Climate Risk Management 25 (2019) 100191

Contents lists available at ScienceDirect

Climate Risk Management

journal homepage: www.elsevier.com/locate/crm

Index-based livestock insurance to manage climate risks in Borena zone of southern Oromia, Ethiopia

Abayineh Amare[a,*], Belay Simane[b], Julius Nyangaga[c], Akalu Defisa[a], Dereje Hamza[a], Biriki Gurmessa[a]

[a] *Jimma University College of Agriculture and Veterinary Medicine, Department of Rural Development and Agricultural Extension, P.O. Box 307, Jimma, Ethiopia*

[b] *Addis Ababa University, College of Development Studies, Centre for Environment and Development, P.O. Box 1176, Addis Ababa, Ethiopia*

[c] *Consultant at Right Track Africa, Kenya*

ABSTRACT

Index-based livestock insurance has been introduced in Borena zone of southern Ethiopia by the International Livestock Research Institute working in partnership with Oromia Insurance Company and humanitarian agencies since 2012 as an instrument to help protect pastoralists' herders against drought related mortality of livestock. Despite the some positive success to the concerted efforts, the continued adoption of index-based livestock insurance by pastoralists and agro-pastoralists has been limited. The current study highlighted the status, and determinants of index-based livestock insurance to managing risks resulted from the changing climate in the study area. The study used household surveys from 359 sampled households, key informant interviews, and focus group discussions to collect the data. Descriptive statistics (i.e. frequency, percentage, mean, and standard deviation), inferential tests (Chi-square test and *t*-test), and binary logit model were used to analyze the collected data. The results of the current study evidenced that the adoption of indexed insurance is below expectation. The results further indicated that several factors appeared to affect demand for index-based livestock insurance. Those households in a farming system with moisture stress, those who perceived climate risks, those who aware the insurance, who are better educated, who have access to credit and off-farm activity are more likely to adopt the index-based livestock insurance. Furthermore, households who have a membership to a large number of social organizations are more likely to purchase the insurance. However, households who are far from the weather station and old aged households are less likely to purchase index-based livestock insurance. Adaptation pathways to support the uptake of index-based livestock insurance must take in to account these critical factors influencing household's decision to adopt the insurance scheme. It is also imperative to integrate the insurance into indigenous institutions and link it with the local development process.

1. Background and justification of the study

It is readily acknowledged that Africa is one of the most vulnerable continents to climate change and climate variability (Tache, 2008). It has been recognized that frequency of droughts and other climate-related risks has increased in the recent past, leading to the loss of large numbers of livestock and livelihoods, and particularly affecting pastoralist/agro-pastoralists communities in Africa in general and in Ethiopia in particular (Kunow, 2016; Jensen et al., 2015; Chantarat et al., 2009). Likewise, droughts have repeatedly hit the Borana plateau of Ethiopia, causing huge mortality in livestock and heightening hardships in humans (Doti, 2010; Angassa and Oba, 2007; Desta and Coppock, 2004). The literature contains reports of vicious cycles of drought and related livestock deaths in Borena in the years 1973/74, 1983/84, 1991/92, 1999/00 and 2005/06 (Berhanu and Fayissa, 2010; Angassa and Oba, 2007; Desta and Coppock, 2004). This situation has further exacerbated the food security crisis among the already food-insecure Borena pastoralist/agro-pastoralist households.

* Corresponding author.
E-mail address: abaytana82@gmail.com (A. Amare).

https://doi.org/10.1016/j.crm.2019.100191
Received 14 January 2019; Received in revised form 4 June 2019; Accepted 7 June 2019
Available online 12 June 2019

An array of adaptation practices were practiced to improve the resilience of pastoralists'/agro-pastoralists' livelihood to uncertain future impacts of climate change. For example, pastoralists and agro-pastoralists in Borena have traditionally used various risk-management mechanisms; these include splitting herds, pasture management by creating dry- and wet-season grazing areas, and movement of herds to access water and pasture in other areas (Kunow, 2016; Chantarat et al., 2009, 2013), livestock diversification, and crop cultivation (Megersa et al., 2014). There also exists a range of customary insurance arrangements that involve informal inter-household transfers in the form of cash or livestock. *Despite all these concerted efforts in reversing the situation, climate change remains a great challenge to the Borena herders* (Jensen et al., 2015; Angassa and Oba, 2007). This is mainly due to the fact that traditional risk-sharing arrangements are weak and insufficient. For instance, Awel and Azomahou (2014) highlight the ineffectiveness of traditional risk-sharing arrangements, arguing that this mechanism cannot cope with spatial covariate shocks. Similarly, Dercon et al. (2014) showed that group risk-sharing mechanisms are very strong among households in Ethiopia, but tend to offer only a partial form of insurance, as they are characterized by limited commitment. This does not guarantee full insurance against covariate risks. Moreover, informal mutual assistance mechanisms that developed to help recover from losses due to idiosyncratic shocks do not function effectively under covariate, catastrophic natural disasters, where all neighboring community members suffer substantial losses (Barrett, 2011). Similarly, formal insurance service has remained underdeveloped in most poor, rural regions due to classic incentive problems associated with asymmetric information, such as moral hazard and adverse selection, as well as the high transaction costs involved in preventing opportunistic behavior by insurers (Marcantonio and Kayitakire, 2017).

This state of affairs calls for a continued effort to find ways of improving the resilience of vulnerable communities and to create a holistic approach to protect the household against covariate climate risks. With this understanding, recently, index-based livestock insurance was introduced as one of the modern risk-management tool in Borena zone of Ethiopia in 2012 by the International Livestock Research Institute (ILRI), working in partnership with Oromia Insurance Company and humanitarian agencies. Besides its potential impacts in reducing the widespread welfare loss that arises from large scale covariate weather risks, this insurance product has elicited considerable attention, especially since it is free from information asymmetry, moral hazard, and adverse selection problems (Barnett et al., 2008). Index insurance indemnity payouts are determined based not on actual losses experienced by policyholders, but on easily observable, objective weather or environmental parameters – such as rainfall, temperature, or remotely sensed estimates of vegetation levels that are highly correlated with losses (Barnett et al., 2008; Zant, 2008) that constrain individual the opportunity to manipulate the record. This allows insurers to avoid both the moral hazard and adverse selection problems associated with indemnification of losses specific to the insured as well as the significant transaction costs associated with monitoring the behavior and verifying the losses of the insured (Miranda and Farrin, 2012).

Although index-based livestock insurance is so new in Ethiopia, demand for index-based insurance is generally low and the uptake of this product continues to be below expectation in Africa (Jensen et al., 2015; Giné, 2009). The causes for failures and low adoption of the index-based livestock insurance were attributed mainly to several physicals, economic and institutional constraints. Lack of good quality data; start-up costs and related economic support by the government; difficulty in transferring covariate risk to the international reinsurance market; inappropriate and/or costly delivery mechanisms; lack of an enabling environment; and unfamiliarity with the insurance market are the most common constraint from supply side (Sina, 2012; Mahul and Stutley, 2010; Cole et al., 2009). On the demand side, the most common constraints are: premium affordability (Carter, 2012), farmers' trust in insurance providers (Cole et al., 2009), financial illiteracy (Giné and Yang, 2009), cognitive failure (Skees and Collier, 2008), and low willingness to pay (Chantarat et al., 2009). However, due to heterogeneity in socio-economic characteristics and institutional arrangements in the different part of Africa, it is difficult to extrapolate these results in Ethiopia.

Existing studies of index insurance uptake in Ethiopia are rooted in the experience of crop insurance programs that ensure against income loss from yield fluctuations (Bogale, 2014). However, the causes for failure and low uptake of this introduced insurance, such as livestock insurance by pastoralists and agro-pastoralists, remains scarce in Ethiopia. To the extent that the livelihood systems, risk mitigation strategies, and the long-term welfare outcomes associated with shocks differ between crop-based and pastoral-based production systems, we would expect the uptake for and benefits of index-based livestock insurance to similarly diverge in these contexts.

This paper aims to contribute to the growing literature on the uptake of index-based livestock insurance. Overall, this study is designed to examine factors leading to the uptake of index-based livestock insurance for scaling-out the insurance product to other areas of pastoralist/agro-pastoralist. The study is central in showcasing the success of index-based livestock insurance and identifying key challenges for effectively scaling-up of this insurance scheme as climate change adaptation action. Hence, the central objective of this study is to examine the level of uptake and determinants of the uptake of index-based livestock insurance among pastoralist/agro-pastoralist in Borena Zone of Ethiopia.

