use in the face of adverse shocks (Dercon *et al.* 2008). In the event of a shock, households with better social capital are able to more easily smooth their consumption. In contrast, those that do not have enough social capital will be forced to rely on last-resort of negative coping strategies such as selling off productive assets. Such coping strategies, however, tend to have high opportunity cost and result in a much lower rate of recovery, consequently, leading to lower resilience capacity in the future.

4. Conclusion

This study delves into the critical role of social capital in mitigating the impacts of climate change and fostering adaptation within rural Ethiopian communities. Utilizing data from a vast sample of 4,951 households obtained from the Ethiopian Socioeconomic Survey (ESS), the research specifically examined the effect of social capital on:

Reducing climate change shocks: The analysis employed a probit regression model and revealed that households with higher levels of social capital (measured through *iddir* membership, borrowing, and transfers) displayed a lower susceptibility to drought shocks compared to those lacking such connections. This suggests that strong social networks act as a buffer against climate-induced hardships.

Enhancing risk reduction: The findings further indicate that robust social capital is associated with a decreased vulnerability to broader climate shocks. Households with strong social ties are seemingly better equipped to navigate challenges due to the support and resources available within their networks.

Boosting adaptive capacity: The study also highlights the positive impact of social capital on increasing households' ability to adapt to climate change. This aligns with collective action literature, where trust and reciprocity fostered through community-based organizations like *iddirs* as well as relying on friends and relatives are seen as crucial motivators for collective action and coping mechanisms in the face of changing climatic conditions.

The research emphasizes the unique value proposition of *iddirs* in supporting adaptation efforts. Their widespread presence compared to other organizations makes them ideal entry points for implementing climate change adaptation measures. Additionally, their effectiveness in mobilizing communities for action surpasses state-driven approaches, making them valuable partners in development efforts.

Policy implications

The findings urge policymakers, planners, and development agents working in rural areas to acknowledge and integrate the role of social capital when designing climate change adaptation interventions. This recognition opens avenues for leveraging existing social capital structures to build community resilience and empower people to navigate the challenges posed by a changing climate.

The need for further research

While the study underscores the significance of social capital in adaptation, further research is necessary to:

- Confirm the multifaceted roles of social capital in various aspects of climate change adaptation.
- Explore more nuanced approaches to harnessing the potential of community-based organizations like *iddirs* in building collective resilience.

By actively engaging with these crucial research areas, we can unlock the full potential of social capital and empower rural communities to face the daunting realities of climate change with greater strength and preparedness.

Appendices

Table A: The effect of *iddir* membership on climate change adaptation

	Dependent variable (climate change adaptation index)	**Probit**	**dy/dx Marginal effects at the mean**
Social capital	Iddir membership(1=yes)	0.328*** (0.0450)	0.09997*** (0.0134)
Location	Rural residence (=1)	0.373*** (0.0536)	0.11374*** (0.0161)
Household characteristics	Sex of household head	0.438*** (0.0482)	0.13357*** (0.0143)
	Age of household head	-0.0126*** (0.00151)	-0.00386*** (0.00045)
	Education in years	0.0314*** (0.00778)	0.00956*** (0.00236)
	Dependency ratio	-0.0443** (0.0197)	-0.01351** (0.00601)
	Household size	0.0663*** (0.0107)	0.02022*** (0.00323)
Idiosyncratic shock	Incidence of illness	-0.0733 (0.0500)	-0.02237 (0.01526)
	Constant	0.0336 (0.112)	
	Observations	4,234	4,234

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' computation using ESS 2015/16 data

Table B. Model specification tests
Goodness of fit statistics (percent correctly predicted and pseudo R-squared)

	-------- True --------		
Classified	D	~D	Total
+	2833	930	3763
-	110	163	273
Total	2943	1093	4036

Classified + if predicted Pr(D) >= .5
True D defined as cca != 0

Sensitivity		Pr(+ D)	96.26%
Specificity		Pr(-~D)	14.91%
Positive predictive value		Pr(D +)	75.29%
Negative predictive value		Pr(~D -)	59.71%
False + rate for true ~D		Pr(+~D)	85.09%
False - rate for true D		Pr(- D)	3.74%
False + rate for classified	+	Pr(~D +)	24.71%
False - rate for classified	-	Pr(D -)	40.29%
Correctly classified			**74.23%**

Variable	Obs	Mean	Std. Dev.	Min	Max
P1	4036	.7289527	.1299329	.2105541	.9597

Note:
-The predicted probability indicate the likelihood of y=1. If the predicted probability is greater than 0.5 we can predict that y=1, otherwise y=0.
-The percent correctly predicted values are the proportion of true predictions to total predictions.
-The average of predicted probabilities for having social capital is about 72.89% which is similar to the actual frequency for having social capital, which is 74.2 %
-The probit model correctly predicts 74.23% of the values and the rest are misclassified.

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[1] Although the main interest in this analysis lies in identifying the conditional effects, which does not require strictly following the exogenity criterion, some income and asset related variables were excluded in the models. The robustness of the estimated models is checked by including these variables in a different set of estimations. The results show that most other covariates in the probit models are significant and have the expected signs. Accordingly, the probability of being affected by climate change shocks declines with higher crop income, livestock holding and with access to credit.

2 As discussed by Weldegebriel and Prowse (2013) some of these components such as non-farm diversification can be considered as an autonomous adaptation strategy in and of itself as it helps to build the resilience and adaptive capacity of households in the face of climate variability and change.