2. The study site

This study was conducted in Borana zone of southern Oromia regional state of Ethiopia. It is located between 3°36–6°38′North latitude and 3°43′–39°30′ East longitude. It is bounded by Kenya in the South. Yabello is the capital town of the zone and lies 570 km south of Addis Ababa. The zone covers 48,360 km^{2}of which 75% consists of lowland. The Borana rangelands cover about 1.9 million ha. It consists of pastoralist and agro-pastoralist farming system (Fig. 1)

The Borana zone is a vast pastoralist landmass consisting mainly of arid and semi-arid agro-ecological zones with a bimodal rainfall pattern. This zone experiences four different seasons within the year. These are 1) Bona season is long dry spell from December to February; 2) Gana season is the long rainy period from March to May; 3) Adolessa season is the short dry spell from June to August; and 4) Hagaya season the short rainy period from September to November (Debela et al., 2019**)**. The study area receives an

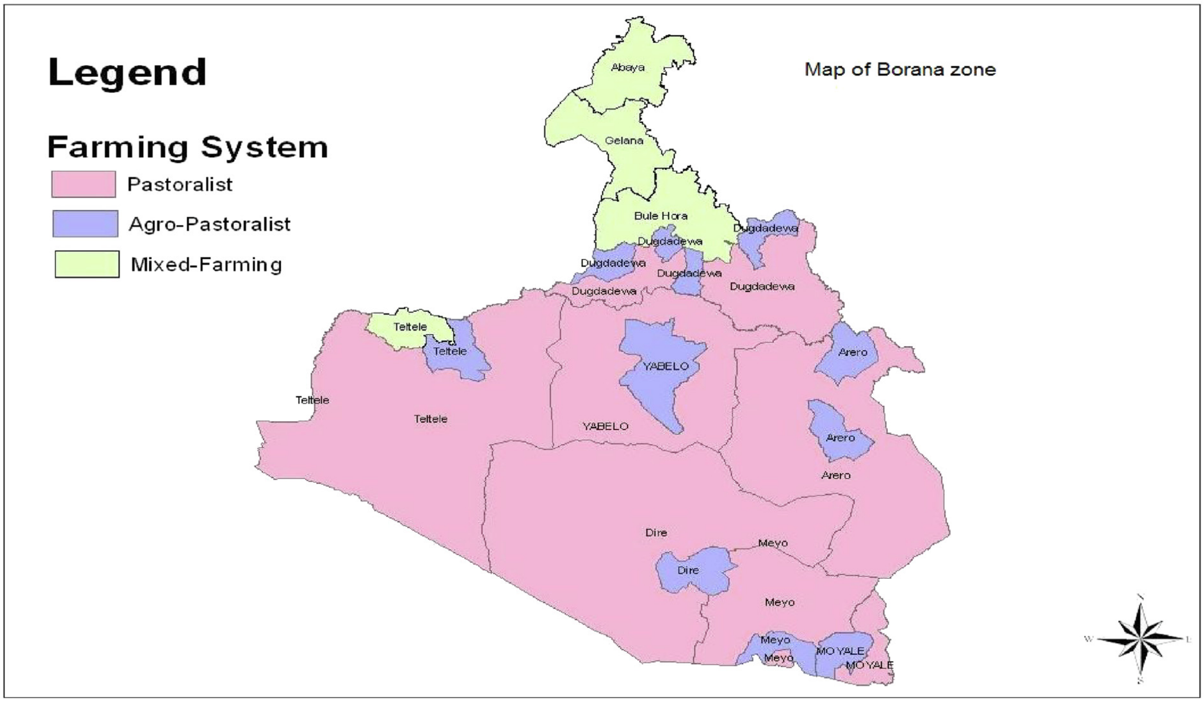

Fig. 1. Location of the case study area.

average of 700 mm annual rainfall which varies between 350 mm around Wachile in Arero district to about 1100 mm in Moyale town in Moyale district. The Borana Oromos, who inhabit the lowlands of Borana zone, traditionally relied on a system of mobile pastoralism as the primary source of income and sustenance, with limited cereals cultivation for own consumption (Berhanu, 2011). There are widespread concerns that more frequent drought, perhaps associated with climate change, is making pastoralism a more tenuous enterprise (Barrett and Santos, 2014). As a result, indigenous social insurance mechanisms have declined in recent times. Informal community networks, therefore, cannot effectively mitigate the effects of shocks (Santos and Barrett, 2011).

3. An overview of index-based livestock insurance

The index for IBLI Borana is calculated at the *district* level as a cumulative deviation of periodic Normalized Differential Vegetation Index (NDVI) measures; an indicator of vegetative cover widely used in drought monitoring programs in Africa for each IBLI sales period. IBLI insurance contracts are sold during two sales periods (SP) – January-February and August-September – prior to the start of the short and long rainy seasons. The insurance contracts cover a full 12-month period. Index readings for each sales period are announced and indemnity payments made to policyholders if the contractually stipulated strike rate is triggered, at the end of the season. The IBLI premium rate differs across *woredas* and by livestock species but is the same for all buyers ensuring the same livestock species within a *woreda*, irrespective of individual loss experience. The *woreda* specific premium rates are applied to the value of herd that an IBLI buyer chooses to insure in order to establish the total amount that they must pay for IBLI coverage. Not all the Borana (pastoralists) use IBLI and for those who do, they do not buy for all their livestock. It is the factors that underlie this decision that this study seeks to explore.

Index insurance has gained widespread interest in recent years as an instrument for reducing uninsured covariate risk in poor rural areas that typically lack access to commercial insurance products. For instance, over the past ten years, there has been a growing interest among researchers, international multilateral and non-governmental organisations, and national governments in exploring the possibility of using a particular form of microinsurance—insurance tailored to the needs of the poor—to cover the potential losses of smallholder farmers associated with weather shocks (Patt et al., 2008). This alternative form of insurance, known as index-based insurance, has been offered to stimulate rural development by allowing smallholder farmers to better adapt to climate change (Dercon et al., 2014). This index-based insurance offers significant potential advantages over traditional insurance. Because indemnity payments are not based on individual claims, insurance companies and insured clients need only monitor the index to know when payments are due. This sharply reduces the transaction costs of monitoring and verifying losses, while also removing some of the well-known structural problems including moral hazard, adverse selection, and systemic risk that bedevil conventional insurance (Barnett and Mahul, 2007).

A growing literature highlights primary avenues through which insurance might bring about positive impacts (Cole et al., 2012; Barnett et al., 2008; Dercon et al., 2014). Insurance provides alternative risk management strategies. By altering the ability of households to cope with risk ex-post, insurance may change optimal behavior before a shock is actually observed. A systematic review of the effectiveness of micro-insurance and especially index-based insurance by Cole et al. (2012) shows that insurance encourages investment in higher risk activities with higher expected profits. Karlan et al. (2012) show that farmers who purchase rainfall index insurance in Ghana increase agricultural investment. Hill and Viceisza (2010) use experimental methods to show that in a game setting, insurance induces farmers in rural Ethiopia to take greater, yet profitable risks, by increasing the (theoretical) purchase of fertilizer. Recent impact evaluations of the original IBLI pilot in northern Kenya nonetheless find income and productivity gains, on average, for IBLI policyholders (Jensen et al., 2015).

4. Methods and materials

4.1. Sampling framework

While IBLI was marketed and sold to any household on the Borana plateau, the current study used multi-stage sampling techniques to select sample respondents. In the first stage, the study site was clustered into two major farming systems - pastoralism, and agro-pastoralism, a farming system so as to maximize livelihood variation across the Borana pastoral and agro-pastoral area. In the second stage, all districts from each farming system were listed and a total of three districts were randomly selected. This includes Arero and Dire districts from the pastoral farming system, and Yabelo district from the agro-pastoral farming system. Finally, a total of 359 households were selected based on simple random sampling technique using proportional sample size.

4.1.1. Methods of data collection

Both qualitative and quantitative data were gathered and used for this study. In view of the diverse impact of IBLI on pastoralists and agro-pastoralists, and the nature of the information needed on various aspects of this research, employing a single method of data collection method is insufficient to satisfy data requirements. Therefore, this demands a mixed methods of data collection approaches to generate adequate and reliable data that enhanced through triangulation. This research employed mixed methods to collect data from primary and secondary sources as described below;

Household Survey: The primary data was gathered from selected respondents during fieldwork in the Borena Zone of Southern Ethiopia. In order to address the above-stated research objectives, this research used semi-structured interview schedule and households were asked to answer questions related socio-economic, institutional, and environmental factors. During the survey, households were also asked questions about their participation in index-based insurance purchases, access to information about insurance, and their level of insurance understanding. The survey also uncovered the nature of index-based livestock insurance and the underlying constraints to participate in this insurance. Similarly, the households were asked about the traditional ways in which they had been coping with the drought. The interview schedule was pre-tested prior to conducting the formal survey by administering it to 18 selected respondents at Yabelo district. On the basis of the results obtained from the pre-test, the necessary modification was made on the interview schedule. Training on methods of data collection and the contents of the interview schedule were given to selected enumerators. Finally, the questionnaires were administered to 359 sampled households in the study area from August 04–25, 2018.

Focused Group Discussion: to have detail information to be used to draw the right conclusion from the survey work, qualitative information was gathered using FGDs. The participants for the FGDs were selected purposively from development agents, community leaders, and local level coordinators of the insurance. Information on factors influencing farmers' decision to adopt index-based livestock insurance and its challenges were generated during the discussions. Furthermore, the discussants were also asked to provide information about their perception of IBLI and outcomes in terms of the changing livelihood strategies as a result of the newly introduced insurance scheme. A total of three FGDs were conducted, one FGD per selected district.

Key Informant Interview: in-depth interviews with purposively selected key informants were undertaken. This method was conducted in two ways. One is guided by the general interview guide (checklist questions), and the second is an informal conversational interview conducted with purposively selected individuals. Key informants include elders, female headed pastoralist, religious leaders, local level officials and experts who lived and served longer in the locality. Topics to be treated include major constraints to livestock production and change they experienced in climate conditions of their local areas over the past 20–30 years and barriers to the newly introduced IBLI product and options to upscale the scheme.

In addition, secondary sources and literature were consulted to augment and triangulate the primary sources. Review of reports on previous IBLI and other project documents, workshop proceedings, journal articles, policy briefs and strategy documents were used and supported with primary sources.

*4.1.2. **Methods** of data processing and analysis*

Data Processing: Data editing is conducted at two stages; one is field level editing which was done during the survey by the enumerators immediately after the interview. This helped to identify unfilled questions, inconsistent answers, and wrong figures. After checking the responses, the enumerators had an opportunity to call-back to correct/clarify responses. Then duly trained data entry technicians entered the data into well designed data entry STATA template. The second stage data cleaning was performed after the data were entered. This was done by generating descriptive statistics and check for inconsistencies and outliers. The data were cleaned and edited using STATA to verify the validity of assigned values as well as logical consistency. Crosstabs, frequencies, and mean were generated to check the data consistency. This data cleaning played a crucial role to detect inaccurate, incomplete, and unreasonable data and improved the quality through correction of detected errors and omissions. As a result, we have excluded 21 sampled respondents response from a total of 380 sampled households because of incompleteness and inconsistency.

To analyze and present the data collected from sampled households, descriptive statistics, inferential tests, and econometrics model were used. Frequency, mean and standard deviation were used to describe the general characteristics of sampled respondents. The study further used pictorial presentations such as line-graphs and bar-graphs. Inferential statistics (*t*-test and chi-square test) were used to see the differences in the demographic characteristics and socio-economic variable between adopter and non-adopter households. A binary logit model was also used to examine the determinants of the household's decision to adopt IBLI.

The qualitative data obtained from KIIs and FGDs were transcribed and then the transcriptions were translated to English. Qualitative data collected were organized and analyzed using simple narration that summarizes the main findings.

4.1.3. Binary logit model specification

Logit and Probit models are usually used to establish the relationship between household characteristics and a dichotomous response variable (adopter and non-adopter). The advantages of these models over the Linear Probability model are that the probabilities are bound between 0 and 1. The models specify a functional relationship between the probabilities of the farmer's decision to adopt IBLI to various explanatory variables.

Following Gujirati (1995), a binary logit model is expressed as follows:

$$\mathrm{P_i} = \mathrm{E(Y{=}1/X_i)} = \frac{1}{1 + \mathrm{e}^{-(\beta_o+\beta_1 \mathrm{X_i})}} \tag{1}$$

For ease of exposition, Eq. (1) can be expressed as:

$$P_i = \frac{1}{1 + e^{-Z_i}} \tag{2}$$

where: $Z_i = \beta_o + \beta_1 X_i$

If $\mathrm{P_i}$ is the probability of being adopter, then the probability of non-adopter is given by $1 - \mathrm{P_i}$, which is expressed as follows:

$$1 - P_i = \frac{1}{1 + e^{Z_i}} \tag{3}$$

Therefore, this can be written as:

$$\frac{P_i}{1 - P_i} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} = e^{Z_i} \tag{4}$$

where Pi/(1 − Pi) is simply the odds ratio in favor of adoption; the ratio of the probability that the household will be adopter to the probability that it will be non-adopter.

Taking the natural log of Eq. (4) above, it is possible to arrive at a log of the odds ratio, which is linear not only in X's but also in the parameters,

$$L_i = Ln\left(\frac{P_i}{1 - P_i}\right) = Z_i = \beta_o + \beta_i X_i \tag{5}$$

where:

$\mathrm{P_i}$ is the probability of being adopter ranging from 0 to 1

$\mathrm{Z_i}$ is a function of n-explanatory variables ($\mathrm{X_i}$) and is expressed as:

$$\mathrm{Z_i} = \beta_0 + \beta_1 \mathrm{X_1} + \beta_2 \mathrm{X_2} + \beta_3 \mathrm{X_3} + \beta_4 \mathrm{X_4} + \ldots + \beta_n \mathrm{X_n}$$

β0 is the intercept or constant term,

β1, β2, β3, β4, ⋯βn are the slope of the equation in the model (parameters to be estimated),

Li is a log of the odds ratio,

Xi is a vector of relevant household characteristic.

If the disturbance term ($\mathrm{U_i}$) is introduced, the logit model becomes:

$$\mathrm{Z_i} = \beta_0 + \beta_1 \mathrm{X_1} + \beta_2 \mathrm{X_2} + \beta_3 \mathrm{X_3} + \beta_4 \mathrm{X_4} + \cdots + \beta_n \mathrm{X_n} + \mathrm{U_i} \tag{6}$$

Based on Gujirati (1995) and Maddala (1992), the parameters of the model were estimated using the Maximum Likelihood (ML) method.

The dependent variable used in the binary logit model was a household's uptake of index-based livestock insurance. The sample was classified into adopters and non-adopters of the indexed livestock insurance based on the question of whether the respondent was purchased the insurance or not. The value of "1" was assigned to households who purchased indexed insurance, while "0" was assigned to households who did not purchase the insurance.

4.1.4. Definition of variables and working hypotheses

A large body of adoption literature showed that farm size, herd size and education status of the household are expected to increase willingness to pay (WTP) for rainfall-based index insurance (Bogale, 2014; Hassan and Nhemachena, 2008). Farmers with higher levels of education are more likely to adopt modern technologies. Education may promote an understanding of the effects of risk and hence may increase the demand for insurance. Although empirical studies have reported positive relationships between income and adoption of agricultural technologies (Bogale, 2014; Aidoo et al., 2014; Arshad et al., 2015), the income level of farmers reduces their willingness and ability to invest in agricultural insurance (Faye et al., 2005). This is just because as farmers participate in off-farm investments as a risk management strategy, the probability of using insurance may decrease. Chand et al. (2016) reported that the age and gender of household heads are important in determining WTP for weather insurance. It is expected that age and gender negatively influence the demand for index-based insurance.

A number of empirical studies have shown that family size and on-farm income/savings have a positive impact on farmers' willingness to adopt index-based insurance (Abugri et al., 2015; Ntukamazina et al., 2017; Bogale, 2014). Koloma, (2015) also reported that higher family size helps to positively influence the decision on making investments like purchasing insurance contracts. Furthermore, Mohammed and Ortmann (2005) showed that awareness about the importance of livestock insurance is expected to have a positive sign since the probability of adopting may increase the more a farmer understands insurance.

It is also well noted that distance to the weather station negatively influenced the uptake of index-based insurance (Bogale, 2014). Membership to social organizations, which reflects social capital that the household is in possession of, can also serve as a complement to other means of dealing with weather shocks (Abugri et al., 2015; Bogale, 2014; Mohammed and Ortmann, 2005). Therefore, a large number of social groups that a household member to it can influence the demand for index-based livestock insurance. Previous studies noted that the type of farming system a farmer living affects the decision to adopt livestock insurance (Abugri et al., 2015; Bogale, 2014). They argued that farmers living in more exposed to weather-related risks will have a higher demand for index-based livestock insurance. Similarly, access to early-warning information to climate-related risks helped farmers decision to purchase an insurance (Chand et al., 2016; Bogale, 2014). In general, the potential explanatory variables expected to influence the decision to adopt IBLI and their expected sign of influence are summarised in Table 1.

5. Results and discussions

5.1. Socio-economic profile of sampled households

Descriptive results of the study are presented in Tables 2 and 3. These results explain the socio-economic characteristics of the sampled respondents. The survey revealed that 65.5% of sampled households are from a pastoralist farming system, whereas 34.5% of the sampled households drawn from agro-pastoral farming system. 85% of the sampled households are male, while the remaining 15% are female. A relatively low level of household's awareness of IBLI was observed. The results showed that about 53.2% were not aware of index-based insurance. The average household size is 5.86 and the average age of household heads is about 46 years. The average year of schooling is 2.5 years which is below the national average of 4.7 years (McIntosh et al., 2013). The average herd size and farm size of sampled respondents are 7.35 TLU and 1.47 ha, respectively. The average number of social groups a household have a membership is 2.65. On average, less than half of the respondents have access to credit service (34.8%) and practiced off-farm activities as an alternative source of income (37%).

5.2. Trends in the uptake of index-based livestock insurance in Borena zone

In this section, an attempt was made to examine the experience and status of farmer's participation in IBLI in Borena Zone of southern Ethiopia. To understand the extent of uptake of IBLI in the study area, we have examined data on the sales of IBLI during the period 2012–2017 that obtained from ILRI reports. It helped us to explore the status of the number of livestock insured by this insurance scheme and the number of households purchased the product during this period. This section also contains the percentage net change of the number of households purchased IBLI and percentage change of the number of livestock insured under this

Table 1
definition and expected signs of explanatory variables.

Variables	Definition	Expected sign
Sex of HH	Dummy for sex of the household head: 1 = male; 0, otherwise.	(-)
Age of HH	Age of household head in years	(−)
Family size	Number of household members	(+)
Farming system	Categorical for farming system: 1 = mixed farming, 2 = agro-pastoral, 3 = pastoral	(+)
Education status	Education of household head in years of schooling	(+)
Access to credit	Dummy for access to credit: 1 = Yes, 0 = No	(+)
Herd size	Total livestock holding in Tropical Livestock Unit	(−)
Weather-related risk perception	Dummy for weather risk perception: 1 = yes, 0 otherwise.	(+)
Farmers awareness of IBLI	Dummy for awareness of IBLI: 1 = yes, 0 otherwise	(+)
Early warning information	Dummy for receiving climate warning information: 1 = yes, 0 otherwise	(+)
Off-farm income	Dummy for participation in off-farm: 1 = Yes, 0 = No	(-+)
Farm size	Total land holding in hectares	(+)
Distance to the weather stations	Distance to the weather station in walking hours	(−)
Membership to social organization	Number of social groups households have members	(+)

Table 2
Socio-economic characteristics of respondents in terms of discrete variables in the survey.

Variable	Category	Frequency	Percentage
Farming system	Pastoralist	235	65.5
	Agro-pastoralist	124	34.5
	Total	359	100
Weather-related risk perception	Perceived	95	26.5
	Not perceived	264	73.5
	Total	359	100
Access to credit	yes	125	34.8
	no	234	65.2
	Total	359	100
Farmer' awareness of the insurance	yes	168	46.8
	no	191	53.2
	Total	359	100
Off-farm activity	yes	133	37
	no	226	63
	Total	359	100
Early warning information	yes	179	49.9
	no	180	50.1
	Total	359	100
Sex HH	Male	305	85
	Female	54	15
	Total	359	100

Table 3
Socio-economic characteristics of respondents in terms of continuous variables in the survey.

Variables	Min.	Max.	mean	St.d
Livestock size	0.00	24	7.35	5.23
Family size	1.00	11	5.86	1.99
Age of the HH	22.0	83	45.92	12.96
Education status	0.00	14	2.50	3.43
Farm size	0.00	5	1.47	0.9415
Distance to the weather stations	0.25	5	1.371	0.8258
Membership to social organization	0.00	7	2.65	1.51

Fig. 2. Trends in the uptake of IBLI over years in Borena. Source: Taye and Mude (2018).

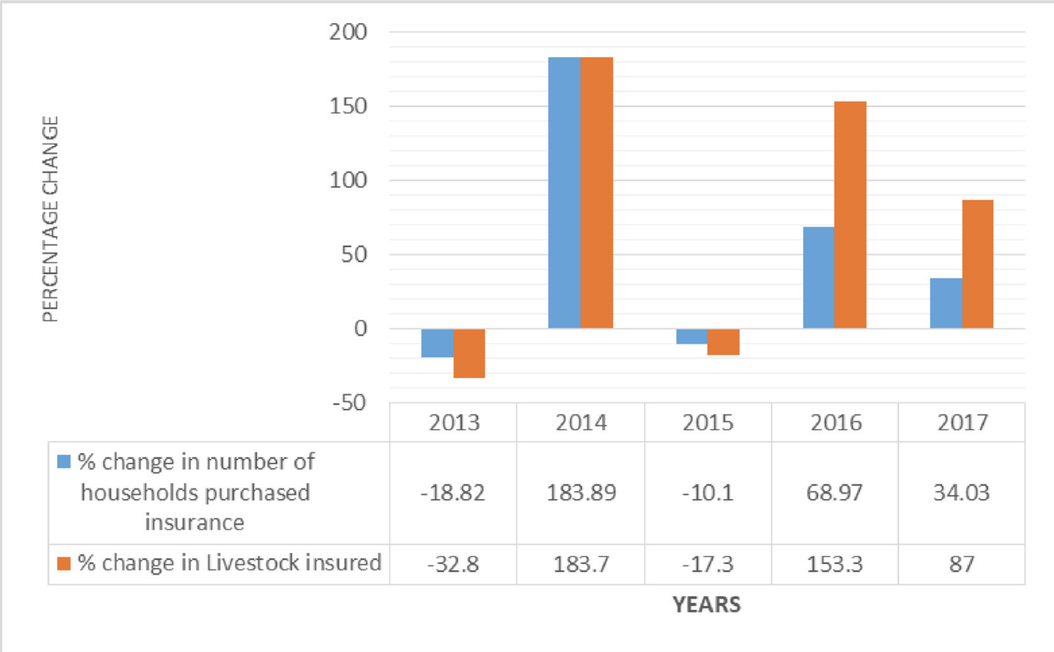

Fig. 3. Percentage change in the uptake of IBLI over years in Borena Zone.

insurance scheme of the specified period. The general trends observed during the period of 2012–2017 in Fig. 2 is an increase in the number of households participated in IBLI and the number of livestock insured under the new insurance product. Between 2012 and 2017, the number of households participated in the IBLI was increased from 627 to 2942, respectively. Similarly, the number of livestock insured by IBLI was increased from 1876 in 2012 to 14,017 in 2017. This shows that over time the pastoralists/agro-pastoralists had become more acquainted with the importance of the IBLI and hence demanded more insurance product. The information acquired from our focussed group discussants also confirmed the increasing demand of IBLI in their locality.

Fig. 3 presented the percentage change in the number of households who purchased the insurance and livestock insured from 2012 to 2017. Although the number of households who purchased IBLI and the total number of livestock insured had shown an increasing trend over the period, the percentage change for the year 2012 and 2015 had declined. On the contrary, the highest percentage change for both households and livestock insured was observed for the years 2014 and 2016. This is probably due to the fact that the drought occurred in 2014 and 2015 in the area influenced farmers to participate in the insurance and increase the number of their livestock to be covered under the insurance scheme.

5.3. Utilization of IBLI in the sampled districts

Fig. 4 depicted trends in the number of sampled households who purchased IBLI in Arero, Yabelo, and Dire districts. The uptake of IBLI has followed a similar dynamic in all sampled districts. The figure showed that the number of households purchased IBLI increased over time in all three districts over the years. The increment in IBLI purchases was derived by the complex web of factors on a variety of household behavior and well-being indicators. The qualitative information from key informants and focus group discussions revealed that herders used indigenous knowledge on ecological signals to making purchase decisions. Since 2014/5, the ecological signals alerted them the future uncertainty in the area. The increased participation of herders to purchasing this insurance had informed by the foreseen bad rangeland conditions.

5.4. Trends of insured livestock in sampled districts

The trend in livestock insured over years (2012–2018) was assessed for the major livestock categories including cattle, camel, and shoat for the three districts considered. The results in Figs. 5–7 showed that the number of livestock insured in the three districts is gradually increasing. Increased climate risks are an important factor that have been considered for the gradual increment of livestock under this insurance over the years. The number of cattle insured in Dire district increased from 34 in 2012 to 257 in 2018. This is an increase about eight times the number of cattle insured in 2018 over the number of cattle insured in 2012. Similarly, the number of cattle insured in Yabelo district had been increased by about eighteen times in 2018 as compared to 2012. Considering the entire period, the increase in the number of cattle insured in Arero district had been about fifteen times.

The number of camels insured in Dire had shown about forty-one times increase in 2018 over the number of camels insured in 2012. The increase in the number of camels insured in Yabelo district in 2018 is about twenty-six times of 2012. Similarly, the

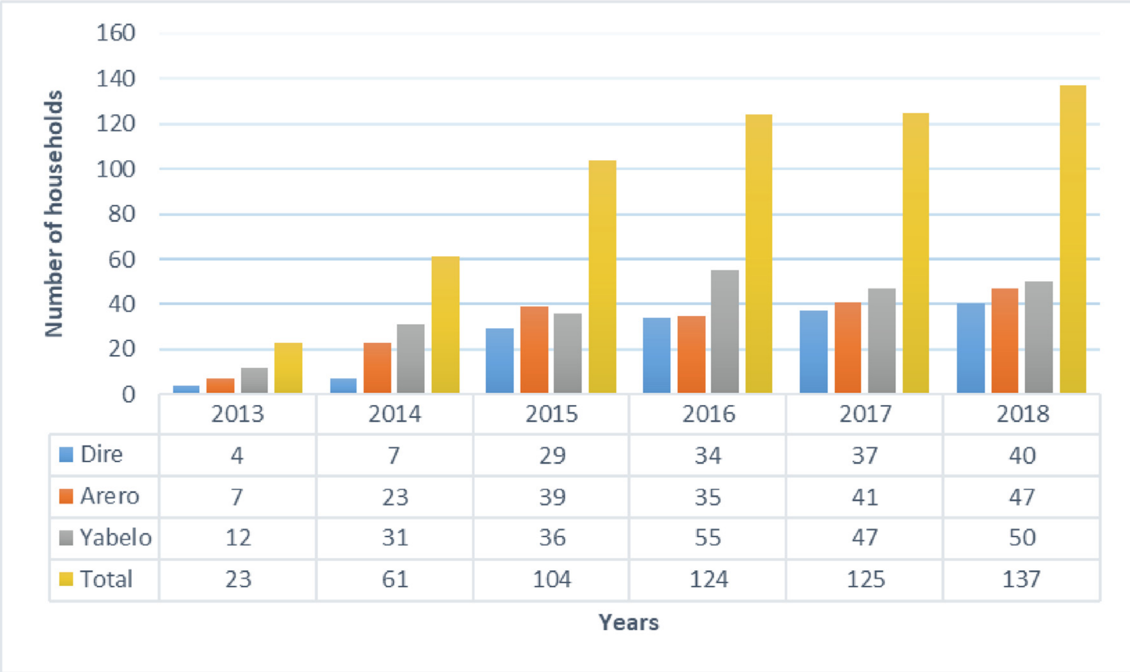

Fig. 4. Trends of households' participation in IBLI over years.

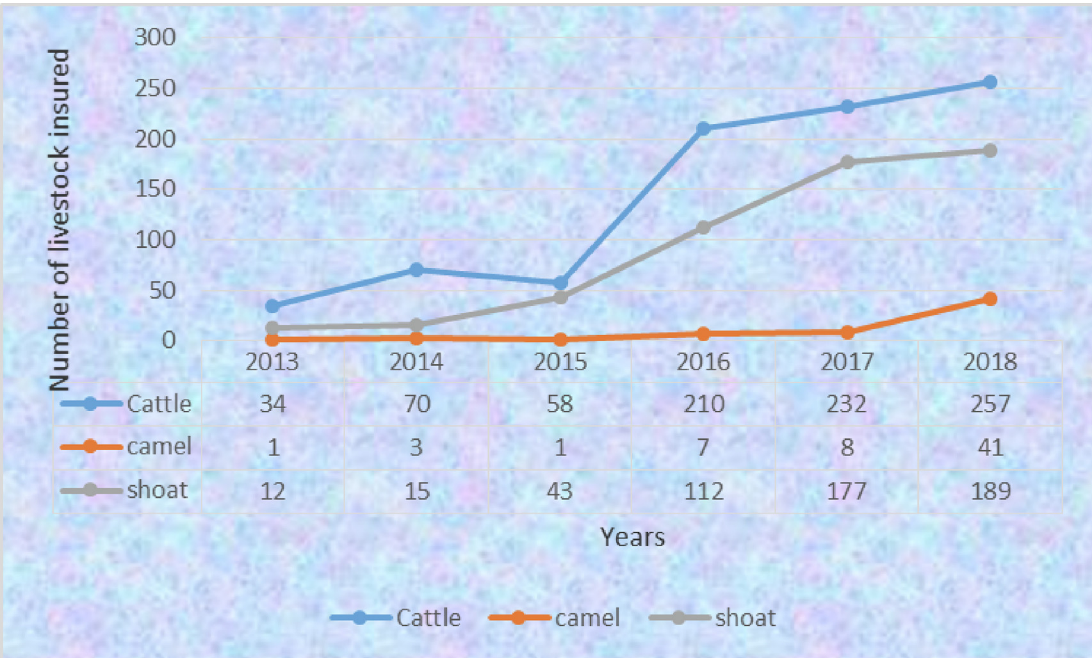

Fig. 5. Trends in number of livestock insured in Dire District.

number of camels insured in Arero district increased by seventy-eight times in 2018 as compared to 2012. Furthermore, considering the entire period (2012–2018), the number of shoats insured in the three sampled districts has shown increasing trends.

5.5. Determinants of the uptake of IBLI in Borena zone

This section presented the comparison between adopter and non-adopter of IBLI of sampled households and critical factors that are directly impacting the decision to uptake the insurance. Chi-square test and independent *t*-test were used for dummy and

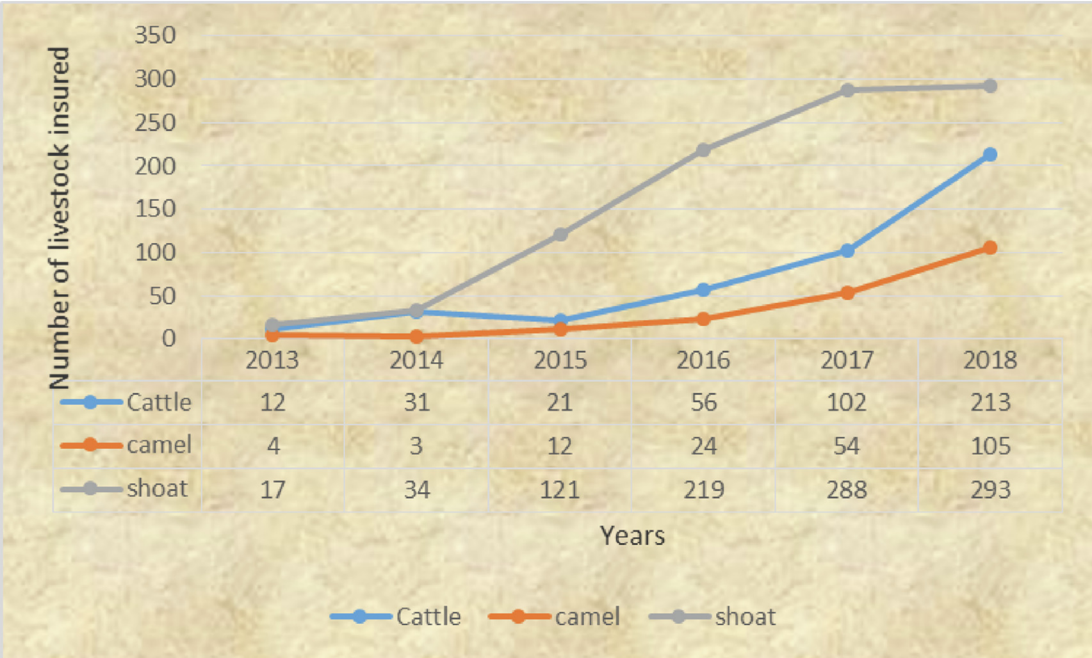

Fig. 6. Trends in number of livestock insured in Yabelo District.

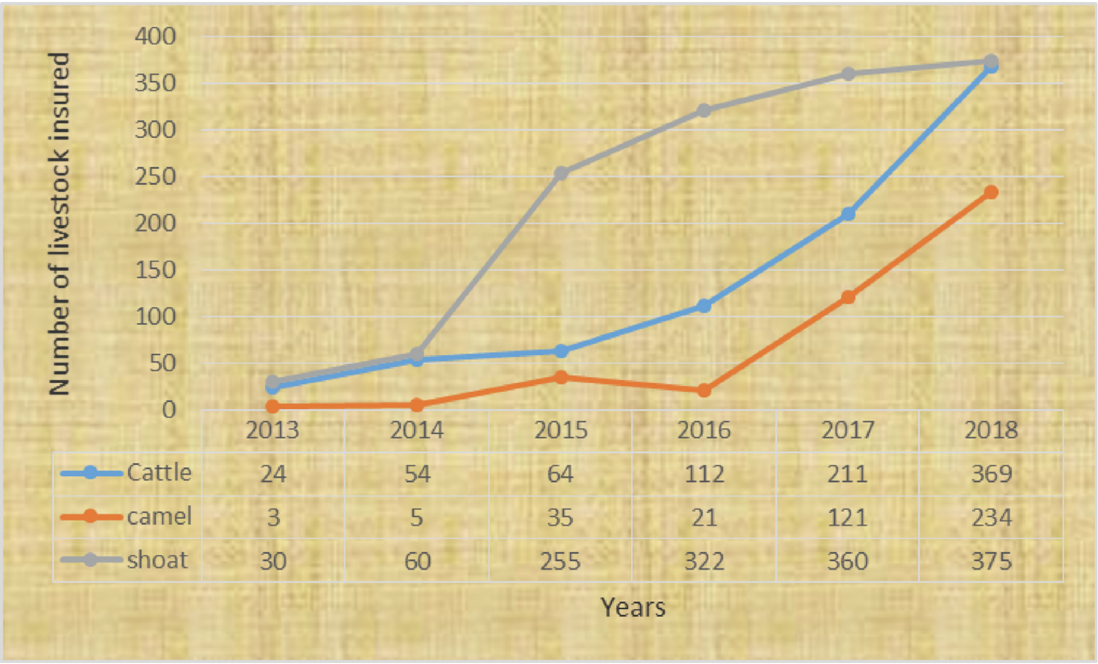

Fig. 7. Trends in number of livestock insured in Arero District.

continuous variables, respectively to observe differences between households adopted and not adopted the index-based livestock insurance.

The chi-square analysis showed that a large proportion of households who adopted IBLI are from the pastoral farming system as compared to agro-pastoral farming systems. The result further indicated that large proportion of households who adopted IBLI have perceived weather-related risks, accessed credit service, received early warning information, aware about the insurance, and practiced off-farm income activities as compared to their counterparts (Table 4). The independent *t*-test result showed that there is a significant mean difference between households who adopted IBLI and not adopted households with respect to social capital, herd size, landholding size, and distance to the weather station, and education status.

Table 4
Association between discrete variables and adoption of IBLI.

Variable	Category	Adopter of IBLI (number)	Non-adopter of IBLI (number)	Chi-Square value	Sig.
Farming system	Pastoralist	85	150	49.302***	0.000
	Agro-pastoralist	52	72		
Weather-related risk perception	Perceived	64	31	46.698***	0.000
	Not perceived	73	191		
Access to credit	yes	93	32	106.719***	0.000
	no	44	190		
Farmer' awareness of the insurance	yes	106	62	83.188***	0.000
	no	31	160		
Off-farm income	yes	90	43	77.951***	0.000
	no	47	179		
Early warning information	yes	69	110	0.023	0.881
	no	68	112		
Sex HH	male	114	191	0.529	0.467
	female	23	31		

***, **, * Significant at 1, 5, and 10 percent probability level, respectively.

The present study considered socio-demographic, socio-economic, institutional, and perception factors as driving factors for farmers to adopt index-based livestock insurance products. The results of the logit model revealed that education status, social capital, farm size, herd size, off-farm income, access to credit, farmers perception about to weather-related risks, and farmers awareness of the insurance have a significant positive influence on herders decision to adopt IBLI. On the other hand, the age of household head and distance to the weather station significantly decreased herders decision to purchase index-based livestock insurance. It is also noted that environmental factors (i.e. farming system), was found to be an important driver for farmers to adopt the insurance product.

Farming system: The effect of the farming system can also be seen as significant where, on average, households in the *pastoral farming system* adopted IBLI as compared to those in the *agro-pastoral farming system*. The chi-square test result (Table 4) showed that differences in the farming system of the household head are statistically significant ($p < 0.000$) between the adopters and non-adopters of the IBLI. Households living in pastoralist farming are more likely to adopt index-based insurance as compared to their counterparts living in the agro-pastoralist farming system. The results of the current study revealed that herder's decision to uptake the insurance product would likely be low in the agro-pastoral farming system where drought-related risk is less frequent as compared to pastoralist farming system. The binary logit model result in Table 5 depicted that the farming system is an important factor in determining a household's decision to purchase IBLI. This is probably due to the fact that drought is more frequent in the pastoral area as compared to the agro-pastoral area. The extent of uptake of index-based livestock insurance will most likely come from farming systems where livelihood strategies of households are widely exposed to weather-related risks. The odds ratio in favor of the adoption of IBLI reveals that a shift from agro-pastoral farming system to the pastoral farming system increases the probability of the household adopt IBLI by 1.1648. This supports the notion that index-based livestock insurance is expected to be attractive propositions in the pastoralist dominated farming system as compared to agro-pastoral farming systems. The result is also consistent with

Table 5
Parameter estimates of explanatory variables as determinants of household adoption of IBLI.

Variables	Odds ratio	Std. err	z	p-value
Farming system	0.1648	0.0722	−4.11 ***	0.000
Risk perception	4.3179	2.600	2.43 **	0.015
Awareness of IBLI	6.2470	3.4835	3.29 ***	0.001
Early warning information	0.2230	0.1364	−2.45	0.140
Access to credit	10.5153	6.0950	4.06 ***	0.000
Sex of HH	0.75550	0.6601	−0.32	0.748
Farm size	4.0976	1.3667	4.23 ***	0.000
Livestock in TLU	1.1684	0.0655	2.77 ***	0.000
Distance to the weather station	0.1604	0.0687	−4.27 ***	0.000
Membership to social groups	3.0036	0.7579	4.36 ***	0.000
Family size	1.1682	0.1824	1.00	0.319
Education of HH	1.0244	0.0839	0.29 **	0.04
Age of HH	0.9705	0.0213	−1.36	0.174

Number of observations: 359.
LR chi2 (15): 368.21.
Prob > chi2: 0.000.
Pseudo R^2: 0.7713.
Log-likelihood: −54.576.
***, **, * Significant at 1, 5, and 10 percent probability level, respectively.

previous literature (McCarthy, 2003; Bogale, 2014).

Off-farm income: Farmers can earn additional income by engaging in various off-farm activities. This is believed to raise their financial position. It includes investments in shops, motorcycle, water sale from groundwater, flour mills, etc and is negatively related to the decision to purchase the insurance. The descriptive results in Table 4 showed that out of the total households interviewed, about 37% herders had participated off-farm activities, while about 63% had not participated. The chi-square analysis revealed a significant association between participation in off-farm activities and herder's decision to purchase index-based livestock insurance. The econometric result revealed that the odds ratio in favor of the adoption of IBLI increases by the factor of 2.567 (Table 5). This can be explained by the fact that pastoralists and agro-pastoralists use the income earned through off-farm activities to pay for the premium. It is more arguable that farmers with high off-farm income tend to have higher payment capacity than those with low off-farm income, ceteris paribus. The present study is consistent with previous literature (Smith & Watts, 2009; Skees and Barnett, 2006). For instance, Smith & Watts (2009) reported that Moroccan farmers with relatively high incomes were more likely to consider purchasing rainfall insurance than farmers with low incomes. On the other hand, the results of this study are also inconsistent to the finding of Mohammed and Ortmann (2005). Their finding revealed that farmers who participated in different off-farm activities see off-farm investments as an alternative method of risk management strategy. Farmers who have alternative risk management strategies have a higher tendency to reduce the probability of livestock insurance adoption.

The responses from key informants and FGD participants revealed that the reason for their continued participation to purchasing IBLI was mainly attributed to the additional income they had got from off-farm and non-farm activities. For instance, during FGD, 67 years old women in Dire district explained that;

> *"Before four years ago, I hadn't purchased any insurance for my livestock. During that time, I hadn't any additional sources of income. My family income source was solely from the sale of livestock and livestock products. In 2015, I have started a small business on supplying sugar, salt, soap, and other basic commodities to the local market. Initially, the profit was not as such attractive and gradually improved. I have started purchasing this insurance in 2017. It is very simple to imagine how the income that I am earning from this small business helping me to purchase insurance for my livestock."*

Weather-related risk perception: the results showed that about 26.5% of the total sampled households perceived decreased rainfall, increased temperature, and increased livestock diseases, decreased fodder and water for livestock over years. The results further indicated that out of total households who perceived weather-related risks, about 67.4% of households purchased IBLI, while the remaining 32.6% do not purchase (Table 2). The chi-square ($\chi 2 = 46.698$; $P = 0.000$) result showed that there is a positive and statistically significant difference between adopter and non-adopter households in terms of their perception on weather-related risks at 1% significant level. This difference is a clear indication for pastoralists and agro-pastoralists perception of weather-related risks is an important factor in determining their decision to purchase IBLI. The econometric results showed that the odds ratio in favor of the probability to adopt IBLI increases with an increase in farmer's perception of risks related to climate change (Table 5). This implies respondents who perceived that the weather-related risk will often pose pressure on their livelihoods and experienced drought in the near past were more likely to pay for index insurance as a precautionary measure. Other pastoralists/agro-pastoralists who do not perceive the potential impact of climate change and its associated variability could delay their decisions until they could obtain some more information. Pastoralists/agro-pastoralists who perceived the changing climate favour to use index-based insurance as a risk transfer measure and as an important means for mitigating climate change-related livestock death. The qualitative result further supports the notion that households who perceived the changing climate tend to adopt the IBLI. During FGD, 67-year male pastoralist at Yabelo district explained that; "*temperature is increasing over years. 20 years ago, drought was not frequent. Drought occurred probably within five or six years. However, nowadays, drought is very frequent. Heat-induced livestock diseases are occurring frequently. Similarly, rain is not coming in the expected seasons. Sometimes, rain comes very late and went early. On the other hand, the rain comes early and went early. Even, the amount of rainfall during the rainy season is not adequate. Overall, the frequent drought coupled with inadequate rainfall is a major risk affecting my family livelihood leading to the death of our livestock. Due to this problem, I have recognized the very importance of IBLI that is promoted in our District. I personally purchased this insurance over the past four years".* The result is in conformity with the earlier studies (Bogale, 2014; Aidoo et al., 2014; Arshad et al., 2015).

Access to credit: The results showed that 25.9% and 8.9% of the adopter and non-adopter sampled households accessed credit services, respectively (Table 2). The chi-square ($\chi 2 = 106.719$; $P = 0.00$) result showed that access to credit was positively and significantly influenced the uptake of IBLI (Table 4). The econometrics result found that access to credit service had positively and significantly influenced the probability of adoption of IBLI at less than 1% significant level. The odds ratio in favor of adopting IBLI increases by a factor of 10.5153 (Table 5). Similarly, the result from a key informant interview also supported the notion that access to credit has a significant role to encourage households to purchase the insurance. For instance, *53 years old men in Arero district, during the in-depth interview speaks how access to credit program helped him to purchase IBLI. "I have received a total of five thousand birr from a micro-credit institution in the year 2017. I used three thousand birr to purchase the insurance product and the remaining two thousand birr to purchase fodder to start livestock fattening to generate additional income. During that time, I was not financially capable to purchase IBLI."* This tells us that poor households continue to be discouraged to purchase IBLI due to lack of other financial mechanisms that motivate and increase the uptake of insurance product. Although Oromia Insurance Company exerted continuous efforts to deliver the insurance in Borena Zone, poor households may continue to be discouraged from purchasing index insurance because of lack of alternative financial resources. This can be minimized by linking insurance product to other credit services. Access to credit helps farmers to enhance their financial ability to pay index-based livestock insurance premium during the two sales windows in each year. This is due to the fact that poor individuals have a lower capacity to build capital for climate risk management and risk transfer (Tadesse et al., 2015). The result is in conformity with the finding of Bogale (2014), Arshad et al. (2015) and Abugri et al. (2015).

Table 6
Association between continuous variables and the adoption of IBLI.

Variables	Adopters of IBLI		Non-adopters of IBLI		t-value	Sig.
	mean	St.d	mean	St.d		
Livestock size	10.6111	4.56625	5.3368	4.57849	10.61***	0.000
Family size	5.9927	2.14715	5.7838	1.89978	0.963	0.336
Age of the HH	41.4964	13.32408	45.5676	12.75925	0.659**	0.021
Education status	3.7956	4.57923	2.3198	3.33338	1.277***	0.020
Farm size	2.0080	1.03886	1.1378	0.69390	9.511***	0.000
Distance to the weather stations	0.8553	0.52262	1.6894	0.81860	−10.65***	0.000
Membership to social organization	3.77	1.384	1.96	1.117	13.537***	0.000

***, **, * Significant at 1, 5, and 10 percent probability level, respectively.

Farmers' awareness of the insurance: It has been well noted that pastoralists and agro-pastoralists awareness about the importance of livestock insurance is expected to have a positive influences. Many pastoralists and agro-pastoralists in the study area have a limited understanding of IBLI. The results in Table 2 above revealed that about 53.2% of households reported that they are not aware of IBLI. Out of the total households who are aware of the insurance, nearly 63% have adopted the insurance. The chi-square test revealed that there exists a significant relationship between adoption of IBLI and pastoralist/agro-pastoralist awareness about the insurance ($X^2 = 83.188$, $p = 0.000$) (Table 4). The econometrics result further showed that pastoralist/agro-pastoralists' awareness about insurance has positively and significantly influenced the uptake of the insurance product. If the household heads are aware of the insurance, the odds ratio in favor of households' adoption of IBLI will increase by the factor of 6.2470 (Table 5). This might be due to the fact that household who is aware of the program and has some basic information about the program's benefits is better off in terms of his tendency to accept and pay for IBLI than one who is unaware and lacks the basic information. This result suggests a strong and continuous need for awareness creation and training on this insurance product. This result supports the findings of earlier researchers on technology adoption (Mohammed and Ortmann, 2005).

Membership to social groups: Membership in the existing local organizations was used as a proxy for social capital a household possesses. This social capital has the potential to internalize economic externalities and help the adoption of adaptation options in response to climate variability and change (Swinton, 2000; Amare and Simane, 2017). It is noted that self-help grouping and formation of cooperatives is a more reliable and pragmatic means of achieving social capital and ensuring dissemination and adoption of innovative technology (Dikito, 2001; Coleman, 1998). The average number of the social groups that the sampled households are a membership for adopters and non-adopters of IBLI are found to be 3.77 and 1.96, respectively. The independent *t*-test results revealed that social capital is statistically significant at $p < 0.000$ between adopter and non-adopter of the insurance scheme (Table 6). The econometrics result further revealed that membership for many social groups organized at the local level is positively and significantly related to the likelihood of uptake of index-based livestock insurance at less than 1% significance level. Specifically, the binary logit result showed that the odds ratio in favor of the adoption of IBLI would increase by a factor of 3.0036 (Table 5). The qualitative results also support the notion that social capital is playing to increase the uptake of IBLI in the study area. For example, 45 years old woman pastoralist in Arero district said that;

> *"I have purchased the insurance after I have received a continuous advice from the member of the social group where I have a membership to. I have got an advice to purchase the insurance from group members. One of the group members critically advised me and financially supported me to purchase this insurance for both cattle and sheep".*

The two possible explanations of this result are: 1) having a membership to many social groups increase awareness on the potential benefits of index insurance in reducing the impact of climate change on livestock production; and 2) membership to social groups have positive effects on the income-generating capacity of their members and this may capacitate farmers' financial status to purchase the insurance product introduced in the area. This result supports the findings of earlier researchers on technology adoption. While assessing a farmer's decision to adopt adaptation options, Amare and Simane (2017) noted that social capital increased the farmer's decision to adopt small-scale irrigation. On the same vein, while assessing farmers willingness to pay for crop insurance, Abugri et al. (2015); and Bogale (2014) found a significant influence of social capital on farmers decision to purchase the insurance.

Education status of HH: there exists a statistical mean difference in educational status between adopter and non-adopter of IBLI. The descriptive result indicated that the mean years of schooling for adopters is about 3.8 years, while for non-adopter is 2.3 years with a significant mean difference (Table 6). The result from the binary logit model revealed that education is an important factor which affects the adoption of IBLI. The result revealed that the odds ratio in favor of the adoption of the insurance product increases by factor 1.02 when the mean year of schooling is increased by one year (Table 5). This implies households with better access to education are more likely to pay for indexed based livestock insurance which has a potential to reduce the adverse effect of extreme droughts on livestock production and productivity, particularly in the moisture-stressed area. This might be due to three possible reasons: 1) education helps farmers to search and use relevant information for their livestock production. Therefore, education may facilitate the diffusion and enhanced use of new technology through informed decision; 2) education helps farmers to anticipate the consequences of climate change and understand the potential benefit of index-based livestock insurance to minimize the possible impact of climate change. Index based insurance products can be difficult to understand especially for populations with low literacy rates and little or no previous insurance experience. Education helps to reduce this problem because educated farmers are more likely consulting different agencies that promote index-based livestock insurance as an adaptation option that would have a significant positive impact to reduce their vulnerability to climate change and variability, and 3) Education helps to play in reducing cognitive failure in poor households. Cognitive failure is a psychological phenomenon that can affect the willingness of poor individuals to spend their limited income to cover risks (Skees et al., 2007).

This result supports the view of numerous studies that show the positive impact of education on farmer's decision to adopt crop and livestock insurance (Bogale, 2014; Smith & Watts, 2009; De Angelis, 2013). While studying the willingness to pay for crop insurance, Smith & Watts (2009) and De Angelis (2013) reported that farmers with more literacy rates were more interested in rainfall insurance and willing to pay higher amount. More educated farmers are likely to appreciate crop insurance issues better than their less educated counterparts.

Farm size: It is well recognised that there are a bundles of land property rights in the pastoral and agro-pastoral areas of the country. These bundle rights include, private land right, common land right. This study only considered the land that individual pastoralist household hold. Landholding and ownership is a critical factor for agricultural and livestock production and adoption of agricultural innovation for the farm community. The size of cultivated land is positively and significantly related to the adoption of index-based livestock insurance in response to climate variability and change in the study area. The average landholding for adopter group was 2.0 ha while that of the non-adopter group is 1.13 ha. The *t*-test analysis showed that landholding had statistically significant and have a positive relationship with the adoption of IBLI with $t = 9.511$; and $p = 0.000$ (Table 6). The econometrics result further revealed that the odds ratio in favor of purchasing IBLI increases by factor of 4.0976 (Table 5).

Similarly, in other adoption studies, a positive correlation was found between the farmer's decision to pay for agricultural insurances and farm size. This was because larger farm sizes tend to have more advantage for the adoption of innovations due to economies of scale (Osipenko et al., 2015). However, the result of the current study is also inconsistent with other research results of a different country. The result from Aidoo et al. (2014) showed that farmers with large farm size are less willing to adopt crop insurance as compared to farmers who own small farmland size. This is probably due to the fact that farmers who have large farm size have the capacity to diversify into other crops and enterprises since they have easy access to land.

Livestock holding: The average livestock holding for adopters of sampled households is 10.61TLU, while for the non-adopters is 5.33 TLU. Non-adopter households have, on average, smaller herd size. In line with prior expectation, livestock holding in TLU positively influences household's decision to purchase IBLI at 1% significance level. This result revealed that the odds ratio in favor of adopting the insurance increase by a factor of 1.1684 with an increase of livestock in one TLU (Table 5). This might be explained by two possible reasons. First, this might be attributed to the fact that farmers having larger herd size relatively feeling highly vulnerable to risks emanating from climate change and variability; second, having large number of livestock enhances herders financial capacity and so that they can make decision to purchase insurance for their livestock. Under a situation where there is a decline in natural pastures due to climate change and variability, many pastoralists opt to store forage and save water using the indexed livestock insurance. This result is inconsistent with prior expectation and inconsistent with previous studies (Chand et al., 2016; Arshad et al., 2015).

Distance to the weather station: Mean distance travelled to the nearest weather station by adopters, and non- adopters of IBLIare 0.8553 h and 1.689 h, respectively. The *t*-test analysis result showed that ($t = -10.658$; $P = 0.000$) there is a statistically significant mean difference between adopter and non-adopter categories in terms of distance to the weather station (Table 6). As hypothesized, distance from the home of a household to the weather station was found to have a significant ($p = 0.000$) negative impact on the likelihood of adoption of IBLI. The probable reason is that distant farmers from the weather station had limited access to climate information and this undermines the potential benefits of purchasing IBLI to reduce the high level of livestock production risk imposed by climate variability and change. This result suggests that improving access to climate information for farmers would increase the probability of uptake the insurance product. Similar results were reported in the previous literature (Bogale, 2014; Arshad et al., 2015).

Overall, the results revealed that both pastoralist and agro-pastoralist recognized the adverse impact of climate change and its associated effects on their livelihood system in general and livestock production in particular. They noted that climate change degraded their capacity to overcome the adverse effects through time. During the focus group discussion, they concluded that they are powerless against climate change. This is majorly due to the fact that the frequent drought happening in the area leads to a shortage of grazing and water for their livestock. This effect further led to livestock mortality where their livelihood majorly base. To the worst extent, the impact of climate change degraded herders' capacity even not to finance the insurance that support reduction of livestock mortality due to forage and water scarcity. As a matter of fact, index-based livestock insurance is a crucial instrument to support the powerless herders and to sustain their livelihoods system in the changing climate.

6. Conclusions

The purpose of this study was to understand the status of index-based livestock insurance that has been introduced to the pastoralist and agro-pastoralist farming system of Borena zone and examine critical factors influencing its uptake. The trends in the uptake of the insurance revealed that the sales of IBLI and livestock covered under this insurance have increased over the past years. However, the evidences showed that a significant number of respondents remained are not adopting insurance. The binary logit results indicated that the decision to purchase IBLI is positively influenced by education status, access to credit, off-farm income, farmer's perception to climate risks, and awareness to the insurance scheme, herd size, and social capital. On the contrary, distance to the weather station negatively impacted the decision to adopt the insurance product.

The findings from this study contribute to filling the gaps related to promoting the uptake of index-based livestock insurance in Borena Zone of southern Ethiopia and further to scale-up the insurance to other pastoral and agro-pastoral areas of the country. In this respect, integrating the use of IBLI with credit that will allow cash-constrained households to purchase insurance is important. Rethinking the complementarity between credit and insurance is essential than considering insurance as a substitute for credit and vice versa to effectively manage risks caused by severe climate shocks and extremes. We have also learned that social capital is the most important factor that encourages the household's decision to purchase IBLI. This is due to the fact that the insurance company and its international partners prefer to reach out to farmers through their organized social groups. Efforts towards out-scaling IBLI should target to encouraging households membership to existing indigenous and self-sustained social groups and/or integrate the insurance scheme into these indigenous institutions with the ultimate goal of ensuring sustainable and efficient use of IBLI in the study area.

The results also suggested strengthening training and financial literacy that target to enhance household's awareness about the insurance to help pastoralists/agro-pastoralists to make informed decisions to purchasing IBLI. Overall, successful uptake and scale-up of this insurance require effectively integrating the insurance scheme with local development process.

Declaration of Competing Interest

None.

Acknowledgments

We wish to express our profound gratitude to the Africa Climate Leadership Fellowship Program (AfriCLP); and the International Development Research Centre (IDRC) for their financial support in accomplishing this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.crm.2019.100191.

References

Abugri, S., Amikuzuno, J., Daadi, E., 2015. Looking out for a better mitigation strategy: smallholder farmers' willingness to pay for drought-index crop insurance premium in the Northern Region of Ghana. Agric. Food Security 6 (71), 1–9. https://doi.org/10.1186/s40066-017-0152-2.
Aidoo, R., Mensah, O.J., Wie, P., Awunyo-Vitor, D., 2014. Prospects of crop insurance as a risk management tool among arable crop farmers in Ghana. Asian Econ. Financial Rev. 4 (3), 341–354.
Amare, A., Simane, B., 2017. Determinants of smallholder farmers' decision to adopt adaptation options to climate change and variability in the Muger Sub-basin of the Upper Blue Nile basin of Ethiopia. Agric. Food Security 6 (64), 1–20. https://doi.org/10.1186/s40066-017-0144-2.
Angassa, A., Oba, G., 2007. Relating long-term rainfall variability to cattle population dynamics in communal rangelands and a government ranch in southern Ethiopia. Agric. Syst. 94, 715–725.
Arshad, M., Amjath-Babu, T.S., Kächele, H., Müller, K., 2015. What drives the willingness to pay for crop insurance against extreme weather events (flood and drought) in Pakistan? A hypothetical market approach. Clim. Dev. 8 (3), 234–244.
Awel, Y.M., Azomahou, T.T., 2014. Productivity and welfare effects of weather index insurance: Quasi-experimental evidence. Working Paper, UNU-MERIT and Maastricht University.
Barnett, B.J., Barrett, C.B., Skees, J.R., 2008. Poverty traps and index-based risk transfer products. World Dev. 36 (10), 1766–1785.
Barnett, B.J., Mahul, O., 2007. Weather index insurance for agriculture and rural areas in lower income countries. Am. J. Agric. Econ. 89 (5), 1241–1247.
Barrett, C.B., 2011. Covariate catastrophic risk management in the developing world: Discussion. Am. J. Agric. Econ. 93 (2), 512–513.
Barrett, C.B., Santos, P., 2014. The impact of changing rainfall variability on resource-dependent wealth dynamics. Ecol. Econ. 105, 48–54.
Berhanu, W., 2011. Recurrent shocks, poverty traps and the degradation of pastoralists' social capital in southern Ethiopia. Afr. J. Agric. Resourc. Econ. 6 (1), 1–15.
Berhanu, W., Fayissa, B., 2010. Analysis of the household economy and expenditure patterns of a traditional pastoralist society in southern Ethiopia. Working Papers 201005, Middle Tennessee State University. Department of Economics and Finance.
Bogale, A., 2014. Weather-indexed insurance: an elusive or achievable adaptation strategy to climate variability and change for smallholder farmers in Ethiopia. Clim. Dev. https://doi.org/10.1080/17565529.2014.934769.
Carter, M.R., 2012. Designed for development: Next generation approaches index insurance for smallholder farmers. ILO/MunichRe Microinsurance Compendium 2.
Chand, S., Bhattarai, M., Kumar, A., Saroj, S., 2016. Status and determinants of livestock insurance in India: a micro-level evidence from Haryana and Rajasthan. Indian J. Agric. Econ. 71 (3), 335–346.
Chantarat, S., Mude, A., Barrett, C., Turvey, C., 2009. The Performance of Index-Based Livestock Insurance: Ex-ante Assessment In the Presence of the Poverty Trap. Cornell University, Ithaca, New York.
Chantarat, S., Mude, A.G., Barrett, C.B., Carter, M.R., 2013. Designing index-based livestock insurance for managing asset risk in northern Kenya. J. Risk Insurance 80 (1), 205–237.
Cole, S., Bastian, G., Vyas, S., Wendel, C., Stein, D., 2012. The Effectiveness of Index-Based Microinsurance in Helping Smallholders Manage Weather-related Risks. EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.
Cole, S.A., Gine, X., Tobacma, J., Topalova, P., Townsend, R., Vickery, I.J., 2009. Barriers to household risk management: evidence from India. Working paper No. 09–116. Harvard Business School Finance. FRB of New York Staff Report No. 373.
Coleman, J., 1998. Social capital and the creation of human capital. Am. J. Sociol. 94, 95–120.
De Angelis, K., 2013. Index-based livestock insurance: the case of Mongolia. World Resourc. Inst. 5, pp.
Debela, N., McNeil, D., Bridle, K., Mohammed, C., 2019. Adaptation to Climate Change in the Pastoral and Agropastoral Systems of Borana, South Ethiopia: options and barriers. Am. J. Clim. Change 8, 40–60.
Dercon, S., Hill, R.V., Clarke, D., Outes-Leon, I., Taffesse, A.S., 2014. Offering rainfall insurance to informal insurance groups: evidence from a field experiment in Ethiopia. J. Dev. Econ. 106, 132–143. https://doi.org/10.1016/j.jdeveco.2013.09.006.
Desta, S., Coppock, D.L., 2004. Pastoralism under pressure: tracking system change in southern Ethiopia. Hum. Ecol. 32, 465–486.
Doti, T., 2010. Climate variability, pastoralists' vulnerability, and options. The case of the Borana of Northern Kenya. In: Mwiturubani, D.A., van Wyk, J.A. (Eds.),

Climate Change and Natural Resources Conflict in Africa. Monograph 170. Institute for Security Studies, Pretoria, South Africa.

Faye, I., Deininger, K., 2005. Do new delivery systems improve extension access? Evidence from rural Uganda. In: Paper presented at the American agricultural economics association annual meeting, 2005 July 24–27, Providence, RI, US.

Giné, X., 2009. Experience with weather insurance in India and Malawi. Innovations in insuring the poor. International Food Policy Research Institute, Washington DC.

Giné, X., Yang, D., 2009. Insurance, credit, and technology adoption: field experimental evidence from Malawi. J. Dev. Econ. 89 (1), 1–11. https://doi.org/10.1016/j.jdeveco.2008.09.007.

Gujirati, D.N., 1995. Basic Econometrics, third ed. McGraw-Hill Co., New York.

Hassan, R., Nhemachena, C., 2008. Determinants of African farmers' strategies for adapting to climate change: Multinomial choice analysis. Afr. J. Agric. Resourc. Econ. 2 (1), 83–104.

Hill, R.V., Viceisza A., 2010. An Experiment on the Impact of Weather Shocks and Insurance on Risky Investment." Discussion Paper No. 00974, IFPRI.

Jensen, N.D., Barrett, C.B., Mude, A.G., 2015. The Favorable Impacts of Index-Based Livestock Insurance: Evaluation Results from Ethiopia and Kenya. ILRI, Nairobi.

Karlan, D., Osei, R.D., Osei-Akoto, I., Udry, C., 2012. Agricultural decisions after relaxing credit and risk constraints. NBER Working Papers No. 18463. National Bureau of Economic Research, Inc Oct.

Koloma, Y., 2015. Crop Microinsurance for Maize Farmers in Burkina Faso: access and agriculture performance in the Dandé Village. Strategic Change 24, 115–129.

Kunow, A., 2016. Livestock Insurance for Risk Management, CapEx Series on Pastoralism. Swiss Agency for Development and Cooperation (SDC), Global Cooperation / Global Programme Food Security, Berne.

Maddala, G.S., 1992. Introduction to Econometrics, second ed. Macmillan Publishing Company, New York, USA.

Mahul, O., Stutley, C., 2010. Government Support to Agricultural Insurance: Challenges and Options for Developing Countries. World Bank, Washington DC.

Marcantonio, F.Di, Kayitakire, F., 2017. Review of pilot projects on index-based insurance in Africa: insights and lessons taught. In: Tiepolo, M. (Ed.), Renewing Local Planning to Face Climate Change in the Tropics, Green Energy, and Technology.

McCarthy, N., 2003. Demand for rainfall-index based insurance: a case study from Morocco (Discussion Paper No. 106). Environment and Production Technology Division. International Food Policy Research Institute, Washington, DC.

McIntosh, C., Sarris, A., Papadopoulos, F., 2013. Productivity, credit, risk, and the demand for weather index insurance in smallholder agriculture in Ethiopia. Agric. Econ. 44 (4–5), 399–417.

Megersa, B., Markemann, A., Angassa, A., Zárate, A.V., 2014. The role of livestock diversification in ensuring household food security under a changing climate in Borana, Ethiopia. Food Security 6, 15–28.

Miranda, M.J., Farrin, K., 2012. Index insurance for developing countries. Appl. Econ. Perspect. Policy 34 (3), 391–427.

Mohammed, M., Ortmann, G., 2005. Factors influencing the adoption of livestock insurance by commercial dairy farmers in three Zobatat of Eritrea. Agrekon 44 (2), 172–186.

Ntukamazina, N., Onwonga, N., Sommer, R., Rubyogo, C., Mukankusi, M., Mburu, J., Kariuki, R., 2017. Index-based agricultural insurance products: challenges, opportunities, and prospects for uptake in sub-Sahara Africa. J. Agric. Rural Dev. Tropics Subtropics 118 (2), 171–185.

Osipenko, M., Shen, Z., Odening, M., 2015. Is there a demand for multi-year crop insurance? Agric. Finance Rev. 75 (1), 92–102.

Patt, A., Peterson, N., Carter, M., Velez, M., Hess, U., Pfaff, A., Suarez, P., 2008. Making index insurance attractive to farmers. Paper presented at a workshop on 'Technical issues in index insurance. Columbia University, New York held October 7–8, 2008 at IRI.

Santos, P., Barrett, C.B., 2011. Persistent poverty and informal credit. J. Dev. Econ. 96 (2), 37–347.

Sina, J., 2012. Index-based Weather Insurance—International & Kenyan Experiences. Adaptation to climate change and insurance (ACCI), Nairobi, Kenya.

Skees, J.R., Barnett, B.J., 2006. Enhancing microfinance using index-based risk-transfer products. Agric. Finance Rev. 66 (2), 235–250.

Skees, J.R., Collier, B., 2008. The Potential of Weather Index Insurance for Spurring a Green Revolution in Africa. The Watkins House, Lexington, KY. www.globalagrisk.com.

Skees, J., Murphy, A., Collier, B., McCord, M., Roth, J., 2007. Scaling up Index Insurance What is Needed for the Next Big Step Forward? Frankfurt is Main. German Financial Cooperation.

Smith, H.V., Watts, M., 2009. Index Based Agricultural Insurance in Developing Countries: Feasibility, Scalability and Sustainability. Paper prepared for the Gates Foundation.

Swinton, S.M., 2000. More social capital, less erosion: evidence from Peruvian Altiplano. Tampa. Paper Presented at the Annual Meeting of the American Agricultural Economics Association from July 30-August 02.

Tache, B., 2008. Pastoralism under Stress: Resources, Institutions and Poverty among the Borana Oromo in Southern Ethiopia (Ph.D thesis). Norwegian University of Life Sciences, Department of International Environment and Development Studies.

Tadesse, M., Shiferaw, B., Erenstein, O., 2015. Weather index insurance for managing drought risk in smallholder agriculture: lessons and policy implications for sub-Saharan Africa. Agric. Food Econ. 3 (26), 1–21. https://doi.org/10.1186/s40100-015-0044-3.

Taye, M., Mude, A., 2018. Understanding Index-based Livestock Insurance: IBLI Ethiopia Program. Conference Paper. International Livestock Research Institute.

Zant, W., 2008. Hot stuff: Index insurance for Indian smallholder pepper growers. World Dev. 36 (9), 1585–1606.